Nomura Fixed Income Research

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How the Events of 9/11 Affect Thinking about Risk

Updated
28 February 2002

Originally Released
3 January 2002

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In nature there are unexpected storms; in life there are unpredictable vicissitudes.
-Chinese proverb

If anything can go wrong, it will.
-Murphy's Law

I. Introduction

The attack on the World Trade Center on 9/11 has influenced thinking about risk. Particularly in the structured finance arena, the tragedy has served as a reminder of both the power and limits of quantitative risk modeling.

Too often, the quantitative methods used in creating structured finance securities fail to reflect the real world when it matters most, during times of stress. Models and their underlying assumptions drawn from "normal" conditions should not be expected to perform well during unusual and extreme conditions. But, in the structured finance context, the primary purpose for elaborate and sophisticated models is often to predict the performance of securitized assets during unusual and extreme conditions. Ironically, the structured finance community expects the most from its quantitative models when they are inherently at their weakest.

Unusual and extreme conditions are a key focus in structured finance, where a frequent goal is to create securities of extremely low risk. Structured finance professionals try to predict the credit performance of securitized assets under adverse economic conditions, an exercise central to assessing the adequacy of credit enhancements. Structured finance professionals also try to predict the likelihood of extreme interest rate and currency exchange rate fluctuations. Such fluctuations can influence the available cash flow for a securitization. Particularly in the mortgage arena, prepayment risk stems primarily from interest rate movements.

No quantitative models predicted the attack on the World Trade Center or its consequences for structured financings. This is hardly a shortcoming of the models. Rather, it illustrates the need for professionals to fully acknowledge the limitations of their models and to think beyond the pat answers that models supply. Although the attack was unpredictable, it was really just an example of the class of events called "catastrophes." Specific catastrophes are always surprises when they happen. Otherwise, people would take action beforehand to prevent them or to protect against them.

Contacts:

Mark Adelson
(212) 667-2337
madelson@us.nomura.com

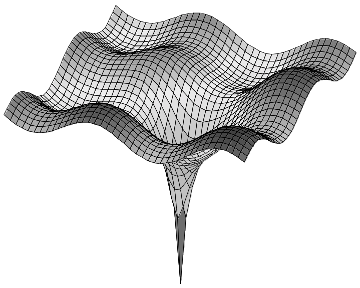
Teresa Cho
(212) 667-2339
tcho@us.nomura.com

Javier Villanueva
(212) 667-9170
jvillanueva@us.nomura.com

Lisle Leonard
(212) 667-9076
lleonard@us.nomura.com

Nomura Securities International, Inc.
Two World Financial Center
Building B
New York, NY 10281-1198
Fax: (212) 667-1046

However, the occurrence of catastrophes is not surprising in the least. Much of history is the study of such events and their consequences.



The lesson is clear: Professionals need to understand the insufficiency of their quantitative models to capture the effect of catastrophes. When models' underlying assumptions break down or cease to have predictive relevance, then the resources of judgment, imagination, experience, and common sense become the primary tools for making real world business decisions.

II. Why Models?

Quantitative models are indispensable tools for structured finance professionals. They help us understand and predict how structured finance transactions should perform, so long as the *status quo* is maintained. In fact, many structured finance professionals use an "expected case"[1] as the point of departure for their analyses. It is also reasonable and practical to use models for predicting how slight variations in the *status quo* (*i.e.,* perturbations as opposed to shocks) would translate into performance variations for structured financings.

Models have appealing features. First and foremost, they make use of highly evolved techniques of data analysis and statistical inference developed by scientists and mathematicians. High school and college statistics classes teach us to use and to rely on basic statistical tools. For example, they teach us that:

- tossing coins is a binomial process
- the normal (Gaussian) distribution is the limiting case of expanding a binomial process
- the sample mean (M) is the best linear unbiased estimator of the population mean (μ)
- the sampling distribution of the sample mean (M) will be approximately normally distributed even if the underlying population is not normally distributed (Central Limit Theorem)
- many natural phenomena *appear to be* approximately normally distributed
- the sample standard deviation[2] (s) reveals and quantifies the reliability of the sample mean (M) as an estimator of the population mean (μ), and it usually provides encouragement for using the sample mean as a measure of central tendency
- for a normally distributed population, the sample variance (s^2) is the best unbiased estimator of the population variance (σ^2)
- sums of normally distributed random variables are also normally distributed
- hypothesis testing and the use of confidence intervals exploit the properties of the normal distribution and distributions derived from the normal

The foregoing points and others are among the tools that we have received by the time we finish our educations in statistics and probability. Because these are among our main tools, we eagerly apply them to the real world task of trying to predict the performance of structured financings.

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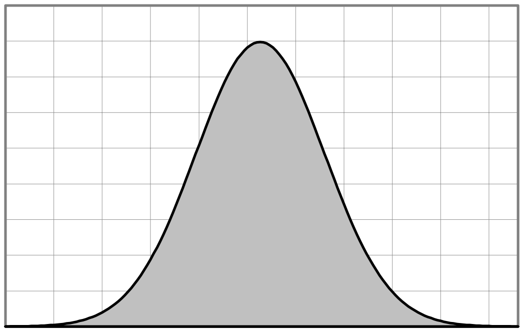
[1] The term "expected case" can mean different things in different contexts. Market participants sometimes use the term "expected case" in referring to a case in which the present status quo is maintained. Other times, they use the term to refer to the single case that they view as most likely (*i.e.*, the case that they expect to occur). Yet other times, the term refers to the mathematical expected case, which is the probability weighted average of all possible outcomes. The mathematical expected case is sometimes interesting because it may not be possible as a real-world outcome. For example, in a mathematical sense, the expected outcome from throwing a fair six-sided die is 3½.

[2] The sample standard deviation determined with the "*n*-1" or "unbiased" method: $s = \sqrt{\frac{\sum_n (x_n - \bar{x})^2}{n-1}}$

III. Learning to Believe in Models: Normal Distributions and Random Variables

By the time we leave the halls of academe, we have received a significant indoctrination on the beauty of the normal distribution and on its desirable properties. The Central Limit Theorem itself arguably encourages us to see the normal distribution in the world around us.[3] So, when we observe a phenomenon that appears to be *approximately* normally distributed, we are prone to conclude that it is strictly normal. In plain terms, if we see a roughly bell-shaped curve, we are prone to think it is a normal distribution. The convenience and accepted methodology associated with the normal distribution call to us like a Siren's song.



$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\left(\frac{(x-\mu)^2}{2\sigma^2}\right)}$$

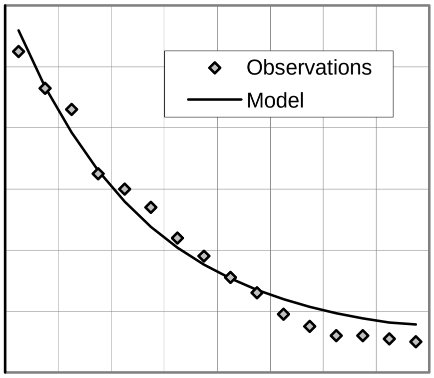
In all fairness to our teachers and professors, they do tell us to be careful. For example, they teach us to use the fat-tailed t-distribution rather than a standard normal distribution when we construct a confidence interval for the sample mean (based on a sample standard deviation). In addition, when they teach us to use the chi-squared (χ^2) statistic to assess the reliability of the sample standard deviation (s) as an estimator population standard deviation, they warn us that the χ^2 statistic may mislead us unless the underlying population is normally (or very nearly normally) distributed.

Beyond conditioning us to be enamored of the normal distribution, our education encourages us to treat any process or phenomenon that we cannot control or precisely predict as a "random variable." In this context, we mean a variable whose values are random but whose statistical distribution exists. That is, even though the future state of the variable cannot be predicted with certainty, it will follow certain rules, which are sufficient to fully describe its behavior over repeated observations. If we are willing to make the leap of ascribing a specific form of distribution to a variable, virtually any phenomenon on which we can collect data becomes grist for the statistics mill. *We sometimes forget that certain phenomena may not follow any set of stable rules in the long-run* (*i.e.,* a non-stationary process).

IV. Models vs. Reality

A model that works most of the time is usually a pretty good model. Newtonian physics is an example. It works most of the time, but not under extreme conditions (*i.e.,* bodies moving at nearly the speed of light). Under extreme conditions, Newtonian physics becomes inadequate and must be replaced by other models. Quantum mechanics and the theory of relativity arose to augment the Newtonian model and to supply a better description of the real world. These models too leave some gaps. Even newer models will need to be developed to describe more precisely the physical world – and it seems likely that such new models will themselves have gaps (as have all physical theories in the past).[4]

Exponential Curve Fit



[3] One suggested explanation of the frequent appearance of the normal distribution is that various phenomena may simply be aggregations (*i.e.,* sums) of large numbers of independent random effects and hence appear to be approximately normally distributed by the Central Limit Theorem. *See* Berrie's Statistics Page, http://huizen.dds.nl/~berrie/index.html and http://huizen.dds.nl/~berrie/clt.html.

[4] "The fuel on which science runs is ignorance. Science is like a hungry furnace that must be fed logs from the forests of ignorance that surround us. In the process, the clearing we call knowledge expands, but the more it expands, the longer its perimeter and the more ignorance comes into view." Matt Ridley, GENOME (2000 Perennial) p.271.

So it is with financial models. They are imperfect approximations of reality. In many such models, professionals choose the normal distribution (or one drawn from the normal distribution, such as the lognormal distribution) to model a real world phenomenon. Even though the chosen distribution may be reasonable in its general shape, it may not fully capture or express the frequency of extreme events in the real world – the tails may be too thick or too thin. One commentator used the term "wildness" to describe the essential attribute of the real world that models often fail to capture:

> Even though many economic and financial variables have approximately normal distributions, the picture is never perfect. Resemblance to truth is not the same thing as truth. Those outliers and imperfections are where the wildness lurks.[5]

Similarly, the choice of variables upon which to base a model is a source of imperfections. We are biased toward variables that reflect easily quantifiable phenomena and on those that can supply seemingly large data samples. We are prone to ignore phenomena that cannot be quantified or, even worse, we try to quantify the unquantifiable. These limitations of the modeling process have long been recognized:

> The real trouble with this world of ours is not that it is an unreasonable world, nor that it is a reasonable one. The commonest kind of trouble is that it is nearly reasonable, but not quite. Life is not an illogicality; yet it is a trap for logicians. It looks just a little more mathematical and regular than it is; its exactitude is obvious, but its inexactitude is hidden; its wildness lies in wait.[6]

V. Examples of Model Weaknesses

The desire to construct technically rigorous models pushes us to use variables for which there are seemingly large data samples. For example, in constructing a quantitative model to describe the credit performance of residential mortgage loans, it is tempting to rely on the abundant and highly detailed data collected by private information vendors. Such data can provide an extremely comprehensive view of how mortgage loans perform during good and mildly recessionary times (such as 1990-91). Simple extrapolation can produce predictions about future performance under similar conditions. On the other hand, such data may not provide an equally reliable view of mortgage performance during more severe recessionary times. Although professionals may desire comparable data compilations covering the recessions of the early1980s, the mid-1970s, and the Great Depression, that desire remains unsatisfied. Therefore, in defining the development sample for a quantitative model, structured finance professionals run the risk of excluding performance under extreme (adverse) conditions. In technical terms, this is using a biased development sample for building a model. Here too, academics have warned practitioners, but the warnings sometimes fall on deaf ears.[7]

The relative infrequency of "catastrophes" creates great challenges for model builders. On a day-to-day basis, we observe phenomena that appear to be bound within certain ranges and relationships that appear stable. Interest rates, exchange rates, and commodity prices are examples of phenomena that generally *appear* range-bound. The relative long-term return on stocks and bonds is an example of a relationship that generally *appears* stable. After enough time, we are prone to

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[5] Peter L. Bernstein, *The New Religion of Risk Management*, HARVARD BUSINESS REVIEW, March-April 1996, p.47.

[6] Peter L. Bernstein, *The New Religion of Risk Management*, HARVARD BUSINESS REVIEW, March-April 1996, p.47 (quoting Gilbert K. Chesterton, ORTHODOXY, chap. 6, available online at: http://www.pagebypagebooks.com/Gilbert_K_Chesterton/Orthodoxy/The_Paradoxes_of_Christianity_p1.html).

[7] Remarks of Prof. Stephen Ross of the Massachusetts Institute of Technology, keynote address at a conference titled *Risk Management: The State of the Art* (13 Jan 2000, at New York University Leonard Stern School of Business). Ross contends that model builders need to look at more scenarios – especially negative ones – than they have been. In addition, in designing scenarios, model builders need to look beyond recent observations and statistics. Ross contends that model builders should consider all the bad things that have ever happened in all different countries over extended periods. *In essence, he encourages looking beyond statistics to economic history.*

conclude that such phenomena and relationships are immutable. Many have made such mistakes in the past…

In the 1970s, the Hunt brothers were caught in a squeeze of rapidly declining silver prices. The volatility of silver price fluctuations was unprecedented and completely beyond the scope of what market participants envisioned as possible.[8] Later, in 1993, Metallgesellschaft AG lost about $1.5 billion when its oil futures hedging strategy failed to work as expected. The company's hedging strategy triggered margin calls and a funding crisis. At the same time, the regular relationship of higher spot prices and lower future prices (backwardation) became inverted (contango), causing the company to lose money every time it had to roll its hedges. Metallgesellschaft's management simply had not envisioned the complex and subtle interplay that led to the financial disaster. Later still, in the late 1990s, Long Term Capital Management lost roughly $4 billion when its quantitative strategy failed. Wrong assumptions about the availability of liquidity are often blamed for the collapse of LTCM.[9]

Other examples hit closer to home in the structured finance arena. During the mid-1990s home equity and manufactured housing lenders embraced gain-on-sale accounting as a way to boost reported earnings per share. In recording gain upon the securitization of home equity loans or manufactured housing loans, lenders had to project prepayments. Those projections were drawn from prepayment models based on observations from the preceding few years. At the same time, the lending environment was experiencing secular change. Lenders were competing more aggressively and were becoming more assertive in soliciting borrowers to refinance their loans. Existing prepayment models failed to incorporate variables reflecting the heightened competition and the intensified solicitation. Accordingly, they systematically underestimated the prepayments that actually occurred. The recorded gains turned out to be illusory. The consequences were severe: many home equity and manufactured housing lenders went bust or ceased operations.

More recently, prepayment models for conforming mortgage loans generally under-predicted the refinancing activity that has just occurred. Unprecedented declines in interest rates over the past year simply went past the outer limits of the development sample for such models. Moreover over the past few years, the primary mortgage market has undergone changes that could not have been predicted by any model. The role of mortgage brokers has grown significantly and the market has become increasingly driven by lenders rather than borrowers. At the same time, the Internet has promoted faster refinancing activity by improving borrowers' access to information. Collectively,

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[8] *See, e.g.,* http://www.coin-shop.com/gold23.htm.

[9] A good account of the LTCM story appears at http://www.pbs.org/wgbh/nova/stockmarket/. That web site is designed to augment a PBS documentary on the LTCM story titled "The Trillion Dollar Bet," which originally aired on 8 February 2000. Interestingly, LTCM's trading and hedging strategy was based substantially on the Black-Scholes option pricing model. One of the key underlying assumptions of that model are that stock returns are lognormally distributed. Note the prominence of σ in terms d_1 and d_2 of the central equation of the model:

$$C = S\,\mathrm{N}(d_1) - K\mathrm{e}^{(-rt)}\,\mathrm{N}(d_2)$$

where:

C = theoretical call premium
N = cumulative standard normal distribution
r = risk-free interest rate
e = base of natural logarithm
σ = standard deviation of stock returns
S = current stock price
K = option strike price
t = time until option expiration
ln = natural logarithm

$$d_1 = \frac{\ln(S/K) + \left(r + \frac{\sigma^2}{2}\right)t}{\sigma\sqrt{t}} \qquad d_2 = d_1 - \sigma\sqrt{t}$$

The term $\mathrm{N}(d_1)$ is the delta or hedge ratio for an option. It reflects the approximate change in the price of a call option for a $1 change in the price of the underlying stock. Query whether the Black-Scholes model has been generally so successful "because of" or "in spite of" its underlying assumptions.

these factors significantly limited the reliability and predictive power of prepayment models. However, even before the drop in interest rates, prepayment models for conforming mortgage loans were far from perfect. Consider the fact that each major investment bank has its own prepayment model and that those models produce a very wide range of predictions.[10] This is evidence that the prepayment process does not lend itself fully to modeling. The process changes as the efficiency of refinancing improves. In technical terms, the prepayment phenomenon is a non-stationary process.[11]

The fluctuation of interest rates is another example of a phenomenon that challenges modeling. Certain applications that require simulated interest rate paths use a "random walk with mean reversion"-type of process – a mechanical process that treats interest rate fluctuations as random variables whose distributions can be described. At first blush, this seems reasonable. However, with further consideration, a potential flaw becomes apparent: in treating interest rates as a "random variables" for modeling purposes, we implicitly assume that its future states will be ruled by the laws of probability, just like roulette or a game of dice. This assumption might be wrong, especially in the case of short-term interest rates. Rather than obeying the laws of probability, short-term interest rates seem to be governed by the actions of Chairman Greenspan and his colleagues at the Federal Reserve.[12]

The fact that short-term interest rates are not ruled by the laws of probability hardly means that we cannot or should not treat their fluctuations as random variables for modeling purposes. Rather, it means that we must remain mindful of having used an unrealistic assumption in the modeling process.

Back to the structured finance arena for a few more examples: generic credit scores based on data compiled by the national credit bureaus are often called FICO scores. The acronym FICO is derived from the name "Fair Isaac & Co.," which produces the statistical models that generate the credit scores. Many lenders use FICO scores as part of their lending processes and some incorporate FICO scores as part of their own proprietary scoring models. FICO scores are designed to express the likelihood that a consumer borrower will default. FICO scores have worked best in mainstream product areas and with borrower populations that mirror the population at large. When conditions are otherwise, lenders have experienced disappointment from their use of FICO scores. For example, in the high-LTV (125%) mortgage lending area, the actual frequency of defaults on loans originated in 1997 and 1998 was substantially higher than would have been implied by the borrowers' high FICO scores. *The scoring models did not capture the impact of the borrowers' strong appetite for leverage. The models could not capture that effect because credit bureau databases do not contain data on leverage.*[13] Thus, the scoring models were missing a key factor. One market observer has cleverly described a similar type of situation as follows:

> The information you have is not the information you want.
> The information you want is not the information you need.
> The information you need is not the information you can obtain.
> The information you can obtain costs more than you want to pay.[14]

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[10] On a Bloomberg try the following for virtually any MBS: ticker <Mtge> VALL <Go>

[11] Similarly, we can characterize the prepayment process as having a distribution that cannot be fully observed or described.

[12] In addition, although we have not experienced hyperinflation in the U.S., a number of other nations did during the past century. Query whether the experience of those nations should influence the degree to which an interest rate model uses mean reversion mechanism.

[13] Credit bureau databases have highly detailed information on a consumer's liabilities but little or no information about his assets. Accordingly, it is not possible to calculate the consumer's leverage from the available data.

[14] Peter L. Bernstein, AGAINST THE GODS (1996 John Wiley & Sons), p. 202.

VI. The Opposing Point of View

The appeal of quantification – the comfort of certainty and exactitude – has drawn some market players to conclude that quantitative models are the ***essence*** of securitization. For example, one market participant has stated:

> A better definition of securitization is that it consists of the use of superior knowledge about the expected financial behavior of particular assets, as opposed to knowledge about the expected financial behavior of the originator of the chosen assets, with the help of structure to more efficiently finance the assets. This definition is superior because it better explains the need for the most essential aspects of any securitization any where in the world under any legal system, and it better defines the place of securitization within several of the broader financial trends that have occurred at the end of our century.
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> * * *
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> Securitization, in the correct circumstances, is one of the very most efficient forms of financing. This is because of two additional trends. The first is the increasing importance of the use of information to create wealth. The second is the increasing sophistication of computers and their uses. Securitization is made possible by the combination of these two trends. Computers enable one to store and retrieve extensive data about the historical behavior of pools of assets. *This historical data in turn enables one to predict, under the right circumstances, the behavior of pools of such assets subsequently originated by the applicable originator. Because our knowledge about such behavior may be so precise and reliable, when structured correctly, a securitization may entail less risk than a financing of the entity that originated the securitized assets.* Again in Lord Kelvin's terms, our knowledge about the likely behavior of pools of assets is "measurable" and we "express it in numbers." It is a superior sort of knowledge from the perspective of the world of finance. Accordingly, such a securitization may be fairly labeled to be more efficient and indeed may require less over-all capital than competing forms of financing.[15]

The foregoing material eloquently expresses the opinion that computers and models permit structured finance professionals to predict asset performance with great reliability and precision. It is not an inherently irrational viewpoint, but it is wrong because it ascribes unrealistic capabilities to models and computers. That fact that quantitative models may be even worse at predicting the performance of corporations and corporate securities is a faulty basis upon which to conclude that models are reliable – in absolute terms – in the securitization arena.[16]

There is no disputing that quantitative models are essential tools for securitization professionals. The models are an indispensable part of the securitization process. Nevertheless, the material quoted above goes too far. No matter how well we study the historical performance of various asset classes we will never escape the limitations – including limited precision and the inherent backward-looking nature – of the modeling process. Other writers have captured the more realistic view with equal eloquence:

> Clearly, we cannot put future data into the computer, because we do not know the future data. Instead, we program past data - the only available fuel for our models. Therein lies the logician's trap: Past data from real life are untrustworthy because they compose a sequence rather than the set of independent observations that the laws of probability demand. As Paul Samuelson has pointed out, history provides us with only one sample of the economy and the capital markets, not with thousands of separate autonomous, and stochastic numbers. Even

[15] Jason Kravitt, *Introduction to Securitization* (1998) (emphasis added), available online at www.securitization.net. The cited work begins with an interesting quotation: "When you measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meager and unsatisfactory kind…" William Thomson, Lord Kelvin, Popular Lectures and Addresses (1891-1894).

[16] In some settings, the ***relative*** performance may be much more important than its absolute performance. For example, a portfolio manager might measure his investment performance relative to an index, without regard to absolute returns. On the other hand, different settings require a focus on ***absolute*** performance as well. An investment strategist or a corporate CFO might focus on absolute performance in deciding how to allocate assets between cash and other holdings. In the structured finance setting, models that address the credit performance of securitized assets must be reliable in absolute terms because they are the basis for setting credit enhancement levels. Whether such a model is relatively more or less reliable than a corporate earnings model will not determine its success as an analytic tool for securitization. The tool must be reliable in absolute terms or it will mis-size credit enhancement levels for deals.

> though many economic and financial variables have approximately normal distributions, the picture is never perfect. Resemblance to truth is not the same thing as truth. Those outliers and imperfections are where the wildness lurks.
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> * * *
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> It is hubris to believe that we can put reliable and stable numbers on the impact of a politician's power or the probability of a takeover boom… It is equally silly to limit our deliberations only to those variables that do lend themselves to quantification, excluding all serious consideration of the unquantifiable. It is irrational to confuse probability with timing and to assume that an event with low probability is therefore not imminent. Such confusion is by no means unusual. And it surely is naïve to define discontinuity as anomaly instead of as normality; only the shape and timing of the disturbances are hidden from us, not their inevitability.[17]

Look at it another way. The following table contains quantitative data about the attack on the World Trade Center:[18]

Total Energy Released in Attack on World Trade Center	
Total energy released	Equivalent to nearly 1,700 tons TNT
Energy Released from Collapse of the Towers	
Average height of the towers	1,365 feet
Total weight	1.25 million tons
Collapse energy	2×10^{12} joules
Equivalence to TNT	500 tons
Energy Released from Jet Fuel	
Energy in one gallon of jet fuel	135,000 btu
Maximum fuel capacity of a Boeing 767	23,980 gallons
Approximate fuel detonated at impact	3,000 gallons
Explosive energy, both planes	9×10^{11} joules
Equivalence to TNT	180 tons
Burning energy from remaining jet fuel	5×10^{12} joules
Equivalence to TNT	990 tons
Kinetic Energy of the Airplanes	
Maximum takeoff weight of a Boeing 767	442,000 pounds
Typical cruising speed	530 mph
Kinetic energy of both planes	9×10^{9} joules
Equivalence to TNT	2 tons
Examples of Energy Released in Other Events	
Tomahawk cruise missile	0.5 tons TNT
U.S. tactical nuclear warhead	300 to 200,000 tons TNT
Typical tornado	5,100 tons TNT
Hiroshima bomb	20,000 tons TNT

Even with the table and its numbers, our knowledge of the attack remains "of a meager and unsatisfactory kind."[19] The numbers are irrelevant to understanding the magnitude of the tragedy. Moreover, they do not help us to understand how frequently such tragedies will occur or how we can protect against them.

[17] Peter L. Bernstein, *The New Religion of Risk Management*, HARVARD BUSINESS REVIEW, March-April 1996, p.47.

[18] David Appell, *Recipe for the Unspeakable*, SCIENTIFIC AMERICAN (Nov. 2001) p.15.

[19] See footnote 15.

VII. Overcompensating – Chicken Little Was an Idiot

Chicken Little misconstrued normal events to be the end of the world. He overreacted. Following the attack on the World Trade Center, and the subsequent reports of deteriorating economic conditions, some market participants overreacted. Notwithstanding the huge magnitude of the tragedy in human terms, some market participants behaved as though they expected general *financial and economic* collapse. They had become so used to good times, that even slightly bad *economic* times appeared terrible to them.

What we have experienced since 9/11 has been rather mild compared to what investment graded tranches of most structured financings are able to withstand. It would take a rather severe and prolonged downturn before investment-grade classes of most securitizations would really face a material risk of default.

An unemployment rate in the 5% ballpark is hardly the end of the world. Double-digit unemployment is a much rougher prospect. A recession that lasts fewer than six calendar quarters is not especially troubling. One that lasts more than a dozen consecutive quarters would create *much* greater difficulties. Right now, the strong consensus is that the economy will recover in 2002 or 2003. Nobody expects that recession will persist until 2004 or 2005. The bottom line: a one or two year recession with mid-single-digit unemployment rates should not pose a significant threat to investment-grade tranches of securitizations.

VIII. Conclusion

Most of the time, the prospect of truly bad times seems remote. This is natural and appropriate. Truly bad times are indeed rare. But they are also unpredictable, and they seem to appear all throughout human history. We can count ourselves truly lucky if we can live out our lives without experiencing tough times like our parents, grandparents, and great-grandparents sometimes did.

Our mathematical models generally will fail to capture the impact of rare and severe situations like the attack on the World Trade Center. Their rareness makes them outliers and their severity encourages us to discard them as aberrations. In building models, we allow ourselves to use biased samples that overweight good times. We artificially simplify non-stationary processes. We choose distribution forms that are convenient, even if their tails are too thin. If we find it too difficult to quantify a seemingly relevant factor, we are prone to simply ignore it. *Political and social factors rarely appear as variables.* And yet, all this is acceptable, provided that we appreciate our models' limitations. We must not ask our models to carry more than they can bear.[20] Certainly, after 9/11, we have to have heightened sensitivity to such issues.

There are concrete implications for different classes of market participants. For a portfolio manger, there is opportunity to exploit the known design features of certain widely-accepted models. In the residential MBS area, for example, S&P's credit enhancement model does not differentiate the credit enhancement needs of mortgage pools based on the identities of the issuers. Such an "equal" treatment of issuers ignores the differences in historical performance that issuers have achieved. Thus, a portfolio manager can "beat" the S&P credit enhancement model by considering factors that the model ignores.[21]

Quantitative models have a long track record of *underestimating* risk. This suggests that certain securities, which bear disproportionate credit or prepayment risk, will be more often rich than cheap.

[20] An alternative approach is to try to make a better model by including more adverse scenarios in the development sample. This amounts to using distributions with fatter tails. See footnote 7.

[21] *Jumbo MBS Credit Enhancement: More of the Same, or Less?*, Nomura Fixed Income Research (5 Dec 2001)

In other words, if the market relies heavily on a model for pricing a prepayment or credit risk, the "up in quality" trade will be the better strategy most of the time.

OAS models are very sensitive to their assumptions. They are more reliable as tools for gauging relative value among similar securities than they are as tools for gauging relative value among dissimilar securities. Professionals can make the most of their OAS models by remaining focused on when the models perform at their best, for relative value analyses of similar securities.

In ABS backed by new asset classes, there is opportunity to differentiate between situations where a modeling process has driven credit enhancement levels and those where it has not. When a modeling process has been the driving force, greater caution is warranted. The danger will be in underlying assumptions. Even when all the underlying assumptions are reasonable, equally reasonable alternative assumptions could produce drastically different answers in some models. Conversely, there will be less risk – and potential opportunities – in lower-rated tranches or in riskier asset classes when a quantitative model is used but is not necessarily the centerpiece of an analysis.

Switching viewpoint from that of a portfolio manager to that of an investment strategist, risk manager, or CFO changes things considerably. Most broadly, the modeling bias to underestimate risk argues toward limiting exposure to certain product areas (*i.e.*, those most exposed to model risk). It also argues for imposing more intensive controls and oversight in those areas. However, this does not mean that investors should shy away from new asset classes or exotic ABS. Rather, it means that investment strategists, risk managers, and CFOs should consider exotic ABS and deals backed by new assets on a case-by-case basis with particular attention to *how* risks have been analyzed.

A model cannot justify poor business results any more than it can deserve credit for success. Responsibility for making business decisions rests on professionals, not models. Professionals will do their jobs better if they augment their models with the equally powerful tools of judgment, imagination, experience, and common sense.

Recent Nomura Securitization Research

Downgrades of Heilig-Meyers Credit Card Deals Reveal New Extent of ABS Ratings Volatility (1 March 2001)

The LTV Bankruptcy Case and Its Threat to Securitization – Is it Over or Just Beginning? (7 March 2001)

Alt-A MBS Face Changing Times (30 April 2001)

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NEW YORK

Nomura Securities International
2 World Financial Center, Building B
New York, NY 10281
(212) 667-9300

TOKYO

Nomura Securities Company
2-2-2, Otemachi, Chiyoda-Ku
Tokyo, Japan 100-8130
81 3 3211 1811

LONDON

Nomura International PLC
Nomura House
1 St Martin's-le-grand
London EC1A 4NP
44 207 521 2000

Nomura Fixed Income Research

New York

David P. Jacob	(212) 667 2255
Joshua Phillips	(212) 667 2042
Arthur Q. Frank	(212) 667 1477
Javier Villanueva	(212) 667 9107
Lisle Leonard	(212) 667 9076
James Manzi	(212) 667 2231
Teresa Cho	(212) 667 2339
Mark Adelson	(212) 667 2337

Tokyo

Nobuyuki Tsutsumi 81 3 3211 1811

London

John Higgins 44 207 521 2534