
SOCIETY OF ACTUARIES

Article from:

# Risk Management

December 2008 – Issue 14

# From Subprime Crisis to Risk Management

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"One dollar can get you a large soda at McDonald's, a used VHS movie at 7-Eleven or a house in Detroit."[1] A house was listed and sold for one dollar in Detroit. There is another house and an empty lot listed for one dollar also. I cautioned my colleagues that this happened in Canada in the early 1980s when the interest rate was double-digit and could happen here in the United States. It is happening in Detroit right now.

This crisis started first in the subprime mortgage securities market and quickly spread across the credit derivative market like wildfire. According to the timeline of events published by Reuters, there were signs of trouble at subprime lenders around the end of 2006. So far, this fast-moving financial storm has swallowed up two Bear Stearns hedge funds with subprime exposure, the British mortgage lender Northern Rock, the big U.S. mortgage lender Countrywide Financial, Bears Stearns itself, a U.S. regional lender IndyMac, Fannie Mae, Freddie Mac, Lehman Brothers, Merrill Lynch, AIG and Washington Mutual. Who will be next?

Stephen Roach summarized the changing nature of this crisis well in a recent article. "The credit crisis is the first stage. Sparked by the subprime meltdown that began in the summer of 2007, a cross-product contagion quickly spread to asset-backed commercial paper (ABCP), mortgage-backed securities, structured investment vehicles (SIVs), interbank offshore (LIBOR) financing, leveraged lending markets, auction rate securities, so-called monoline insurers, and a number of other opaque products and structures."[2]

Isn't commercial paper supposed to be a relatively safe short-term instrument? Why is it a problem now? The problem is that ABCP is backed by asset-backed securities (ABS) with subprime exposure. The ABCP business model is to borrow in the low-yielding commercial paper market and invest in the higher-yielding ABS market. When the ABS market was in a tailspin, nobody wanted to buy the commercial paper.

What is the problem with subprime ABS? Why did the investment community take so long to figure out the location and the extent of the damage? This is due in part to the cross-product contagion that Roach mentioned above. The credit derivative on mortgage securities that led to the destruction at AIG is a very interesting topic. For now, we will focus on the complex mortgage securities like ABS and CDO. I hope the readers will begin to appreciate the complexity of this crisis and the difficulties that risk managers are facing.

## The Setup of a Perfect Storm

In order to prevent the U.S. economy from going into recession after the dot-com bubble burst in 2001, Greenspan and company lowered the interest rate to a historically low level. This, however, paved the way for another asset bubble, which burst in 2007. House prices kept on increasing for several years before the summer of 2007. Everybody thought that buying a property was a sure win that could never go wrong.

As house prices went up, buying a home was getting out of reach to a lot of people, including the now infamous NINJA (No Income No Job & Asset) borrowers. In the interest of writing more business and therefore bigger bonuses, mortgage lenders simply looked the other way. People could take out mortgages with low

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1 http://www.detnews.com/apps/pbcs.dll/article?AID=/20080813/METRO/808130360.
2 Stephen Roach, "Pitfalls in a Post-Bubble World," Morgan Stanley, Aug. 1, 2008.

documentation or no documentation on income. In the United Kingdom, this is called a self-documentation loan, so it is not strictly a U.S. phenomenon. As interest rates went higher, the interest-only loan and adjustable rate mortgage (ARM) loan became more popular. The problem with the ARM is that the low initial rate would be reset several years after initiation to a much higher rate. Some of the ARMs launched several years prior hit the reset date in 2007, and higher delinquencies and foreclosures started to show up. The values of mortgage securities with subprime exposure were depressed.

As ARMs reset, the borrower has the choice of (1) refinancing at a higher rate, (2) selling the house or (3) walking away. In general, (1) was neither affordable nor readily available and (2) might not make sense because some homes were already below water. Therefore, more people chose to walk away from their properties. The refinancing option was almost closed for the NINJA borrowers because of the tightening lending standard. Harvard economist Martin Feldstein said the following regarding the severity of the negative equity situation: "Because of the decline in house prices that has already occurred, more than 10 million homeowners now have mortgages that exceed the values of their house. This is 20 percent of the all homeowners with mortgages. For half of that negative equity group, the debt exceeds the house value by more than 20 percent."[3]

The story would not be complete without mentioning, as one of my colleagues put it, "the systematic risk created by accountants." This assertion may be controversial and could well be worth another article by itself. The fact is that most of the financial companies have adopted the market value accounting under FAS 157 in 2007, and other companies were doing the same at the beginning of 2008. Under this regime, assets are marked using observed market prices where available or market implied parameters where appropriate. The problem is that the trading in ABS and CDO screeched to a halt as the credit crisis unfolded. Now, marking to market in an illiquid market is extremely difficult and has to be performed every quarter nonetheless. As house prices continue to drop, the expectation for mortgage defaults will continue to go up, and the prices of mortgage securities will go down. It has taken several iterations to mark these asset prices down step by step. People have complained about the reasonableness of the market expectation of default, but to no avail; this is how the accounting regime works at the moment.

## Unpredictable Consumer Behavior

In previous economic cycles when households were under stress, consumers would keep paying their mortgages and car payments, so that they would have a roof over their heads, and so they could go to work and pay their credit card bills. However, this is now being turned upside down. In recent months, consumers appear to be more willing to keep their credit cards current but send their house keys back to the mortgage company in "jingle" mails.

Modeling mortgage defaults turns out to be more challenging than modeling prepayments. Loan level data (analogous to policy data) is required to do so. Up until now, MBS modeling was done by grouping loans into buckets (analogous to model points). While consumers taking out mortgages at the same time period would have

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3 Martin Feldstein, "How to Shore up America's Crumbling Housing Market," Financial Times, Aug. 27, 2008.

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similar loan rates and could be reasonably modeled by grouping, the same consumers would have different creditworthiness (FICO scores) and different loan-to-value (LTV) ratios (the ratio of a mortgage loan to the property's value). However, the price of their houses in different states are affected by very different local economic conditions. Furthermore, a loan that is 90 days overdue is more likely to default than a loan that is 30 days overdue. These are the key variables used in modeling mortgage defaults, but since they are heterogeneous, it is difficult to group them.

In the originate-and-distribute model, MBS are supposed to be on a bank's book for a few months before being sold. When a famous quant was asked about MBS modeling in an International Association of Financial Engineers (IAFE) meeting, he observed that no serious attempt was made to model these products since they were supposed to be short-lived on the balance sheet. This was true until the market crashed and banks had to hold a large number of unsold securities. The development of default models is still in the early stages. Also, there are proprietary default models in broker dealers' shop, and there are other newly developed default models available but not yet widely implemented. Most importantly, none of these models were really tested until the subprime crisis.

## Conflicting Data Sources

The dilemma between using policy data or model points in building liability models is not new to actuaries. Our fellow actuaries would probably say, "Tell me about it." So what is the big deal?

Andrew Davidson observed that there are many participants[4] in the secondary market for non-agency mortgages, which include the subprime mortgages. In the ABS structure where loans are securitized, there are rules set up to direct the flow of interest and principal payments and the allocation of losses in the case of mortgage default. Generally, a trustee is set up to monitor and report the performance of the ABS as well as to direct payments according to the rules. When ABS and perhaps CDO tranches are packaged into a CDO, another set of rules and trustees is created. In a typical ABS securitization, there could be up to 9,000 underlying mortgage loans. The default calculations generally begin with a cash flow projection at the loan level. The loan level cash flows and losses are then passed through the waterfall (cash flow rules) to construct the tranche cash flows and losses at the security level. In the case of a CDO, the security level cash flows and losses are then passed through the CDO waterfall to build the CDO tranche cash flows and losses. This layering of rules and structure is very tedious, time consuming and computationally intensive.

The collection of, and the selling of, information within this sector is big business, and present another set of difficulties regarding the modeling of defaults. For instance, there is a specific company (that will remain nameless) that collects information from mortgage servicers and trustees, groups underlying loans into buckets and then finally models the cash flow rules for each deal. This company literally holds a monopoly, which risk managers love to hate. Even if the loan level information that the company

4 http://www.ad-co.com/newsletter/issues2007/SixDegreesofSeparationAug07.pdf.

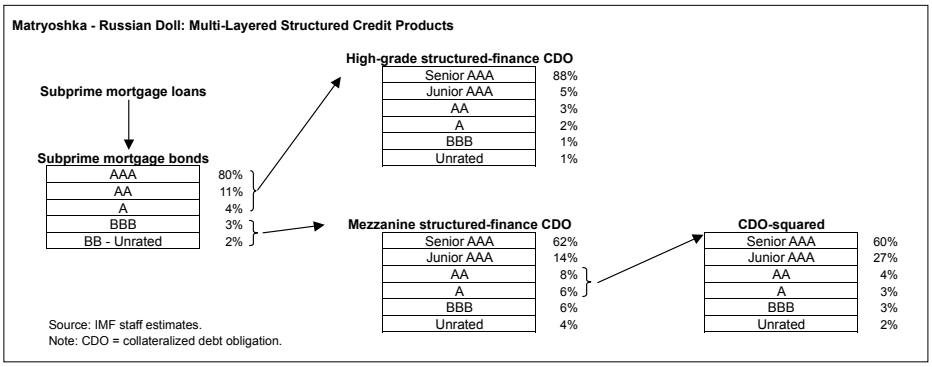
provides is not adequate, at the same time the risk managers cannot do without the cash flow modeling for mortgage securities that the company provides.

There is another company that specializes in the collection and maintenance of loan level information. It provides the best source for mortgage loan information that is also a necessity for modeling defaults. However, this company does not model the cash flow rules of the various securitized deals. Risk managers need both the loan level information from the second company and the cash flow rules of each deal from the first company to perform risk calculations. Unfortunately, there is no linkage between these two data sources.

## When is an AAA not an AAA?

Actually, this question did not come up before this credit crisis. In the past, AAA-rated securities were taken at face value, and we now know that this is part of the underlying problem. Not all AAA securities are the same. Rating agencies are called to give their blessing on the quality before a securitization is complete. For the lack of better knowledge, the same methods for rating corporate bonds were applied to these structured-finance products. However, these structured-finance products turned out to be very different, and this has led to many downgrades within this sector, as the delinquency and foreclosures have skyrocketed. Fitch was the first one out to revise its rating methodology of structured-finance products that has led to permanent downgrades of many such products. Fitch was met with a great deal of protest and resistance, but now the other agencies are expected to follow suit.

The following diagram that outlines the linkage between ABS and CDO securities is taken from the International Monetary Fund, Global Financial Stability Report.[5]




Reproduced from "Global Financial Stability Report", April 2008, IMF

Starting from the top left corner, subprime loans are securitized into ABS. According to the IMF estimate, some 75 percent of recent U.S. subprime mortgage loans have been securitized as ABS using over-collateralization (OC) and subordination. Of these, 80 percent have been funded with AAA-rated tranches. The problem is within the bottom 5 percent, rated BBB and below. A large number of investors are not allowed to buy below-investment-grade securities, but this was solved by securitizing these BBB tranches in a CDO structure; so BBB-rated ABS tranches were turned into AAA-rated mezzanine structured-finance CDO tranches. However, the distinction between AAA and BBB began to get blurry. Investment banks obtained higher profits, and the investors got higher-yielding AAA securities. Everybody was happy before the meltdown, but now we ask: "Is an AAA really an AAA?"

## Valuation of MBS with Credit Loss

Valuation is an important step within risk management. To valuate an MBS security with credit loss, we need: the underlying theory, prepayment and default models; deep liquid markets to observe the market prices of similar instruments; a method to extract the implied prepayment and default rates; a model of house price movements; and finally an interest rate

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5 International Monetary Fund, Global Financial Stability Report, April 2008.

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model that correlates with the house price movements. These are all very important topics that require a substantial amount of research and effort to bring to fruition. In fact, there is disagreement as to whether all these steps are necessary or even achievable at all.

Levin and Davidson pointed out the difficulties of MBS modeling in a recent issue of the Journal of Portfolio Management. They said, "Development of MBS modeling has traditionally been delegated, with few exceptions, to practitioners. Mortgage modeling generally involves both theoretical and empirical analysis because borrower behavior cannot be determined by theoretical considerations alone."[6] Historically, different shops would have put a different price on the same MBS based on their own models. This is due to the fact that most models are based on their own empirical analysis. So, at this time, there are no generally agreed methods to extract the implied prepayment and default rates.

When valuating a bond without default, a risk-neutral interest rate model is usually employed. For MBS, there are two main risk factors—interest rate and house price movements. We need a model for both risk factors. How should one go about modeling house price movements within a risk-neutral world?

Next there is the question of discounting. After an MBS security cash flow is projected with the proper prepayment rate and default rate, the same cash flow has to be discounted to obtain a price. Should the discounting be done at LIBOR flat or at a spread? At what spread if a spread is required?

## Closing Thoughts

Well before the onset of the subprime crisis, I met a risk manager from a monoline insurer. Monoline insurers generally receive periodic premiums and pay credit default losses after a deductible is subtracted. The manager was worried about the sources of the underlying risks along with their liquidity risk exposure. Their portfolio statistics indicated that default losses were negligible, and in the meantime premiums kept rolling in. Where was the risk? I was dumbfounded.

Historical statistics can be misleading. First of all, the stability of the ABS and CDO structure was not tested in any crisis before. Without getting into the product details and identifying the key drivers, it is easy to underestimate the risk. Credit insurance differs from pure life insurance in that there are systemic factors that drive the credit risk. The law of large numbers cannot be relied upon in this situation to accurately predict the possible impact of the claims.

House-price bubbles are not unique to the United States. According to the work published by the International Monetary Fund in its World Economic Outlook of April 2008,[7] house price increases that were not explained by fundamentals were higher in Ireland, the Netherlands and the United Kingdom than in the United States. Also, the outstanding mortgage debts as a percentage of GDP in Australia, Denmark, the Netherlands and the United Kingdom were all higher than in the United States. Relative to the United States, there are countries where house prices have risen more and where households are even in greater debt. These countries will also be in trouble should their house prices start to fall. In fact, the house prices in the United Kingdom have started to fall recently. Shall we stay tuned? ✦

6 A. Levin and A. Davidson, "The Concept of Credit OAS in Valuation of MBS," The Journal of Portfolio Management, Spring 2008.

7 International Monetary Fund, World Economic Outlook—Housing and the Business Cycle, April 2008.