Subprime Crisis: How Regulatory Inertia and Convenient Myths Defeated Market Discipline

This paper makes the case that the mechanism by which global capital markets became glutted with toxic structured finance debt was a technical flaw in the rating process. If structured debt were re-rated every time performance data is updated, misrepresentations about credit quality could be identified within an actionable time frame for traders, and the market would once again be able to price appropriately for risk.

1. Statement of the Problem

At the time of writing, estimated principal losses on securities from the structured finance market (*structured securities*) are between $1.5 and $3.6 trillion U.S. dollars.[1] From 2002 to 2006, baseline issuance of cash market structured securities was between $1 and $2.75 trillion U.S. dollars—in aggregate, slightly under $9.5 trillion, with over half mortgage-related.[2] Clean numbers like these may incline the reader to consider 15% - 40% as a good estimate of aggregate losses in the market.[3] Stifle that temptation. Since the structured finance market runs by stringent risk measurement rules with apples to apples comparison and averaging is a fool's game, estimates made by casual ratio analysis are not meaningful. Since no one including the U.S. government will buy the universe of distressed securities, the more relevant and interesting question is on the remaining value of individual securities.

It is the opinion of this author that the proper way to revalue structured securities is to apply the same model originally used for the initial valuation estimates, updating it with new performance data. That is because the key to current valuation is to measure *remaining* risk; the cumulative loss to-date is already known. Re-rating is not part of the current market paradigm. In the author's view, the failure to re-rate structured securities is the origin of the market collapse.

2. Definition of Structured Finance

Structured finance has its own terminology (indeed, its own language) that is confusing to many non-practitioners and some practitioners. The absence of formal structured finance pedagogy contributes to the general confusion, and it does not help that the term *structured finance* means one thing to a largely academic readership but another, different thing to the credit markets. Both usages get at the recombinant nature of quantitative finance: the possibility of synthesizing new financial propositions by teasing value benchmarks out of asset prices, put-call parity conditions and geometric series calculations. However, they refer to different financing activities. The academic reference is mainly to synthetic replication techniques used in risk transfer markets. The practitioner reference is to a style of corporate finance for the debt capital markets to create a financial optimum, which may be tax-related but more commonly is funding-related. In the latter case, *structure* refers explicitly to the process of redesigning capital structure to achieve that funding optimum.

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[1] Roubini, Nouriel, **Forbes.com**, ***Dr. Doom: Nationalize Insolvent Banks***, February 12, 2009.

[2] International Monetary Fund, ***Global Financial Stability Report: Market Developments and Issues***, April 2007, p. 62. Figures attributed to Fitch, Standard and Poor's, JP Morgan Chase, Merrill Lynch, European Securitization Forum and Federal Reserve Bank of Australia. Redundancy between CDOs and re-levered MBS securities (RMBS CDOs) would make the MBS percentage even higher. Outstandings of global synthetic corporate and structured exposures rose from under $5 trillion to a little over $25 trillion U.S. dollars in the same period, cumulatively over $50 trillion. (Note that outstandings and issuance are not the same unit of measure.) The latter figures are attributed to the British Bankers' Association 2006 survey of London credit derivative market participants and include swap exposures to corporate names and structured credits.

[3] Since, anecdotally the cumulative losses on the handful of structured deals with fraud in the 1990s were in the low 30 to 40% range, a good *ex ante* estimate of cumulative losses on the cohort of troubled vintages would also be low 30 to 40%.

3. Rules of the Structuring Game

The key insight behind credit market structured finance is that yield realized on a company's core financial receivables should more than cover its cost of capital, otherwise its long-term solvency is in doubt. At the same time, the payment risk on diversified pool of borrowers is theoretically lower than that of a single borrower. Therefore, it may be cheaper for firms (especially growing ones) to raise funds backed by the credit of their business receivables than their own credit, but only if these receivables can first be isolated from the company bankruptcy risk.

If the borrower is a client of a bank, the business receivables are likely to be private contracts that do not trade on a market. Then, the transaction is called *securitization* because the structuring process (detailed in the next paragraph) transforms them into tradable securities. These are called asset-backed (ABS) or mortgage-backed (MBS) securities. If the borrower is a bank and the collateral is an obligation of the banks' clients, the securities are called collateralized debt obligations (CDOs). Note that it is possible to repackage any sort of financial instrument, even non-fixed income products, but the process cannot legitimately be called *securitization* if the underlying collateral is already a security. That is a fine point of terminology; a more substantive point is that when ABS and MBS are created, an on-the-spot revaluation of the assets takes place because there is no arm's-length benchmark of credit quality. On the other hand, CDOs use the rating-implied default percentage as the risk measure. This distinction turns out to be crucial for controlling the amount of leverage in repackaged instruments.

In a typical structured finance funding arbitrage, a corporation exchanges a pre-identified pool of existing receivables (on-balance sheet) for cash. The exchange of cash for value is called a sale or—for this application, a *true sale.* The word *true* distinguishes the exchange from a mere pledge of assets for a secured loan.[4] At the moment the exchange takes place, the receivables are said to "go off" the balance sheet of the corporation, and the ownership is transferred to a special purpose entity (*SPE*) designed to be legally isolated from the seller's bankruptcy. The SPE is now the issuer of record; the lenders (*investors*) now own an undivided interest of the receivables' future cash flows and they will be repaid to the extent cash is available to pay the amounts due. Their rights and protections are detailed in the bond indenture. Even it is not market practice for investors to read the indenture from cover to cover, they are well aware that if the real value of the assets is lower than expected and structural protections turn out to be insufficient to refund the debt in full, they will not have recourse to the corporation for repayment.

When the goal of the transaction is credit arbitrage, more than one class of debt is always issued:[5] risk-averse investors accept a yield below the company cost of capital in exchange for a being higher up in the capital structure (*waterfall*) with (presumably) a prior claim on cash inflows; yield-seeking investors receive a higher rate of return in exchange for being further down in the waterfall where the access to collected cash is less secure. Risk tiering (*tranching*) is a tool for matching the financial profile of the securities to the risk-return appetites of their buyers. The endgame of this structuring exercise is to raise

[4] The distinction between a true sale and a secured loan is vitally important in the United States, where the bankruptcy code empowers the bankruptcy judge to unwind contractual obligations of the bankrupt company. In effect, the bankruptcy judge has *carte blanche* to "do structured finance" so as to revive the company; the senior structured investor who gives the company liquidity and competitive to restructure incrementally by fronting its financial assets with cash does not sign on to the risk of becoming part of the bankruptcy estate. Outside the U.S., where bankruptcy judges honor the prior contractual commitments of bankrupt companies, or where the risk of overlapping claims is addressed explicitly in securitization laws, the true sale concept is less vital.

[5] Cash transactions where only one class of securities is issued are known as participations. The strategy is not credit-arbitrage but risk sharing of a large loan exposure.

the most cash at the lowest funding cost consistent with the quality of the receivables being repackaged. A well-structured transaction draws on all the monetary and informational resources of the deal to align the risk and return relationships appropriately. Then, everyone is a winner.

Before they buy, structured investors rely heavily on *ratings*, standardized measures of credit risk, to determine that the stated returns on the security are commensurate with the default risk they are undertaking. Considerable difference in rating methodology exists not just within different types of structured finance issuer (ABS, CDO, etc.) but also between providers of ratings. Some structured ratings are measures of default probability whereas others are direct price proxies (*reduction of yield* or *expected loss*). Pricing a structured security involves looking up the equilibrium cost of capital corresponding to its rating and average life[6] on the market yield-spread curves, and adjusting based on investor preference and opinion.

All rating approaches have the same deficiency in common: though they allow for *ad hoc* upgrades and downgrades to the original rating, they do not view rating as a function of time. The failure to revisit and revise structured ratings leaves the market without an arm's-length benchmark of value from the time the transaction goes to market until it matures. As a result, with the exception of a few corporate names, secondary market liquidity has been notoriously lacking in the (non-agency) structured finance sector.

It turns out that the failure to refresh the rating in light of data that becomes available after the deal goes to market is an invitation for the financial arranger and the borrower to commit fraud.

4. Market-Wide Myths about SROs

There are three approved providers of ratings under U.S. securities law. Officially, they are called *Nationally Recognized Statistical Rating Organizations* (NRSROs, or more succinctly, SROs) because they use collected historical performance statistics on bonds to validate their systems of credit designation. Although their ratings form the basis for pricing credit-sensitive instruments, SROs are an obscurity in the capital markets. Recently they have come under severe criticism for their role in the market collapse. While the author concurs that SROs bear their share of blame, in my analysis their real source of culpability is their failure to develop a time-sensitive rating—which was mirrored by the market's failure to demand better measures.

To a great extent, the very human desire to find and punish the culprits is a distraction; the most effective way to reinstate market confidence is to seal off the loopholes in the credit supply chain. But first we must get rid of uninformed beliefs, or myths, that are distracting us from achieving a solution. These five myths (four involving SROs) feed on each other:

1. The structured market failed because subprime collateral got into the mix;
2. The structured market failed because rating agencies stopped evaluating the collateral;
3. SROs played a central role in creating and marketing tranches of graded claims;
4. The credit of subordinated debt is always inferior to more highly rated, senior debt; and
5. Structured securities do not need to be re-rated because a well-structured transaction will not experience ratings volatility.

[6] The Average Life (sometimes referred to as the *weighted average life*) is the bullet-repay equivalent maturity of an amortizing pool. Average life (or sometimes mistakenly duration, which resembles the average life calculation substituting time-weighted total cash flows for principal cash flows) is substituted for the maturity in pricing structured bonds. It is calculated as the sum-product of period-weighted principal cash flows normalized by the initial principal balance.

The counter-arguments are as follows:

1. The old *you can't make a silk purse out of a sow's ear* argument does not apply to finance. Prime collateral is not silk and subprime collateral is not flesh. Both are financial claims; their value difference is a matter of degree. Furthermore, one can always fund at least $1 of AAA securities by repackaging a diversified pool of subprime collateral. But, to know how much AAA paper can be issued, it will be necessary to re-underwrite the collateral in the pool and "size" the maximum amount of AAA product consistent with the definition of AAA. That is where the SRO comes in: market institutions don't do this.

2. SROs do not conduct due diligence on the collateral, and they have never made a secret about accepting collateral data at face value from intermediaries without further investigation. That is the job of the seller or its accounting firm or sometimes a special servicer.[7] The reason offered by SROs as to why they never second-guessed the quality of data provided to them was their stated belief in the integrity of the banking system and its processes. This is a *preservation of reputational capital* argument—the same rationale that was (and still is) offered in defense of the SRO business model. Alas, when market participants believe that fraud and misrepresentation will have no adverse consequences, the value of reputational capital is $0.

3. Although SROs are intimately involved with sizing, grading and marketing structured securities, it is the *investor* (unwittingly perhaps) who finally determines the rating of the security by accepting a price or interest rate. That is because price, structure are non-linearly interdependent variables: the size of a tranche determines its rating; the rating determines its cost of capital and hence the weighted average cost of capital in the transaction; the WA cost of capital in turn determines the quantity of residual cash flow (excess spread or XS) available to the support tranches; and XS is another source of credit enhancement that drives the rating. To ignore the nonlinear relationship between structure, rating and price or interest cost, is to build in a loophole in the system for one party, usually the seller, to exploit at the expense of the other, usually the buyer.

4. It is impossible to determine the risk-return characteristics of structured securities *prima facie*; they must be modeled in a statistical, cash flow analytic framework. Historically that job was assigned to the rating agencies in their special role of honest broker, but it is a job that anyone with proper training can perform. Unfortunately, most practitioners in the structured market have never modeled structured deals on the job or in the classroom; without that experience, it is hard to intuit the sensitivity of security value is to the combined effects of default risk and structure: *credit convexity*. Partitioning risk into safe (*Class A*, for simplicity's sake) and risky (*Class B*) classes does not eliminate volatility (true risk). It simply allocates it to the yield-seeking investors. Theirs is not the linear risk-return profile of Class A. In scenarios where the drivers of risk (default, loss-given-default, leverage, high interest rates) are favorable, Class B will outperform Class A in relative value—but not in total return across the sample space. Over some ranges, small changes in values of one or more variables can wipe out the Class B altogether. The next section walks through this analysis.

5. All structured securities experience credit volatility, but for well-structured transactions there is a natural decay (similar to the decay of option value in options) that translates into a hidden credit strength. That is because the volatility of risk is time-dependent. Specifically, it amortizes as the time-to-maturity expires. This phenomenon is shared by all credit instruments but it is particularly

[7] The special servicer is a relatively new market institution whose primary mission is to ensure the integrity and representativeness of collateral data.

meaningful for structured securities because the borrower cannot "change its mind" or implode at maturity. "The borrower" consists of thousands of obligors, each unaware of supplying collateral to particular deals, who either pay as scheduled, prepay or default. Those whose payment deviates from the contractual terms, who are the source of risk, eventually fall out of the pool according to a logistic pattern. That is why, even if macro-economic volatility rises on a diversified pool of homogeneous amortizing receivables, the risk distribution becomes increasingly singular with the passage of time. If all goes well, all securities except the first lost piece will transition smoothly from their original rating up the credit scale and eventually become "AAA." The immanence of credit transitions can be demonstrated also with reference to the illustrations in the next section.

4. Credit Convexity and De-Leveraging Illustrated

To aid in the debunking of myths four and five (that structured risk is intuitively linear and that it is static) I present graphs of rating outputs of a very simple transaction with senior-subordinated (A/B) tranches, analyzed in a cash flow model and the following additional assumptions:

- the loan being securitized is a fixed-rate, level pay instrument
- defaults are 10% cumulatively in a logistical pattern (inflection at month 55)
- recoveries are a constant 50% of defaults
- prepayments are cumulatively 20% in a hockey-stick pattern (inflection at month 45)
- interest rates on A and B are 7% and 9%, respectively
- the B is sequentially, meaning that all principal due is first allocated to the A before it is allocated to the B
- the ratings are determined by measuring the reduction of yield (class interest rate less the yield to maturity) and mapping the amount of the reduction to Moody's "reduction of yield" scale[8]

A sensitivity analysis on credit quality in the A and B tranches is run with defaults rising from 10% to 80% and subordination decreasing from 20% to 1%. Repayment in this scenario is sequential, meaning that the Class A has 100% of principal allocated to it before the Class B is entitled to any return of principal. As mentioned above, the output is the *reduction of yield* on each class expressed in basis points for each scenario,[9] the scenario jointly defined by default rate and subordination level. Since the average reduction of yield serves as a rating-equivalent, I have superimposed the credit grades AAA/Aaa, BBB/Baa and CCC/Caa, to help the reader identify the rating.

[Figure 1 insert]

Inspection of the A tranche output scenarios *via* Figure 1 matches a linear intuition of structured credit quality. Each line represents the –IRR of a default *isocurve* (x-axis) on the sub-domain of subordination (12% - 1%) or, alternatively, leverage (6.5x – 99x). These outcomes form beautiful parallel lines. As you move away from the upper RH corner (low-default scenarios) the security holder's absolute likelihood of loss rises, and as you move from left (less leverage/more subordination) to right (more leverage/less subordination) the security holder's relative likelihood of loss rises, in well-spaced, parallel lines.

[Figure 2 insert]

[8] Note that this is only one of several possible mappings; that each would result in marginally different rating results, but all would have the same basic curvature.

[9] The difference between the coupon and the IRR on the vector of cash out/inflows for a given model run.

The analysis in Figure 1 is offered more from the seller's perspective, who may have a better idea of the collateral risk and creates a structure around that information. Changing the axis in Figure 2, offers more the perspective of a buyer who knows the structure and watches the impact of unfolding collateral quality on his or her slice of risk over time. Here the –IRR of a subordination *isocurve* (domain: 1% - 12%) is mapped to default ranges (10%-80%). The picture is still very linear, but note how A tranches supported by thick B tranches in the upper RH corner enjoy slight positive convexity with respect to a small increases in default rates and highly levered A tranches high have slight negative convexity. "Convexity" here refers to credit convexity, defined above.

By contrast, inspection of the B tranche dynamics leads to a few surprises. Figure 3 for Class B is analogous to Figure 1 for Class A. As mentioned above, the picture of the nonlinear relationship between risk and credit protection in the Class B inevitably astonishes people and still has that effect on me. It reveals the clear separation between securities that will repay in full and those that will default—in other words, the default boundary which, without doing a cash flow analysis and knowing how to scale the results, can only be discovered after it is too late. However, knowledge of structuring and rating permits those possibilities to be mapped out and their *ex ante* probabilities to be assigned.

[Figure 3 insert]

This picture shows how it is possible for sellers to originate securities that they know to be under-collateralized, up to two or three years before the evidence of fraud becomes clear. They are able to exploit the chasm in analytics and financial knowledge through plausible deniability. "How could we know?! Everything seemed fine."

Note that in this graph, the credit enhancement variable is referred to as "leverage" (because the Class B does not have subordination) and leverage does not change by 1% increments. It changes much faster because as the denominator goes down by 1%, the numerator goes up by 1%. To move from the left to the right (X axis, above) is to increase leverage. Risk in structured deals arises because credit enhancement is levered, which is to say, shared by all the classes in claims-paying priority. To move from the right to the left is to de-lever. A reasonably well structured deal, one in which the risk is contained in the envelope of credit enhancement, will naturally move from the right to the left as the senior classes pay off and credit enhancement becomes dedicated to the remaining classes.

[Figure 4 insert]

Figure 4 for the Class B is analogous to Figure 2 for the Class A. By reversing the axes and looking at the problem the other way, leverage can be seen to actually help the Class B because it lowers the total financing cost of the structure. Call this the Alan Greenspan strategy.

Lowering the funding cost frees up additional excess spread (XS) for both classes, but the marginal utility of that incremental XS for the Class B will be much higher than for the Class A, and over some scenarios (up to 33% defaults) the highly levered Class B generates very high returns. But at some point the benefit from high XS and leverage reaches its maximum. After the maximum comes a cliff, beyond which value plummets as the risk continues to rise. That dynamic explains the first "twist" around the 33% default level in Figure 4. The second twist, above the 70% default level, comes about because the Class B receives interest before the Class A receives principal. Because the Class B receives interest ahead of Class A, and because the Class B rate of interest is higher, and because (in this case) sequential repayment of the Class A means that the Class B is not being repaid, so that the absolute amount of yield is higher—because of all these factors, the curves in the picture "twist" again.

The above graphs definitively illustrate the dynamics of *all* structured finance transactions with a pay-through waterfall. All senior securities exhibit similar risk/return dynamics to those shown in Figures 1-2, and all subordinated securities exhibit similar risk/return dynamics to those shown in Figures 3-4. Transactions where the cash is not allocated in a pay-through manner (i.e., those with triggers) will have securities with a target pattern of returns that may deviate from these norms. Such securities will typically siphon cash away from the other tranches in stressed scenarios.

In fraudulently structured transactions - those in which the collateral is known to be worse than stated - the senior securities with high ratings ultimately turn out to be under-collateralized (illustrated in the ranges moving down and to the left on Figures 1-2) while the subordinated tranches, which typically bear low investment grade ratings, will be virtually wiped out with the passage of time. Most likely, they were not structured for immediate sale but rather held in portfolio by the arranging banks for repackaging in future CDOs (collateralized debt obligations), ABCP (asset-backed commercial paper) or SIVs (structured investment vehicles), where the inflated rating could be re-used to prop up the nominal value of the collateral.

These graphs also help to develop an intuition for the dynamic nature of structured credit.

While the cumulative default statistic becomes increasingly certain, the subordination percentages of the junior tranches decrease as the deal pays down. Another way of saying this is that cushion, whether in the form of subordination, overcollateralization, reserve funds or spread differential (XS), becomes less levered across different classes. If the cumulative loss rate lies within the envelope of total credit enhancement, the credit of these tranches will improve. If not, the amount of leverage will increase until there simply is not enough cash to repay subordinated classes, and their losses will be irreversible.

Deleveraging can be visualized in **Figure 4** as skipping from the line representing the original subordination level to left. For example, the line corresponding to 1% subordination would be the most convex line that crosses –IRR=0 at the 31% default mark. All the lines to the left of it are increasingly linear, which means that unexpected changes in the default level will have less of a marginal impact, and the tranche can also bear a greater default percentage. Moving across the lines to the left is thus the natural progression of the deal as it unwinds, although this progression is invisible to the market insofar as ratings are not adjusted to take these natural credit migrations into consideration.

5. Conclusion: Sealing the Gaps in the Supply Chain

From 1976 through 2002, the structured finance market was a phenomenally successful credit market innovation and unrivaled force for the democratization of the credit markets. It enabled anyone with demonstrably good asset quality (and many without it, too) to raise funds. Defaults were de minimus (except in cases of outright fraud) due in large part to the invisible amortization of risk described previously.

Although the cash-oriented structured market did not receive much academic attention in its first twenty-five years, now is a good time to reconsider its significance in purely intellectual terms, which, the author contends, has been overlooked. Effectively, the structured finance market closes the circle on the supply chain of credit threading through the balance sheets of institutions in the credit markets:

(i) A static pool of assets from a seller/originator is re-underwritten and the cumulative loss estimated;
(ii) The assets are repackaged in an SPE and refinanced at their intrinsic value;
(iii) With re-rating, it becomes possible to fine-tune the original estimates of (i);

(iv) Fine-tuning the estimates in (iii) gives the market confidence to develop secondary market liquidity and improves the information content of prices, so that fair value assessments are improved regardless of whether a model or mark-to-market approach is used;
(v) Information obtained from steps (i)-(iv) becomes an input in structuring and pricing the next securitization. This improves the fairness of transaction pricing by realigning the incentives in favor of reliable borrowers.

[Figure 5 insert]

The rise of financial engineering has been moving the financial system towards completeness and closure incrementally, but many loopholes remain. So long as those loopholes are in place, market players will continue to have a strong financial incentive to play against them instead of using real information to value transactions straightforwardly. The biggest loophole is that the rediscounting rate of repackaged assets is only calculated and disseminated into the market once when structured securities go to market. This creates an opportunity for sellers and intermediaries to sell "ticking time bombs" to the investor public: securities that deteriorate some time after the rating. It also creates an incentive for commercially-driven rating agencies to turn a blind eye and offer excuses of plausible deniability.

The big loophole would disappear if structured transactions were re-rated at step (iii) in the cycle above and information on the total transaction experience at step (iv) were made available for consideration in future financings, step (v). This is a relatively simple fix that demands very little drain on social or financial resources and is in the interest of the entire financial community. The alternatives are deeply suboptimal from the twin standpoints of social equity and capital efficiency. Nevertheless, an information solution can only be realized through the willingness of the market to submit to a framework of controls based on superior information quality - a funding meritocracy - to maintain market order until market institutions discover new loopholes and devise new workarounds.

History has repeatedly demonstrated that the driving force for intellectual transformation does not emerge from the inner circle of practitioners and rarely emerges from government. Intellectual leadership is the job and the raison d'être of the academy. Today there is an unrivaled opportunity for universities to lead the market out of the subprime crisis by spearheading an information revolution in the classroom. The obstacle, as Yogi Barra put it, is that *in theory there's no difference between theory and practice, but in practice there is*. To lead change faculties of finance, business and economics first need to become much more familiar with the practice elements of structured finance, of which this paper scarcely scratches the surface.