

Simulating the Financial Consequences of the Subprime Mortgage Crisis

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Background

Once upon a time mortgage bankers practiced sound lending. Mortgage borrowers had to put up at least 20% in equity and mortgage payments could not exceed 25% of gross income. The first break with this tradition was the collateralization of mortgages; the packaging of mortgages and selling them as units to those interested in income. Now a banker could keep the mortgage or sell it. If sold, the banker made money on the origination fees and a small service fee for collecting the mortgage payments and passing the proceeds to a third party. This essentially transformed a mortgage banker into a mortgage broker if the banker decided to hold few if any mortgages. Holding few mortgages meant that the mortgage banker was no longer satisfying his mortgage credit standards, but the standards of the intermediary. The intermediary, or investment banker, would collect a diversified portfolio of mortgages and sell portions of this portfolio to other institutions interested in a steady income such as pension funds. The investment banker had to be careful that the creditworthiness of the portfolio satisfied the buyers, otherwise he would have unsold inventory. Thus mortgage credit standards were ultimately set by buyers of mortgage participations.

Keen on marketing new financial instruments, investment bankers eventually struck gold with collateralized mortgage obligations (CMOs). CMOs sliced and diced a mortgage portfolio into three subportfolios or tranches. Tranch A was assigned the first five years of normal principal repayments. This portion of the CMO was usually guaranteed by a triple A third party and carried the guarantor's credit rating. In addition to the normal principal repayments, Tranch A received any prepayments and repayments of mortgages. If there were no prepayments or repayments, Tranch A would amortize, or be paid off, in five years. The perceived risk of Tranch A holders when CMOs were reigning supreme was significant prepayments and repayments that would rapidly hasten the maturity of the securities. Because of its short maturity and triple A credit rating, Tranch A holders received a low rate of interest. Interest payments above that required to satisfy Tranch A were passed to Tranches B and C.

After Tranch A was paid off, Tranch B would receive all normal principal payments plus prepayments and repayments until it was paid off. Its higher interest rate was comparable to a B or C bond credit rating depending on the quality of the mortgages and the possible presence of a credit enhancer. Tranch B would be paid off in 15 years from normal principal repayments. Again, prepayments or repayments would hasten its maturity. After Tranch B was paid off, all principal and interest payments would be dedicated to Tranch C. With no prepayments or repayments, Tranch C would be fully paid off in 30 years along with all the underlying mortgages. Tranch C had no credit enhancements, had the longest time duration to maturity, and carried the greatest risk as it was last in line. Usually Tranch C was unrated as its credit rating, if rated, would be equivalent to junk bonds. As compensation, Tranch C investors received the highest interest rate of the three tranches.

The three tranches provided buyers with a variety of choices: Tranch A with a short maturity and triple-A credit, Tranch B with a medium credit rating and maturity, and Tranch C with the longest maturity and the highest yield. While some industry observers referred to Tranch C as the equity tranche; others disagreed citing the fact that nothing had gone wrong with the mortgage market for over 20 years. Since most mortgages are paid off prematurely from home ownership transfers and prepayment of principal, much of Tranch C would be paid off before the 30 years were over. “Equity” was considered a misnomer because there was virtually no associated risk with Tranch C holders receiving their full amount of interest and amortization payments. With a history of two decades of generally rising home prices, a mortgagee unable to make mortgage payments would sell the home to recoup his or her equity investment rather than walking away from a property. And even if the mortgage were to go into default, rising house values would minimize foreclosure losses.

The problem was that nothing had gone wrong for twenty years. Time has a way of erasing bad memories such as the savings and loan debacle of the early 1980s. CMOs eventually became very popular because interest rates on Tranch C securities were far above alternative long-term investments such as U.S. government bonds. Oil exporting nations and nations with strong positive trade balances such as China, flush with surplus U.S. dollars, became enamored with high yielding Tranch C securities in preference to low yielding long term U.S. government bonds. Such overwhelming demand for CMOs put further pressure on investment bankers to originate mortgages for slicing and dicing. Since the holders of CMOs had no idea what exact mortgages backed their securities, the opportunity was present to slip in a few mortgages into a CMO whose credit terms did not meet traditional standards and nobody would be the wiser. Mortgage bankers’ natural reluctance to reduce credit standards to enhance the flow of mortgages to the investment bankers was sidestepped by the emergence of mortgage brokers, whose only mission was to process mortgage applications to feed the CMO production machine. Both the mortgage brokers and investment bankers, as middlemen earning only commissions and fees for their services, had no vested interest in these securities. Thus they had nothing to lose and everything to gain by lowering mortgage standards. The buyers of CMOs had no idea of what mortgages they were buying – only the investment banker who held these mortgages in escrow knew what actually backed a CMO.

Little or no risk was subscribed to Tranch C because of the widely accepted New Paradigm that “home prices can only go up.” If a bad apple lacked the income to support a large mortgage, a rising market guaranteed a sale that would result in little, if any, loss in a foreclosure. Therefore what was the risk in granting teaser mortgages with low initial interest rates, but with significant step-ups in two years’ time (Adjustable Rate Mortgages or ARMs) for the full value of the house? With little or no equity infusion by the mortgagee, people with no cash reserves could qualify to buy a house. The government viewed ARMs as a positive social good because ARMs opened up home ownership for just about everyone.

The New Paradigm that this time things are different and house prices can only go up was so full heartedly accepted that it was no longer necessary to verify information provided by the applicant on financial assets and income (so-called liars' mortgages). This meant that a person who not only did not have any cash, but also barely enough income to pay the mortgage payments with the teaser rates, could qualify for a mortgage. Teaser rates and mortgages for the full value of a house created a new class of homeowners who previously had been excluded from the mortgage market by traditional credit standards. Their buying of homes for the maximum amount permissible under lax credit conditions further boosted home prices and homebuilding activity. Knowing full well that they could not afford the mortgage once the teaser rates expired, the new homeowners planned to refinance with another low interest mortgage before the interest rate was significantly hiked up.

Another group of buyers, faithfully following the sage advice of real estate TV evangelists to create micro-Trump fortunes, took full advantage of low interest teaser rate mortgages for the full value of a house to purchase 2, 3, 4, or 5 houses at a time. The house-flippers ordering multiple homes from homebuilders had no intention of living in a house and had no renters lined up for the others. They were confident that they could unload these homes as they were completed to the next flipper at an even higher price. These faithful Ponzi followers further fueled the flames of the home buying and building frenzy.

No one warned of the danger of such rank real estate speculation and the government took no action to cool the market. It would have been incredibly easy for the government to put an end to the ruckus by enacting a requirement of a minimum of 5% down. This would have eliminated a huge number of the buyers who lacked the \$50,000 downpayment to buy a \$1 million MacMansion. Just the opposite occurred, government welcomed the escalation of home prices and the availability of ARMs not only to expand home ownership, but also to provide a means for people to refinance their existing mortgages and spend the excess money to keep the economy going and the elected officials in office.

This same phenomenon of government inaction occurred during the stock market boom of the 1920s. Slowly raising brokers' margin requirements throughout the 1920s would have cooled the stock market, but government officials failed to do so because high stock prices were fueling economic activity. Buy 10,000 shares of RCA with only 10% down, make a killing, and buy a car and a new house with the profits and keep the economy roaring. Why kill the goose that was laying the golden egg? Then as now, government leaders failed to take any action that would burst a bubble that everyone said couldn't burst by the emergence of a New Paradigm that things were truly different. In the 1920s, New Paradigm was that stocks had reached a "permanently high plateau."

New Paradigms have a nasty habit of lasting just long enough to ensure maximum damage. Just as the bursting of the stock market bubble in 1929 plunged the New Paradigm into a sea of margin calls, the bursting of the real estate bubble in 2006 plunged the New Paradigm into a sea of defaulted mortgages as the supply of new homes

overwhelmed demand. When the bubble burst, it was estimated that there were about 7.5 million subprime mortgage loans making up about 14% of all mortgages of which 9% were ARMs. In addition to the 14%, another 9% are considered near-prime, a small step up from subprime. While these may not be overwhelming percentages on an aggregate basis, CMOs issued over the last years of the boom were peppered with subprime and near-prime mortgages. This is where the problem lies.

The first casualties when prices began their inevitable decline were the house flippers who could no longer flip. Rather than watch mortgage, insurance, and property tax payments consume their cash reserves on multiple houses, they walked away from their financial obligations leaving the banks and home builders to figure out what to do. One would think that an obligation to make mortgage payments would follow the mortgagee when he or she takes a walk. This is not true. A 1930s depression inspired law makes it difficult for a bank to pursue a homeowner who defaults on a mortgage. The bank takes possession of the house and that's about all that the law allows. A banker cannot attach other financial assets or earnings of a mortgage defaulter. The consequence of an individual defaulting on a mortgage is a very low credit rating. This would probably preclude the individual from ever qualifying for another mortgage, but this is a consequence defaulters can apparently live with.

The second group to walk was those who had planned to refinance their homes before the stiff upward adjustment in their adjustable rate mortgages (ARMs) took place. Refinancing is no longer an option because of declining home values and a stiffening of mortgage standards. Like the first group, these individuals will be forced to walk because their budgets, already strained making teaser interest rate payments, cannot afford to pay the much higher step-up in interest rates. Some can no longer even make teaser rate mortgage payments because the slowing economy has caused commission and bonus based incomes to fall, growing unemployment has caused others to lose their jobs, and all suffer from higher fuel and food prices.

The emerging third group is made up of those who do not see the point of continuing to make payments on a million dollar mortgage for a house whose value has declined to \$700,000, a situation known as negative equity. This is a viable course of action as long as the defaulter can live with a damaged personal credit rating. The first group has already defaulted, the second is in the process of defaulting, and the third will grow depending on the duration of the housing depression.

When a bank holds a mortgage in default, it is obviously in the bank's interest to take possession of the house and act to preserve the value of the house, and make the insurance and property tax payments. But in today's world, the bank does not hold the mortgage. It merely acts as an agent to collect the mortgage payments and forward them to the investment banker who had collected a pot full of mortgages to be sliced and diced for resale as CMOs. While the investment banker holds the physical mortgage, the actual owners are a vast array of investors spanning the globe who do not know exactly which bits and pieces of mortgages they purchased. Thus the mortgage banker collecting the mortgage payments and the investment banker who disperses the funds to the CMO

holders have no vested interest in the defaulted property. Those who do have a vested interest do not know which mortgages are in default as they don't know which mortgages they hold. All they know is that they are not receiving the payments they expected when they purchased the CMOs. A house in foreclosure has to be checked to ensure that it is not being vandalized and insurance payments have to be paid to protect against fire and other perils and property taxes have to be paid to avoid seizure by a municipality. Presumably the mortgage banker is making these payments and will have to wait for liquidation to be reimbursed for these advances. Ultimately the CMO holders will be bearing these costs.

The separation of the physical mortgage papers from the bank servicing the requirement has another repercussion. Normally foreclosure presumes that the bank making the foreclosure holds the mortgage. This is no longer true, the mortgage is held in an escrow account by an investment banker. Some judges are now insisting that the letter of the law be followed and the bank has to show that it actually possesses the mortgage documents before the foreclosure process can proceed. Since the banker does not physically hold the mortgage documents and the investment banker is not anxious to depart with the collateral for the CMOs, people not making mortgage payments can continue living in their homes, perhaps making or perhaps not making insurance and property tax payments.

Working out the Simulation Details

A \$100,000 30-year 7% mortgage will result in interest payments of \$139,000 and \$100,000 in amortization or principal repayment. The 7% assessed interest may be a low estimate of the blended initial teaser rate and the higher long-term interest rate. With a little rounding, mortgage amortization is only \$6,000 during the first five years, \$20,000 between 6 and 15 years and a whopping \$74,000 between 16 and 30 years. Interest income is shifted from Tranch A, which represents the least risk, partly to Tranch B and largely to Tranch C. The following table shows the assignment of interest payments and principal repayments among the three tranches.

	Principal	Total Interest First 5 Years \$34,000	Total Interest 6-15 Years \$60,000	Total Interest Over 15 Years \$45,000	Total Interest & Principal
Tranch A	\$6,000	\$1,000	-	-	\$7,000
Tranch B	\$20,000	\$7,000	\$15,000	-	\$42,000
Tranch C	\$74,000	\$26,000	\$45,000	\$45,000	\$190,000
Total	\$100,000				\$139,000

Suppose that the CMO was underwritten three years before home prices reversed direction. The house flippers have already walked and the second group will walk by the time Tranch A has matured. Buyers of Tranch A securities will not suffer any loss of interest and principal repayment as these have been guaranteed by third parties, some of whom have already suffered lower credit ratings and the need to raise more capital.

Tranches B and C securities will see loss of interest income and principal depending on how much money can be recouped from a resale of a house to a third party.

The whole CMO is not at risk. Some of the mortgages were traditional in nature where the mortgage amount was below the market price with the mortgagee in reasonably good financial shape. ARMs do not necessarily represent a default situation. Suppose an individual owns a \$500,000 home with a \$200,000 existing mortgage. The individual refinances the home for \$400,000 with an ARM to add an additional room and pay college tuition. At the end of the two-year teaser interest period, the mortgagee has the financial wherewithal to make payments or refinance if so desired. Moreover, for mortgages in default, CMO holders will eventually obtain the proceeds from liquidating the foreclosed properties.

Suppose that the CMO at its underwriting consisted of 1,000 mortgages varying between \$400,000 and \$1,000,000 with a total value of \$700 million. The value of interest and principal payments for the three tranches are seven times (technically 7,000) the values in the preceding table. Suppose that anywhere between 20% and 30% of the portfolios are house flippers and subprime borrowers whose income and circumstances are such that they will be forced to walk when the teaser period is over. Group 1, the house flippers, have already defaulted and Group 2 will default before the maturity of Tranch A securities. Although the guarantor will ensure that Tranch A holders suffer no loss, it is assumed that the guarantor has access to the proceeds on liquidating foreclosed properties to compensate for losses in principal. Losses in interest payments will have to be made up by the guarantor. Whatever is left after reimbursing for the losses in principal for the Tranch A security owners will accrue to Tranch B security owners, and when Tranch B security holders are made good on losses in principal, the residue accrues to Tranch C security holders.

Thus the third group who voluntarily walk away from their homes as a consequence of negative equity is the major unknown. With individuals already demonstrating their willingness to walk, the question is how many will walk in the future. This will depend on the length of the housing depression and the depth of the decline in home prices.

Suppose that a knowledgeable expert has opined that negative equity will be responsible for 0% to 3% of mortgages to default in year 1, another 2%-8% in year 2, another 7%-12% in year 3, and another 10%-15% in year 4 and thereafter depending how long before there is a housing recovery. Another knowledgeable expert has opined that there is only a 5% chance that there would be a recovery in year 1, 20% chance in year 2, 30% chance in year 3, and 45% chance in year 4 and beyond. Furthermore banks will eventually recoup 40%-70% of a mortgage in default net of expenses (home security coverage, insurance, property taxes, legal and administrative fees) either by selling the home at a significant discount or by drastically revising the mortgage terms. Since some of the homes in default were ransacked by their previous owners from removing appliances to punching holes in the walls and pouring paint on the floors with their

abandoned pets as mute witnesses, house flippers are back in action buying distressed properties and restoring them to a salable condition.

What is the risk of loss faced by Tranch B and C investors?

	A	B	C	D	E	F	G	H	I	J
1	Subprime CMO Financial Loss Calculator									
2										
3						Duration of Housing	Year		Group 3	
4							1	1	17	
5					Group	Depression	2	1	53	
6					1 & 2	4	3	1	88	
7							4	1	128	Total
8	Number of Mortgages in Default				227				286	513
9										
10	Amount of Mortgages in Default				\$157,870				\$198,259	\$356,129
11										
12	Amount of Mortgages Not in Default									\$343,871

The number in mortgages in default for Groups 1 & 2 is between 20% and 30% of the total number of 1,000 mortgages. The duration of the housing depression in cell F6 is a discrete probability distribution reflecting the expert's opinion. The number of defaults for each year in cells I4:I7 is also a probability distribution reflecting the expert's opinion on the percentage of those likely to walk away from their obligations. The total number of defaulted mortgages out of a population of 1,000 mortgages is in cell J8. The defaulted amount of mortgages is calculated in cell J10 with the formula:

$$=RiskCompound(J8,RiskPert(400,700,1000))$$

where the first part of the RiskCompound function is the number of defaults and the second part is the probability distribution of the mortgage amount.

As shown below, mortgages not in default determine the portion of principal and interest that flows through to Tranch A, B and C holders. The shortfall is the difference between expected and actual payments of principal as this is what is amortized by the proceeds from foreclosed properties.

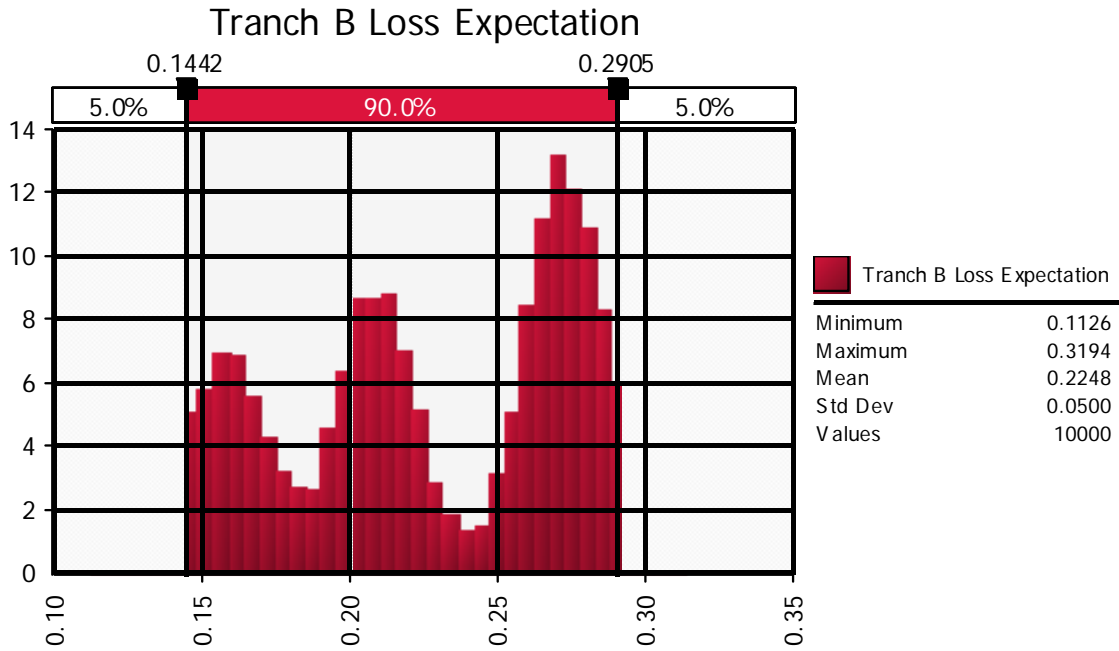
	A	B	C	D	E	F	G	H	I
15								Money	
16								Collected	
17								Mortgages	
18						Scaling up to		not in	
19						Portfolio of:		Default	Shortfall
20	Portfolio Size				\$100,000	\$700,000			
21									
22	Interest Payments of CMO to Tranch A				\$1,000	\$7,000		\$3,439	0
23	Principal Payments of CMO to Tranch A				\$6,000	\$42,000		\$20,632	(\$21,368)
24	Total to be Paid to Tranch A				\$7,000	\$49,000		\$24,071	
25									Remaining Proceeds
26	Interest Payments of CMO to Tranch B				\$22,000	\$154,000		\$75,652	
27	Principal Payments of CMO to Tranch B				\$20,000	\$140,000		\$68,774	(\$71,226)
28	Total to be Paid to Tranch B				\$42,000	\$294,000		\$144,426	
29									Remaining Proceeds
30	Interest Payments of CMO to Tranch C				\$116,000	\$812,000		\$398,890	
31	Principal Payments of CMO to Tranch C				\$74,000	\$518,000		\$254,464	(\$263,536)
32	Total to be Paid to Tranch C				\$190,000	\$1,330,000		\$653,354	

Assuming that Tranch A guarantors have the first right to foreclosed properties, the proceeds of liquidating defaulted mortgages go first to repaying the shortfalls in principal payments on Tranch A securities, then Tranch B, and finally Tranch C. Tranch A guarantors have to make up for any deficit in interest income.

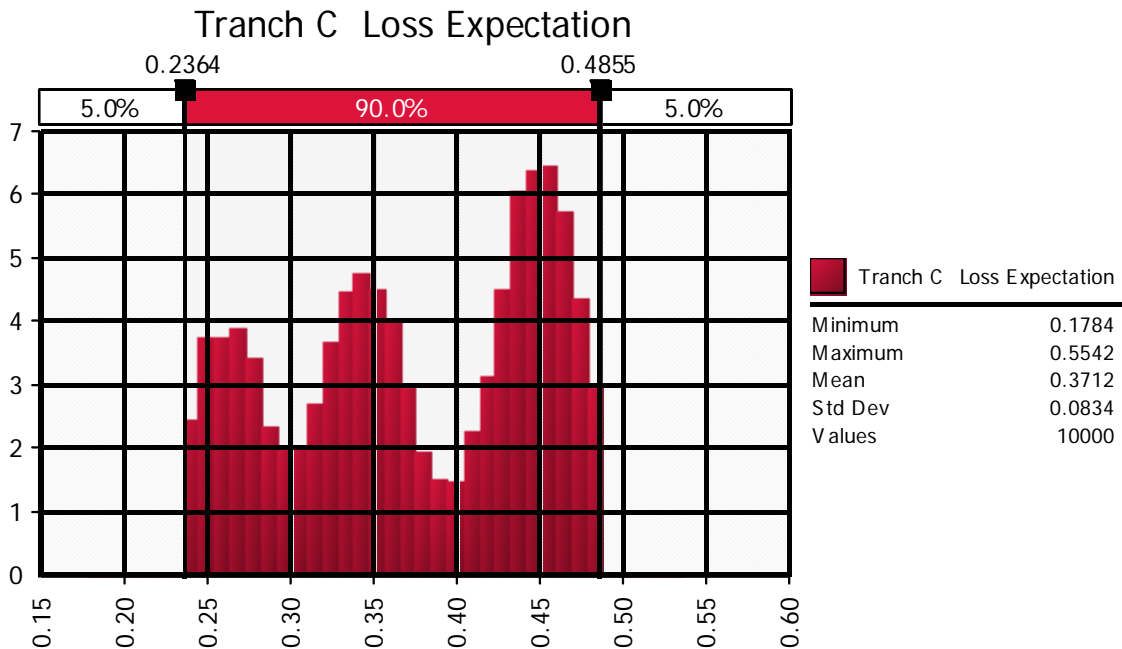
	I	J	K	L	M	N
15		Proceeds From				
16		Liquidation of				
17		Foreclosed				
18		Properties		Total	Financial	As % of
19	Shortfall	\$214,027		Collected	Loss	Expectations
20						
21						
22	0			\$7,000		
23	(\$21,368)	\$21,368		\$42,000		
24				\$49,000		
25	Remaining Proceeds	\$192,659				
26				\$75,652		
27	(\$71,226)	\$71,226		\$140,000		
28				\$215,652	\$78,348	27%
29	Remaining Proceeds	\$121,433				
30				\$398,890		
31	(\$263,536)	\$121,433		\$375,897		
32				\$774,787	\$555,213	42%

A simulation was run using @Risk software with the percentage loss for Tranches A and B being output cells.¹ As shown below, losses for Tranch B security holders vary between 11% and 32% of their investments with a mean of 22%. There are sufficient funds from liquidating foreclosed properties to make Tranch B owners whole on principal repayment – their shortfall is in interest payment expectations. The trimodal appearance of the probability distribution is from the varying duration in the recovery period of the housing depression and its impact on the number of those walking away from their obligations.

¹ Available from Palisades Corporation (www.palisades.com).



As expected, Tranch C investors suffer a more significant loss varying between 18% and 55% with a mean of 37%. Tranch C investors do not receive what they expected in both interest and principal payments.



One might have expected even worse results, but over half of the mortgages are fully paid off as expected. For those in default, there is a substantial recovery (40%-70%) of principal from liquidating the properties.

While this is a hypothetical situation, reality may be far worse. One can see why CMO detractors before the housing crisis claimed that Tranch C securities were “toxic waste” if anything should go wrong with the housing market. Just as no one believed the naysayers of the 1920s, their words turned out to be prophetic.

Why Did the Financial Intermediaries Suffer?

The central question is why so many mortgage brokers and CMO underwriting firms lose billions of dollars in write-offs and/or forever close their doors if they were acting as pure intermediaries. There are two reasons. The first is that as house prices initially stabilized and investor appetite for CMOs waned, the mortgage brokers/underwriters felt that this was only a hiccup in the New Paradigm of forever rising home prices. They continued writing mortgages, but kept them in inventory waiting for the CMO market to reemerge when home prices reassumed their upward trend. When home prices retreated and the CMO market vaporized, the intermediaries were left holding the toxic waste.

The second reason is the Napoleonic complex. Some say that the start of Napoleon’s downfall can be traced to the day when he started to believe his own propaganda of invincibility. Likewise, brokers/underwriters began to believe their own propaganda on the inherent safety of Tranch C and purposely invested funds in Tranch C securities for their high yield to boost corporate income and consequently their bonuses.

There is one solace about this sad situation – we can rest assured that though the circumstances are different, it will be repeated again and then again. The next likely area may be hedge funds whose managers, some of whom have earned over a billion dollars in bonuses, have adopted a New Paradigm of perpetual gains by forever rolling over futures in agricultural, mineral, and energy commodities. Here, too, another day of reckoning is in the works, but with RiskCompound function and @Risk simulations, we will be able to assess the potential damage, which may well dwarf the CMO fiasco.