The Credit Crunch of 2007: What Went Wrong? Why? What Lessons Can Be Learned?

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Abstract

This paper explains the events leading to the credit crisis that began in 2007 and the products that were created from residential mortgages. It explains the multiple levels of securitization that were involved. It argues that the inappropriate incentives led to a short-term focus in the decision making of traders and a failure to evaluate the risks being taken. The products that were created lacked transparency with the payoffs from one product depending on the performance of many other products. Market participants relied on the AAA ratings assigned to products without evaluating the models used by rating agencies. The paper considers the steps that can be taken by financial institutions and their regulators to avoid similar crises in the future. It suggests that companies should be required to retain some of the risk in each instrument that is created when credit risk is transferred. The compensation plans within financial institutions should be changed so that they have a longer term focus. Collateralization through either clearinghouses or two-way collateralization agreements should become mandatory. Risk management should involve more managerial judgment and rely less on the mechanistic application of value-at-risk models.

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Starting in 2007, the United States experienced the worst financial crisis since the 1930s. The crisis spread rapidly from the United States to other countries and from financial markets to the real economy. Some financial institutions failed. Many more had to be bailed out by national governments. There can be no question that the first decade of the 21st century has been disastrous one for the world's financial institutions and for the financial sector generally.

This paper examines the origins of the crisis, what went wrong, and why it went wrong. It also provides some observations on how similar crises can be avoided in the future.

1. THE U.S. HOUSING MARKET

A natural starting point for any discussion of the credit crunch of 2007 is the U.S. housing market. Figure 1 shows the S&P/Case-Shiller composite-10 index for house prices in the U.S. between January 1987 and February 2009. Between 2000 and 2005, house prices rose much faster than they had in the previous decade. The very low level of interest rates between 2002 and 2005 was an important contributory factor, but the increase was for the most part fueled by mortgage lending practices.

The 2000 to 2006 period was characterized by a huge increase in what is termed subprime mortgage lending. Subprime mortgages are mortgages that are considered to be significantly more risky than average. Before 2000, most mortgages classified as subprime were second mortgages. After 2000, this changed as financial institutions became more comfortable with the notion of a subprime first mortgage.

Mortgage lenders started to relax their lending standards in about 2000. This made house purchase possible for many families that had previously been considered to be not sufficiently creditworthy to qualify for a mortgage. These families increased the demand for real estate and prices rose. To mortgage brokers and mortgage lenders the combination of more lending and higher house prices was attractive. More lending meant bigger profits. Higher house prices meant that the lending was well covered by the underlying collateral. If the borrower defaulted, the resulting foreclosure would not lead to a loss.

How could mortgage brokers and mortgage lenders keep increasing their profits? Their problem was that, as house prices rose it was more difficult for first-time buyers to afford a house. In order to continue to attract new entrants to the housing market, they had to find ways to relax their lending standards even more---and this is exactly what they did. The amount lent as a percentage of the house price increased. Adjustable rate mortgages (ARMs) were developed where there was a low ``teaser" rate of interest that would last for two or three years and be followed by a rate that was much higher.[1] A typical teaser rate was about 6% and the rate after the end of the teaser-rate period was typically six-month LIBOR plus 6%. However, teaser rates as low as 1% or 2% have been reported. Lenders also became more cavalier in the

[1] If real estate prices increased, lenders expected the borrowers to prepay and take out a new mortgage at the end of the teaser rate period. This would have been profitable for the lenders. Prepayments penalties, often zero on prime mortgages, were quite high on subprime mortgages.

way they reviewed mortgage applications. Indeed, the applicant's income and other information reported on the application form were frequently not checked.

Why was the government not regulating the behavior of mortgage lenders? The answer is that the U.S government has since the 1990s been trying to expand home ownership, and had been applying pressure on mortgage lenders to increase loans to low and moderate income people. Some state legislators (such as those in Ohio and Georgia) were concerned about what was going on and wanted to curtail what they considered to be predatory lending.[2] However, the courts decided that national standards should prevail.

A number of terms have been used to describe mortgage lending during the period leading up to the credit crunch. One is “liar loans” because individuals applying for a mortgage, knowing that no checks would be carried out, sometimes chose to lie on the application form. Another term used to describe some borrowers is ``NINJA" (no income, no job, no assets.) To quote from Krinsman (2007), ``In 2005 and 2006 lenders made it easier for borrowers to obtain subprime loans. For example, the typical subprime borrower with a (FICO) credit score between 450 and 680 could obtain a loan with little or no down payment, provide little or no documented proof of income or assets, obtain a loan with a low initial ‘teaser’ interest rate that reset to a new, higher rate after two or three years..." (Mortgages where the borrower had a FICO score less than 620 were typically classified as subprime, but when the down payment was low, 680 was sometimes used as the subprime cutoff.)

Mian and Sufi (2008) have carried out research confirming that there was a relaxation of the criteria used for mortgage lending. Their research defines “high denial zip codes” as zip codes where a high proportion of mortgage applicants had been turned down in 1996, and shows that mortgage origination grew particularly fast for these zip codes between 2000 to 2007. Moreover their research shows that lending criteria were relaxed progressively through time rather than all at once because originations in high denial zip codes are an increasing function of time during the 2000 to 2007 period. Zimmerman (2007) provides some confirmation of this. He shows that subsequent default experience indicates that mortgages originated in 2006 were of a lower quality than those originated in 2005 and these were in turn of lower quality than the mortgages originated in 2004.

Standard & Poor’s has estimated that subprime mortgage origination in 2006 alone totaled $421 billion. AMP Capital Investors estimate that there was a total of $1.4 trillion of subprime mortgages outstanding in July 2007.

One of the features of the US housing market is that mortgages are non-recourse in many states. This means that, when there is a default, the lender is able to take possession of the house, but other assets of the borrower are off-limits. Consequently, the borrower has a free American-style put option. He or she can at any time sell the house to the lender for the principal outstanding on the mortgage. (During the teaser-interest-rate period this principal often increased, making the option more valuable.) Market participants realized belatedly how costly the put option could be. If the borrower had negative equity, the optimal decision was to exchange the house for the outstanding principal on the mortgage. The house was then sold, adding to the downward pressure on house prices.

[2] Predatory lending describes the situation where a lender deceptively convinces borrowers to agree to unfair and abusive loan terms.

It would be a mistake to assume that all mortgage defaulters were in the same position. Some were unable to meet mortgage payments and suffered greatly when they had to give up their homes. But many of the defaulters were speculators who bought multiple homes as rental properties and chose to exercise their put options. It was their tenants who suffered. There are also reports that some house owners (who were not speculators) were quite creative in extracting value from their put options. After handing the keys to their houses to the lender, they turned around and bought (sometimes at a bargain price) other houses that were in foreclosure. Imagine two people owning identical houses next to each other. Both have mortgages of $250,000. Both houses are worth $200,000 and in foreclosure can be expected to sell for $170,000. What is the owners' optimal strategy? The answer is that each person should exercise the put option and buy the neighbor's house. (There were ways of doing this without getting a bad credit rating.)

As Figure 1 illustrates, the bubble burst during the 2006-2007 period. Many mortgage holders found they could no longer afford mortgages when teaser rates ended. Foreclosures increased. House prices declined. This resulted in other mortgage holders, who had borrowed 100%, or close to 100%, of the cost of a house having negative equity. Some exercised their implicit put options and "walked away" from their houses and their mortgage obligations. This reinforced the downward trend in house prices.

The United States was not alone in having declining real estate prices. Prices declined in many other countries as well. The United Kingdom was particularly badly affected.

2. SECURITIZATION

The originators of mortgages in many cases chose to securitize mortgages rather than fund the mortgages themselves. Securitization has been an important and useful tool in financial markets for many years. It underlies the "originate-to-distribute" model that was widely used by banks prior to 2007.

Securitization played a part in the creation of the housing bubble. Research by Keys et al (2008) shows that there was a link between mortgage securitization and the relaxation of lending standards. When considering new mortgage applications, the question was not ``Is this a credit we want to assume?'' Instead it was ``Is this a mortgage we can make money on by selling it to someone else?''

When mortgages were securitized, the only useful information received about the mortgages by the buyers of the products that were created from them was the loan-to-value ratio (i.e., the ratio of the size of the loan to the assessed value of the house) and the borrower's FICO score. The reason why lenders did not check information on things such as the applicant's income, the number of years the applicant had lived at his or her current address, and so on was that this information was considered irrelevant. The most important thing for the lender was whether the mortgage could be sold to others---and this depended primarily on the loan to value ratio and the applicant's FICO score.

It is interesting to note in passing that both the loan-to-value ratio and the FICO score were of doubtful quality. The property assessors who determined the value of a house at the time of a mortgage application sometimes succumbed to pressure from the lenders to come up with high values. Potential borrowers were sometimes counseled to take certain actions that would improve their FICO scores.[3]

[3] One such action might be to make regular payments on a credit card for a few months.

We now consider the products that were created from the mortgages.

Asset-Backed Securities

The main security created from pools of mortgages was an asset-backed security (ABS). Figure 2 shows a simple example illustrating the features off an ABS. A portfolio of risky income-producing assets is sold by the originators of the assets to a special purpose vehicle (SPV) and the cash flows from the assets are allocated to tranches. In Figure 2, there are three tranches: the senior tranche, the mezzanine tranche, and the equity tranche. The portfolio has a principal of $100 million. This is divided as follows: $75 million to the senior tranche, $20 million to the mezzanine tranche, and $5 million to the equity tranche. The senior tranche is promised a return of 6%, the mezzanine tranche is promised a return of 10%, and the equity tranche is promised a return of 30%.

The equity tranche is much less likely to realize its promised return than the other two tranches. An ABS is defined by specifying what is known as a "waterfall." This defines the rules for allocating cash flows from the income-producing assets to the tranches. Typically, cash flows from the assets during a particular time period are allocated to the senior tranche until the senior tranche has received its promised return. Assuming that the promised return to the senior tranche is made in full, cash flows are then allocated to the mezzanine tranche. If the promised return to the mezzanine tranche is made in full and cash flows are left over, they are allocated to the equity tranche. The precise waterfall rules are outlined in a legal document that is usually several hundred pages long. If any cash flows remain after the equity tranche holders have received their promised returns they are usually used to repay principal on the senior tranche.

When an ABS is created from a pool of mortgages it typically lasts for the whole life of the mortgages. The weighted average life of the mortgage pool depends on prepayments and defaults. At some stage, principal payments are made to tranches. The extent to which the tranches get their principal back depends on losses on the underlying assets. In Figure 2, the first 5% of losses are borne by the principal of the equity tranche. If losses exceed 5%, the equity tranche loses all its principal and some losses are borne by the principal of the mezzanine tranche. If losses exceed 25%, the mezzanine tranche loses all its principal and some losses are borne by the principal of the senior tranche.

There are therefore two ways of looking at an ABS. One is with reference to the waterfall rules. Cash flows go first to the senior tranche, then to the mezzanine tranche, and then to the equity tranche. The other is in terms of losses. Losses of principal are first borne by the equity tranche, then by the mezzanine tranche, and then by the senior tranche.

The ABS is designed so that the senior tranche is rated AAA/Aaa. The mezzanine tranche is typically rated BBB/Baa. The equity tranche is typically unrated. Unlike the ratings assigned to bonds, the ratings assigned to the tranches of an ABS are what might be termed "negotiated ratings." The objective of the creator of the ABS is to make the senior tranche as big as possible without losing its AAA/Aaa credit rating. (This maximizes the profitability of the structure.) The ABS creator examines information published by rating agencies on how tranches are rated and may present several structures to rating agencies for a preliminary evaluation before choosing the final one.

ABS CDOs

Finding investors to buy the senior AAA-rated tranches created from subprime mortgages was not difficult for the creators of an ABS. Equity tranches were typically retained by the originator of the mortgages or sold to a hedge fund. Finding investors for the mezzanine tranches was relatively difficult. This led financial engineers to be creative (arguably too creative). Financial engineers created an ABS from the mezzanine tranches of different ABSs that were created from subprime mortgages. This is known as an ABS CDO and is illustrated in Figure 3.

The senior tranche of the ABS CDO is rated AAA/Aaa. This means that the total of the AAA-rated instruments created in the example that is considered here is 90% (75% plus 75% of 20%) of the principal of the underlying mortgage portfolio. This seems high but, if the securitization were carried further with an ABS being created from the mezzanine tranches of ABS CDOs (and this did happen), the percentage would be pushed even higher.

In the example in Figure 3, the AAA-rated tranche of the ABS would probably have been downgraded in the second half of 2007. However, it is likely to receive its promised return if losses on the underlying mortgage portfolio are less than 25% because all losses of principal would then be absorbed by the more junior tranches. The AAA-rated tranche of the ABS CDO in Figure 3 is much more risky. It will get paid the promised return if losses on the underlying portfolio are 10% or less because in that case mezzanine tranches of ABSs have to absorb losses equal to 5% of the ABS principal or less. As they have a total principal of 20% of the ABS principal, their loss is at most 5/20 or 25%. At worst this wipes out the equity tranche and mezzanine tranche of the ABS CDO but leaves the senior tranche unscathed.

The senior tranche of the ABS CDO suffers losses if losses on the underlying portfolios are more than 10%. Consider, for example, the situation where losses are 20% on the underlying portfolios. In this case, losses on the mezzanine tranches are 15/20 or 75% of their principal. The first 25% is absorbed by the equity and mezzanine tranches of the ABS CDO. The senior tranche of the ABS CDO therefore loses 50/75 or 66.7% of its value. These and other results are summarized in Table 1.

ABSs and ABS CDOs In Practice

Figure 3 illustrates the nature of the securitizations that were carried out. In practice, more tranches were created and many of the tranches were thinner (i.e., corresponded to a narrower range of losses) than those in Figure 3. Figure 4 shows a more realistic example of the structures that were created. This is taken from an illustration by Gorton (2008), which was in turn taken from an article by UBS.

Two ABS CDOs are created in Figure 4. One is created from the BBB rated tranches of ABSs (similarly to the ABS CDO in Figure 3). This is referred to as a Mezzanine ABS CDO (or Mezz ABS CDO). The other is from the AAA, AA, and A tranches of ABSs. This is referred to as a High Grade ABS CDO. There is also a third level of securitization based on the A and AA tranches of the Mezz ABS CDO.

Many of the tranches in Figure 4 (for example, the BBB tranches of the ABS that cover losses from 1% to 4% and are used to create the Mezz ABS CDO) seem to be very risky. In fact, they are less risky than they appear when the details of the waterfalls of the underlying ABSs are taken into account. In the arrangement in Figure 4, there is some over-collateralization with the face value of the mortgages being greater than the face value of the instruments that are created by the ABSs. There is also what is termed

"excess spread". This means that the weighted average of the returns promised to tranche holders is less than the weighted average of the interest due on the mortgages. If because of these features there are cash flows left over when all ABS tranches have received their promised returns, the cash flows are used to reduce the principal on the senior tranches.

Many banks have lost money investing in the senior tranches of Mezz ABS CDOs. The investments were typically financed at LIBOR and promised a return quite a bit higher than LIBOR. Because they were rated AAA, the capital requirements were minimal. In July 2008 Merrill Lynch agreed to sell senior tranches of Mezz ABS CDOs that had previously been rated AAA and had a principal of $30.6 billion to Lone Star Funds for 22 cents on the dollar.[4]

3. RATINGS

The rating agencies played a key role in the securitization of mortgages. The traditional business of rating agencies is of course the rating of bonds. This is based largely on judgment. The rating process for instruments such as the tranches of ABSs and ABS CDOs was different from the rating of bonds because it was based primarily on models. The rating agencies published their models. Interestingly, different rating agencies used different criteria. Moody's criterion was expected loss. If a tranche has a similar expected loss to a Aaa bond, it was rated Aaa. The S&P criterion was probability of loss. If the probability of loss for a tranche was similar to the probability of default for a AAA bond, it was rated AAA.

Many traders relied on the AAA/Aaa ratings of senior tranches without developing their own models or carefully examining the assumptions on which the models of the rating agencies were based. Risk weights required for the tranches were low (typically 7% of the tranche principal) and the promised return was much higher than that obtainable on other assets rated AAA/Aaa.

Were the ratings unreasonable? Hull and White (2009) have examined this question. Their conclusions are that the AAA/Aaa ratings for the senior tranches of ABSs were not too unreasonable. However, the AAA/Aaa ratings awarded to the senior tranches of Mezz ABS CDOs are much less easy to defend. Although the BBB tranches from which Mezz ABS CDOs were created have no higher expected losses and probability of losses than bonds that are rated BBB, the probability distribution of their loss is quite different and this has implications for the riskiness of the tranches of Mezz ABS CDOs.[5]

Two key factors determining the riskiness of the tranches of ABS CDOs are the thickness of the underlying BBB tranches and the extent to which defaults are correlated across the different pools used to create the Mezz ABS CDO. Consider an extreme situation where the tranches are very thin and the mortgages in all pools have the same default rate. The BBB tranches of all the underlying ABSs then have

[4] Merrill Lynch agreed to finance 75% of the purchase price. When the value of the tranches fell below 16.5 cents on the dollar, Merrill Lynch found itself owning the assets again.

[5] Given that Mezz ABS CDOs accounted for a small percentage of the investment in the products created for mortgages, the rating agencies are not as blameworthy as is sometimes supposed.

a certain probability, say p, of being wiped out and a probability 1-p of being untouched. All tranches of the ABS CDO are then equally risky. They also have a probability p of being wiped out and a probability 1-p of being untouched. It would be appropriate to give all of them the same rating as the underling BBB tranches. This is an extreme example, but it illustrates why BBB tranches should not be treated in the same way as BBB bonds for the second level of securitization.

4. AVOIDING FUTURE CRISES

Many factors contributed to the financial crisis that started in 2007.[6] Mortgage originators used lax lending standards. Products were developed to enable mortgage originators to profitably transfer credit risk to investors. The products bought by investors were complex and in many instances investors and rating agencies had inaccurate or incomplete information about the quality of the underlying assets. Rating agencies moved from their traditional business of rating bonds to rating structured products and assigned a AAA rating to tranches that were in some cases highly dependent on the structure of the correlation between the underlying assets.

The returns earned on AAA/Aaa tranches were high (e.g., LIBOR plus 120 basis points) and they required very little capital because of the AAA rating. Traders loved the products because they gave good returns on regulatory capital and therefore led to high bonuses.

How can future crises be avoided? Here are a few observations:

Agency Costs: Originators and Investors

Agency cost is a term used by economists to describe the cost in a situation where the interests of two parties in a business relationship are not perfectly aligned. It should be clear from the discussion earlier in this chapter that there were agency costs in the U.S mortgage market because the interests of the originators of mortgages and the interests of investors were not perfectly aligned. The present crisis might have been less severe if the originators of mortgages (and other assets where credit risk is transferred) were required by regulators to keep, say, 20% of each tranche created. This would have better aligned the interests of originators with the interests of the investors who bought the tranches. The market for structured products virtually disappeared during the credit crisis. However, the finance sector has a short memory. The market is likely to reappear at some future time. Regulators and rating agencies should be sensitive to situations where the interests of parties are not aligned.

The most important reason why originators should have a stake in all the tranches created is that this encourages the originators to make the same lending decisions that the investors would make. Another reason is that the originators often end up as administrators of the mortgages (collecting interest, making foreclosure decisions, etc). It is important that their decisions as administrators are made in the best interests of investors.

The originators of mortgages did sometimes keep the equity tranches of ABSs. This aligned their interests somewhat with the interests of the investors who purchased these tranches. However, the equity tranche was often regarded as a ``free good." The originators had obtained adequate compensation for the

[6] See also Hull (2008, 2009).

mortgages from the sales of the other tranches to investors. Furthermore, once the equity tranche had been wiped out, mortgage originators had no stake at all in the performance of the mortgages.

It is important to note that there is a difference between a) a mortgage lender securitizing 80% of its portfolio and b) a mortgage lender securitizing 100% of its portfolio while keeping 20% of each tranche. In the first case, there will always be a suspicion that the better loans have been retained by the originator and that screening was lax on the rest. Rating agencies might reasonably assign a higher rating to tranches of a portfolio where a percentage of each tranche has been retained. However, the regulatory capital for the whole portfolio of mortgages that is originated should be the same in both cases.

This idea might have reduced the market excesses during the period leading up to the credit crunch of 2007. However, it should be acknowledged that one of the ironies of the credit crunch is that securitization did not in many instances get the mortgages off the books of originating banks. Often AAA-rated senior tranches created by one part of a bank were bought by other parts of the bank. Because banks were both investors in and originators of mortgages, one might expect a reasonable alignment of the interests of investors and originators. But the part of the bank investing in the mortgages was usually far removed from the part of the bank originating the mortgages and there appears to have been little information flow from one to the other.

European Union regulators have made proposals similar to the one here (with 10% instead of 20% of each product created in a credit transfer arrangement being retained). Not surprisingly, they have been met with a great deal of opposition from the banks, as pointed out by Rhode (2008). However, many banks have received huge capital injections from the government and may not be in a strong position to oppose the proposal.

Agency Costs: Financial Institutions and Their Employees

Another source of agency costs concerns financial institutions and their employees. Employee compensation falls into three categories: regular salary, the end-of-year bonus, and stock or stock options. Many employees at all levels of seniority in financial institutions, particularly traders, receive much of their compensation in the form of end-of-year bonuses. This form of compensation tends to focus the attention of the employee on a short-term results.

If an employee generates huge profits one year and is responsible for severe losses the next year, the employee will receive a big bonus the first year and will not have to return it the following year. The employee might lose his or her job as a result of the second year losses, but even that is not a disaster. Financial institutions seem to be surprisingly willing to recruit individuals with losses on their resumes.

Imagine you are an employee of a financial institution buying tranches of ABSs and ABS CDOs in 2006. Almost certainly you would have recognized that there was a bubble in the US housing market and would expect that bubble to burst sooner or later. However, it is possible that you would decide to continue trading. If the bubble did not burst until after December 31, 2006 you would still get a nice bonus at the end of 2006.

It is not necessarily the case that salaries on Wall Street are too high. Instead, it is the case that they should be calculated differently. It would be an improvement if annual bonuses reflected performance over a longer period of time than one year (say, five years). One idea is the following. At the end of each

year a financial institution awards a ``bonus accrual" (positive or negative) to each employee reflecting the employee's contribution to the business. The actual cash bonus received by an employee at the end of a year would be the average bonus accrual over the previous five years or zero, whichever is higher. For the purpose of this calculation, bonus accruals would be set equal to zero for years prior to the employee joining the financial institution (unless the employee manages to negotiate otherwise) and bonuses would not be paid after an employee leaves it. Although not perfect, this type of plan would motivate employees to use a multi-year time horizon when making decisions.

Transparency

An ABS or ABS CDO is typically defined by a legal document several hundred pages long. As already mentioned, many investors did not analyze this document carefully when they bought AAA-rated tranches of the structures. They relied on the "AAA" label. Once the tranches were perceived as risky it became almost impossible to trade them. This was because potential investors did not understand enough about the underlying portfolio and the algorithm used to determine the cash flows received by the various tranches.

ABSs , and particularly ABS CDOs, are arguably among the most complex credit derivatives that are traded. Lawyers should move with the times and define these instruments using software rather than words. In addition to providing a data file with the attributes of the mortgages and other instruments underlying the derivatives, lawyers should provide software enabling the cash flows realized by different tranches in different circumstances to be calculated. The user's inputs to the software would define a possible outcome concerning interest and principal payments on the underlying instruments each year. The outputs would be the cash flows realized by each tranche holder each year. The problems of defining structures like ABS CDOs where tranches are defined in terms of many other tranches could be handled efficiently with the software tools that exist today. The creators of tranches should be required to publish information about the performance of the underlying assets and tranches in a way that compatible with the software.

There are companies that provide investors with detailed information about tranches of the sort suggested here. However, the information is expensive and not widely available to researchers and financial commentators. Ensuring that the information is widely available would be advantageous for the functioning of markets.

Investors and independent researchers would be able to run scenario analyses and form their own opinions about the values of different tranches. It is likely that this would have led to the illiquidity of the ABS and ABS CDO market in 2007 and 2008 not being as severe as it was. (Indeed, investors might have better understood the risks in the ABS CDO market in the first place.) A good case can be made for defining many derivatives (particularly the more complex ones) using software rather than written confirmations because the latter are very cumbersome as a description of how the products work.

The Need for Models

Normally financial institutions do not trade instruments unless they have satisfactory models for valuing them. Typically there is a group within a financial institution that has the responsibility of vetting the model used for valuing a product and the product cannot be traded in any volume until the model has

been approved. What is surprising about the subprime crisis is that financial institutions were prepared to trade senior tranches of an ABS or an ABS CDO without a model. Possibly it was thought that a model is unnecessarily for valuing a AAA-rated instrument. But the lack of a model makes risk management almost impossible and causes problems when the instrument is downgraded.

The readiness of financial institutions to trade ABS CDOs is particularly surprising. An ABS CDO is similar in structure to what is called a CDO squared in the synthetic CDO market. CDO squareds are recognized by traders in the synthetic CDO market as highly risky products that are difficult to price. The market for them is much reduced for this reason. A tranche of an ABS CDO is no less risky and no less difficult to price than a tranche of a CDO squared, but it was nevertheless considered by many financial institutions to be a good investment. Because models were not developed, the key role of correlation in valuing ABSs and (particularly) ABS CDOs was not well understood.

How Models Are Used

Having the models to value ABSs and ABS CDOs would have helped, but it would not by itself have been enough to mitigate the subprime crisis. To understand how models might have helped we have to consider how they should have been used.

The risk measures used by regulators, and by financial institutions themselves, are largely based on historical experience. For example, value-at-risk measures for market risk are typically based on the movements in market variables seen over the last two to four years. Credit risk measures are based default experience stretching back over 100 years. Stress testing often involves looking at the largest market moves experienced over the last 10, 20, or 30 years.

There can be no question that historical data provides a useful guide for risk managers. But historical data cannot be used in conjunction with models in a mechanistic way to determine if risks are acceptable. In risk management it is important that models be supplemented with human judgment. A risk management committee consisting of senior managers should meet regularly to consider the key risks facing a financial institution. Stress tests should be based on the scenarios generated by these managers in addition to those generated from historical data. The risk committee should be particularly sensitive to situations where the market appears to be showing bouts of "irrational exuberance".[7]

One of the lessons from past financial crises is that correlations increase in stressed market conditions. Using standard value-at-risk techniques to estimate correlations from past data and assuming that those correlations will apply in stressed markets is not appropriate. One of the roles of the risk management committee would have been to recognize the bubble in house prices and insist that stress tests where default rates simultaneously rise in all parts of the country be carried. Of course, it is also important that key decision makers within the bank actually listen to risk managers and the risk management committee---particularly during periods of irrational exuberance. There is some evidence that they are reluctant to do t**his.**

[7] Irrational exuberance was a term coined by Alan Greenspan during the bull market of the 1990s.

5. REGULATORY CHANGES

There can be little doubt that once financial institutions recover from the current crisis the regulatory environment will change. Banks and other financial institutions will be given less discretion to assess risks for themselves. The replacement of Basel I by Basel II was a trend toward self regulation. It is likely that this trend will be reversed.

The most important thing that regulators can do is insist that all transactions, regardless of the credit ratings of the two sides to the transactions, are collateralized. In some cases, the collateralization will involve clearinghouses. In other cases it will involve two-way collateralization agreements with zero thresholds. It will hopefully never again be possible for a financial institution such as AIG to take a huge exposure without posting collateral.

6. CONCLUSIONS

The credit crisis that started in 2007 had a devastating effect on financial markets throughout the world. Its origins can be found in the U.S housing market. The U.S government was keen to encourage home ownership. Interest rates were low. Mortgage brokers and mortgage lenders found it attractive to do more business by relaxing their lending standards. Products for securitizing mortgages had been developed so that the investors bearing the credit risk were not necessarily the same as the original lenders. Rating agencies gave a AAA rating to senior tranches that were created by securitization. There was no shortage of buyers for the AAA-rated securities that were created because their yields were higher than the yields on other AAA-rated securities. Banks thought the `good times' would continue and, because compensation plans focused their attention on short-term profits, chose to ignore the housing bubble and its potential impact on the very complicated products they were trading.

House prices rose as both first-time buyers and speculators entered the market. Some mortgages had included a low ``teaser rate'' for two or three years. After the teaser rate ended, there was a significant increase in the interest rate for many borrowers. Unable to meet the higher interest rates they had no choice but to default. This led to foreclosures and an increase in the supply of houses be sold. The price increases between 2000 and 2006 began to be reversed in 2006 and 2007. Speculators and others who found that the amount owing on their mortgages was less than the value of their houses (i.e., they had negative equity) defaulted. This accentuated the price decline.

There are a number of steps that need to be taken to avoid future crises. The interests of the originators of loans should be aligned with the interests those who ultimate bear the credit risk. This could be achieved by requiring originators of loans to keep some of the risk in each instrument created from the loans. The compensation plans within financial institutions should be changed so that there is much less emphasis on short-term performance. Some banks such as UBS moved in this direction in late 2008, and early in 2009 The products that are traded should be made more transparent so that their risks are widely understood. Risk management should involve a heavy dose of managerial judgment, not just the mechanistic application of models. Finally collateralization, either through clearinghouses or through bilateral collateralization agreements should become a compulsory feature of derivatives markets.

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Figure 1: U.S. Real Estate Prices, 1987 to February 2009
S&P/Case-Shiller Composite-10 Index

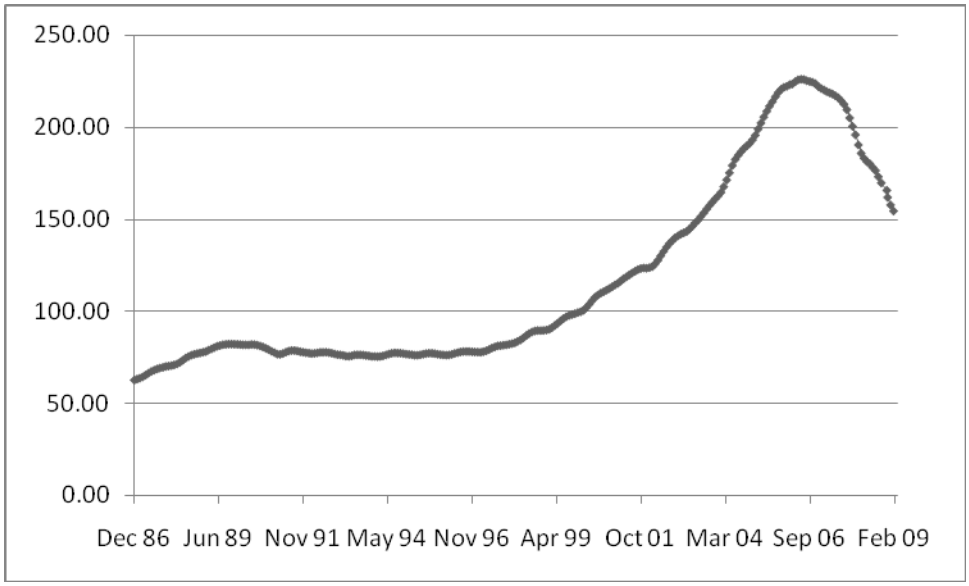

Figure 2: An Asset Backed Security (Simplified)

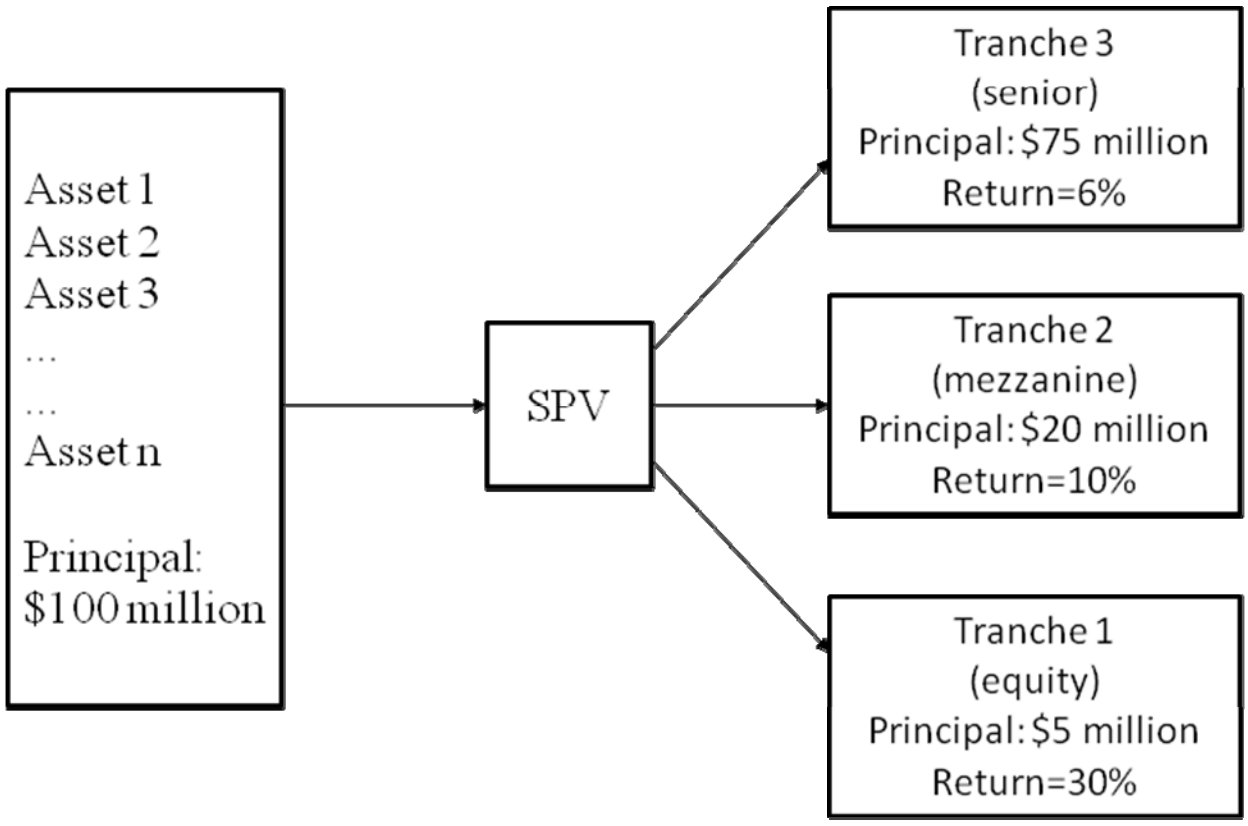

Figure 3: An ABS CDO (Simplified)

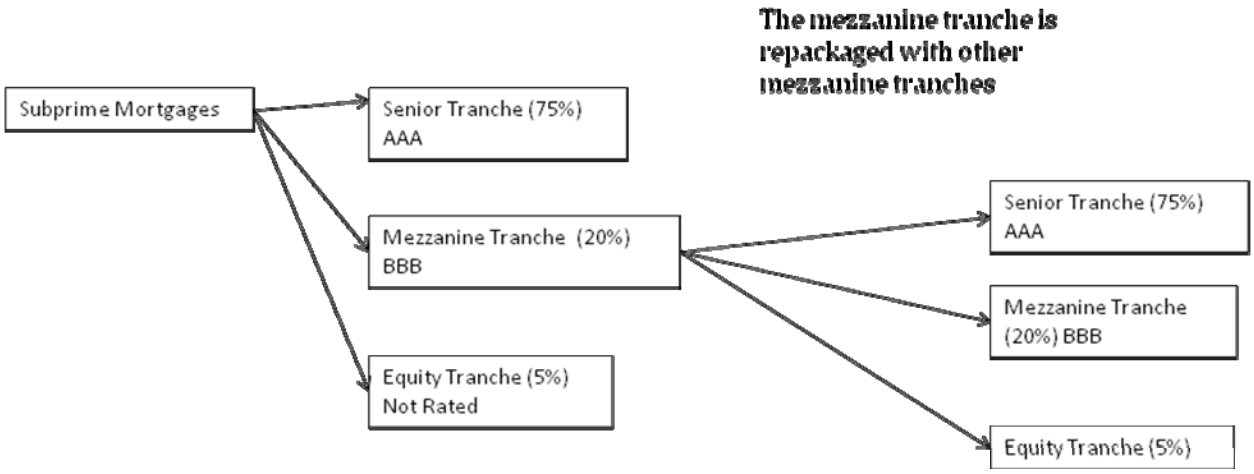

Figure 4: A More Realistic Structure

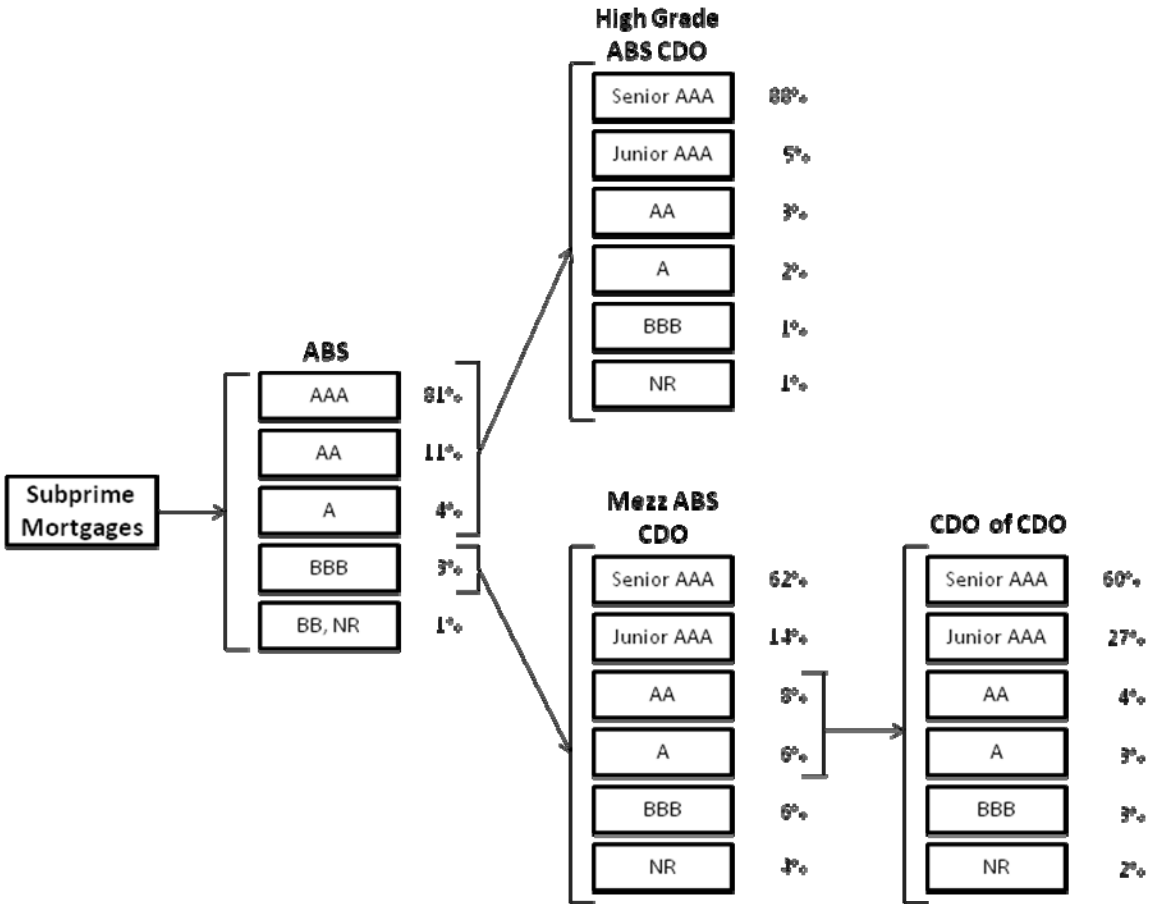

Table 1

Examples of Losses to AAA Tranches of ABS CDO in Figure 3

Losses to Subprime portfolios	Losses to Mezzanine Tranche of ABS	Losses to Equity Tranche of ABS CDO	Losses to Mezzanine Tranche of ABS CDO	Losses to Senior Tranche of ABS CDO
10%	25%	100%	100%	0%
15%	50%	100%	100%	33.3%
20%	75%	100%	100%	66.7%
25%	100%	100%	100%	100%