

## Prepayment Models for Sub-Prime Mortgages by Sanjeeban Chatterjee

Over the last few years there has been a proliferation of sub-prime loan products in the marketplace. Andrew Davidson & Co., Inc., (AD&Co) a leader in prepayment modeling, has developed models for both fixed and adjustable-rate sub-prime mortgages. The fixed rate models cover 15 and 30 year maturities, whereas the adjustable-rate model can take any first and periodic reset as input, and can adjust for interest-only and loans with prepayment penalties. The new models incorporate AD&Co's vision to provide a single framework for fixed and adjustable-rate mortgages, across collateral types.

It is important to note that for developing the prepayment models, we did not distinguish between voluntary and involuntary prepayments, but looked at total terminations. A termination is recorded whenever the outstanding balance becomes zero. However, defaults are becoming more and more important in the sub-prime world. The new AD&Co suite of credit models addresses issues faced by market participants while modeling defaults.

### Data Issues

We define Sub-Prime loans as first lien non-revolving mortgages. These are not HELOC's. Sub-prime borrowers typically have less than perfect credit and the loans usually have high Spread-At-Origination (SatO). All existing prepayment models have been developed using data from Intex.

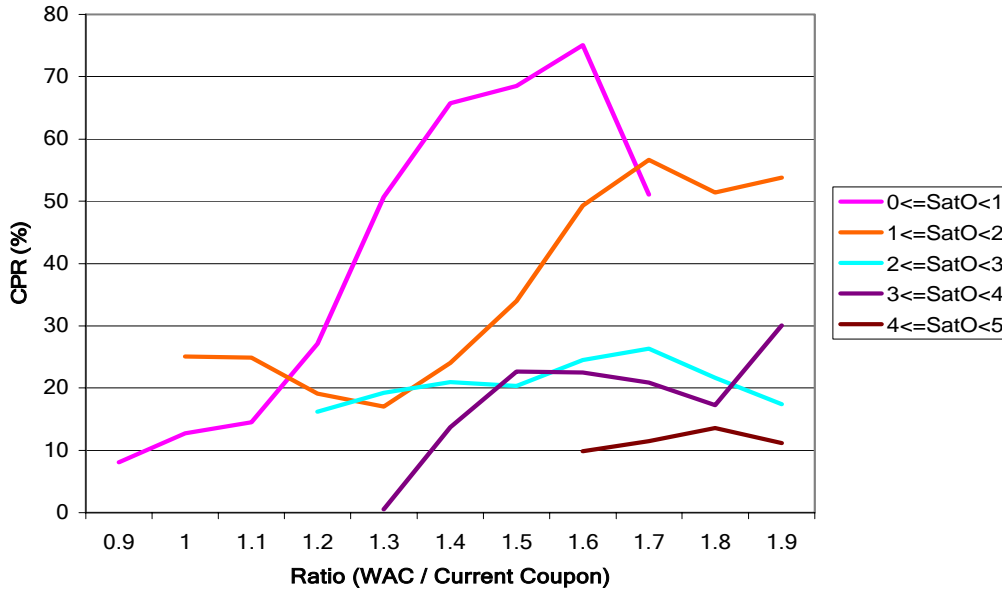
The fixed rate 30 and 15 year models were developed using data from RFC.

The adjustable-rate model was developed using data from 5 of the largest issuers (with largest balance outstanding as of December 2005). They are:

Countrywide  
Residential Funding Corporation  
Structured Asset Investment  
Morgan Stanley  
Long Beach

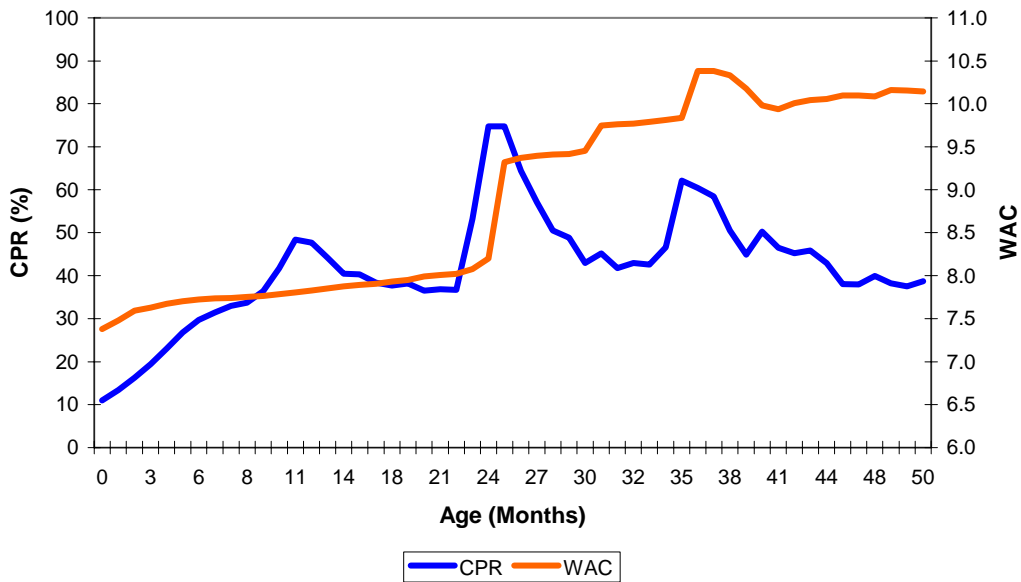
**Trends**

Spread-at-Origination (SatO) has a big impact on the level of prepayments as shown in the chart below. Speeds slow down as the SatO increases.



For sub-prime ARMs, we observe the following trends as shown in the chart below.

**Aggregate Prepayments By Age vs. WAC**



There are distinct prepayment spikes at 12, 24 and 36 months. In trying to explain the peaks, we note that the 12-month prepayment spike is not rate related. It is probably due to credit curing (borrowers making on-time payments for a year are probably offered better rates). The 24 and 36-month spikes are clearly

rate driven. Also, prepayments start to rise before rates start to increase, showing that borrowers are aware of what rates are going to be after reset (in the short term).

**The Prepayment Model**

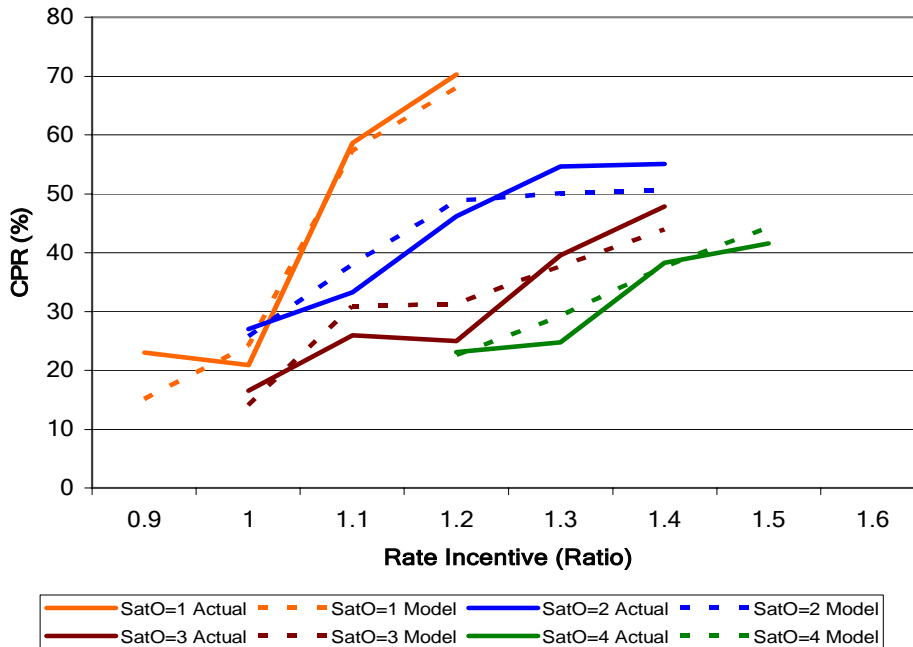
The prepayment model uses the functional form with Active Passive Decomposition (APD) for burnout. In the ARM model, the 12-month prepayment spike is modeled using the Credit Cure Effect. SatO is lowered around the 12 month period so that prepayments increase. The 24 and 36-month spikes are modeled using a Risk Aversion Factor and a moving average of 6-month forward-looking WAC. The current month's rate incentive is calculated by adjusting the current WAC using the Risk Aversion Factor and the 6-month moving average. The Risk Aversion Factor increases around a reset period. This increases prepay speeds around the reset dates and before rates actually start to increase. Loans with prepayment penalties are modeled using an indicator variable (1 if the loan is in a penalty period, 0 otherwise). This is then input into the computation of the adjusted WAC obtained using the 6-month forward moving average method. This leads to slower speeds when a loan is in a penalty period. Interest-Only (IO) loans are modeled in a similar fashion.

**Model Input and Output**

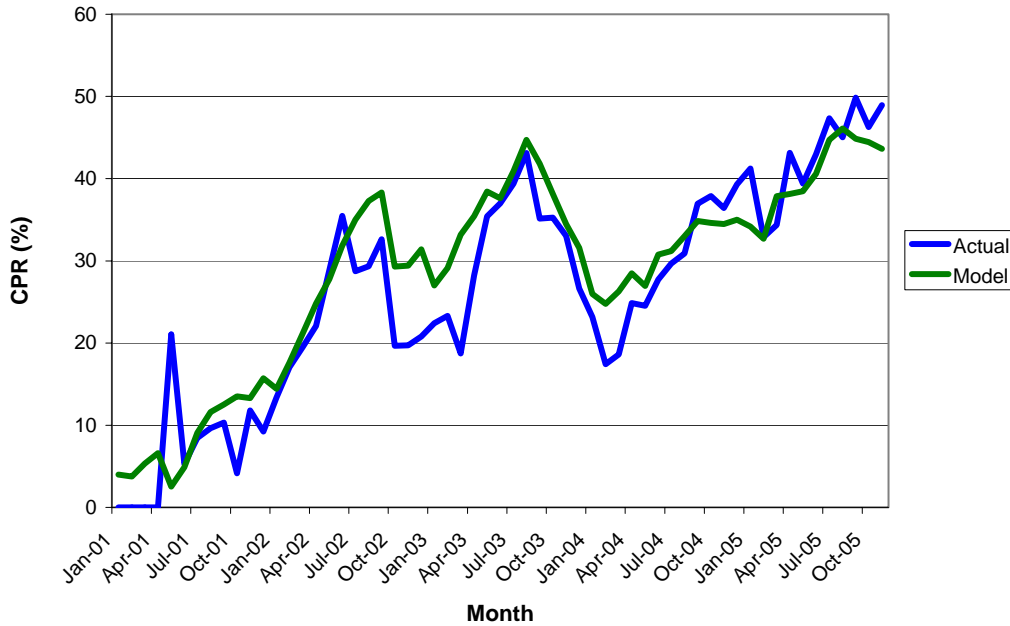
Inputs: WAC, WAM, Original LTV, Original Loan Size, Spread-at-Origination (SatO), Rate and HPI forecast  
 Factors Considered: Turnover, Refinancing (Rate Incentive), Credit Cure and Cashout (HPI)  
 Functional Form: Active Passive Decomposition for Burnout  
 Output: Vector of prepayment speeds up to the maturity of the loan  
 WAC Calculator Module: Use ARM characteristics (Caps, Floors, Reset Periods) to calculate WAC, given the term structure of rates

**Model Fit (Fixed and ARM)**

Fixed-Rate Model Fit by SatO (We see that the model captures the SatO effect quite well)



## ARM Model Fit by Month



## Integration with Vendor Systems

The new models have been integrated with several vendor and valuation systems. The WAC calculation is done outside the prepayment model (based on inputs from the term structure of rates). The computed WAC is then input into the prepayment model to obtain the prepayment vector. If the original balance and LTV is not available, then the mean value is used.

## The Loan Dynamics Model™

To enable clients to run these highly credit-sensitive instruments, AD&Co has released the Loan Dynamics Model. This model distinguishes between voluntary and involuntary prepayments. For the Loan Dynamics Model, the prepayment model was developed using data for only voluntary prepayments. The form of the prepayment model is the same as described before. It uses the APD method for burnout and uses the same factors and functional form as described above.

We value any feedback from clients. If you have any questions about the models or this article, please contact Sanj Chatterjee ([sanj@ad-co.com](mailto:sanj@ad-co.com)) at 212-274-9075.



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