

FactSet Agency Prepayment Model

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Key Model Features

The Rate Sheet

Being based on a dynamic model for the rate sheet allows the FactSet prepayment model to account for a range of intuitive prepayment characteristics in a precise way. These include naturally accounting for credit curing, industry capacity effects, low loan balance, refi lock-out, and obviating the need for ad hoc features such as the media effect.

Refinance Incentive

Replicating the Rate Sheet dynamically allows the FactSet prepayment model to use as input to the refinance incentive a rate that more accurately reflects the true rate available to borrowers in a given market environment, rather than rely on a single definition for the prevailing market rate.

Turnover and Equity Take-Out

A house price appreciation driven turnover curve captures equity take-out in strong housing markets, as well as the lock in effect of loans falling under water in weak markets.

Burnout

The FactSet prepayment model attempts to proxy the underlying latent cause of burnout through a multiplier which dampens speeds due to the refinance component. The multiplier is path dependent, and primarily driven by the model predicted factor at the last time step.

The GNMA Model

The distinctive features, such as mortgage insurance premiums, lower loan balances, and greater credit impairment, of GNMA pools are naturally accounted for within the general prepayment framework.

Historical Performance

Graphical Comparisons of actual versus model predicted CPRs are displayed for a selection of agency generics.

Introduction

It seems intuitive that borrowers will refinance when they have an economic incentive to do so. Determining how to measure that economic incentive, therefore, is a fundamental challenge facing any prepayment model. It is well established folklore that borrowers do not optimally exercise the embedded call options within their mortgages. While this may ultimately be true, how one would measure the degree to which this holds is a complicated problem.

To determine how best to model the incentive to refinance, we start by asking the following simple question.

When a borrower wants to obtain a mortgage, what rate will they be able to get? The FactSet prepayment model centers on being able to answer this very important question.

Obviously, this is a complicated problem, and answering this question, even in a statistical sense, presents a number of challenges. A reasonable estimate of what rate a borrower will eventually get when seeking a loan breaks down into determining the effect of factors over which the borrower has direct influence (e.g. what type of loan to take, how much to borrow), and factors over which the borrower has no direct influence (e.g. FICO score at time of loan application¹, Supply/Demand issues within the mortgage market). Obviously, the more information we have regarding these factors, the better our model will be able to make these estimates.

In 2003, the agencies began reporting a richer set of pool level statistics, concerning features of the loans at the time of their origination. Statistics such as Loan- To- Value (LTV) and credit scores (FICO) were available to modelers for the first time. The FactSet prepayment model relies heavily on this data and basic economics to address, what is in our view, the primary challenges facing a prepayment model.

Key Model Features

The Rate Sheet

The fundamental interaction in the mortgage market is that between the borrower and mortgage broker. It is the mortgage broker who, when confronted with a borrower, will translate the borrowers desire for a loan with a given set of characteristics, into an offered mortgage rate. It is the mortgage broker who will advise the borrower of the different rate options that are available to him or her. The broker typically does this by consulting daily wholesale rate sheets issued by the various mortgage servicers with whom the broker has a relationship. The broker typically then gets paid a fee, or commission, on each loan sold to the particular mortgage servicer. It is the rate sheet which then constrains borrower choices, and provides the focal point for the economics which drive rate sensitive borrower financing decisions.

Any determination of what rate a given borrower will end up obtaining depends critically on what rates are available to that borrower. A prepayment model that seeks to determine the likely rate that is available for an arbitrary pool of mortgages, therefore, must attempt at its core to model the mortgage rate sheet. The FactSet prepayment model offers a dynamic model for the evolution of the rate sheet over time, as well as providing a proscription for borrower migration across the rate sheet. This allows the FactSet prepayment model to dynamically project what the true adjusted rate available to a borrower is likely to be at any given time.

¹ Although borrowers can influence their FICO scores over time, they do not have the type of immediate influence over FICO score as they do over the choice between a fixed rate loan and an adjustable rate loan, for example.

Refinance Incentive

The approach to how to define the baseline refinance incentive in the industry has evolved over time from the simple difference between the new and old mortgage rate to the percent change between the new “prevailing market rate” and the old rate, to the percent change in present value (often referred to as the percent savings). Whatever forms the refinance incentive has taken there has still been a need to perform ex post adjustments to it in order to match observations. In this way, too much emphasis has been placed on determining the correct sensitivity, or propensity, to refinance, for a given incentive, in order to match observations. Some of these efforts have been forced to take on an ad hoc flavor, such as introducing “media effects”, and other means of recharging pools. We believe such solutions have been due largely to a misspecification of the refinance incentive.

However, refinance incentive outputs are only as good as the refinance inputs, and we believe it is the emphasis we place on correctly modeling the inputs to the refinance incentive, as opposed to massaging the output, which is of fundamental importance and which sets our model apart.

Turnover and Equity Take-Out

Refinance activity constitutes the largest variable component of the prepayment speed and drive the majority of prepayments when speeds are high. The remaining baseline prepayment speeds represent a relatively rate insensitive component. The FactSet prepayment model is thus split into rate driven prepayments, and rate insensitive prepayments.

Burnout

Burnout is the result of accumulated credit profile changes in a pool of mortgages over time, restricting the ability of the borrower to obtain a good rate, and therefore diminish the appeal of a refinance. Since better quality borrowers within a pool will have a higher incentive to refinance, and if they do refinance, they subsequently leave the pool, the credit profile of a pool will migrate lower over short and intermediate term horizons. Our dynamic model of the rate sheet is a significant step forward in capturing the real changes in the credit profile of borrowers through time; however, it cannot capture the evolution of all the significant variables which drove the application of the spread- at- origination. Therefore, we must explicitly model some burnout.

The GNMA Model

GNMA pools have distinct features that need to be addressed by a prepayment model. We address these differences very naturally within the same economically motivated framework we use to drive the conforming loan models. In particular, our model contains natural mechanisms to account for the mortgage insurance premiums, lower loan balances, and greater credit impairment prevalent in GNMA pools. In this way, GNMA pools require no ad hoc treatment within our model. We use this section to highlight the robustness of our approach.

The Rate Sheet: What's my Mortgage rate?

Understanding the Rate Sheet

While rate sheets will differ from lender to lender, there are a number of universal features which deserve explanation. In figure 1 we present a sample rate sheet², and endeavor to discuss its basic features.

At the top of our hypothetical rate sheet, we have some standard information regarding the lender, and the date and time for which this rate sheet applies. Below this is a header declaring the pricing terms on conforming fixed rate loans. In

² Example is an amalgamation, presented for illustrative purposes only, and not attributable to any specific lender.

general, a lender will have a multipage rate sheet that provides pricing on all the loan types the lender services, such as conforming ARMs, jumbo fixed rate, etc.

The rate sheet then lists the current unadjusted rates being offered. There are two tables, one listing rates on 30 year fixed, and one on 15 year fixed mortgages. In the first column are the rates that are available. The next three columns present the points charged, or rebate due, to obtain the given rate, within a given lock period. In this case, the rate lock periods are 15 days, 30 days, and 60 days. Below each table we see a note indicating that 20 year fixed are currently being quoted the same as 30 year fixed, and 10 year fixed loans are being quoted the same as 15 year fixed. These rates are generally the wholesale rates, and the broker usually takes a commission by reducing the rebate, or increasing the points, passed on to the borrower.

These rates are the unadjusted rates, and the next section of the rate sheet provides the rate adjustments that must be made based on borrower and loan characteristics. We note that all adjustments are to the rate, and that all adjustments are cumulative. The first adjustment group is the most common, and the most important; it is the LTV/FICO adjustment. The LTV/FICO matrix provides a way to read off the adjustor to rate for a given LTV, FICO pair. It is important to note that the adjustments fall into discrete buckets, and that while not always exactly true, changing buckets through a 5% decrease in LTV is roughly equivalent to changing buckets through a 20-point increase in FICO. That is, moving one cell to the left on the matrix usually produces the same adjustor as moving one cell up on the matrix. In the context of our example, this is illustrated by noticing that a 30 year fixed loan with a FICO of 685 and an LTV of 71% will receive the same rate adjustment as a 30 year fixed loan with a FICO of 705 and an LTV of 76%.

Rate adjustments for the 20 year fixed and 30 year fixed, are covered by the first matrix, while the 15 year fixed and 10 year fixed are covered by second matrix. While not necessary, it is often typical for 20 and 30 year amortizations to have the same credit adjustments; the same for the 10 year and 15 year amortizations. The third matrix gives the additional adjustments that would be incurred if the loan where a cash- out refinance. The NA entries reflecting that cash- out refinances are simply not available for low credit or no documentation borrowers, or any borrower who is seeking more than 85% LTV.

In addition to the LTV and FICO adjustments, there are usually a number of other pricing adjustments which may impact a rate. Our example rate sheet contains some, but not all, of the extra adjustments you might see. They include adjustments for low loan balance, geography (state adjustors), investment property (i.e. owner occupied), whether escrow for property tax and hazard insurance is being waived, multiple unit residence, etc. One important last thing to note is that it is possible to achieve a somewhat better rate than the base rate without having to pay points. That is, rate adjustments can be negative in certain situations.

Finally, an important feature which we have left off our example rate sheet is mortgage insurance. We do this is because mortgage insurance is important enough to warrant its own extensive treatment. We discuss mortgage insurance in a separate section.

Changing Industry Risk Tolerances and Capacity Effects: Evolution of Rate Sheets through Time.

The most obvious source of variability on a rate sheet is the initial list of unadjusted rates and the points or rebate that corresponds to them. These are driven by market dynamics and change intraday, and so too rate sheets get updated several times a day when fixed income markets are volatile. The various adjustors tend to be more stationary through time for a given lender, but adjustors can, and do, change through time; at times dramatically so. We discuss the some of the drivers of change.

As with any industry, the mortgage market goes through cycles. When demand outstrips supply, lenders can charge incrementally more to originate a loan, and when supply outstrips demand, competitive market forces force lenders to

charge incrementally less to originate a loan. This is nothing more than basic economics, and the mortgage market is not immune from it.

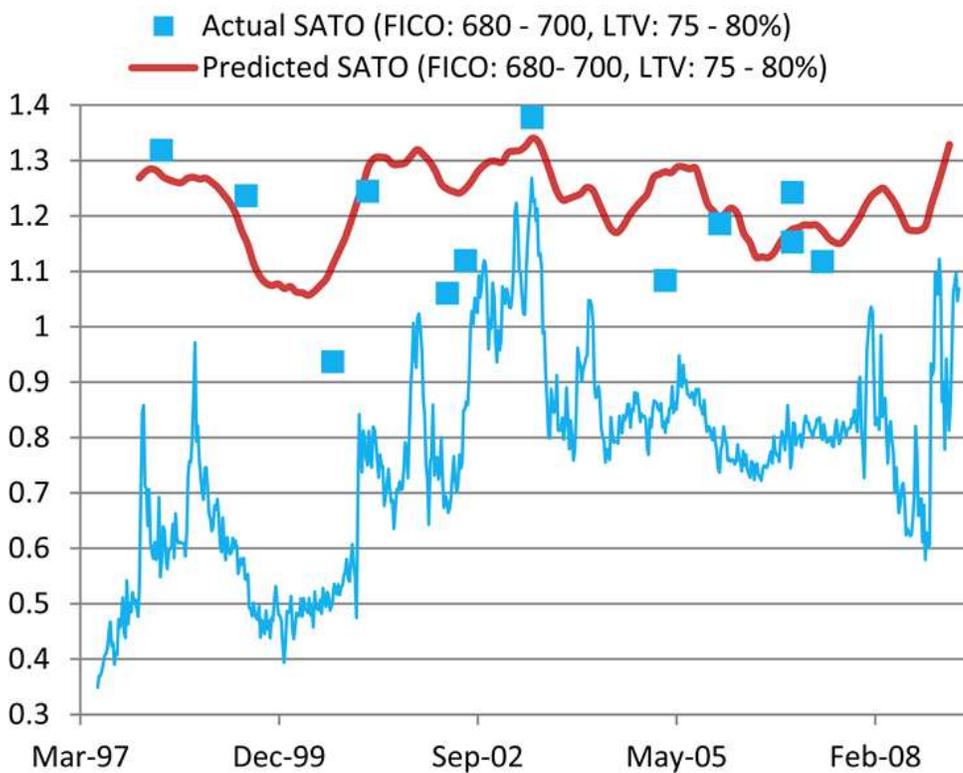
One driver of change in the supply and demand equation within the mortgage industry is the prevailing mortgage rate itself. As the current coupon falls, the percentage of outstanding loans which become in the money increases. After a long enough period of time during which rates were rising, a significant decrease in rates can precipitate a refinancing wave, during which time pent up demand is released. The mortgage market experienced significant refinancing waves, for example, in 1997- 1999 and 2002- 2004. During these refinancing waves, demand for mortgages surges, and given the relatively large drop in interest rates, the suppliers of those mortgages can charge higher relative premiums for originating a loan than they had been able to prior to the surge. So while the base unadjusted rate is much lower, the rate adjusters on the rate sheet actually increase, especially on a relative basis. This phenomenon is what some have termed a Capacity Effect.

Through the rate sheet, the manner in which the capacity effect impacts prepayment speeds is straightforward. Particularly important to point out is that the rate adjustments will increase more for poorer credit quality loans than for better quality loans. The economic reason for this is clear. Increasing demand among higher credit quality borrowers lowers the need for lenders to compete for marginal borrowers, with all loan originators benefitting from an increase in both volume and margin charged on loans originated, irrespective of credit quality. Conversely, as a refinancing wave winds down, demand weakens and lenders begin to trim margins in order to compete for marginal borrowers. This results in a decrease in the rate adjustments through time.

The evolution of the mortgage market from 2000- 2008 deserves special mention. In 2000, the mortgage market was at the bottom of its cycle. Rate adjustments were relatively tame. As rates came off their 2000 highs through late 2002 and into 2003, mortgage applications spiked, and rate adjustments followed suit. As mortgage application volume slacked off peak levels going into 2004, lenders (and the agencies themselves) began lowering credit spreads on all new originations, but especially on the lower credit quality borrowers. Up until 2004, this market followed a typical pattern. However, unlike in prior markets, the agencies had a significant new source of competition in the securitization market, in the form of private investment bank issued CDOs. Competition led the industry as a whole to aggressively continue to lower credit spreads on ever riskier borrowers in an effort to keep up securitization revenues. This created a feedback loop between the housing market and the mortgage market. Home prices were driven ever higher, engendering a euphoria that surrounds all asset bubbles. The rapid appreciation in home prices lowered the risk proposition on many borrowers, and prompted a surge in cash- out refinances, further increasing competitive forces within the mortgage market.

The challenge for prepayment modeling is twofold. First, cash- out refi's tend to be somewhat rate insensitive. This rate insensitivity is understandable when we consider that, in the short term, an annualized home price appreciation rate significantly above the mortgage rate will lead to a negative real mortgage rate, regardless of whether the nominal mortgage rate increases or decreases by 100 basis points. The second challenge pertains to proper calibration of a dynamic model for relative coupon evolution through time. The presence of a high percentage of cash- out refinances in newly originated pools means that a model must be able to account for the extra effect on mortgage spread due to the cash- out refi's. Recall from our example rate sheet that a cash- out refinance adds an additional spread to the already credit adjusted rate in a cumulative fashion. Figure 2 displays the actual SATO of a series of agency generics by origination date, and shows the predicted SATO generated by the FactSet prepayment mode, along with the MBA Mortgage Application Index (in logarithmic scale to allow for graphical overlay) across the same time period. All generics had a weighted average FICO between 680 and 700, and a weighted average LTV between 75 and 80% at origination. As we see in the figure, the FactSet model is able to capture a significant amount of the variation in SATO for a given credit profile through time. The FactSet prepayment model is thus able to account for a capacity effect in a natural way, through a dynamic evolution of the rate sheet.

Figure 2: Evolution of Relative Coupon Through Time



Changing Individual Risk Profiles: Credit Curing.

In the prior section, we discussed how the spread charged to a given credit risk profile might evolve over time. That is, how the adjustment corresponding to a fixed cell on the rate sheet changes over time due to overall market supply and demand dynamics. In this section we will discuss how an individual borrower, or pool of borrowers, might move within the rate sheet over time. That is, we will look at how a borrower's LTV/FICO bucket assignment can change over time.

It is well known in prepayment modeling, that the Spread at Origination (SATO) of a loan is powerful predictor of prepayment behavior, as it serves as a proxy for several factors which make a loan a riskier proposition for the lender when the spread is high. On the other hand, when the spread is less than one, it offers a measure of borrower self selection, as it serves as a proxy for any points in origination paid by the borrower to obtain below market rates. However, absent a more refined description of the particular loan characteristics which lead to a given SATO on a pool of mortgages, modelers are forced to accept SATO as a static number, and have no way of properly evolving SATO to reflect the changing risk parameters of individual loans.

With the advent of the agencies reporting pool level statistics such as the weighted average FICO, LTV, and Original Loan Balance on outstanding and newly issued pools, we have been able to construct a rate sheet based approach to explaining the spread at origination. While this data is extremely useful, it still suffers from the problem that it is essentially static. Borrower FICO scores, and Loan to Value ratios should be expected to migrate over time; however the agencies do not update these quantities³. This is not simply because the information is being intentionally withheld, as determining current quantities would incur real expense.

In the FactSet prepayment model, we compute a proxy for the current LTV by using house price appreciation (HPA), the original LTV, the original and current loan balance⁴. Since these are pool level statistics, we can appeal to the law of large numbers to justify the approximation (and since we will never have access to individual loan market appraisals, it's an approximation we are forced to live with). When calibrating the model to historical data, we use the S&P Case- Shiller Home Price indices to compute house price appreciation⁵.

In terms of our example rate sheet, the estimate for current LTV allows us to move across the rows of the FICO/LTV matrix as home equity accumulates or dissipates. This allows the FactSet prepayment model to naturally account for several complicated behavior patterns. In normal to strong housing markets, it allows for a natural way for a pool to be recharged following a refinancing wave. As we can note from our example, the premium charged over the best rate falls off quickly as LTV decreases and we move to the left on the FICO/LTV matrix, and so as home equity accumulates over time, the average spread charged to the pool will decline as average LTV falls (assuming no cash out refinances). Thus, in the FactSet prepayment model, no "media effect" is needed.

The Refinance Incentive

Functional Form

If we assume that borrowers are mostly rational and that the mortgage market is generally competitive, then at the time of origination, after taking points into account, all pools are at the money. There is no economically rational model of the refinance incentive which can account for this when taking a single "prevailing market rate" as input. This is why, before even coming to a definition for the refinance incentive, we are forced to model the rate sheet. In the FactSet prepayment model, we seek to make ex ante adjustments to the inputs of the refinance incentive in order to predict refinancing behavior, rather than ex post adjustments to the refinance incentive in order to match observations.

The rate sheet forms the backbone of the mortgage origination process, and so too should it therefore form the backbone of a prepayment model. Spread at Origination is a powerful tool, but it suffers from being a static conglomeration of rate adjustments. Without a dynamic model for the rate sheet, and hence for the true refinancing rate borrowers face, the notion of when a given pool will be in- , at- , or out of- the- money becomes extremely fuzzy, if not entirely meaningless.

The FactSet prepayment model defines the refinance incentive to be the inflation adjusted present value savings of the remaining payments, with the discount rate taken to be an ex ante adjusted new mortgage rate determined through our dynamic rate sheet. We prefer this functional form for the refinance incentive because it naturally captures the WAM and rate level dependence of the incentive. Also, because we are using the present value savings in real dollar terms

³ The pool level weighted averages do get updated to reflect loans that have prepaid out of the pool, but this is not the same as obtaining current FICO scores for the borrowers, and current LTV's on the properties.

⁴ At present, we assume that FICO scores remain stable over time. This is in part justifiable on the grounds that Fair Isaac Co. reports that the majority of FICO scores are stable over 3, 6 and 9 month horizons, and that significant reversion to the mean exists for score migrations exceeding 20 points in either direction.

⁵ For OAS analysis, FactSet offers various methods to supply the model with forward looking HPA projections. Consult your specialist for more details.

(not percentage savings), our model naturally accounts for loan size. In addition, under mild assumptions about the term and loan balance on the new loan, our refinance incentive is proportional, via the annuity factor, to the inflation adjusted monthly dollar savings. Since 30, 60, and even 90-day lock periods are prevalent in the market, we time weight the current incentive with the prior month's incentive. The model also recognizes the lag between the observed rate, and when the prepaid principal is returned to the investor by the servicer.

The FactSet prepayment model blends incentives, not rates. Depending on the collateral type, the model will compute the refinance incentive associated with a refinance into more than one product, and then blend those incentives according to a weighted average scheme. Conventional 30-year collateral, for example, will derive a refinance incentive by blending the incentive associated with refinancing into another 30-year conventional loan with the incentive to refinance into a conventional 15-year product. The relative weights are determined in part by loan age, and in part by the steepness of the curve.

It is only because we use a dynamically adjusted rate as input that our refinance incentive gains real meaning. It is only after a refinance incentive has been computed with a properly adjusted rate can we make inferences about one pool's propensity to refinance relative to another pool's propensity.

Mortgage Insurance

Whether it's referred to as MIP (mortgage insurance premium), PMI (private mortgage insurance), or LPMI (lender paid mortgage insurance), a further issue a borrower may contend with is mortgage insurance. In order to eschew the potential of losses due to a default, borrowers are often forced by lenders to pay some form of mortgage insurance. Mortgage insurance may be mandatory (as for FHA 30 year fixed loans) or LTV dependent (as for conforming fixed rate loans). It may include an upfront premium, or an annual premium, or both. However it's structured, it represents a very real cost that a significant share of borrowers must contend with. When desiring the ease of shorthand, we will generically refer to mortgage insurance as MIP.

In view of the way we've defined our refinance incentive in terms of inflation adjusted present value dollar savings, the FactSet prepayment model is naturally equipped to deal with mortgage insurance within the framework laid out. Namely, we account for the incentive to terminate mortgage insurance by computing the inflation adjusted present value of the scheduled cash flows. In this way, we can just as easily account for the effect of an upfront MIP rebate (which may be due on an FHA to FHA refinance, for example), as well as for the effect of terminating an annual MIP by refinancing as home price appreciation improves a borrower's LTV profile. Further, this allows us to easily deal with the fact that the mortgage insurance generally has a different tenor than the underlying loan, as annual premiums can be terminated once the loan reaches a loan to original value of 78%⁶. Given that often as much as half of a conforming pool, or more, will have an initial LTV over 80%, and that our model is a pool level model, not accounting for the presence of mortgage insurance would have been a potential source of model misspecification.

Of particular import is the fact that in a housing market experiencing declining prices, there may be many borrowers who did not previously have to pay any mortgage insurance, who may now face mortgage insurance should they attempt to refinance. Thus, when accounting for mortgage insurance in our computation of the total refinance incentive, we calculate the net effect of the change in mortgage insurance terms (if any). In this way, we can naturally account for the possibility that a borrower may be subject to a significant new source of cost, should the LTV of the collateral rise. This can be most dramatically seen in effect in the next section.

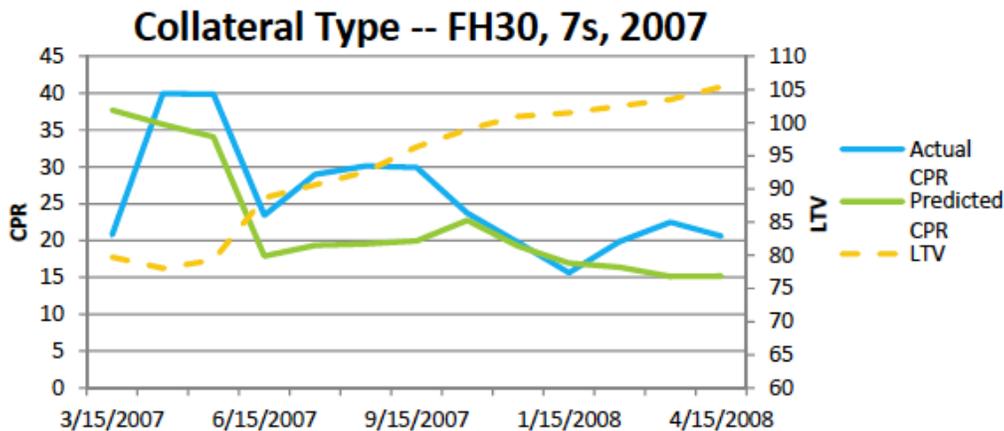
⁶ For FHA loans, there is the additional requirement that the annual premium must be paid for at least 60 months. The FactSet prepayment model takes this into account.

Refi “Lock- Out”

When housing markets are stressed, and average LTV increases due to falling home prices, we can model how the credit profile of a pool will change for the worse. This corresponds to a move to the right across a row of the FICO/LTV matrix, and provides one mechanism by which borrowers can get “locked out” of a possible refinancing opportunity, due to deteriorating loan characteristics, and the rising premiums they would encounter while seeking to refinance. The other mechanism by which borrowers can effectively experience refi lock- out is through a change in mortgage insurance premiums.

In Figure 3, we show how the model projects a declining responsiveness as LTV profile deteriorates by examining the actual and model predicted CPRs of a Freddie- Mac 7s generic originated in 2007, along with the LTV estimated using the S&P Case- Shiller Home Price indices. In particular, we note how subdued both the model projected, and actual pool speeds are after rates dropped below 6% in January, 2008. As we can see from the figure, borrower equity is completely exhausted, and combined with tightening lending standards, the spread charged to these borrowers, both in terms of rate spread and annual mortgage insurance premium, more than offsets the large decline in rates from the date of origination. Without the ability to allow rising LTV to properly negatively impact refinancing cost, our model would have predicted significantly higher speeds than is appropriate. Given the depth of the decline in housing, this factor is likely to impact speeds on a significant fraction of outstanding pools. Models that fail to incorporate this effect properly will need to be frequently recalibrated in order to slow down their projections.

Figure 3: Refi “Lock-Out” Due to Deteriorating LTV Profile



In Figure 3, we show how the model projects a declining responsiveness as LTV profile deteriorates by examining the actual and model predicted CPRs of a Freddie- Mac 7s generic originated in 2007, along with the LTV estimated using the S&P Case- Shiller Home Price indices. In particular, we note how subdued both the model projected, and actual pool speeds are after rates dropped below 6% in January, 2008. As we can see from the figure, borrower equity is completely exhausted, and combined with tightening lending standards, the spread charged to these borrowers, both in terms of rate spread and annual mortgage insurance premium, more than offsets the large decline in rates from the date of origination. Without the ability to allow rising LTV to properly negatively impact refinancing cost, our model would have predicted significantly higher speeds than is appropriate. Given the depth of the decline in housing, this factor is likely to impact speeds on a significant fraction of outstanding pools. Models that fail to incorporate this effect properly will need to be frequently recalibrated in order to slow down their projections.

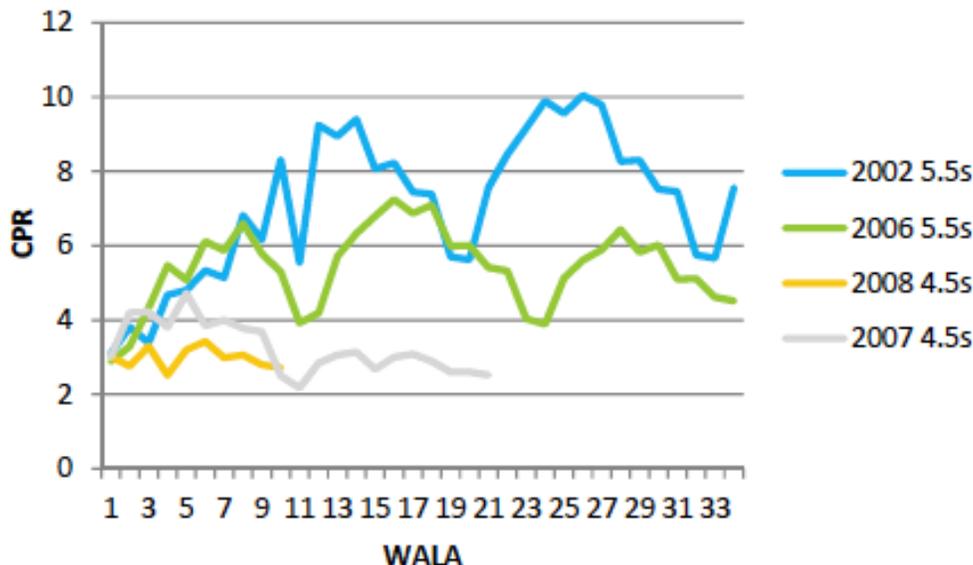
Turnover

Drivers

The FactSet prepayment model separates prepayments into rate sensitive (refinancing), and rate insensitive components (turnover). The turnover component is constructed around a seasoning ramp which is driven by spread- at- origination, our model predicted spread- at- origination, and accumulated home price appreciation (depreciation) over the prior 12 months. Turnover is also seasonally adjusted. Given our ability to model the rate sheet throughout time, we can use it to form an estimate of which spread given collateral “should” have been charged. Any deviation from this is partly explainable by borrower self- selective choices (e.g. whether points were paid, or a rebate in the form of low closing costs, were taken).

In our model, the elbow will shorten in a strong housing market, and extend (even causing the turnover component to “slide back down the ramp”) in a weak one. This choice of model behavior is predicated on the notion that turnover component seasoning is driven primarily by the borrower’s ability to recover sunk costs. There is evidence in the literature⁷, which supports the idea that borrowers do not view points paid appropriately. They fail to understand points paid as sunk costs. That is, even when they have economic incentive to do so, borrowers are reticent to refinance a property until the sunk costs of points have been sufficiently recovered, and tend to wait too long to refinance as a result. We believe that if this mentality holds for refinancing activity, it likely spills over to decisions concerning property disposal as well. Indeed, we believe that a borrower desire to “break even”, after transaction costs (sales commission plus unrecovered points paid), on a property sale is primarily what drives the turnover seasoning process. In our opinion, it is not coincidental that the elbow on the standard PSA seasoning curve (30 months) is approximately equal to the time it takes to recover a 6 percent sales commission and 2 origination points paid, in a moderate housing market with price appreciation rate of 3 percent per annum.

Figure 4: Turnover Components for Discounts by WALA, for Several Origination Years



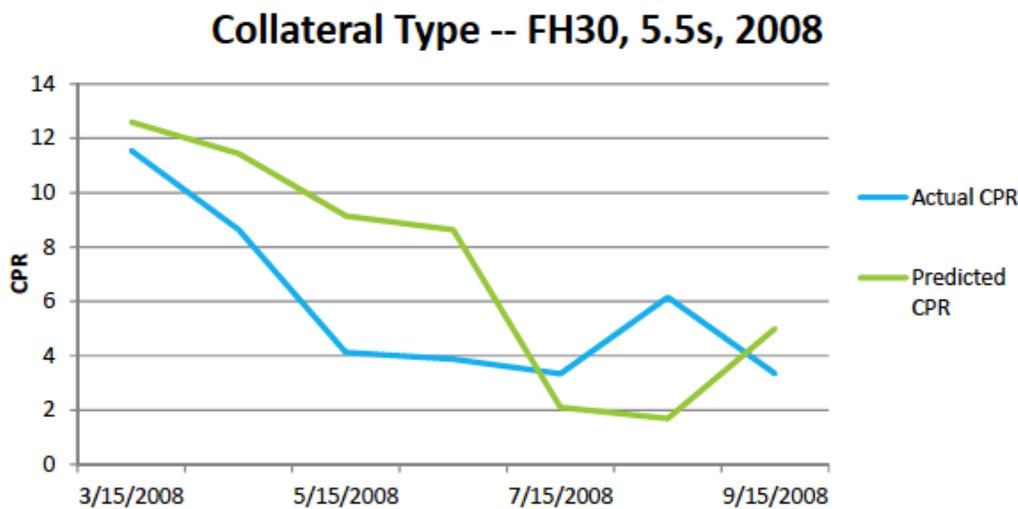
⁷ See “Do Borrowers Make Rational Choices on Points and Refinancing?” by Yan Chang and Abdullah Yavas. www.fma.org/SLC/Papers/DoBorrowersMakeRationalChoicesonPointsandRefinancing.pdf

In Figure 4, we show the model generated seasoning ramp for several origination years by WALA. We note in particular how the 2007 origination initially begins up a ramp, but then slides back down to a very meager baseline of 2% CPR, while the 2008 origination never even begins ascending a ramp. Our Turnover model is calibrated using observations which contain no (or negative) refinance incentive. It is important to point out that it is only due to our ability to model the rate sheet, and hence model the real rate available to pool collateral, which makes this calibration unbiased. Our ex ante adjusted rate allows us to identify those premium coupons which have no incentive to refinance, which might otherwise appear to. Without it, our calibration data set for the turnover model would be heavily skewed toward discounts.

Lock- In: Underwater and Out- of- the- Money

Traditionally, an out of the money coupon would display a moderate amount of lock- in in the turnover component, as higher rates would mean a higher monthly payment must be made to obtain a loan of the same size. The FactSet prepayment model affords a moderate amount of rate driven lock- in to slow baseline turnover speeds. With the fall of home prices across the nation from their peak in 2006, originations from 2005 onward are susceptible to lock- in from the evaporation of home equity. For some pools, this will mean a significant number (if not the majority) of properties will fall “under water”. Similarly to the way borrowers can be “locked- out” of a refinance opportunity by a deteriorating LTV profile, borrowers can be “locked- in” to their current properties due to a small or negative home equity position. The FactSet prepayment model is able to capture this by allowing the turnover component to be driven in part by current LTV. Figure 5 shows an example of both of these effects.

Figure 5: Turnover “Lock-In” Due to an Out of the Money Mortgage Rate and Deteriorating LTV Profile



Burnout

Definition

It is well known in prepayment modeling, that the Spread at Origination (SATO) of a loan is powerful predictor of prepayment behavior, as it serves as a proxy for several factors which make a loan a riskier proposition for the lender when the spread is high, and as a measure of borrower self selection when the spread indicates below market rates. Absent a more refined description of the particular loan characteristics which lead to a given SATO on a pool of mortgages, a typical approach by prepayment modelers, to incorporating the information contained in SATO, is to compute a one- size- fits- all refinance incentive based on some prevailing market rate. With a refinance incentive in hand, SATO then affects the sensitivity of the particular pool to that single refinance incentive.

The strength of the FactSet prepayment model is based in large part upon trying to measure borrower incentive to refinance as accurately as possible by dynamically modeling the spread that varying collateral types would likely be subject to through time. To do this, we employ fairly sophisticated model driven by accumulated home price appreciation, which takes into account industry capacity effects. There are, however, other factors which invariably impact credit quality of a borrower which we have not modeled in a dynamic way (such as FICO score, total debt to income, etc.). While SATO captures the combined effect of these variables, it is a static measurement. Given that better quality borrowers will have more opportunities and incentive to refinance, and will hence select out of the pool, there is a natural tendency for the credit quality of a pool to deteriorate over time. Since this biased evolution toward lower credit quality is latent, it will appear as if the pool is reacting with a declining propensity to refinance for a given incentive. This phenomenon is referred to in prepayment lore as Burnout.

The FactSet prepayment model attempts to proxy the underlying latent cause of burnout through a multiplier which dampens speeds due to the refinance component. The multiplier is primarily driven by the predicted factor our model would have generated given the actual mortgage path realized up to this point. Since, in our view, short to intermediate term burnout is caused by changing credit conditions, the multiplier is allowed to cure over time. This credit curing is an important feature, as it means that it is possible for burnout to completely cure if enough time has elapsed. In fact, the model actually predicts an increasing cure rate over time. Thus burnout is modeled as a short- to intermediate- term phenomenon. The longer term tendency of a pool to slow down over time is fully captured by the fact that, all other things being equal, the inflation adjusted present value dollar savings which defines our measure of refinance incentive will naturally decline as a function of loan age.

An Example: Burnout as Applied 2002 Issuance

To illustrate how burnout works in our model, in figure 3 we present the burnout functions through the 2003- 2004 refinancing wave on Freddie- Mac 2002 generics with various coupons. We note that the burnout functions for the 6s, 7s and 8s all have the same slope, indicating they accumulate incentive at roughly the same rate, despite having different coupons. Furthermore, we notice that the 7s and 8s have burnout functions which bottom well below the 6s. In light of our dynamic relative coupon function, we can interpret this behavior as follows. Initially, the spread charged to a given borrower seeking to refinance will likely be very similar to the spread charged at origination. For the 2002 issuance year, initially as the refinance wave begins, capacity effects act to drive the relative coupon higher. However, as the capacity effect eases and home equity accumulates, so that current LTV declines, the predicted spread for a given borrower drops. For the 2002 6s, the credit profile of the collateral was good to begin with, so there was little to be gained from a declining LTV as the refinancing wave eased. The 7s and 8s had earnest credit impairment issues at issuance, and hence a strong reduction in LTV would make these loans significantly less risky, and hence these loans saw significant spread reductions as capacity constraints eased.

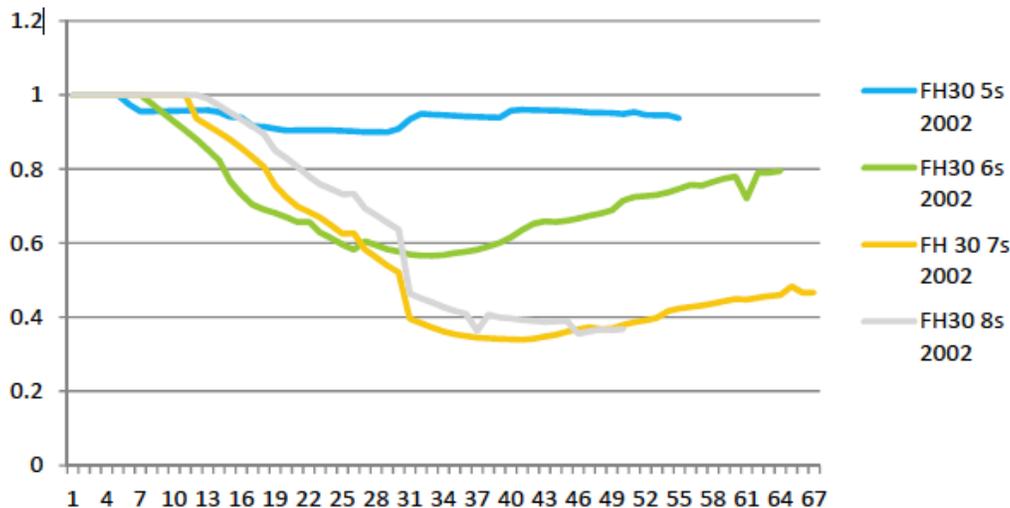
The GNMA Model

The collateral underlying Ginnie Mae (GNMA) MBS pools consist primarily of mortgages insured by either the Federal Housing Administration (FHA) or the Veterans Administration (VA), with FHA loans frequently comprising more than 70% of the pool constituents. In this section we highlight how the FactSet prepayment model treats some of the unique features of GNMA collateral. In contrast to conventional borrowers, loans backed GNMA pools typically are taken out by low to medium income borrowers, who tend to have impaired credit profiles relative to typical conventional borrowers. They typically lack the resources to put down a significant percentage of the purchase price, and as a result have high loan to value ratios (often in excess of 95%). Further GNMA loans tend to have lower balance relative to their conventional counterparts. The combined weaker FICO and LTV profile prevents these borrowers from obtaining competitive terms from the private market, and to obtain financing, they must rely on the FHA or VA to insure their loans. This government insurance is not without cost, and borrowers in the GNMA pools are charged both upfront and annual mortgage insurance premiums (MIP).

For GNMA collateral, refinance incentives are computed for government to government and government to conventional refinances, where each of these will be itself a blend of terms. Thus, the GNMA 30-year collateral would blend refinance incentives obtained from the FHA 30-year rate, the credit adjusted 30-year rate, and the credit adjusted 15-year rate. The relative weights are a function of the current loan to value, the spread between the 30 year and 15-year rate, and the current weighted average loan age. FICO scores are allowed to cure as a function of loan age, which reflects the fact that a regular payment history and declining debt load likely leads to some upward migration of credit scores for the average FHA borrower. The effect of loan balance is accounted for by the inflation adjusted dollar present value savings, which itself is proportional to loan balance, just as for the conforming collateral.

In addition to the rate/term component of the refinance incentive, the net value of a change in mortgage insurance is determined. Thus for an FHA to FHA refinance, a new upfront MIP is determined, and a rebate (if any) of the original MIP is applied. On both fronts, we have accounted for historical changes in FHA regulations. The present value effect of any extension of the annual MIP is accounted for. In contrast, for an FHA to conventional refinance, the present value savings in dropping the annual MIP, based on the remaining scheduled payments until the loan is below 78% loan to original value, is computed.

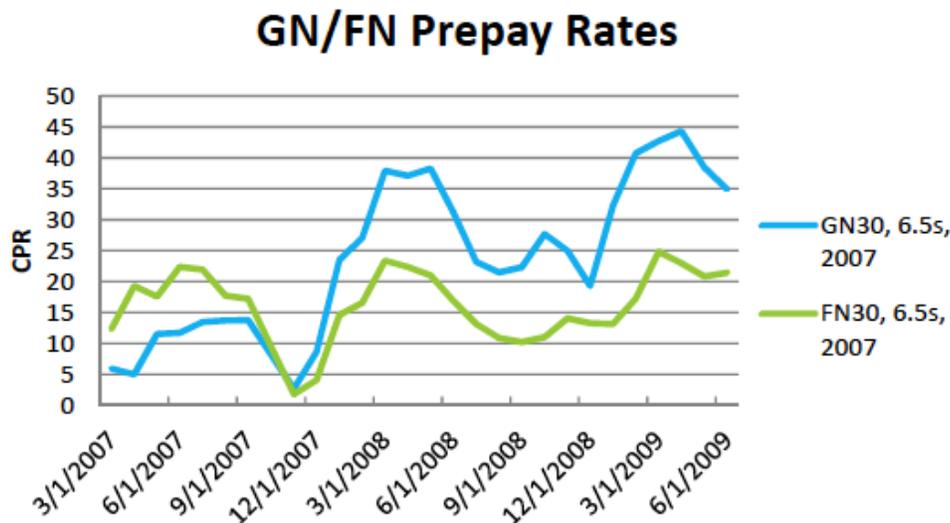
Figure 3: Burnout Multiplier for Various 2002 Issuance by WALA



Convention Turned on its Head. GNMA Prepayment Rates Outpace FNMA and FHMLC During 2008 and 2009 by Wide Margins.

Historically, GNMA pools have tended to prepay at rates that are similar to conventional conforming pools when rates are out of the money, and prepay slower than conventional conforming pools when rates are in the money (by around 10% CPR). Speeds for agency fixed rate pools slowed during 2008 and 2009 despite historic lows in mortgage rates due to a greatly restricted lending environment. During this period, speeds on GNMA's have been as much as 25 CPR faster, on average, than comparable coupon conventional collateral pools. We provide an example of this in Figure 4.

Figure 4: Comparative Example Showing the Speed Differential Between a Ginnie Generic Against a Comparable Fannie Generic



One reason for these higher speeds is servicer buyout activity. Servicers of GNMA loans are allowed to repurchase loans at par if they become 90 days delinquent. In such cases, the servicer can attempt to cure the loan, and then resell it to the secondary market at a premium. Even in the event that the loan cannot be cured, this can still make sense for the servicer. If the loan were left in the pool, the servicer would still be responsible for the net coupons to the investor, up until a foreclosure sale (the costs of which the servicer is partially responsible for whether the loan is repurchased or not). Yet, the servicer only receives interest coverage from the FHA at a debenture rate based on a monthly average 10 year CMT rate. Given the low average yields on the CMT 10 year during the 2008-2009 period, it is easy to see why banks have incentive to repurchase 90-day delinquent loans.

While servicer buyout activity can explain some of the difference in speeds for the generics displayed in Figure 4, it cannot explain all of it. Historically, speeds attributable to servicer buyout have accounted for not more than 10-12% CPR in the most extreme cases. Indeed, were all the excess CPR spread between the GN and FN generics in Figure 4 attributed solely to servicer buyout activity, it would imply that close to 20% of the loans in the pool had become 90 days or more delinquent since the beginning of 2008, and that 100% of those 90 days delinquent loans were repurchased by servicers. Both of these implications seem implausible as servicer repurchase rates seem to be between 25-50% of eligible loans, and 20% is a number more plausible for all loans which are in some form of delinquency (30 days or more, including rolling).

Further, it is clear from examining the relative outperformance of the Ginnies, in this example, that the prepayment rate spread is distinctly correlated with interest rates; the spread widening during the relative rate dips of early 2008 and early 2009 (with the prepayment peaks occurring with a 3 month lag). This suggests that a significant portion (perhaps 8 -10% worth) of the prepayment rate difference between the Ginnie Mae and Fannie Mae generics is indeed demonstrative of the Ginnies being more reactive to rates than comparable conventional conforming loans. Counter intuitive as this might seem at first blush, it makes reasonable sense in light of Table 1.

Table 1: Breakdown of FHA Endorsements by Fiscal Year (in 1000s)

FHA Market Statistics	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Applications	1,142	1,579	1,569	1,764	1,036	718	636	769	2,008	3,000
Total Endorsements	921	1,067	1,287	1,338	998	556	502	532	1,200	2,100
Purchases	847	815	876	677	586	354	314	278	632	1,086
Refinances	74	252	411	661	374	159	112	146	456	895
FHA to FHA	74	252	411	661	374	159	112	39	95	394
Streamline	35	189	318	561	292	113	36	22	67	340
% Streamline	48%	75%	77%	85%	78%	71%	33%	57%	70%	86%
Conventional to FHA	NA	NA	NA	NA	NA	NA	NA	108	357	501

Source: FHA

In Table 1, we present some of the statistics regarding the total annual endorsements made by the FHA from 2000 to 2009⁸. In examining the table, the first thing to notice is that the number of FHA to FHA refinancing in 2009 are about 60% of their 2003 level (a number consistent with current GNMA prepayment rates), and that the percentage of those refinancing which are streamline is at historically high levels. The second important thing to notice is the introduction of the Conventional to FHA line item in 2007, and the exponential growth in the volume of endorsements of that type of refinance. Given the decline in home prices, and the larger markets aversion to underwriting high LTV loans, it seems that for a significant portion of existing conventional borrowers, the FHA is acting as lender of last resort. However, to refinance into an FHA endorsed loan involves a greater cost for a formerly conventional borrower, than for an existing FHA borrower. The reason for this is that the existing FHA borrower will receive a possible rebate on their upfront MIP, which will partially offset their new upfront MIP fee. Also, the FHA borrower is already likely paying an annual MIP, so the relative cost increase of that component is less for the FHA borrower. Finally, for borrowers whose LTV now exceeds 100%, or whose credit profile has deteriorated significantly, the streamline refinance option available to existing FHA borrowers affords them a financing option not open to conventional borrowers. The light documentation and lack of need for new home appraisals and/or verification of income mean that there exists an option for some FHA borrowers, which simply does not exist for a similar conforming borrower. The FactSet prepayment model accounts for the net change in mortgage insurance and properly accounts for penalty to rate based on the type of loan being refinanced into. It handles this historically atypical behavior naturally within its framework.

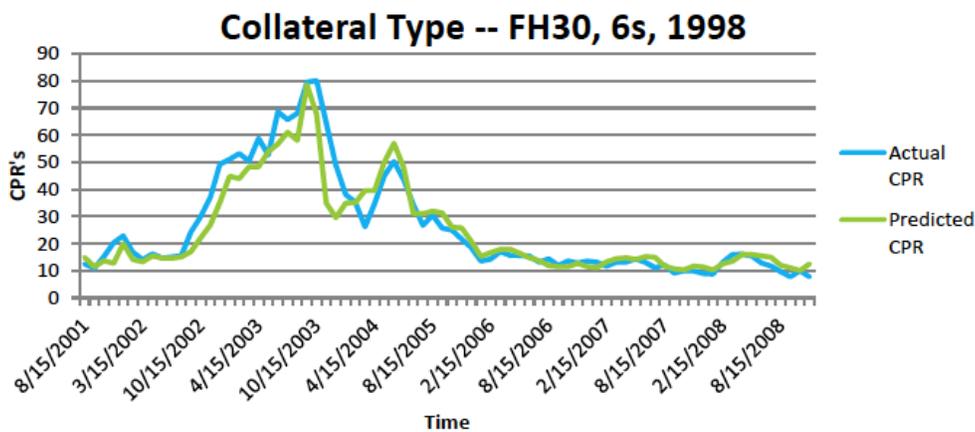
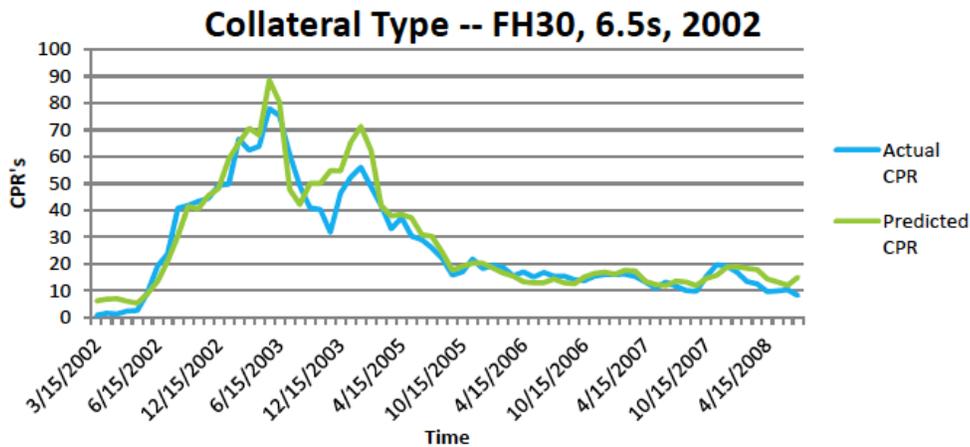
⁸ 2009 numbers include a projected component, as the 2009 HUD fiscal year had not ended at time of writing.

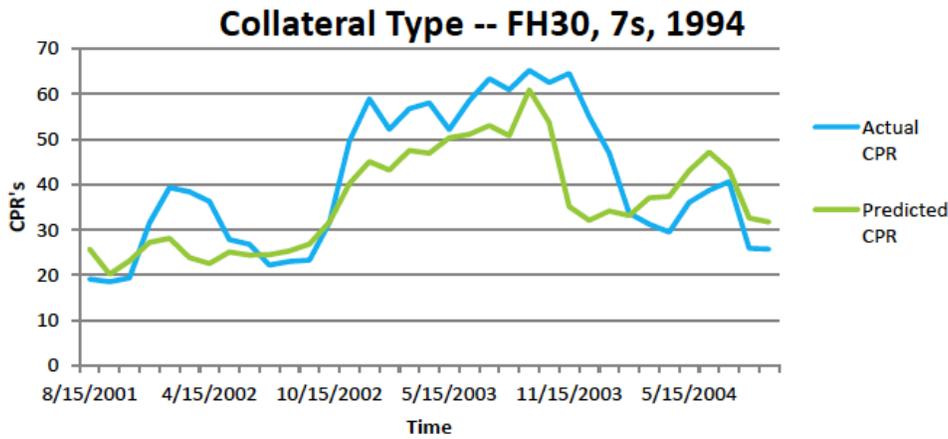
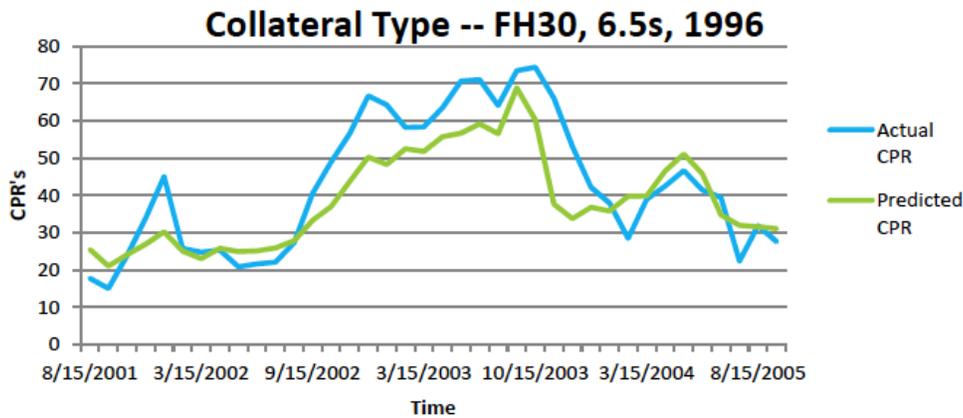
Historical Performance

We now present some historical charts which show how well the FactSet prepayment model is able to capture observed prepayment behavior. Displayed in each chart are the actual historical prepayment speeds, as well as our model predicted speeds.

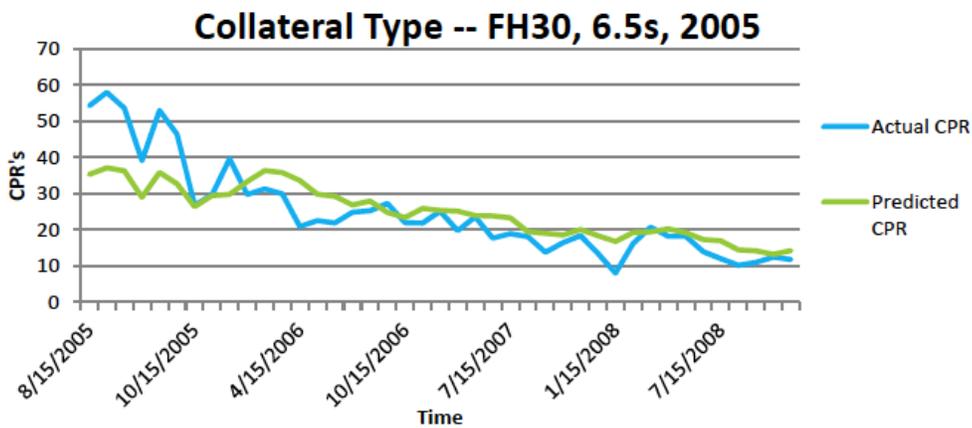
Capturing the Refinancing Wave of 2003-2004 for Varying Amounts of Seasoning

Here we examine the performance of the model through the 2003-2004 refinancing wave. We show how well the model captures the changing propensity of a pool to refinance as it seasons. All the collateral types displayed have very similar FICO, LTV, and general SATO profiles at origination.

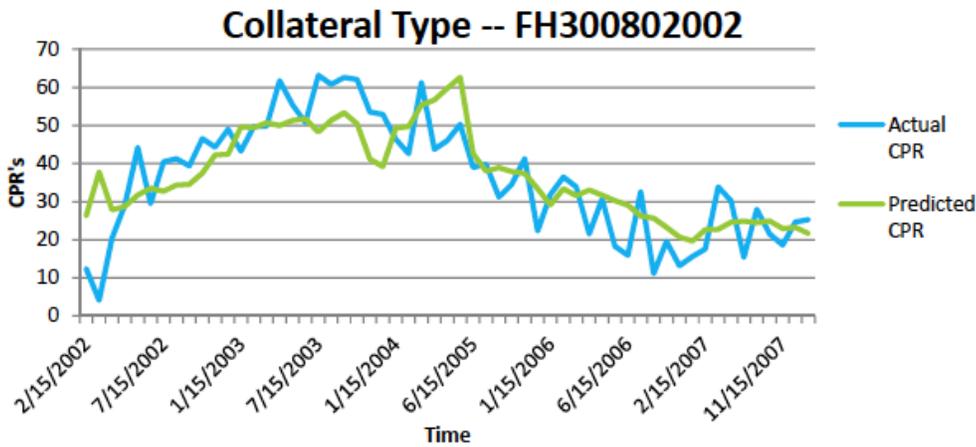




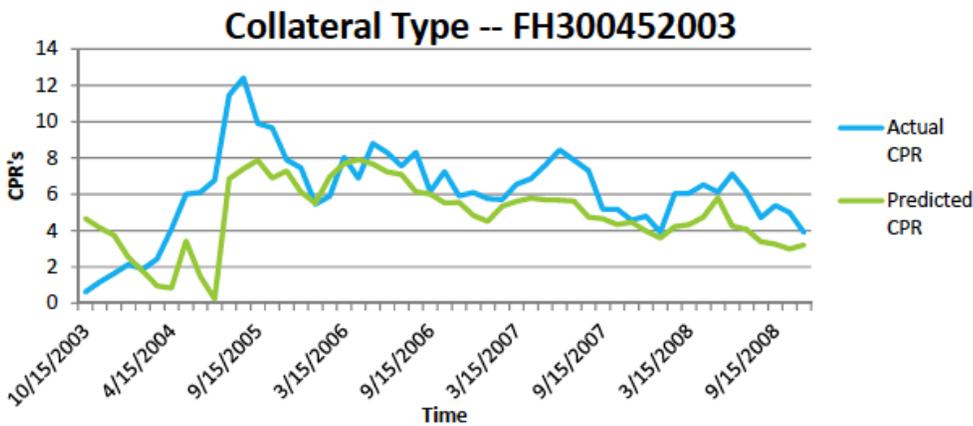
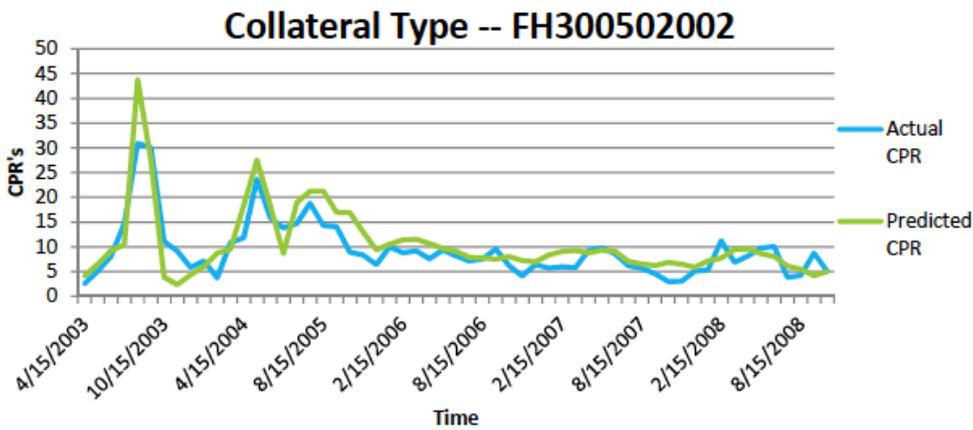
Prepayment Lock-Out Due to Declining Home Equity



High Spread at Origination

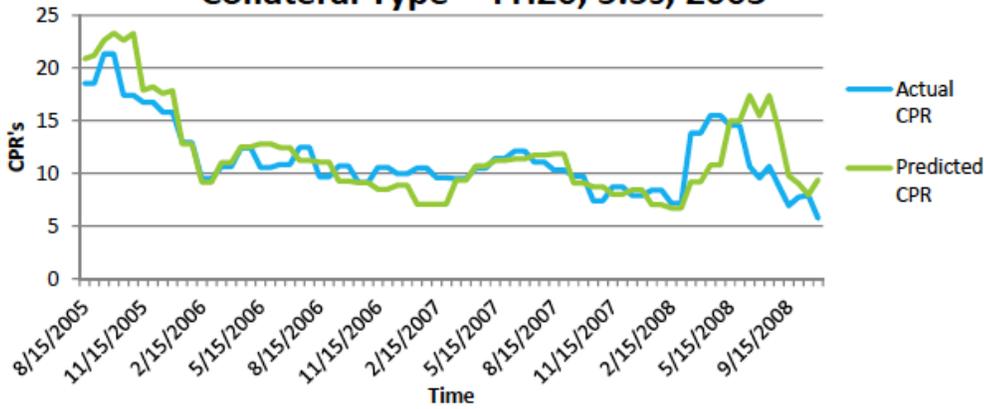


Discounts

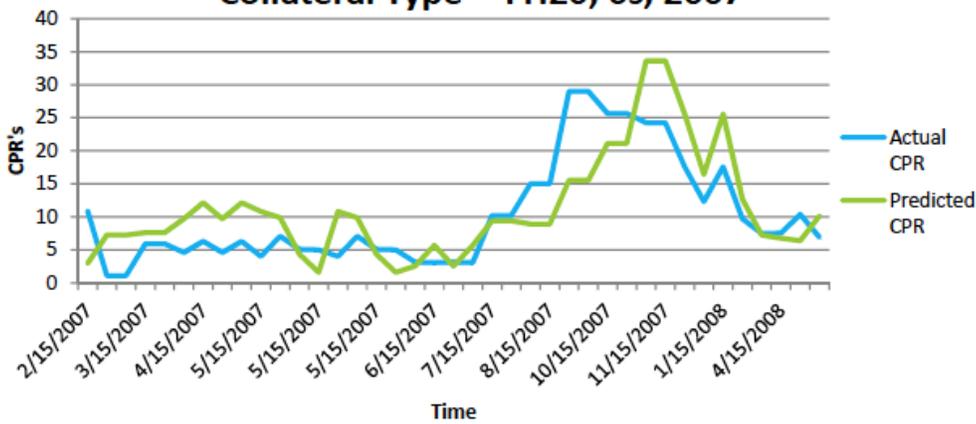


The 20 Year Collateral

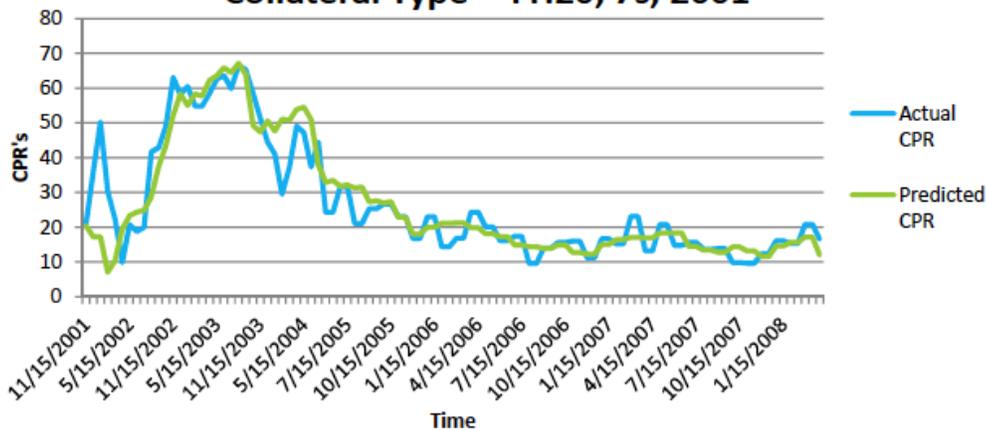
Collateral Type -- FH20, 5.5s, 2003



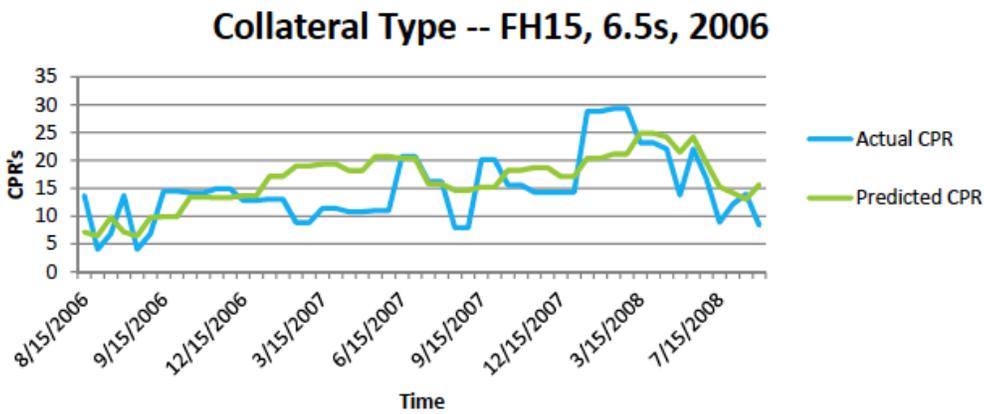
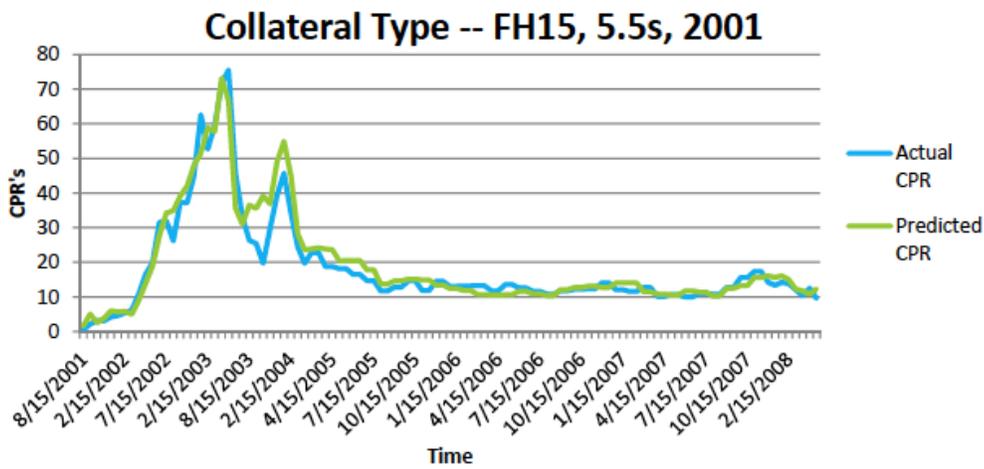
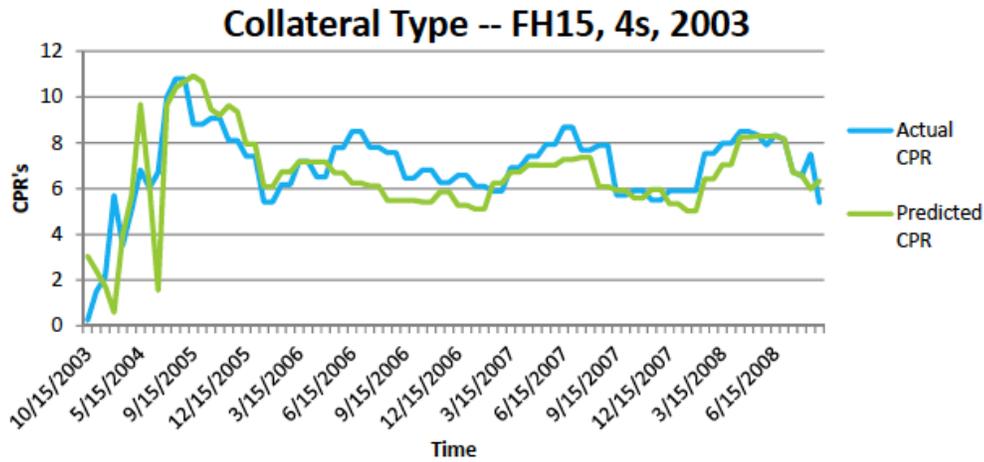
Collateral Type -- FH20, 6s, 2007



Collateral Type -- FH20, 7s, 2001

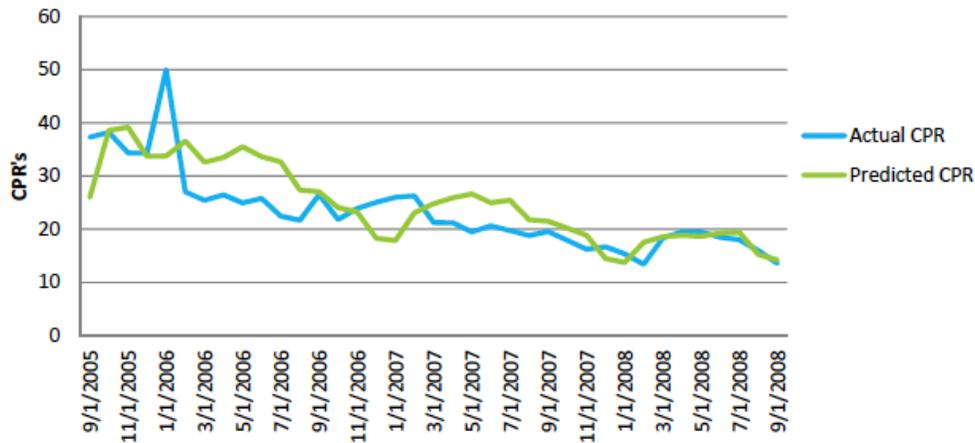


The 15 Year Collateral

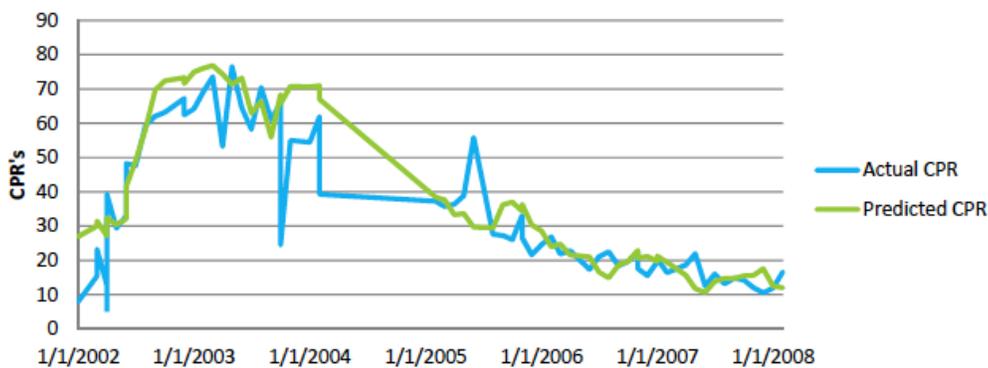


GNMA

Collateral Type -- GN30, 6.5s, 2005



Collateral Type -- GN30, 8s, 2002



Author

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