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Shedding Light on Subprime RMBS

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1. Introduction

The recent credit crisis stems in part from an inability to value certain securities linked to home mortgages. Over the past year, trading in many securities backed by sub-prime and Alt-A mortgages ground to a halt. The lack of an orderly market in these securities contributed to a seizing up of credit more generally. With hundreds of billions of dollars (nominally) resting on the balance sheets of major financial institutions, market participants turned to various proxies in order to mark these positions to market.

The ABX.HE home equity indices constitute one of the more popular pricing proxies for sub-prime mortgages. The indices may nevertheless overstate or understate true, or fundamental, asset values. Supporting this notion, the ABX's sponsor, Markit Group Ltd., cautions that one should not overplay their importance in valuing this asset class.¹

In this study, we contrast the performance of the ABX index against ABSTRAK[®], a fundamental valuation model for structured securities. We construct an index of fundamental fair-market asset values for a basket of securities underlying the most seasoned ABX index and compare this over time to reported ABX prices. While we cannot vouch for the accuracy of the ABSTRAK[®] model, we believe that it offers a useful perspective on the underlying value of these securities. This section provides an overview of the sub-prime problem. The following section outlines the construction of the ABX indices and is followed by a description of ABSTRAK[®]. The final section presents the results of the comparison between ABSTRAK[®] and the ABX.HE indices.

Recent History

The ABX.HE index highlighted concerns in the home equity market and gave a clear, strong indication of the scale of the problem fairly early in the process.² Exhibit 1 below depicts a time series, through November 2008, of the first of the ABX.HE indices to launch (2006-01) and reveals that market concerns first appeared in early 2007 when New Century Financial and HSBC, the number-three and number-two sub-prime lenders respectively, announced serious problems. Although concerns briefly appeared to abate,

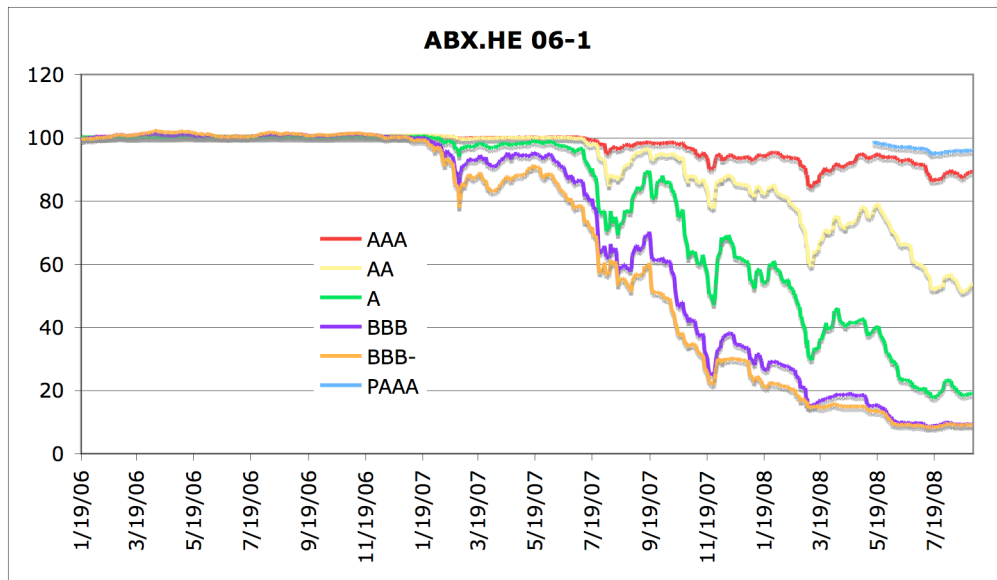
* The author thanks R&R Consulting for its modeling work and for contributing to this article. Thanks also to Eric Falkenstein, who provided many helpful comments.

¹ Please see "Don't Mark to Markit," *The Economist*, March 6, 2008.

² See, for example, "Subprime Mortgage Derivatives Extend Drop on Moody's Reviews," *Bloomberg*, February 22, 2007.

index prices took a turn for the worst starting in June 2007 and have fallen to near zero for the lowest rated sub-prime tranches.³

Exhibit 1. Time Series of ABX.HE 06-1 Constituents

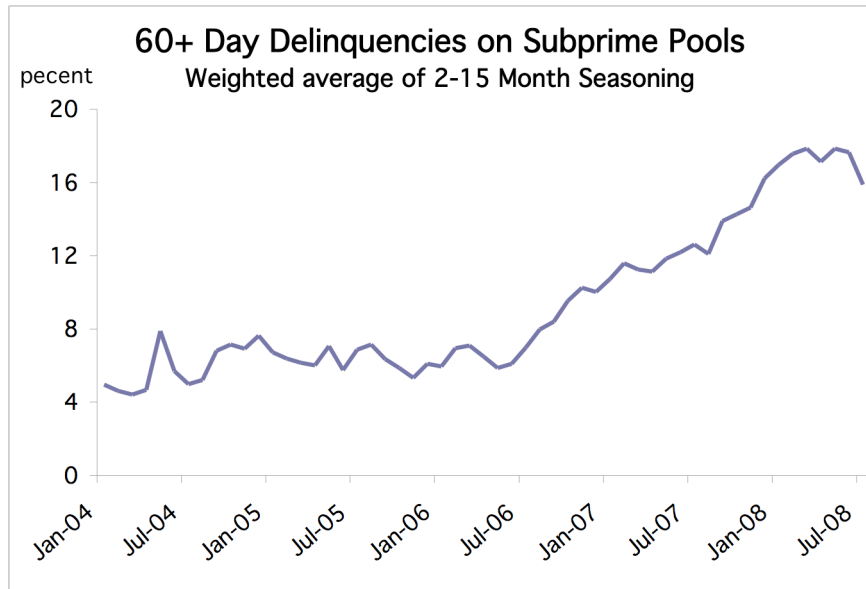


To see why the ABX series fell so quickly in 2007, one need only examine the reported loss performance of the underlying securities. We collected performance data from Bloomberg on a set of 126 sub-prime mortgage pools aged between 2 and 15 months, for the period starting July 2004 and ending July 2008. Around August 2007, the market for these securities disappeared and few new pools were originated thereafter.

We combined the performance histories for the 126 pools by normalizing to adjust for seasoning effects. Historically, there has been a predictable pattern in mortgage pools, where marginal losses increase linearly until about three years, and then level off, as most of the prepayments and delinquencies reveal themselves. Although the recent mortgages were each issued at various points during the sample period, we can “de-season” the sample by referring to the historical pattern of loss rates and adjusting upwards loss rates on young pools and adjusting downwards losses on older pools. At each month, we weighted the cumulative 60+ day delinquency rate by a seasoning factor and combined these to create a time series of 60+ day delinquencies for the pools.

³ Section 4 discusses the relationship between index prices and underlying asset prices.

Exhibit 2. 60+ Day Delinquency Rates



As can be seen in Exhibit 2, delinquency rates for this sample trended higher in June 2006 and became obvious by October of that year. That is, by late 2006, looking at the underlying collateral supporting various bonds, swaps, and indices, one could have seen that these assets were performing outside the expected range of historical experience. Our sample pool delinquencies eventually peaked at more than three times historical average. In summary, ABX prices may have simply been reacting to this development. We explore below whether this reaction was too small or too large.

Impact of Valuation Errors

To the extent the ABX indices are in aggregate too low or too high—and participants relied on them—the market value of assets held by many financial institutions could be misstated. Several commentators have pointed out that current ABX prices predict a disaster scenario that may be outside the realm of the plausible. In December 2007, Wachovia Capital Markets analysts Glenn Schultz and John McElravey noted that the price of the ABX that tracks AAA-rated mortgage backed securities implied losses of around 49% among pools of sub-prime mortgages issued in 2006.⁴ Given that index

⁴ “Is subprime index subpar?”, Wall Street Journal, December 12, 2007.

prices have fallen substantially since then, implied losses would be far in excess of 50%. In April 2008, the Bank of England noted that AAA rated tranches were trading 25% below the model price for the 2007 vintage.⁵ As researchers at the BIS recently argued, “past estimates of total valuation losses at the AAA level may have been inflated by more than 60%”.⁶ Banks have written down hundreds of billions of dollars worth of very nontransparent assets based in part on a handful of illiquid indices. This series of events prompts the question, “Are the ABX home equity indices too pessimistic?”

Furthermore, the *relative* prices of indices within a vintage may provide an opportunity for arbitrage. Indeed, relative value trading in this sector may be the “safest” way to play the current crisis. Is a 44 price for the ABX.HE AAA 07-2 consistent with a 5 price for the ABX.HE BBB 07-2? In any event, with such large and unprecedented losses, it would be helpful to have a true, bottom-up, indicator.

The next section provides a review of the ABX indices. We then discuss the details of ABSTRAK[®]. Finally, we present a methodology for comparing the two and discuss the results of this exercise.

2. The ABX Subprime Indices

In 2006, Markit Group Ltd. introduced an index of sub-prime mortgages that it designated ABX.HE. Though others provide similar information, Markit until recently displayed recent index prices online free of charge and continues to provide historical data for a fee, making it a popular benchmark for this asset class. The ABX.HE indices facilitate calculation of current market prices on financial assets that are otherwise either without a benchmark price or else infrequently traded—as well as making it possible to actually hedge or trade these illiquid products. Indeed, many of the financial write-downs over the past 12 months have referenced the ABX index performance specifically. In this section, we discuss the mechanics of the ABX index.

Within each ABX.HE index grouping (or “roll”) there are five sub-indices based on the original credit rating of the reference obligations by the major bond rating firms: AAA, AA, A, BBB, BBB-. Starting in January 2006, a new roll was issued semiannually, based on asset pools originated during the previous six months.^{7,8} For example, the ABX.HE 2006-01 index is comprised of mortgages originated in the second half of 2005. In May 2008, an additional sub-index, titled “AAA penultimate,” was added to each existing vintage. The latter references the second-most junior AAA tranches.

⁵ See the Bank of England’s *Financial Stability Report*, April 2008, Issue No. 23.

⁶ Ingo Fender and Peter Hördahl, “Overview: a cautious return of risk tolerance,” BIS Quarterly Review, June 2008.

⁷ Because of lack of issuance, no rolls have yet been launched since early 2008.

⁸ In September, 2008, Markit announced the launch of a roll to cover transactions closed during the first half of 2005.

The price of each ABX.HE sub-index is based on a traded credit default swap (CDS) referencing the performance of 20 sub-prime securities or tranches, all issued with the same original rating. Each tranche, in turn, originated from a different issuer and depends on the performance of a distinct collateral pool, as well as the amount of equity cushion that takes the first losses in the structure. The selected tranches are the junior-most within each original rating category, and thus provide a conservative lower bound of credit quality for each tranche. As such, the most senior AAA securities are not included in the ABX.HE.⁹ As described in the next section, the assigned ratings are a function of the asset-backed structure—seniority, cushion, the timing of cash flows—and, of course, the performance of the underlying collateral.

For each index roll, Markit assembles a set of prospective underlying pools that form the basis of a reference CDS. It canvases the broker-dealer community to find those pools that meet the minimum standards for inclusion in the CDS. The candidates are the 20 largest home equity deals originated in the prior six months. No more than four deals can be linked to a single originator and no more than six to a single master servicer.¹⁰ The table below shows a list of the deals included in the 2006-01 index. One tranche from each deal is included in a given sub-index.

Exhibit 3. Transactions included in the ABX.HE 2006-01 index series

ABX.HE 2006-1 Constituent Transactions
ACE Securities Corp. Home Equity Loan Trust, Series 2005-HE7 Asset Backed Pass-Through Certificates Argent Securities Inc 05-W2
Ameriquest Mortgage Securities Asset-Backed Pass-Through Certificates, Series 2005-R11
Bear Stearns Asset Backed Securities I Trust 2005-HE11
CWABS Asset-Backed Certificates Trust 2005-BC5
First Franklin Mortgage Loan Trust, Series 2005-FF12
GSAMP Trust 2005-HE4
Home Equity Asset Trust 2005-8
J.P. Morgan Mortgage Acquisition Corp. 2005-OPT1
Long Beach Mortgage Loan Trust 2005-WL2
MASTR Asset Backed Securities Trust 2005-NC2
Merrill Lynch Mortgage Investors Trust, Series 2005-AR1
Morgan Stanley ABS Capital I Inc. Trust 2005-HE5
New Century Home Equity Loan Trust 2005-4
RAMP 05-EFC4 Trust
RASC 05-KS11 Trust
Securitized Asset Backed Receivables LLC Trust 2005-HE1
Soundview Home Loan Trust 2005-4
Structured Asset Investment Loan Trust 2005-HE3
Structured Asset Securities Co. Mortgage Loan Trust 05-WF4

The credit default swaps referenced by each sub-index are standardized so that they are initially priced at 100. A CDS protection buyer pays a fixed premium (set at origination) each month and in return receives payments from the seller in the event of specific adverse credit events on the underlying tranches—interest shortfall, principal shortfall, or write-down. Because these credit events are future events, the current price can change

⁹ The most senior AAA tranche typically constitutes the lion's share of a deal's structure, suggesting a possible sampling bias.

¹⁰ Source: ABX Marketing Presentation, Markit Index Co., January 2006.

based on anticipation of these future credit events. When the CDS market price is below 100, a credit protection buyer entering into a transaction pays up front the difference between the trade price and 100 as well as the monthly fixed premium going forward. Consequently, a reported ABX sub-index price does not correspond directly to a valuation of the referenced home equity tranches. Rather, the latter must be inferred based on a host of assumptions. We explore this further in the next section.

The sub-index prices are updated daily by surveying 15 dealers for current prices of the relevant CDS. For a given sub-index, Markit discards the highest and lowest CDS price, and calculates a simple average of the remaining prices. According to an estimate reported in the *Wall Street Journal* (December 12, 2007 article cited above), about \$3 billion in notional amount trades every day for the ABX, compared with activity for the S&P 500 index in the range of \$180 billion per day. The bid-ask spread for these derivatives is on the order of 8 percentage points, implying they are not very liquid.

Despite their shortcomings—representing only a fraction of outstanding sub-prime assets, referencing only the most junior tranches and being relatively illiquid – the ABX indices provide a very useful bit of top down data on asset valuations, especially when one is concerned with underwriting standards.

3. Description of ABSTRAK[®]

This section describes the conceptual framework supporting ABSTRAK[®], a real-time valuation algorithm for structured securities implemented in the Java computer language. ABSTRAK[®] was designed by R&R Consulting, a structured security valuation firm founded in 2000 and headquartered in New York City.¹¹

The philosophy underlying ABSTRAK[®] is that meaningful valuation of ABS or RMBS CDO assets from secondary market prices on the securities is not feasible. Instead, ABSTRAK[®] values pools of financial assets from underlying primary data elements obtained from transaction-specific servicer reports. This Monte Carlo-based asset valuation is then fed into a logical inference engine, which uses the resulting cash flows to value the associated asset-backed bonds, or tranches. Uniquely, ABSTRAK[®] can true up the fair market value of structured securities on a monthly basis *via* a feedback signal provided by periodic servicer reports, which are generally available for the vast majority of ABS, MBS and CDO transactions. A further abstraction, beyond the single-transaction engine, is required to value the liabilities of RMBS or ABS CDOs, but this work becomes trivial once ABSTRAK[®] values are produced on the tranches in portfolio.

The complete ABSTRAK[®] platform consists of 1) the asset-side cash flow engine and 2) a structuring tool referred to as the Waterfall Editor[™] that allows the user to represent to any extent desired the allocation rules disclosed in the prospectus or PPM underlying any structured transaction. The Waterfall Editor[™] is a Java-based application that can be used in two independent modes.

¹¹ Sylvain Raynes, a principal of R&R Consulting, contributed this section of the paper.

- 1) As a stand-alone application, it enables the user to enter and test the cash-flow allocation rules (waterfall) of any asset-backed transaction.
- 2) As an integral part of the ABSTRAK[®] platform, it enables the valuation of securities associated with a live transaction.

The Waterfall Editor[™] was originally designed by Charles Deck while working as a summer intern with R&R Consulting. Over the subsequent three years, the program was improved and integrated into the ABSTRAK[®] cash flow engine. The ABSTRAK[®] engine is capable of simultaneously valuing large numbers of tranches.

The ABSTRAK[®] Formalism

The valuation of structured securities inside ABSTRAK[®] is a two-step process. The first step [Calibration] is *automated* while the second [Monitoring] is *automatic*. The two phases are described below. A limited number of technical details are provided as well.

Step 1: Calibration

The term “Calibration” refers to the *a priori* normalization of a transaction, i.e., to its initial valuation grounded in a universal basis. In structured finance, there is a critical need for a widely accepted basis. To date, that function has been served by credit ratings. R&R calibrates each transaction using the credit rating assigned by a major credit rating agency to the senior class of the transaction.¹² The senior class for each transaction is chosen because that class is easiest and most straightforward to compare. The worldwide community of structured finance is cognizant of the rating scales used by Moody’s and Standard & Poor’s, and is thus familiar with the language of ratings. Therefore, the calibration step of the ABSTRAK[®] model uses the senior-class agency rating as a basis, the latter expressed as an average yield reduction from the initial promised coupon, or else from the promised “spread” on floating-rate bonds. For example, Aaa structured ratings by Moody’s Investors Service correspond to a maximum average yield reduction of 0.06 bps, a very small but still non-zero number.

Thus, there is no attempt to either agree or disagree with the initial Moody’s rating. Once the deal is calibrated by matching the public rating on the senior class to the implied ABSTRAK[®] rating, the remaining tranche ratings are naturally computed. As a result, although the ABSTRAK[®]-implied rating and the Moody’s rating on the senior tranche are identical by design, the subordinated bond ratings assigned by the platform can, and in general do, differ from the corresponding Moody’s credit ratings when they exist.

¹² The typical structure of an RMBS transaction partitions claims on cash flows into classes. For example, a typical deal may have an A class, an M (for mezzanine) class and a B class. Each credit class is further divided into sub-tranches, commonly referred to as “liquidity” tranches for obvious reasons. Nearly all of the senior tranches are rated.

Before a transaction can be calibrated in the manner just outlined, it must be entered into the ABSTRAK[®] engine *via* the parameterization of the assets and the liabilities of the target transaction. As is well known, the assets normally consist of a collection of loans or other financial contracts in which liability holders (i.e., the bondholders or “certificate” holders) own an *undivided* interest. Since the bondholders merely own an abstract claim on the target pool, access to loan-level data would not improve the quality of the credit analysis unless more credit-sensitive data elements were in fact available at the loan level that were ignored in the rating process. This is because, in the end, all loan-level data will need to be aggregated to the pool level before being subjected to cash flow analysis.

An example of a data element that would likely make a difference is the credit score [FICO score] of each obligor, updated on a monthly basis. However, collecting such critical data would impose a significant financial and administrative burden on the servicer without any guarantee that the resulting security values would be more accurate than those arising through the monthly feedback loop enabled by the variables already contained in monthly remittance reports.

Within ABSTRAK[®], the evolution of the underlying assets’ credit status is parameterized using non-stationary Markov transition matrices modulated on a monthly basis by the pool’s cumulative loss curve. Each monthly matrix enables the computation of cash flows at the loan level through a cash flow transfer function specific to the type of loan in the pool. For more information on technical implementation details, please refer to *The Analysis of Structured Securities*, by Sylvain Raynes and Ann Rutledge.¹³ Such cash flows are then aggregated up to the pool level within a continuum framework. By this we mean that individual loans’ performances are synthetically reproduced, and their cash flows summed *in situ* rather than handled as individual loans. The transition matrix system contains a credit-loss tracking parameter as well as a Single-Month Mortality prepayment multiplier [SMM], both of which are calibrated to unity at closing. As outlined below, these two parameters are adjusted through remittance reports during the monitoring phase.

Once asset-side cash flows are computed with respect to each collection period, they are fed to the target transaction’s waterfall to retire its liabilities, or perhaps not. This sub-step requires the availability of a file that describes the capital structure of the transaction and cash allocation rules in a format understandable to ABSTRAK[®]. Prior to calibration, the cash allocation rules are programmed into the Waterfall Editor[™] and stored in an XML file using the Java language to enable visualization of the transaction structure. A screenshot of such a liability file with respect to a typical RMBS transaction can be found within the Waterfall Editor section, under the Valuation tab, on R&R’s website <http://www.creditspectrum.com>.

As outlined above, the main goal of the calibration phase is to ensure that the ABSTRAK[®]-implied senior tranche rating is identical to the one initially assigned by

¹³ Raynes, Sylvain and Ann Rutledge, *The Analysis of Structured Securities*. New York: Oxford University Press, 2003.

Moody's Investors Service. The senior credit rating is translated into the agency's published structured-rating scale and is communicated as an average yield reduction from the promised coupon over the range of statistical possibilities explored *via* Monte Carlo simulation.

The aforementioned step is implemented by adjusting the short-rate volatility of credit losses embedded in the stochastic, cumulative loss process applied to the pooled financial assets. In other words, by definition there exists one, and only one, marginal-loss volatility compatible with the transaction's senior tranche credit rating. This volatility parameter is used to modulate the entries of the monthly transition matrices. These matrices are used directly to compute cash flows *via* the deal's cash flow transfer function. For interested readers, this process is described in further detail in *The Analysis of Structured Securities*, cited above.

This unique, short volatility value is computed through a one-dimensional root-locus procedure. Because this effectively represents one equation in one unknown variable, convergence is guaranteed. As by-products of this convergence process, the initial credit ratings of all other tranches are simultaneously derived and stored in memory.

In addition to tranche-wise average yield reductions and equivalent ratings, the ABSTRAK[®] platform computes a set of 17 metrics with respect to each security or CUSIP number. These range from standard credit duration and convexity up to the fair market CDS spread on each tranche or sub-tranche. These metrics are updated and refreshed monthly as part of the re-valuation process implemented during the monitoring phase.

One of the most significant metrics computed by the ABSTRAK[®] engine is the relative fair market value [RFMV] of the security, defined as the bond's dollar fair market value divided by its remaining outstanding principal balance. As usual, the RFMV is computed by discounting the cash flows from each Monte Carlo scenario at the prevailing risk-free rate. In other words, the platform applies the concept of certainty-equivalence to each path realization, obviating the need for the standard notion of a credit spread, the latter being made redundant by measuring credit risk *via* the discount ratio's numerator instead of its denominator, as is normally done in fixed-income finance.

At that point, the transaction is considered "live" and ready for monitoring.

Step 2: Monitoring

The ABSTRAK[®] system monitors all live transactions each month and delivers refreshed time-series results right up to the most recent distribution date. Graphical output is available for each input and modeled parameter. As already indicated, transactions are monitored using remittance reports created by the trustee from servicer data. In addition, seasoned deals can be included in the monitoring process any time after closing. Transactions can also be re-monitored if, as sometimes happens, value-critical data

elements are re-stated. The ABSTRAK[®] monitoring phase does not require human intervention.

The monitoring step is essential and needs to remain in place until the bonds have either paid off or defaulted. On a monthly basis, after remittance reports have been produced and made available to ABSTRAK[®] by the data vendor, the system automatically downloads the updated XML deal files from the vendor's web site *via* FTP and runs the monitoring program. Upon completion, the engine sends e-mail notification to selected users that the valuation updates are ready for viewing, or that data errors were found that must be investigated before a new update can be run. Depending on the asset class, after approximately 18 to 24 months of seasoning, performing deals usually stabilize, resulting in reliable fair market values going forward.

At the purely mathematical level, the monitoring process is straightforward and proceeds through a four-dimensional, integral root locus optimization algorithm very similar to that used during calibration. Specifically, the four dimensions are: 1) prepayments, 2) defaults, 3) 30-day delinquencies, and 4) 60-day delinquencies. In most cases, higher-delinquency buckets are too unstable to deliver reliable signals, not to mention the politics of delinquencies. Although beyond the scope of this paper, a few comments with respect to the prepayment and default re-normalization processes are perhaps instructive.

On a monthly basis, the ABSTRAK[®] platform integrates the transaction's multi-dimensional cash flow density function, computed *via* the above-mentioned sequence of non-stationary Markov transition matrices, to obtain preliminary values for cumulative prepayments and cumulative gross defaults. This integration process, albeit initially volatile, self-stabilizes within about six months post-closing to deliver smoothly varying time series that have strong predictive power due to the well-known combination of optionality and pool amortization. Nevertheless, despite the secular impact of asset-side stabilization just mentioned, the relative value of highly leveraged tranches, e.g., the subordinated tranches of mortgage-backed securities, will remain relatively volatile throughout much of the transaction's lifespan. Although sometimes counterintuitive, this should not be surprising since the bottom 3% of the capital structure of any transaction could be wiped out entirely by any information indicating a cumulative net loss rate of 3% or greater over the remaining life of the deal. The increase in monthly losses required to cause such an event, when extrapolated over a 30-year transaction time frame, is remarkably small.

The preliminary ABSTRAK[®]-resident cumulative prepayment and default rates are then compared to the empirical values of the same data elements and the parameters of the Markov transition-matrix process are adjusted *in situ* so as to match the empirical values. A small margin of error is allowed inside the matching algorithm because statistical errors and servicer data inconsistencies always interfere with an otherwise purely analytical process.

This feedback loop is difficult to execute properly under all circumstances and within all asset classes. Apparently, despite the best of intentions on the part of servicers, actual

remittance reports seem to undergo behavior that is anything but “analytic.” As highlighted above, the same optimization process is next applied to the first two delinquency buckets, after which the deal is ready for the monthly update process.

The ABSTRAK[®] platform completes the monitoring phase by executing a single Monte Carlo simulation, this time starting from the next collection period until the weighted-average, remaining maturity [WARM] of the pool, but using stochastic parameters updated, as indicated, *via* servicer report feedback. This is usually straightforward.

Because the ABSTRAK[®] monitoring phase begins with an integration from zero up to the current time step, the associated re-valuation automatically takes into account the pool’s current amortization as well as the intricate liability pay-down schedule *via* the XML file provided by the Waterfall Editor[™]. It is in this manner that ABSTRAK[®] keeps up in real time with transaction dynamics and is able to incorporate the non-linear impact of credit losses and delinquencies on the fair market value of its liabilities.

In addition to the updated yield reduction on each liability tranche, the platform also computes new values for the 17 liability- and asset-based metrics mentioned above. ABSTRAK[®] updates its entire forecast automatically as often as new information becomes available. Over time, ABSTRAK[®] provides a converging simulation of what will eventually transpire with respect to individual CUSIP numbers.

4. Comparison of ABX and ABSTRAK[®]

In this section, we compare underlying asset prices implied from ABX sub-indices against average prices as calculated using ABSTRAK[®]. We begin with a discussion of possible methodological pitfalls and move to a proposed, simple approach to the problem.

The Challenge

A true “apples-to-apples” comparison between ABSTRAK[®] and the ABX would require us to back out of each ABX sub-index an estimated valuation for the underlying reference tranches. In theory, for each trading date we would a) convert the ABX indices to implied credit spreads, conditional upon an assumed prepayment curve for the underlying bonds; b) translate the implied credit spreads into implied forward default rates; and c) use the implied default rates, along with prepayment assumptions, to compute an average price for the underlying reference bonds.

We note here that the protection period for the ABX credit default swap (unlike a standard corporate credit default swap) is equal to the maturity of the longest-lived reference bond.¹⁴ Hence assumptions about the maturity (or more precisely, the duration) of the underlying bonds are (or, at least, should be) used to value the ABX indices.

¹⁴ According to Markit documents, the termination date of each CDS coincides with the latest legal Final Maturity Date of any reference obligation.

It is not an exaggeration to say that the key to pricing mortgage-backed securities is having a reliable estimate of prepayment rates, both voluntary and involuntary (defaults). A number of factors have been shown to influence prepayment rates, including the general level of interest rates, the rate of housing turnover, mortgage defaults, and the tenor of the loans. Most of these are difficult to predict with confidence. The result is that there is typically wide variation in mortgage-backed valuations. Add in default risk and the confidence around asset values shrinks further.

Before we introduce our proposed methodology, it may be helpful to discuss the relationship between credit default swap (CDS) spreads and bond prices. With annual, fixed premium payments, the CDS spread S , i.e., the annual cost of protection over an N -year period, will be:

$$S = [(100 - \text{CDS price}) / (N * 100)] + \text{fixed premium} \quad (1)$$

In general, the CDS spread should be equal to the yield spread of the underlying bonds:

$$S = y - r \quad (2)$$

In equation (2), y is the bond's yield to maturity and r is the risk free interest rate.¹⁵

As noted in Hull, Predescu and White (2004), "If S is greater than $y - r$, an arbitrageur will find it profitable to buy a riskless bond, short a corporate bond, and sell the credit default swap. If S is less than $y - r$, the arbitrageur will find it profitable to buy a corporate bond, buy the credit default swap and short a riskless bond."¹⁶

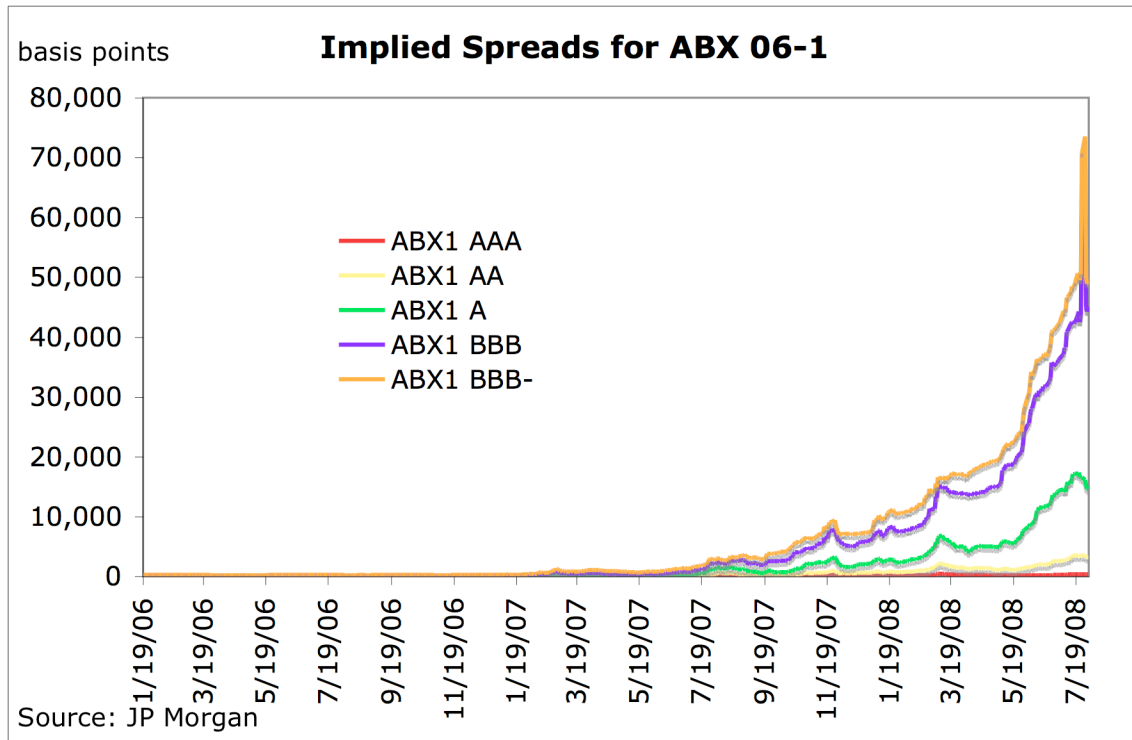
With a CDS implied spread in hand—along with estimated forward risk-free interest rates—it should be straightforward to discount expected cash flows and thus determine a market price for the reference bond.

Two problems prevent us from simply applying this to our ABX exercise. First, the implied spread depends crucially upon prepayment estimates. Except by sheer luck, two different researchers will report different implied spreads on the same ABX index. We display below in Exhibit 4, for example purposes only, credit spreads on the ABX 06-1 sub-indices as determined by JP Morgan.

¹⁵ See Darrell Duffie, "Credit Swap Valuation," *Financial Analysts Journal*, January-February 1999, pp 73-87; and John Hull and Allen White, "Valuing Credit Default Swaps I: No Counterparty Default Risk," *Journal of Derivatives*, 8, 1, Fall 2000, pp 29-40.

¹⁶ Please see Hull, Predescu and White, "The Relationship Between Credit Default Swap Spreads, Bond Yields, and Credit Rating Announcements," *Journal of Banking and Finance*, 28, 2004.

Exhibit 4 Implied Spreads on the ABX 06-1



Second, and as can be deduced from an examination of these implied spreads, many of the ABX constituents are traded not on a spread basis, but rather on an absolute price basis. Note that even for the single-A sub-index, the implied spread exceeds 10,000 basis points, i.e., 100%. This is not unlike the situation in the corporate bond market where performing bonds are quoted on a spread basis while distressed bonds are quoted on a percentage-of-par basis.

A Simple Alternative

Discussions with market participants confirm that the ABX indeed trades on a price basis. Moreover, the conventional view is that the sub-indices themselves can be viewed as proxies for average prices of the underlying reference bonds or tranches. In other words, an ABX price of 75 implies that market participants view the underlying reference bonds as having a weighted average value of 75 cents on the dollar.

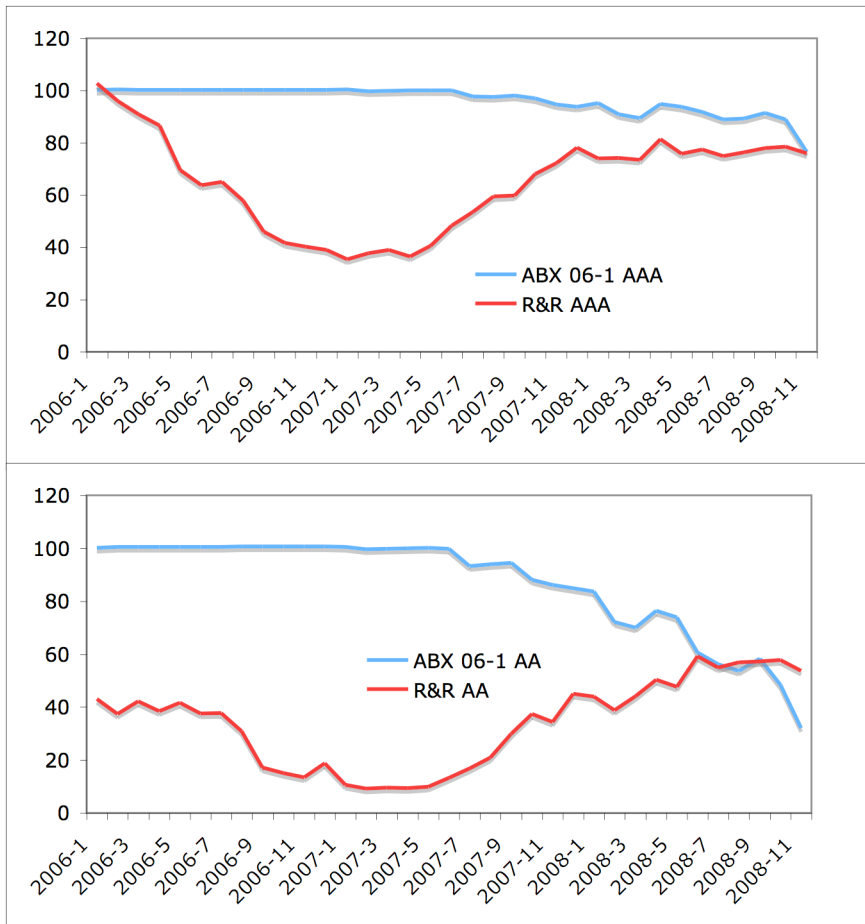
If we accept this premise, our task then simply becomes one of constructing an appropriate set of weights and applying these to the ABSTRAK[®] valuations of the corresponding reference bonds. ABX uses tranche-level factors (as opposed to pool-level factors) as weights on the components of each sub-index. Tranche factors are reported on Bloomberg and can be calculated from servicer data. As of the November 2008 remittance date, all but three of the 2006-1 ABX AAA constituents and five of the ABX BBB- constituents showed factors of unity. A factor of 1 implies that there has been

essentially no amortization for that tranche. Full amortizations have mainly occurred for only the most senior tranches and few if any of these are included in the ABX indices. Because each sub-index reflects the performance of 20 bonds, when all tranche factors are 1, the weight on each bond within a sub-index is 5%.

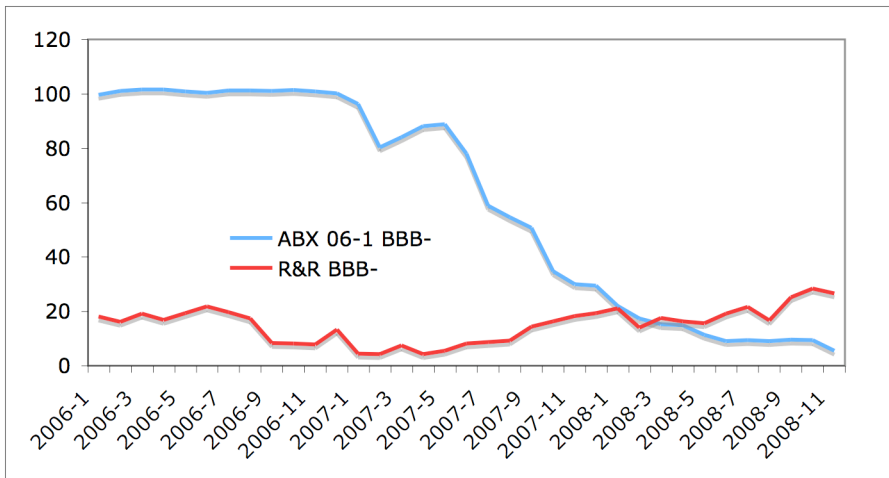
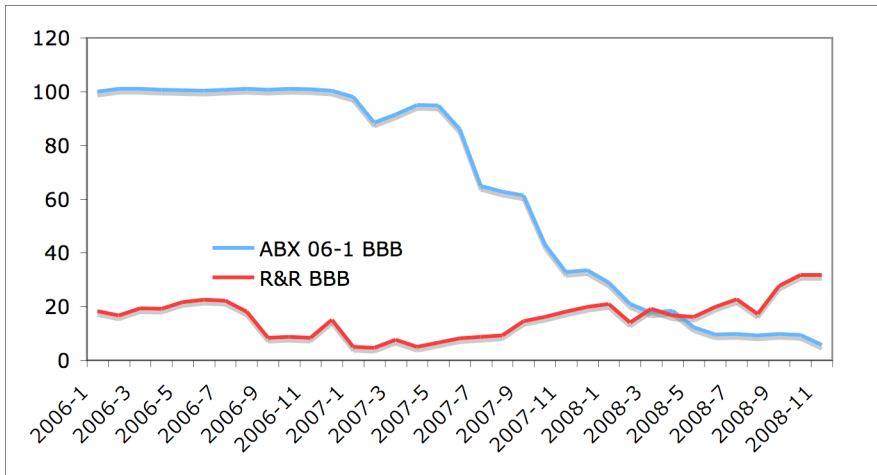
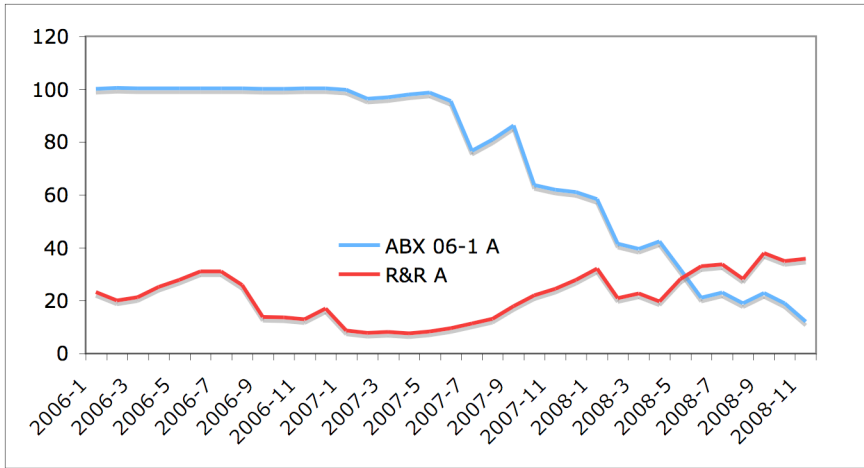
Results

The five graphics in Exhibit 5 visually compare the weighted ABSTRAK[®] valuations (labeled R&R) with each corresponding 2006-01 ABX sub-index series. We used month-end values for the ABX series to match the monthly updates for ABSTRAK[®], necessitated by the frequency of servicer reports. Each ABSTRAK[®]-weighted composite is formed from valuations on the individual tranches that are contained in the corresponding ABX sub-index.

Figures 4 – 8, Comparison Results



Comparison Results Continued



Excluding the AAA chart, the R&R and ABX.HE valuations show wide initial divergence followed by a convergence in opinion, then further divergence. Particularly striking is the initial pessimism shown by the ABSTRAK[®] valuations. Although the low ABSTRAK[®]-assigned valuations generally recover as the transactions mature, they largely precede market assessments.

As indicated for each index below AAA, ABSTRAK[®] recently takes a more benign view than do market participants. A certain degree of optimism reflects the mechanics of the transactions: as RMBS structures season, it becomes increasingly clear whether or not they will perform as intended. Many of these transactions, all originated in the second half of 2005, have seen at least 60% of principal retired as of the November 2008 remittance report date. The ultimate status of the obligations is becoming clear. While many of the junior tranches will be wiped out, others will survive with minimal impairment.

5. Conclusion

Some have argued that the ABX.HE provides misleading information because of heavy use by banks to hedge their illiquid positions.¹⁷ According to that argument, the demand for protection overwhelmed the market and caused index prices to fall to unrealistic levels.

This analysis of the Markit ABX.HE indices for collateral originated during the second half of 2005 does not dispute this conclusion. Moreover, it highlights material discrepancies in the security valuations implied from traded prices (or close approximations thereof) on the ABX.HE 06-1 index and the discounted cash flow fair value equivalents for the ABX.HE 06-1 index constructed using the ABSTRAK[®] formalism, described at length above. Conclusions to be drawn from this analysis are tentative but nonetheless provocative:

1. ABSTRAK[®] valuations indicate that all tranches below the AAA level were under-collateralized at closing, implying at the very least that a careful reverse-engineering of the underlying transactions could have yielded valuable risk information;
2. Information about security impairment was transmitted most rapidly through the ABSTRAK[®] calculation engine, and notably, traded prices lagged both ABSTRAK[®] and the signal from raw collateral performance; and
3. Information communicated through traded prices in the later stages of the crisis may be overstating the risk to bondholders.

¹⁷ Gary Gorton takes this position in his excellent analysis “The Panic of 2007,” a working paper prepared for the Federal Reserve Bank of Kansas City, Jackson Hole Conference, August 2008.