ANDREW DAVIDSON & Co., INC. the Pipeline

AD&Co. News – Nov. '07

Are You in Tune?

By Rob Landauer

Every so often, we all need a little tune-up. If your back is aching, a visit to the chiropractor for an adjustment may be in order. If the timing on your car is misfiring, your neighborhood mechanic has the tools and diagnostics to get the engine purring again.

It is the same case for empirical models that are based on historical data. Every so often, current events deviate sharply from the past and the model needs to be adjusted to more accurately capture recent collateral performance. Adjustments can also be made to help the user assess the model's sensitivity to various parameters or to reflect an opinion on the impact that various loan types and issuers will have on collateral performance.

Regardless of the reason, rest assured that all of the key parameters of our Prepayment, Valuation and LoanDynamics™ models can be easily tuned by the user. This issue will focus on the tuning parameters available on all of our products and the impact adjustments to these dials will have on model performance.

As needed, AD&Co. may issue tuning recommendations for a particular model and version. Tuning recommendations are issued by the respective model analyst/developer tracking the actual versus forecasted performance of the model on a monthly basis. Any new recommendations will be announced in *The Pipeline* and will be available on our website. While AD&Co. advises that all formal tuning recommendations be employed, the user must decide if these tunings make sense for a given portfolio.

For more information on tuning, please visit the Vectors Client Support tab on our website at www.ad-co.com. If you have any questions about how to benefit from these tuning parameters on any of our models, please do not hesitate to contact your account manager.

Happy Thanksgiving!!!

the Pipeline

Prepayment Update – November '07

Tuning the Prepayment Model

By Dan Szakallas

Since we have discussed various way to tune our prepayment models over the past couple months, we believe it is a good time to step back and do a review of all of the tuning parameters that are available within AD&Co's suite of prepayment models.

We make tunings available to clients to give the models as much flexibility as possible, as well as to allow adjustments to the model when market conditions change suddenly. Given the turmoil seen through much of 2007, the tuning parameters have been a useful tool for clients to adjust the forecasts of prepayments to better reflect what they have been seeing on their own portfolio. We have discussed in the last two articles how adjusting the turnover parameter and the slide parameter affects model output, but there are 9 other tuning parameters that can also have strong effects on model outputs, depending on the user's need. We'll look at each parameter and describe how it works and when it should be used.

1. **Scale**
   Using the scale tuning parameter simply adjust the model's SMM vector by multiplying by the value entered. For example, if the user wishes to speed up the model forecasts, they would use a value over 1.0. This parameter does not adjust any of the underlying factors within the model, it simply changes the final forecast value. Values for scale can be any number greater than 0, and the default value is 1.0.

2. **Refi**
   The refi tuning parameter also works as a multiplier. It affects the Refi_SMM component of the overall model SMM. By adjusting this parameter, the user can increase the amount of SMM forecast by the model at a given incentive level. Internally, the model calculates a refinance incentive for a loan/pool based on a number of characteristics, and there is an estimated SMM level at each level of incentive based off the S-curve within the model. Adjusting the refi tuning parameter above 1.0 will increase SMM forecasts for those loans/pools with any level of refinance incentive, and setting to below 1.0 will slow down forecasts for those same loans/pools. This is a useful parameter to use if the model is underpredicting or overpredicting prepayments for premiums, as it can affect those loan/pools without changing the values for discounts. Values for refi can be any number greater than 0, and the default value is 1.0.

3. **Turnover**
   The turnover tuning parameter is a multiplier on the Turnover_SMM component of the model. Changing this value will raise or lower the level of basic housing turnover forecasted by the model. This will affect all loans/pools, regardless of refinance incentive. Using the

turnover tuning parameter can be helpful whenever there are temporary housing spikes or slowdowns, allowing the model to reflect short-term changes. Values for turnover can be any number greater than 0, and the default value is 1.0.

4. Cashout

Tuning the cashout tuning parameter allows the user to strengthen or weaken the amount of Cashout_SMM in the model forecast. This piece of the model is designed to capture the additional amount of prepayments seen from home price appreciation, where borrowers cash out the equity in their homes by refinancing into a new loan. The model will forecast a given amount of cashout_SMM based on the two-year change of the national house price index. For example, the model might forecast an additional 3 CPR for a two-year home price change of 12%, but tuning the cashout parameter will allow the user to increase or decrease that CPR for the given level of 12% appreciation. This parameter also works as a multiplier, and the values can be any number greater than 0, and the default value is 1.0.

5. Credit Cure

The credit cure tuning parameter functions in the same way that cashout does. It is a multiplier directly on the Credit_Cure_SMM forecasted by the model. The credit cure function attempts to forecast prepayments by a borrower who has seen a rise in their credit-worthiness, and can refinance a loan to a better interest rate. This function is heavily dependent on the age of the pool/loan, so the credit cure tuning parameter allows the user to increase or decrease the amount of SMM the model forecasts at any given age of the pool/loan. Values for credit cure can be any number greater than 0, and the default value is 1.0.

6. Slide

The slide tuning parameter is different than all the other tuning parameters. It is designed to change the refinancing S-curve to make the model more or less sensitive to prepayments at different incentives. By adjusting the slide parameter, the user can change the level of refi incentive where prepayments begin to increase. The units of slide are in basis points, and any values entered modify the underlying mortgage coupon for the model being used. For example, if a user is using the FNMA 30YR model, and tunes slide to 25, the user is essentially adding 25 basis points to the FNCL, the underlying mortgage rate the FNMA 30YR model uses to calculate refinance incentive. Adding basis points to the coupon “slides” the S-curve to the right, meaning prepayments will start to increase at a higher coupon level, and subtracting basis points from the coupon “slides” the S-curve to the left, meaning prepayments will start to increase and a lower coupon level. This is most useful for applying a model to loans/pools it was not estimated on, for example like agency quality loans that little or no documentation. Increasing slide for these loans will help reflect the different levels of interest rates available for these borrowers. Values of slide should be in the range of -500 to 500, and the default value is 0.

7. SATO

The SATO tuning parameter affects the spread at origination effect that is built into the model. This effect dampens prepayments for loans/pools that have a high coupon relative to interest rates at the time the loan/pool was originated. This effect is in place for a finite amount of time from the origination of the pool/loan, and the tuning parameter weakens or strengthens the dampening that occurs during that time. For example, if the user tunes SATO to 0, this effectively turns off the SATO effect, meaning that newly originated premiums will have the full amount of SMM projections from age 1 going forward. Values for SATO can be any number greater than 0, and the default value is 1.0.

8. Curve Spread

Curve spread tuning adjusts the model factor that controls for increased or decreased refi incentive based on the spread of the yield curve. If the spread is wide, there is added incentive to refinance from fixed to ARM, and less incentive to refi from ARM to fixed. If the curve is flat, there is less incentive to go from fixed to ARM. The curve spread tuning factor is a multiplier directly on this effect; it increases or decrease the prepayment speed based on the type of pool/loan being analyzed. Values for curve spread can be any number greater than 0, and the default value is 1.0.

9. Aging

The aging tuning parameter is designed to speed up or slow down the aging effect in the model. The aging effect controls when the model forecasts loan/pools to reach their full amount of turnover and refi SMM's. Increasing the aging parameter will make the model reach the full amount of turnover and refi SMM sooner, and decreasing it towards 0 will push the aging peak out further. Values for aging can be any number greater than 0, and the default value is 1.0.

10. Lag

The lag tuning parameter allows the user to adjust the lag weighting on the mortgage coupon used when determining refinance incentive. The model uses a blended mortgage interest rate from the previous 3 months to determine the relative refinance rate for a given loan/pool. Adjusting the lag parameter above 1.0 puts more weight on the interest rate from 3 months ago, and decreasing towards 0 places more weight on the rate from last month. Values for lag can be any number greater than 0, and the default value is 1.0.

11. Burnout

Burnout tuning allows the user to adjust the rate at which the model's burnout occurs. There are two types of burnout tuning, "model" and "sensitivity". Choosing "model" will change the historical burnout rate (if you are running an analysis where the loan/pool has already aged) from pool/loan origination, and going forward into forecast. Choosing "sensitivity" will only change the burnout rate going forward from today, i.e. in the forecast only. This tuning parameter is useful for situations where the user feels that the model does not slow down enough when the loan/pool becomes seasoned, or where too much prepayment occurs too soon and the speeds being forecast for the older ages are too low. Increasing this parameter above 1.0 will make more prepayments occur sooner, and decreasing towards 0 will make seasoned collateral prepay at a higher rate. Values for burnout can be any number greater than 0, and the default value is 1.0.

For more information or for help with any of the tunings, please contact your account manager. Also, check the pipeline every month to find out about any tuning parameter recommendations that we might make. All version-specific tuning parameter recommendations can be found in the support section of our website.

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Valuation Commentary – November ‘07

Using Tuning Dials for Prepay Risk-Neutrality

By Alex Levin

This issue of *The Pipeline* is dedicated to how various tuning parameters embedded in AD&Co.’s prepayment, LoanDynamics™, and valuation models can be used. The articles written by Dan Szakallas and Anne Ching describe how using this important tool can improve the performance of empirical models. This was the initial purpose of exposing the tuning knobs, or dials, to users.

In this article, I will discuss a different use of the tunings that relates to MBS pricing. At first, this may seem to be a purely ad-hoc exercise. In reality, this simple step is marked by full quantitative rigor; it reflects how the MBS risk is priced by the market and how this way of pricing, often termed “risk-neutral,” should be reflected by tuning a prepayment model.

What is Risk-Neutrality?

Let us assume that a single risk factor x exists and that this factor is a continuous random process (diffusion). Let us denote volatility of x as σ. The price of an asset (P) should depend on x; let P_x denote the derivative of price with respect to x. Volatility of the asset’s price is going to be equal to the volatility of the factor (σ) times the exposure (P_x); dividing this by price we get the volatility of return: $\sigma P_x/P$.

The arbitrage pricing theory is based on two key statements:

<u>1. Risky return.</u> Each asset exposed to the risk factor x is expected to return the risk-free rate plus a risky return proportional to the systematic volatility. The coefficient of proportionality is common for all instruments and called price of risk (π). The risky return is therefore $\pi\sigma P_x/P$ for all instruments.

Suppose we have 2 stocks, A and B, and the systematic volatility of A is twice that of B. Considering no other risk factors, we can invest $100 in A and sell $200 in B. It is easy to see that the total returns’ volatilities are offset. The total position becomes free of risk and, as such, should earn only the risk-free rate. This is possible if and only if stock A generates a double risky return to that of stock B. This way of reasoning is often referred to as” arbitrage argument.”

The risky return can be positive or negative; it depends on the sign of P_x. If an asset rewards an investor for bearing the risk, then a hedge should produce a negative risky return (be “expensive”) so that a Delta-hedged portfolio generates nothing but the risk-free rate.

Using the risky return statement directly requires financial engineers to build pricing models so that they compute the risky return and, in particular, measure the derivative (P_x) of price P to risk factor x. Not only can this be a hassle, but taking such a measurement may not always be possible. For example, valuing path-dependent assets via the Monte-Carlo method is not sufficient to compute this derivative in a straightforward fashion.

2. Risk-neutral drift. There is a very simple and nice way to force a pricing system to produce the risky return by itself. Let us purposely add $\pi\sigma$ to the drift rate of our market factor x. With this intervention, each asset will get an additional return that is equal to the product of this rate by the asset's exposure P_x/P ("duration") to x, i.e. precisely $\pi\sigma P_x/P$. The artificial drift is called the risk-neutral drift; a stochastic model that includes such a drift is called a risk-neutral model.

In short, instead of accounting for the risky return in each and every asset directly, we change the dynamics of our common risk factor x so that the required risky returns are generated automatically.

Suppose all bond are exposed to a single market factor, the overnight interest rate, which has an 80 bps annual volatility. Further, suppose that the market rewards 25 bps in return for bearing 1% of the asset's volatility. Then, risk-neutral model for the short rate will feature an additional drift of 25 * 0.8 = 20 bp/yr.

Risk factor as a random parameter. In finance, uncertainty can come in various forms. We may be exposed to tomorrow's economic release that will contain important indicators that look random from today's point of view. Once released, these indicators won't change for a while. Clearly, we deal here with random parameters (constants), but not with continuous randomness.

The arbitrage pricing works for multiple factors and for non-diffusive risks. With diffusive factors, risk-neutrality is achieved by adding an artificial drift rate. With random parameters, we do this by simply changing the value. To illustrate, let us return to the same short rate example now assuming that the factor is a random parameter rather than a random process (this is the actual assumption for the Black-Scholes equity option model). "Volatility" becomes an invalid term and has to be replaced by the usual standard deviation. Now, instead of adding 20 bps to the drift rate, we achieve risk-neutrality by adding 20 bps to the short rate itself.

Risk or bias? One can't firmly separate the ultimate drift or parameter value found in a risk-neutral model into "bias" and "price of risk". All empirical models constructed for the real world are somewhat subjective. A steep forward curve can serve an evidence of a high price of risk, or the expectation that the rate will go up, or both.

Risk-Neutral Prepayment Modeling

In analyzing MBS, Levin [2004] and Levin and Davidson [2005] offer a theory attributing the very existence of an OAS to bearing prepay model risk, i.e. the risk of a systematic difference between actual and modeled prepay speeds. In a simplified view, the market fears faster refinancing (loss to the premium sector) and slower turnover (loss to the discount sector).

Refinancing and turnover can be viewed as additive sources of prepayments (AD&Co's model also includes cashout refinancing and credit cure). The difference between the actual housing turnover (or refinancing) and the one computed by the model is the risk factor. We only regard systematic model errors, i.e. a model bias (inevitable oscillations are diversified over time and not priced by the market).

Errors of prepay modeling exhibit properties of both random processes and random parameters. There is no doubt that uncertainty in prepayment modeling grows over a time horizon subject to some bounds (after all, SMMs can't exceed 1.0 and be below 0.0). However, empirical models can often exhibit a bias that already exists at time zero because they are calibrated to historical data. For example, the AD&Co.prepayment model calibrated to a long historical time period overstates the turnover speed for 2007. In order to construct the risk-neutral dynamics for a factor that exhibits both an uncertain starting level and day-by-day small changes, we will change its starting value and add a drift. Each of these two steps can have different σ's.

Tuning the Knobs

Adding user-controlled drifts to prepay model factors is certainly possible. We demonstrated this in ValueNet, our first WEB-based valuation system. However, for our production OAS system that clients license, we decided to take a shortcut and restrict the user interference with tuning the existing prepayment knobs. This solution effectively exercises a simplified viewpoint on prepayment model risk: we interpret refinancing and turnover scale as random parameters, not random processes. The intuition behind this decision appealed to mere practicality:

- Our built-in tuning knobs were already widely used to improve the prepay model's accuracy. The tunings were initially built to fix potential bias in modeling (a partial purpose of risk-neutral as well)

- Unlike the arbitrage-free interest rate modeling, the price of prepay risk can't be established with absolute accuracy. If we detect unambiguous signals of prepay modeling risks priced by the market, we should be able to capture it with simple prepayment scales or other tunings. Market fears are usually straightforward to read.

- The diffusive part of prepay modeling error is mean reverting. Such a process has a variance rising over a time horizon and saturating, that is somewhat similar to that of a single jump, i.e. a random parameter, especially when the mean reversion is strong.

AD&Co's base prepayment tunings are 1.0s; risk-neutral tunings can be above 1.0 (fear of acceleration) or below 1.0 (fear of slow down). Typically, we find the risk-neutral turnover tuning to be below 1 with the refinancing tuning being above 1. "Physical" (empirical) and risk neutral tunings are multiplicative. If we recommend using turnover tuning of 0.85 and 0.8 (risk-neutral), then the OAS run will use 0.85, but the prOAS will end up using 0.8*0.85 = 0.68

In order to find the best risk-neutral tunings, we first have to select the set of benchmark instruments with established market prices and characteristics. We normally select several agency TBAs with various traded coupons; having as wide a range of GWACs as possible is important. We then seek two (or more) tunings that make OAS to the agency debenture curve a zero. That is, we view MBS with the prepay model risk accounted for simply as agency debts. Technically we are still running Libor OAS, but our OAS target is the agency debt spread to swaps.

Along with optimal tunings comes an understanding of how the market prices prepay model risks. The change in the OAS caused by a risk-neutral tuning is the MBS market's reward of bearing the risk. Let us assume that the optimal refinancing tuning is 1.3 (i.e. 30% acceleration in refinancing); in itself it reduces the OAS of FN6.5 TBA by 15 bps. The latter can be viewed as the risky return earned by the investors for bearing the refinancing risk.

We seek risk-neutral tunings separately for each major TBA market (Fannie versus Freddie, 30-yr versus 15-yr). Although the price of a unit of risk may be quite similar across MBS markets, the base models may exhibit various levels of bias. For example, if a 15-yr model was too fast, we would find the risk-neutral tunings to be lower than they are in other models. Once again, risk and bias are hardly separable.

Using the TBA benchmark is attractive, but not the only way of getting to risk-neutrality. The Trust IO/PO market is another alternative. It has a much greater number of instruments although only few are actually traded in a single business day.

When seeking the prepayment tunings for "market model," mortgage pipeline managers often use effective duration (their primary risk measure) as a target. As a part of AD&Co.'s valuation suite of products, we have designed a risk-neutral calibrator (a spreadsheet application) that lets a user tune to either OAS or OAD targets for an arbitrary number of benchmarks.

The Lessons We Have Learned

The risk-neutral prepayment tuning recommendations are published by AD&Co weekly for 4 fixed-rate MBS classes, FN30, FG30, FN15, FG15, and 2 composite hybrid ARM classes, those of FNMA and FHLC. We tune the fixed rate MBS using just two dials, the refinancing and the turnover scale tunings. In addition, we introduced an a tuning for the hybrid ARMs, the "tail" tuning to express a conservative view on the tail's value. Details of the risk-neutral calibration are demonstrated on http://www.ad-co.com/risk_neutral_model.htm, with the comprehensive market analysis of the TBA market shown separately for both the physical prepay model (the OAS method) and the risk-neutral model (the prOAS method) (see http://www.ad-co.com/market_analysis.htm).

Valuation under risk-neutral prepayments gives the investor the opportunity to make sound rich-cheap investment decisions. Instruments can be compared across MBS markets (TBA, spec pool, IOs, POs, CMOs) fairly. Below I list a few important practical observations collected over the period of 2003-2007.

- Valuation under risk-neutral prepayments is proven to produce more accurate "market" durations than when using the un-tuned empirical model. For example, we tested the Trust IO market over the 2003 market turmoil and found that the prOAS method (valuation with risk-neutral prepay model) predicted price changes much better than the usual OAS method (valuation with empirical prepay model). It convincingly explains why neither the constant-OAS method nor the constant-yield method works particular well for IOs, POs and MSRs.

- Risk-neutral tunings change over time in response to the change in market fears and prepay expectations. When rates drop sharply, most of the outstanding MBS volume is at a premium which leads to a refinancing fear (May-June 2003 is the best example). In contrast, a sharp rise in rates inflates fears that the housing turnover may slow down. Other events, like the recent mortgage crisis, can change the price of risk, even with stable interest rates. Finally, any risk-neutral tuning is a function of $\pi\sigma$ and will change in the presence of higher or lower uncertainty (σ), even with a constant price of risk (π).

- The risk-neutral calibration process requires a firm knowledge of the risk-free benchmark OAS. At times of crises and impaired liquidity OAS targets should be elevated. Without this adjustment, risk-neutral tunings will be misleading and unrelated to prepay model risk. For example, we clearly recognize that the dramatic widening of agency ARMs in August-September is prepay-unrelated and our tuning recommendations are upward biased.

Risk-neutral Tunings in the LoanDynamics™ Model (LDM)

We understand the need to have a risk-neutral default/loss model and will be addressing this need via the LDM tunings. It is too early to say which tunings will be employed and how the calibration will be done. It is expected that the risk-neutral model will produce greater losses than the empirically designed LDM.

References

A.Levin, Divide and Conquer: Exploring New OAS Horizons, AD&Co Quantitative Perspectives (in 3 parts), June 2004.

A. Levin and A. Davidson, Prepayment Risk-and-Option-Adjusted Valuation of MBS, *The Journal of Portfolio Management*, Volume 31, No. 4, Summer 2005.

Credit Commentary – November '07

Tuning the LoanDynamics™ Model

By Anne Ching

The LoanDynamics™ Model (LDM) is an economic model of prepayment, delinquency, default, and loss which is calibrated to historical data. As such, it provides critical information about the relative effects that different variables have on borrower behavior. However, one of the most valuable features of LDM is its flexibility, since it allows users to scale major parameters and inputs within the model.

AD&Co. believes that users should have the ability to perform sensitivity analyses, and to express a view about how a particular collateral type or issuer should perform. Similarly, there are situations when the current market deviates significantly from historical performance, and thus behavioral models require adjustments to reflect market dislocations.

There are six different tuning categories within LDM, which are described in detail below.

1. **SATO (Spread at Origination) Residual** is a very important variable in LDM which proxies for unobserved loan characteristics not disclosed in servicing data, such as DTI ratio, prior default history, employment history, etc. By tuning SATO Residual, users can either reduce or amplify the SATO Residual effect.
2. **Transition Probabilities**
   Users have the ability to scale the transition probability equations for six transitions: Delinquency, Default, Cure, Delinquent Prepayment, Cure and Liquidation. The default tuning is 1.0. However, a user may want to increase the rate at which loans transition from one state to another. A value of 1.5 would increase a particular transition rate by 50%. The model will automatically adjust the remaining transition probabilities so that they sum to 100.
3. **Loss Parameters**
   There are two parts to calculating the expected loss of a loan: the probability of loss and the magnitude of the loss. Users have the ability to scale both for each of the three states from which losses can occur: Current, Delinquent and Seriously Delinquent.
4. **Slide Variables**
   Users can adjust globally the values of loan inputs for LTV, FICO and HPI without having to alter individual loan characteristics manually. For example, a user may want to see the impact of inflating LTV ratios for all loans within a particular pool by 10 percentage points. This is done by entering a value of "10" for **LTV_Slide** tuning.
5. **Stretch Variables**
   While Slide Variables affect loan input variables, Stretch Tunings scale the coefficients of FICO, LTV and HPI variables in the statistical equations used in the model. Tuning

multipliers greater than “1” amplify the contribution of that particular variable, while values less than “1” dampen the impact.

6. **Prepayment Tunings**
   Users have the ability to scale all of the prepayment transition factors present in our prepayment models, which are described in the “Tuning the Prepayment Model” section of this *Pipeline* issue.

With the tuning parameters described above, the process of tuning the LDM is a mix of art and science. The basic idea is that the user changes one or more of these parameters to “tune” a certain subset of model results, given an a priori sense of the appropriate values.

In the case of subprime vintages 2005-2007, AD&Co has found that the “early indicator” of 60+ delinquency levels showed that the LDM was underpredicting delinquency, and was likely to underpredict defaults and cumulative losses in the future. Since these early indicators suggested that these vintages were substantially different from the historical record, AD&Co tuned the LDM by calibrating it to actual delinquency performance of deals comprising the ABX 06-2 and ABX 07-1 indices.

Therefore, given the deterioration of underwriting standards during the period of 2005-2007 for sub-prime loans, AD&Co has recommended that the following parameters be tuned for LoanDynamics V1.6:

1.Transition Tunings: S to C (Cure) = 0.5
- Decreases the rate at which loans recover from seriously delinquent status to current

2. Loss Tunings: Severity TD, TS, TC = 1.1
- Increases the severity of loss by 10% for loans that experience a loss in the current, delinquent and seriously delinquent loan states

3. Slide Variables
- LTV Slide = 8 (increases individual LTV ratios by 8 percentage points)
- FICO Slide = -60 (decreases individual FICO scores by 60 points)
- HPI Slide = -2.5 (shifts HPI scenario down by 2.5 percentage points)

4.Prepay Tunings: Slide = 200
- Decreases refinancing incentive by 200 bp.

If you have any questions about tuning the LDM, or about our recommended tuning for subprime vintages 2005-2007, please don’t hesitate to contact your AD&Co. Account Manager.