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Risk Management Lessons from the Sub-prime Problem

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by Mark Adelson and David Jacob

Introduction

The recently announced write-downs by major financial institutions are staggering. Their magnitude suggests that some institutions were not properly managing risk. A major share of the write-downs relates to instruments that are connected to sub-prime mortgage loans. However, only a modest share of the write-downs relates to asset-backed securities (ABS) backed directly by sub-prime mortgage loans. A much greater share relates to collateralized debt obligations that used subordinated ABS as their underlying assets (structured finance CDOs or SF CDOs).

For example, Citigroup had sub-prime-related write-downs of $17.4 billion for 2007Q4, of which $14.3 billion (82%) related to SF CDOs.[1] Likewise, Merrill Lynch had sub-prime-related write-downs of $11.5 billion in 2007Q4, of which $9.9 billion (86%) related to SF CDOs.[2] For 2007Q3, Merrill had sub-prime-related write-downs of $7.9 billion, of which $6.9 billion (87%) was from SF CDOs.[3] Clearly, the SF CDO dimension of the write-downs warrants special attention.

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[1] *Citi Reports Fourth Quarter Net Loss of $9.83 Billion, Loss per Share of $1.99*, Citigroup press release (15 Jan 2008).

[2] *Merrill Lynch Reports Full-Year 2007 Net Loss From Continuing Operations of $8.6 Billion*, Merrill Lynch press release (17 Jan 2008).

[3] *Merrill Lynch Reports Third-Quarter 2007 Net Loss From Continuing Operations of $2.85 Per Diluted Share*, Merrill Lynch press release (24 Oct 2008).

ABS backed by sub-prime mortgage loans are first-tier securitizations in which the underlying loans are pooled into a trust that issues multiple classes of securities. In a typical sub-prime mortgage securitization, roughly 85% to 90% of the issued securities have senior status and carry triple-A ratings. The remaining portion of the deal is usually divided into nine or more subordinate classes with ratings ranging from double-A-plus through triple-B-minus, or even lower. The subordinate classes hold concentrated risk from the entire pool of mortgage loans. Each of the subordinate classes receives protection from the classes "below" it and provides protection to the classes "above" it in the deal's capital structure. The size of each subordinate class typically falls in the range of 1% to 1½% of the size of the entire deal. Because each subordinate class represents such a thin slice of the deal, a relatively small change in the performance of the underlying loans can mean the difference between full payment and complete loss on a given class. For example, a deal might include a subordinate class that would receive full payment if losses on the underlying loans are below 10%, but which would be wiped-out if losses exceed 11½%.

In contrast to ordinary sub-prime mortgage ABS, SF CDOs are second-tier securitizations. Over recent years, SF CDOs invested primarily in the subordinate classes of sub-prime mortgage ABS.[4] In fact, SF CDO demand for subordinated ABS was so strong that it could not be satisfied by the amount of securities actually issued. To overcome that obstacle, professionals created "synthetic ABS" using credit default swaps. Many of the professionals involved with the SF CDOs took the approach of treating the underlying subordinate classes from sub-prime mortgage ABS as mathematical abstractions. That is, they ascribed mathematical properties to the securities, such as default probabilities, recovery rates, and correlations. They often did not closely analyze the differing structures of the ABS deals, nor did they place much emphasis on non-quantifiable factors.

For example, many CDO professionals treated the portfolios of subordinate ABS classes as diversified. They reached that conclusion from the observation that such securities had displayed historically low correlations of defaults and downgrades. However, the environment was changing in ways that could not be readily quantified. With the passage of time, sub-prime mortgage lenders were gravitating toward increasingly similar business practices. By 2005, many such lenders (1) targeted the same customer base, (2) originated loans through many of the same brokers, (3) used the same or similar credit analysis tools including FICO scores and automated appraisal systems, (4) offered the same or similar loan products, (5) were pushed by competition to loosen their underwriting standards in the same ways, and (6) sold or financed their loans through the same or similar outlets. A natural, but unquantifiable, consequence of the evolutionary change in business practices was an increase in the tendency for loan pools from different lenders to behave similarly – to display high correlation.

In framing their analyses, CDO professionals generally considered only events that actually occurred and for which there was convenient data. Because of their strict adherence to a quantitative paradigm, they did not have a way to deal with scenarios that were reasonably

[4] Some deals, dubbed "mezzanine" SF CDOs, invested primarily in ABS classes that carried ratings in the triple-B range. Others, dubbed "high grade" SF CDOs, invested primarily in ABS classes at the single-A level.

possible based on market conditions but which had never actually occurred before. Thus, CDO professionals got sucker-punched when the "high correlation" scenario became reality.

But that was only the start. The damage from underestimating correlation was sharply amplified by high leverage from the thinly sliced subordinate ABS tranches. Together, high correlation and high leverage produced a toxic cocktail for SF CDOs and their investors.

Overall, the deficiencies in the risk management process at some firms appear to stem from de-emphasizing the common sense aspects of risk management and from over-reliance on mathematical risk management tools. Accordingly, the lessons that seem to emerge from the recent experience carry a strong flavor of "plain old common sense."

The Lessons

Math can find risks but it cannot find safety: Mathematical tools can sometimes find risks that might otherwise not be readily apparent. However, there are also risks that they fail to spot. It can be a grave mistake to conclude that risks are absent just because mathematical tools have not detected or revealed them. As illustrated above, some kinds of risk lie beyond the reach of mathematical tools, and can only be uncovered by other means. Accordingly, risk management professionals must arm themselves not only with the best possible mathematical tools, but also with methods for uncovering risks that evade discovery by mathematical means.

Subordination is sometimes illusory: Sub-prime mortgage ABS sometimes have very intricate cash flow mechanics. The subordination relationships among the classes in a deal can be very subtle. For example, in many deals the residual (equity) class can receive cash distributions even when the performance of the underlying loans breaches the deal's performance covenants ("trigger tests"). The release of cash flow to a deal's residual class boosts the risk to the other classes, especially to the classes right "above" the residual (*i.e.*, the most subordinate rated classes). In addition, the trigger tests determine the allocation of principal distributions among the tranches of a deal. If a deal passes its trigger tests, the subordinate tranches can receive a substantial portion of their entire principal right after the deal's third anniversary. On the other hand, if the triggers are failing, the subordinate tranches receive no principal distributions until the senior classes have been retired. This difference is huge, because in the latter case the full principal amount of the subordinate tranches remains exposed to credit losses for the entire life of the deal.

ABS/MBS professionals are generally aware of the structural nuances of sub-prime mortgage deals. However, CDO specialists and risk management professionals may not be. Perhaps they would have reached better judgments about the riskiness of sub-prime mortgage ABS subordinate tranches if they had fully understood the subordination and cash flow mechanics in the deals.

Structural complexity is its own risk: Structural complexity increases the risk that professionals will misunderstand (or not fully understand) how a deal works. For example, consider Park Place Securities Asset-Backed Pass-Through Certificates, Series 2004-WHQ2.

The deal has numerous senior classes, divided into three groups, corresponding to three underlying loan groups:

Park Place Securities Asset Backed Pass-Through Certificates, Series 2004-WHQ2		
Group I	Group II	Group III
A-1A A-1B A-1C A-1D	A-2A A-2B	A-3A A-3B A-3C A-3D A-3E

In many deals, senior classes within a group that bear sequential designations receive principal distributions sequentially (*e.g.*, class A-2 might not receive any distributions of principal until class A-1 is retired). Less frequently, the "senior" classes within a group may have subordination relationships among them (*e.g.*, realized losses might be allocated to class A-2 before class A-1). However, in some cases, such as Park Place 2004-WHQ2, the relationships are much more involved. Consider the following excerpt from the deal's prospectus:

> With respect to the Group III Certificates, all principal distributions will be distributed concurrently, on a pro rata basis (based on (i) the Certificate Principal Balance of the Class A-3A Certificates, (ii) the aggregate Certificate Principal Balance of the Class A-3B, Class A-3C and Class A-3D Certificates and (iii) the Certificate Principal Balance of the Class A-3E Certificates, respectively) (a) to the Class A-3A Certificates, until the Certificate Principal Balance of the Class A-3A Certificates has been reduced to zero, (b) sequentially, to the Class A-3B, Class A-3C and Class A-3D Certificates, in that order, until their respective Certificate Principal Balances have been reduced to zero and (b) to the Class A-3E Certificates, with the exception that if a Sequential Trigger Event is in effect, principal distributions will be distributed first, concurrently, on a pro rata basis (based on (i) the Certificate Principal Balance of the Class A-3A Certificates and (ii) the aggregate Certificate Principal Balance of the Class A-3B, Class A-3C and Class A-3D Certificates, respectively) (a) to the Class A-3A Certificates, until the Certificate Principal Balance of the Class A-3A Certificates has been reduced to zero and (b) sequentially, to the Class A-3B, Class A-3C and Class A-3D Certificates, in that order, until their respective Certificate Principal Balances have been reduced to zero and second, to the Class A- 3E Certificates, until the Certificate Principal Balance of the Class A-3E Certificates has been reduced to zero.[5]

That painful bit of language might be summarized graphically as follows:

[5] Park Place Securities, Inc., Asset-Backed Pass-Through Certificates, Series 2004-WHQ2, prospectus supplement at S-69 (23 Nov 2004).

<table>
<tr><td colspan="5">Park Place 2004-WHQ2
Group III Principal Distributions</td></tr>
<tr><td colspan="2">Sequential
Trigger Event</td><td colspan="3">Time →</td></tr>
<tr><td rowspan="3">No</td><td rowspan="3">Pro
Rata</td><td colspan="3">A-3A</td></tr>
<tr><td>A-3B</td><td>A-3C</td><td>A-3D</td></tr>
<tr><td colspan="3">A-3E</td></tr>
<tr><td rowspan="2">Yes</td><td rowspan="2">Pro
Rata</td><td colspan="3">A-3A</td><td rowspan="2">A-3E</td></tr>
<tr><td>A-3B</td><td>A-3C</td><td>A-3D</td></tr>
</table>

The "Sequential Trigger Event" feature has profound implications for the timing of cash flows on the A-3D and A-3E classes. Here, structural complexity lays a potential trap for any risk management professional (and for any investor) who does not delve into deal structures.

An SF CDO can embody extreme structural complexity when it is composed of dozens or hundreds of underlying sub-prime mortgage ABS tranches. Indeed, the structural complexity in SF CDOs is often intractable without making simplifying assumptions. The problem for risk management professionals is that it may not be practical or possible to determine whether the simplifying assumptions are reasonable or whether they "assume away" important risks. Here, the only practical approach may be to test the results that come from various alternative assumptions (all of which may be equally reasonable) and to ascertain whether any produce unacceptable consequences. If any do, deeper investigation is warranted.

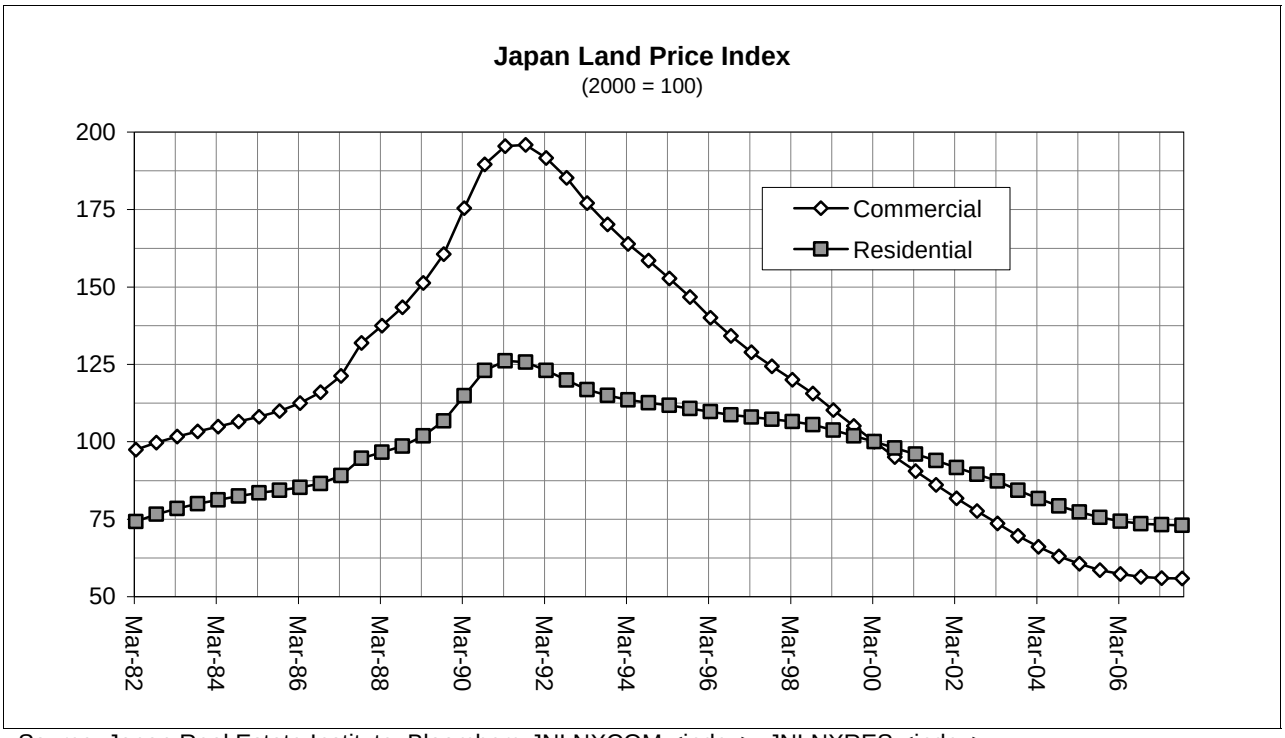
Bubbles happen and they burst: History is full of bubbles. Perhaps the most famous is the Dutch tulip bulb mania of the early 17th Century. In that episode, speculators actively traded in tulip bulbs and drove the prices to levels out of all reasonable proportion to other asset prices. A century later, England had the South Sea Bubble. In that episode, the stock of the South Sea Company started at around £125 per share in January 1720, rose to a peak of roughly £1,000 in August, and then fell back to its original level before the end of the year.

In the 1920s, the U.S. had its most famous stock market bubble. The Dow Jones Industrial Average ended 1924 at a level of 120.51. After climbing for several years, it reached a high of 381.17 on 9/3/1929. The market started falling badly about a month later. It dropped from a level of 350.97 on 10/14/1929 to an interim low of 198.69 on 11/13/1929. It recovered briefly the following year, climbing back to a high of 294.07 on 4/17/1930. Then things really started to slide. The DJIA declined steadily for more than two years, reaching a low of 41.22 on Friday, 7/8/1932. It took more than twenty years for the DJIA to get back to its high of 1929. On 11/23/1954, the DJIA finally reached a new high of 381.71.

Gold is another example. At the start of 1979, the price of gold was $226.80 an ounce. The price rose steadily through the year, reaching $512.00 per ounce on the last business day of December. Then the price shot upward during the first weeks of January 1980, reaching $850.00 an ounce on 1/21/1980. After a period of volatility, the price retreated to $297.75 on 6/21/82. For the next 15 years, the price of gold fluctuated between roughly $300 and $500 per ounce. It dipped below $300 for much of the period from 1999 through 2001. Then it started a climb that

still has not stopped. However, it was not until 1/2/08 that the price of gold reached the $850.00 level at which it had peaked in 1980. Thus the gold bubble of 1980 had produced a high that was not topped for nearly 28 years.

Japan's "bubble economy" of the late 1980s is another example. As shown on the following chart, land values in Japan started rising rapidly around 1986. They peaked in 1991 and have been trending down ever since. The chart reflects land prices for the nation as a whole. The decline has been sharpest for commercial real estate, but residential real estate has also suffered badly. Also, the bubble was most extreme in the major cities and less severe in other areas. In Japan's hottest markets, commercial land prices declined by more than 90%.



Source: Japan Real Estate Institute, Bloomberg JNLNXCOM <index>, JNLNXRES <index>

Although the U.S. has not previously experienced a national real estate bubble, we have had some notable regional and local bubbles. For example:

- Houston home prices peaked in 1983Q2 before starting a five year slide in which they declined by roughly 25%. It was not until 1998 that Houston home prices recovered to the level at which they had been in 1983.

- Home prices in the Los Angeles area peaked in 1990Q3. Then they declined for six years, reaching a level 21.5% below their peak. They recovered to their 1990 levels in 2000.

- Honolulu home prices peaked around the end of 1995. They dropped 16.7% over the next four years. They turned around at the end of 1999 and made it back to their prior high around the end of 2002.

- Boston area home prices peaked in 1989Q3. Then they dropped by 11.8% over the following three years. They slowly recovered, fully regaining their lost ground by 1997Q3.

One of the most extreme recent bubbles in the U.S. was the tech/dot com/NASDAQ bubble. The NASDAQ index entered 1997 at a level of 1,281. Over the next 2¾ years, it rose strongly, more than doubling, to reach a level of around 2,800 by the end of 1999Q3. Then, starting in mid-October, it took off like a rocket. For six months it climbed strongly, reaching an all time high of 5048.62 at the close on 3/10/2000. However, the joy was short-lived. The NASDAQ retreated rapidly, reaching an interim low of 3,205 on 5/26/2000. Following several months of volatility, the index headed lower, ending 2000 at a level of 2,471. It continued its downward path, reaching a level of 1,950 by the end of 2001. The decline continued into 2002. The index reached a cyclical low of 1,114 on 10/9/2002 and ended the year at a level of 1,336.

Risk management professionals cannot afford to ignore bubbles. It seems impossible to predict accurately when a bubble will burst. Accordingly, risk managers need to continually consider the possibility that bubbles could burst at any time.

Close cousins to the bubbles are the phenomena of business cycles, real estate cycles, and credit cycles. Such cycles do not display steady or predictable rhythms. However, they are real in the sense that the business, real estate, and credit environments fluctuate over time. Each may be favorable for a time, and then become unfavorable. Periods of unfavorable conditions eventually end, to be followed by favorable times. The point is that conditions rarely remain stable for extended periods.

Risk managers need to focus on "medium size' risks: It is sometimes useful to think of risks as coming in three sizes: small, medium, and large. Small risks comprise the ordinary, daily fluctuations of the financial markets. Risk management professionals should not need to devote a large portion of their efforts to small risks because these are the under continuous scrutiny by business units and trading desks. At the other extreme, large risks include such items as global war, plague, famine, and pestilence. They are the risks of "biblical" proportions. Risk management professionals should not have to devote much of their attention to large risks because there really is not anything they can do to mitigate such risks. Medium size risks fall in between these extremes. They include severe market fluctuations, bursting bubbles, and geopolitical events of moderate scale.

Working with a firm's senior executives, risk management professionals must obtain a clear understanding of the firm's risk tolerance. That is, they must understand senior management's view of scenarios under which a firm would be expected to survive, and those under which it would not. In addition, risk managers must understand what level of damage or injury to the firm is acceptable under scenarios where it is intended to survive.

A difficult aspect of risk management is figuring out the impact of various medium size stress scenarios on a firm. What happens to the firm if interest rates return to the levels of 1979-1980? What happens if hyperinflation occurs in the U.S. or in another major economy? What happens if global oil supplies drop by 20%, 30%, or more because of conflict in the Middle East? What happens when a housing bubble bursts? What happens when the U.S. suffers a prolonged

recession? These are the types of events that qualify as medium size risks that can have major consequences for financial firms.

Long term averages (including average volatilities) are not particularly helpful for selecting or defining scenarios for risk management analysis. Rather, in selecting or defining scenarios, both risk managers and a firm's senior management should be mindful of all kinds of extreme conditions (including extreme volatilities) that have occurred in the past.

A key role of risk management is figuring out suitable leverage limits, exposure limits, and hedging strategies for satisfying senior management's expectations with respect to the impact of medium size risk. In addition, risk managers arguably should treat model risk as a medium size risk if the firm could suffer material adverse consequences from a model's failure to capture and reflect its subject phenomena reliably.

Fundamental credit analysis is essential: There is no substitute for fundamental credit analysis. In particular, financial engineering is not a substitute for fundamental credit analysis. The rising prevalence of derivatives and structured financings boosted the demand for professionals with financial engineering skills in the 1990s and early 2000s. However, the heightened focus on financial engineering came at the expense of basic credit skills. Several commentators had noted and criticized the trend several years ago, but their warning fell on deaf ears.[6] Risk management departments should make sure that they do not neglect either side of the process.

A key problem at many firms has been reluctance on the part of professionals in the areas of CDOs and structured credit to seek and accept input from ABS/MBS experts. CDO and structured credit professionals made the mistake of thinking that financial engineering could structure away fundamental risk entirely. They were dead wrong, with horrible consequences for their firms. Significantly, the problem was not confined to just one type of firm. It was endemic among CDO and structured credit professionals at all kinds of firms: banks, securities dealers, rating agencies, bond insurers, money managers, and others.

Skewed trading strategies pose a danger: Compensation arrangements – including annual cash bonuses – can motivate employee traders to use skewed trading strategies. A skewed trading strategy is one that produces a modest positive outcome most of the time and an extremely negative outcome on rare occasions.[7] Skewed trading strategies are rarely optimal for firms that have to live with the long-term consequences. In contrast, an employee trader whose full bonus is paid annually usually has a short-term perspective. Risk management professionals should consider whether a firm's compensation policies expose it to the risk of skewed trading strategies. If trading activities leave firms holding risk positions from their deals (*e.g.*, CDO tranches or "residuals" from sub-prime mortgage ABS), they might consider paying the traders

[6] *See e.g.*, International Monetary Fund, *Global Financial Stability Report, Chapter II – The Influence of Credit Derivative and Structured Credit Markets on Financial Stability* at 59-62 (Apr 2006) http://www.imf.org/External/Pubs/FT/GFSR/2006/01/.

[7] *See* Holton, G., *Negatively Skewed Trading Strategies*, Derivatives Week 12(42), pp. 8-9 (2003) http://www.riskexpertise.com/papers/Skewed.PDF

with some of the retained positions, or using deferred compensation arrangements with payouts over five years or longer.

Valuations of illiquid OTC instruments can be unreliable: Security valuations ("marks") are necessary for a variety of purposes. They are the basis of calculating net asset values of mutual funds and hedge funds, and they are the basis for margin calls by lenders to leveraged investors. Marks can also be important for risk management purposes. However, risk management professionals must remain mindful that marks can be unreliable for certain types of structured finance instruments. Examples include both CDOs and subordinate tranches of sub-prime mortgage ABS. The difficulty stems from a number of factors: (i) the absence of a visible and active trading market for those securities, (ii) the limitations of model-based valuation systems, and (iii) the fact that prices in a distressed market may not fairly reflect intrinsic values (*i.e.*, the market is neither fully efficient nor omniscient). The difficulty is exacerbated when a security has the reasonable potential to produce extremely divergent outcomes (*e.g.*, a 100% loss or a 100% repayment of principal). In such cases, professionals may be able to deploy better risk management strategies by thinking in terms of ranges rather than point estimates of value. Using ranges may help to address and quantify the degree of uncertainty associated with the valuations.

One important use of marks is for determining profit and loss (P&L) for businesses that retain unsold positions and book non-cash gains on securitizations. Risk management professionals need to understand the reliability of P&L measurement. The problem is not that most businesses would be biased toward overestimating profits, but rather that they might not realize that they are operating at a loss. That is exactly what happened to some sub-prime mortgage businesses that retained residuals from their securitizations. They booked the residuals at aggressive valuations, but subsequent events revealed the residuals to be worth much less. Risk management professionals have a better chance of dealing with such situations if they realize that the valuation (and the related determination of P&L) may be inaccurate and will only become certain with the passage of time.

Conclusion

Financial risk managers need to rise to the challenges presented by complex securitization instruments. They need to remain mindful that subordinate tranches and the securities based on them can display *extreme* credit volatility. They need to remember that math has its limits and that structural nuances and complexity are real issues. They need to remember that bubbles happen, and they need to focus on the kinds of risks that can imperil their firms. They need to think about scenarios and stress tests drawn from economic and financial history, rather than ones drawn merely from recent times for which convenient data is readily available. They need to have imagination and creativity to consider plausible scenarios that have never actually occurred. Risk managers need to remember that financial engineering is not a substitute for solid fundamental credit analysis. And, lastly, they need to watch out for skewed trading strategies and unreliably security valuations. If they manage to do all that, then their firms will have better prospects for enduring the next period of high stress with minimal damage.

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