Nomura Fixed Income Research

Tranching Credit Risk

Examples with CDOs and the iTraxx℠ Index

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I. Introduction

This report explores the risk and return profiles of tranched credit exposures. The report examines how different tranches in a deal display varying sensitivities to simulation parameters such as default probabilities and correlation. In addition, our analysis shows that tranching allocates risk among tranches in a disproportionate manner. In the market, pricing is often based on a tranche's "expected" level of losses, ignoring the dispersion of losses. We believe that investors can benefit substantially by examining whole distributions instead of relying just on "point estimates" of losses. By doing so, investors can understand the whole risk profile of specific tranches.

Tranching of credit risk is a conspicuous feature of many securitizations and credit derivatives. "Credit tranching" refers to creating a multi-layered capital structure that includes senior and subordinated tranches (classes). For example, a securitization of commercial mortgage loans might create 10 different tranches, each carrying successively lower ratings and supporting the tranches senior to it.

Different tranches within a deal's capital structure present different degrees of risk and have differing performance characteristics. When the deal's underlying assets consist of credit exposures for which default probabilities, recovery rates, and correlations can be reasonably estimated, simulation techniques offer a convenient approach for pricing different tranches and analyzing their risk-return characteristics.

The general approach for pricing tranched credit risk applies in a wide variety of settings. It applies to regular collateralized debt obligations (CDOs), synthetic CDOs, single-tranche synthetic CDOs, and to tranche trading in credit default swaps (CDS). In particular, it applies to tranche trading in the CDS indices such as the Dow Jones CDX℠ and iTraxx℠ index tranches. For illustrative purposes, our examples use hypothetical tranched credit exposures based on the DJ iTraxx Europe℠ index.

Contacts:
Michiko Whetten
(212) 667-2338
mwhetten@us.nomura.com

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

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

II. What Determines the Risk of a CDO tranche?

Several key factors determine the risk of a CDO tranche. Those factors include (1) the risk and size of the underlying portfolio, (2) the size of the tranche, (3) protection to the tranche from subordination of other tranches, and (4) the tranche's maturity. The rating agencies often use those factors in assessing the risk of a particular tranche in a CDO. Subordination and sizing of a deal's tranches determine how the risk of the underlying portfolio is apportioned among the tranches.

In the past, some market participants used a simplified approach for analyzing CDO tranches. They analyzed a CDO tranche primarily by comparing the level of expected losses on the assets of the underlying portfolio to the tranche’s subordination level. For example, if a tranche had protection from subordination equal to three times the historical loss rate on the underlying assets, the tranche would be considered "very safe." More recently, however, the concept of correlation has received increasing attention because it affects different tranches backed by the same underlying pool differently. In addition, other factors such as credit spreads and recovery rates have come into the spotlight as factors that affect the risk of credit portfolios.

Today, simulation techniques for analyzing tranched credit risk are replacing the older approaches. The unexpectedly weak credit performance of many CDOs during 2001 and 2002 somewhat discredited the older approaches. The simulation approaches offer a more rigorous analysis of certain risk factors and help to clarify how different risk factors affect different tranches. In the following section, we illustrate how certain risk factors affect individual tranches of a tranched credit portfolio.

III. Analyzing the Risk-Return Profile of a CDO Tranche

For illustrative purposes, we analyze the risk-return profile of a single-tranche synthetic CDO based on standardized tranches of the Dow Jones iTraxx^{SM} Europe index. However, the analysis in this section also can be applied to tranches of any synthetic CDO or to tranche trading based on any other credit derivative index, such as the Dow Jones CDX^{SM}.[1] The main point of our analysis is to illustrate how the risk-return profile of different tranches can differ from the risk-return profile of their underlying reference pool.

In order to analyze the distributions of losses to the underlying portfolio and individual tranches, we conduct Monte Carlo simulations. In modeling correlated (*i.e.* not independent) defaults, we use the one-factor Gaussian copula model with a uniform correlation.[2]

The DJ iTraxx Europe index consists of 125 equally weighted investment-grade European corporate names that are actively traded in the CDS market. The average credit rating of the reference entities included in the iTraxx index is between triple-B and triple-B-plus.

The standard tranches on the iTraxx index have attachment and detachment points of 0%-3%, 3%-6%, 6%-9%, 9%-12%, and 12%-22%, respectively. Each standard tranche except the most senior tranche represents a 3% exposure to the index portfolio, but has a different level of implied subordination protecting it. For example, an investor in the 3%-6% tranche is exposed to the risk that losses on the underlying portfolio exceed 3%. If losses reach 6%, the tranche would be wiped out. Between 3% and 6%, each dollar of losses on the underlying portfolio translates into a dollar of losses for the investor.

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[1] For a comparison, n^{th}-to-default baskets have a slightly different structure, where a specific basket is wiped out when one default, not a certain amount of loss, occurs. However, the main findings of our analysis are also applicable to n^{th}-to-default baskets, where the first-to-default (FTD) basket is the first loss (equity) tranche and a higher number-to-default basket can be viewed as a senior tranche.

[2] For detailed illustration of the simulation technique using the one-factor Gaussian copula model, see *Correlation Primer*, Nomura Fixed Income Research (6 August 2004).

A. Model Assumptions

Because iTraxx index assigns equal weight to all 125 of its components, we ascribe a one-dollar notional amount to each of the 125 reference entities. In order to conduct simulation, we need to specify the following characteristics of the underlying portfolio and individual tranches:

- the term of the simulation,
- default probabilities of the individual reference entities over the term of the simulation,
- discount factors,
- recovery rates, and
- default correlation among individual credits.

We select a five-year term for our simulation and we use DJ iTraxx Europe Series 1, which matures in September 2009, as our specific reference portfolio. The portfolio comprises 18 double-A credits, 50 single-A credits, and 57 triple-B credits.[3] We assign a 5-year historical default rate to each reference entity based on its whole letter rating. We use the historical average recovery rate compiled by Moody's. We also assume just one correlation number that characterizes the degree that defaults tend to occur together. Table 1 shows the details of our model parameters.

Table 1: Model Assumptions (One-factor Gaussian copula)	
Reference portfolio	DJ iTraxx Europe Series 1
Number of reference entities	125
Average credit ratings	BBB+/BBB
Tranche size/subordination	0%-3%, 3%-6%, 6%-9%, 9%-12%
5-year default probability	Moody's long-term default rates (1970-2003)
double-A (Aa)	0.24%
single-A (A)	0.54%
triple-B (Baa)	2.16%
Recovery rate	40%
Correlation	20% uniform correlation (We also analyze 0% and 40%.)
Portfolio notional amount	$125
Notional amount of each credit	$1
Maturity of the portfolio	5 years
Discount Rate	0%

[3] The ratings were as of June 2004. See *Fitch Credit Default Swap Index Analytics*, available on www.fitchratings.com.

MODEL INGREDIENTS

Default probability: We use the historical default rates compiled by Moody's for default probabilities of reference entities. Moody's proprietary database covers over 16,000 corporate issuers of long-term public debt globally since 1919. We assume the 5-year cumulative default probability for each rating (Aa, A, and Baa) based on Moody's long-term global cumulative issuer-weighted default rates for 1970-2003.[4] A more conservative approach would be using the higher default probabilities measured in the period 1994-2003.[5]

Another way to assess default probabilities is to use "implied" default risk from single-name CDS spreads. In general, the default probability implied from CDS spreads is significantly higher than the level suggested by the historical default data compiled by the rating agencies.

Recovery rate: Once default occurs, the amount recovered on distressed debt affects the amount of losses suffered by an investor. For an assumed recovery rate, we use Moody's historical average recovery rate of 40% for 1982-2003. Recovery rates vary depending on credit quality of a bond, as well as geographic region and industry. For investment-grade senior unsecured bonds, the historical average recovery rate is 41.3%, while the figure for speculative-grade bonds is 39.2%.[6]

Default correlation: The historical levels of default correlation are difficult to measure, because bond defaults are relatively rare events. The rating agencies generally view industry classification and geographic proximity as factors that affect the degree of default correlation among reference entities. In principle, a simulation could specify a unique correlation parameter for each pair of reference entities. However, doing so becomes a daunting task when a portfolio contains a large number of credits. (*e.g.*, a 100-name portfolio would require 100 x 99 ÷ 2 = 4950 correlation numbers!) A simpler approach is to assume a uniform degree of correlation among each pair of reference entities in a portfolio. The one-factor Gaussian Copula uses such an approach. In the market, the iTraxx and CDX index tranches are quoted with "implied correlations" derived from such a model. The market implied correlation in CDS indices ranges from less than 10% to more than 30%. In modeling CDOs, S&P uses a flat correlation of 30% for corporate entities in the same industry and zero correlation between entities in different industries. In the following section, we present the main analysis using a 20% correlation, but also provide a sensitivity analysis using alternative correlation levels of 0% and 40%.

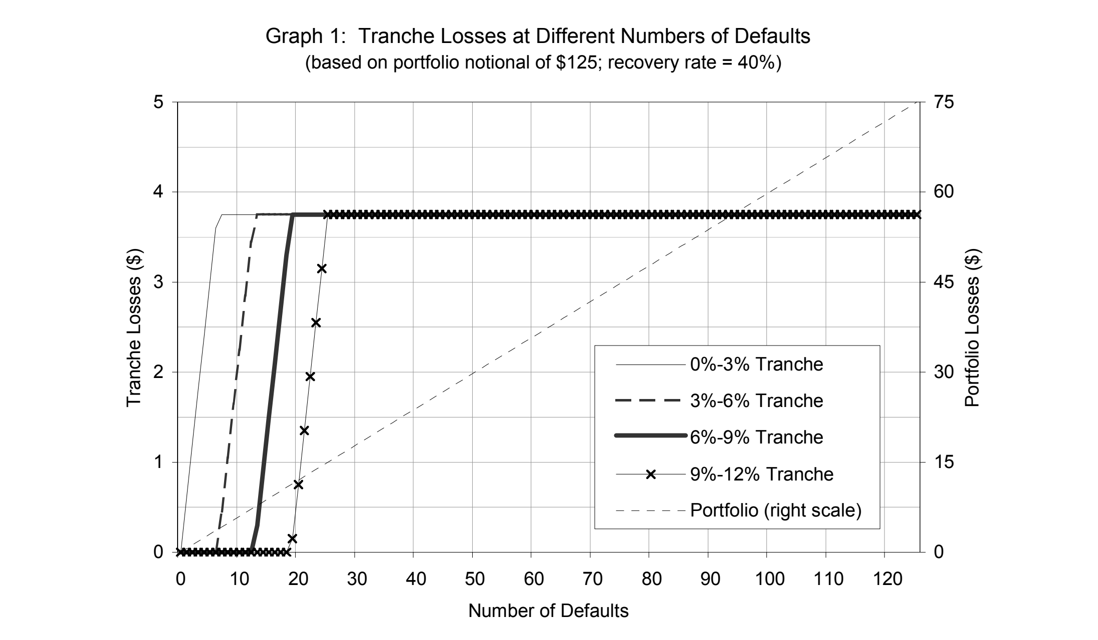
B. Number of Defaults and Portfolio/Tranche Losses

Based on the assumed recovery rate of 40%, each default in the portfolio would result in a loss of $0.60. In the portfolio of $125, the maximum loss to the portfolio would be $ 75 (= 125 x $1 x (1-.40)) if all 125 credits defaulted. Each of the tranches under consideration is sized at 3% of the portfolio amount, corresponding to a notional size of $3.75. Each tranche starts to suffer losses after the total portfolio loss reaches the tranche's attachment point (*e.g.* 3% for the 3%-6% tranche). After the portfolio loss exceeds the tranche's detachment point (*e.g.* 6%), that tranche is wiped out, and the next junior tranche starts to receive losses. For each tranche, the maximum loss possible is equal to the tranche notional, or $3.75. (See Graph 1)

[4] Hamilton, D., et al., *Default & Recovery Rates of Corporate Bond Issuers (1920-2003)*, Moody's special comment, January 2004, p.25.

[5] The long-term average 5-year default rates (1970-2003) for Aa, A, and Baa ratings are 0.24%, 0.54%, and 2.16%, respectively. On the other hand, last decade (1994-2003) has seen higher default rates for A and Baa ratings. The 5-year default rates for 1994-2003 for Aa, A, and Baa ratings are 0.00%, 2.75%, and 5.86%.

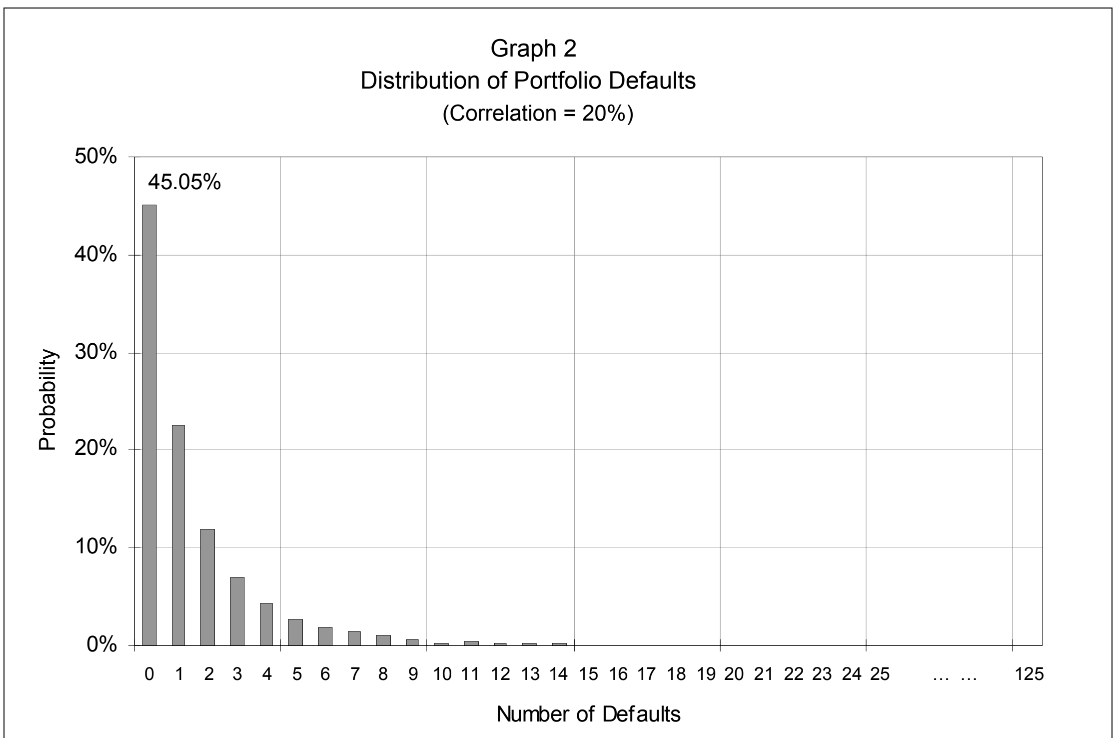
[6] Hamilton, D., et al., *Default & Recovery Rates of Corporate Bond Issuers (1920-2003)*, Moody's special comment, January 2004, p.15.



Source: Nomura

Because each default causes losses of 60¢ to the portfolio, the relationship of portfolio losses to the number of defaults is linear with a slope determined by the recovery rate. On the other hand, for individual tranches, the relationship of losses to the number of defaults is an "S"-shaped curve defined by the attachment point, where the loss line kinks upward, and the detachment point, where the loss line turns flat.

Graph 2 below shows the distribution of simulated defaults for the hypothetical portfolio, assuming a 20% correlation. The distribution is skewed to the right, with a peak at zero defaults. Based on simulation with 10,000 iterations, the likelihood of zero defaults is about 45%.



Source: Nomura

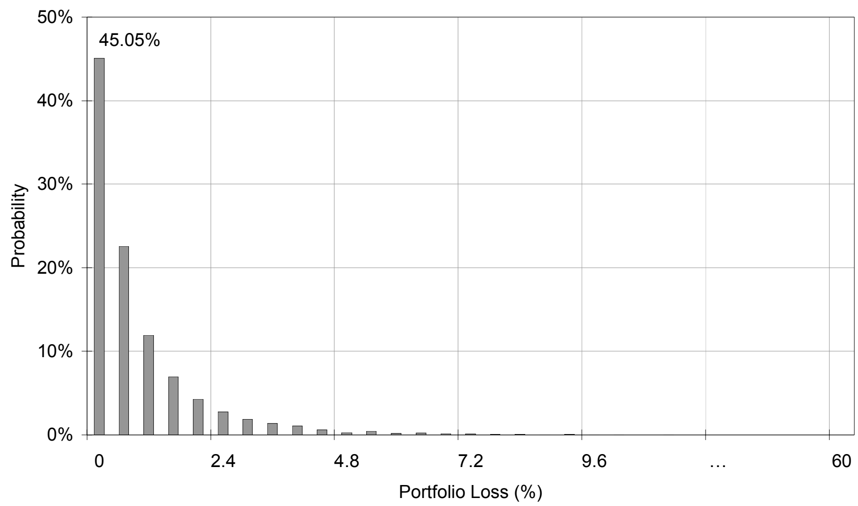
C. Risk Profiles of Portfolio vs. Individual Tranches

In this section, we analyze the loss distribution of the portfolio and individual tranches. We calculate a percentage loss by dividing the dollar loss amount over five years by the notional amount of the portfolio or a tranche.

1. Portfolio Losses

Because each default increases the loss amount to the whole portfolio by 60¢, the distribution of portfolio loss, shown in Graph 3, is very similar to distribution of the number of defaults, shown in Graph 2. Based on simulation, the portfolio's mean loss is $0.92 on the $125 notional. The portfolio's break-even spread is about 15 bps per annum.[7] Graph 2 and Graph 3 show that the portfolio has a 45.05% probability of experiencing zero loss.

Graph 3
Distribution of Portfolio Losses
(Correlation = 20%; Recovery rate = 40%)



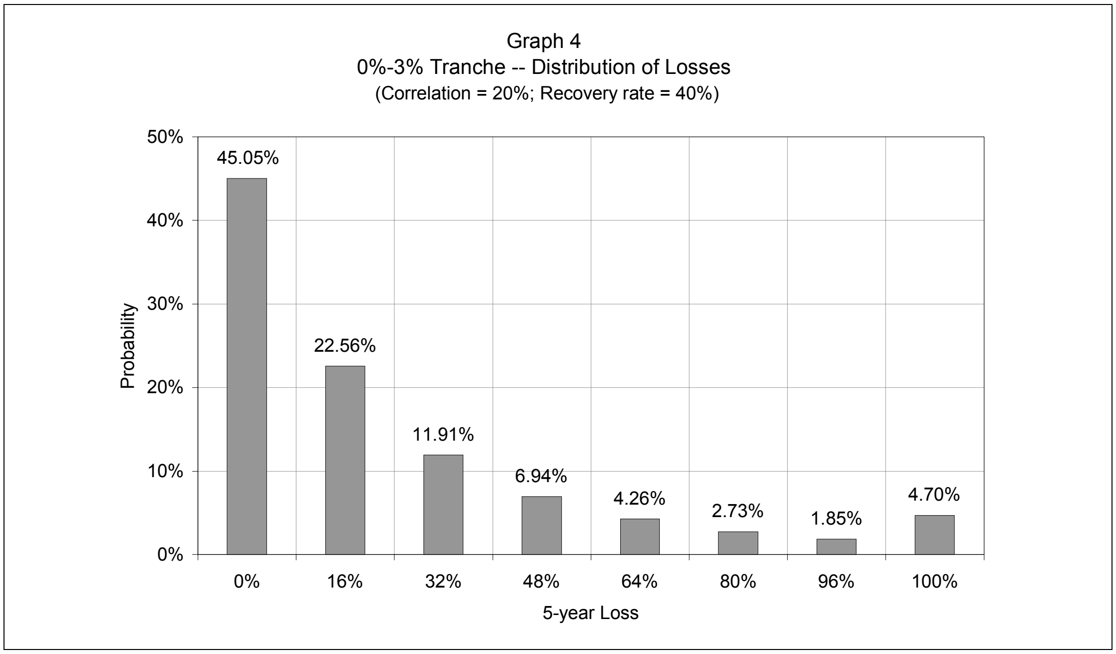
Source: Nomura

2. 0%-3% Tranche

Graph 4 shows the distribution of losses for the 0%-3% tranche. Starting with the first default in the portfolio, each default inflicts 16% losses on the 0%-3% tranche. After six defaults, 96% of the tranche has been consumed. The seventh default wipes-out the tranche entirely.

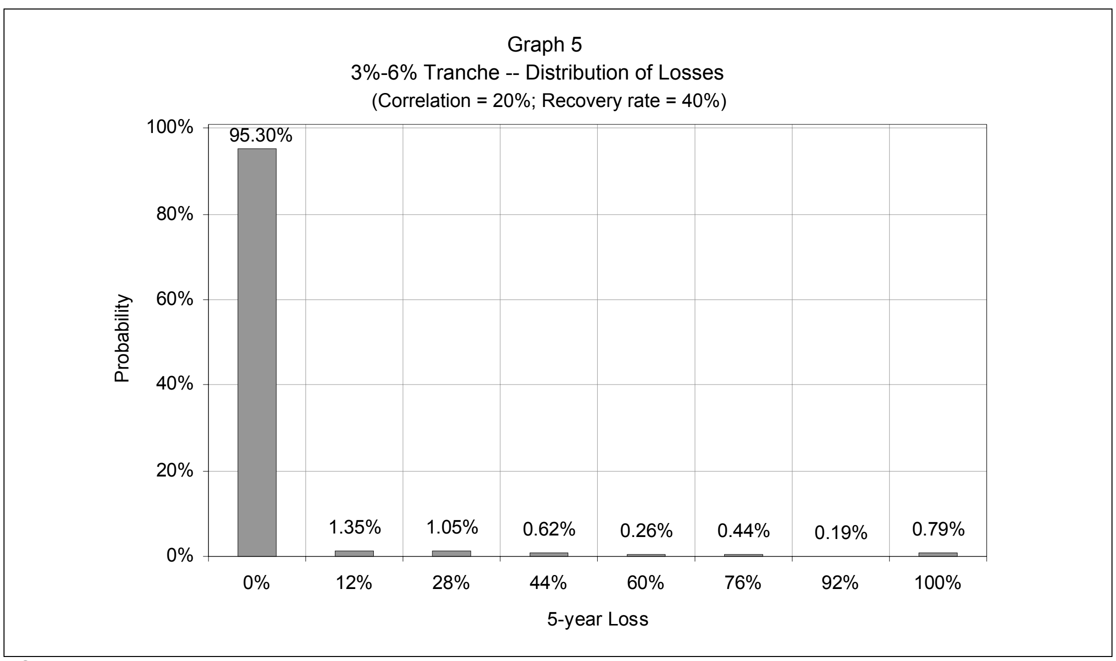
Comparing Graph 4 to Graph 3, the performance of the 0%-3% tranche displays greater dispersion than that of the portfolio as a whole. This reflects the higher risk inherent in the first-loss tranche. In the 0%-3% tranche, the risk is amplified because the notional amount is only 3% of the whole index portfolio. Based on simulation, the breakeven spread for the tranche is about 500 bps. While the probability of zero loss is the same as for the whole portfolio (45%), the probability of high levels of losses is much larger than for the portfolio because of the leverage effect. There is a 4.70% probability of the maximum loss (100% or $3.75).

[7] We calculate breakeven spread so that present value of the expected spread payments equals that of the expected losses over the 5-year term.



3. 3%-6% Tranche

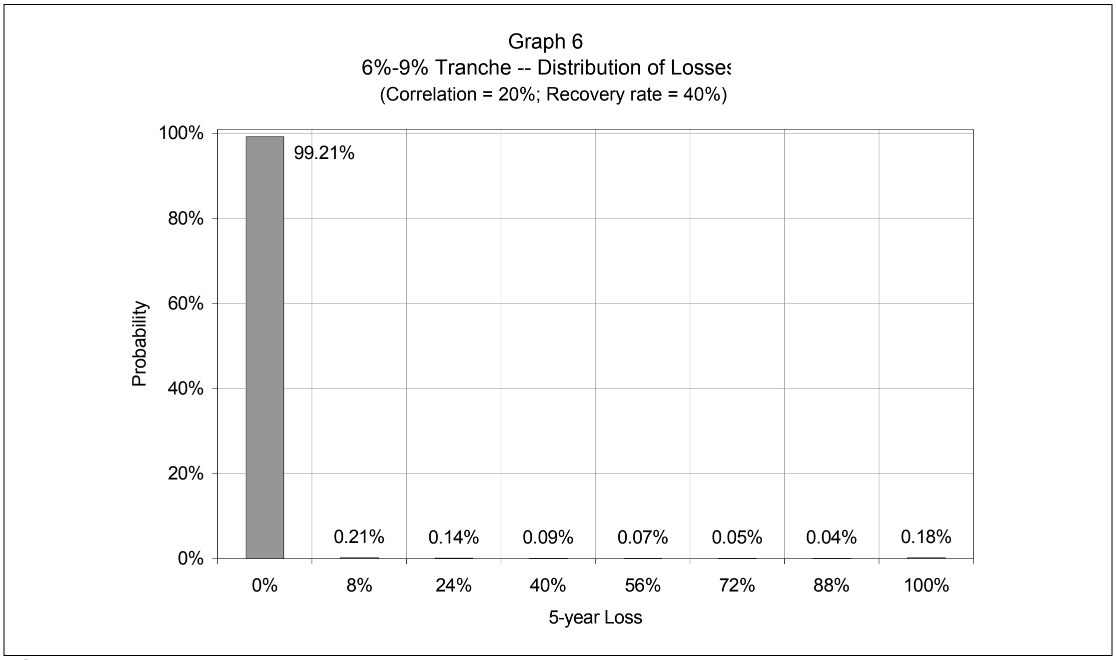
The 3%-6% tranche is a mezzanine tranche, and its loss distribution is much less dispersed than that of the 0%-3% tranche. In fact, as shown on Graph 5, in the simulation the 3%-6% tranche experienced no loss more than 95% of the time. The breakeven spread for the 3%-6% tranche is about 50 bps.



Source: Nomura

4. 6%-9% Tranche

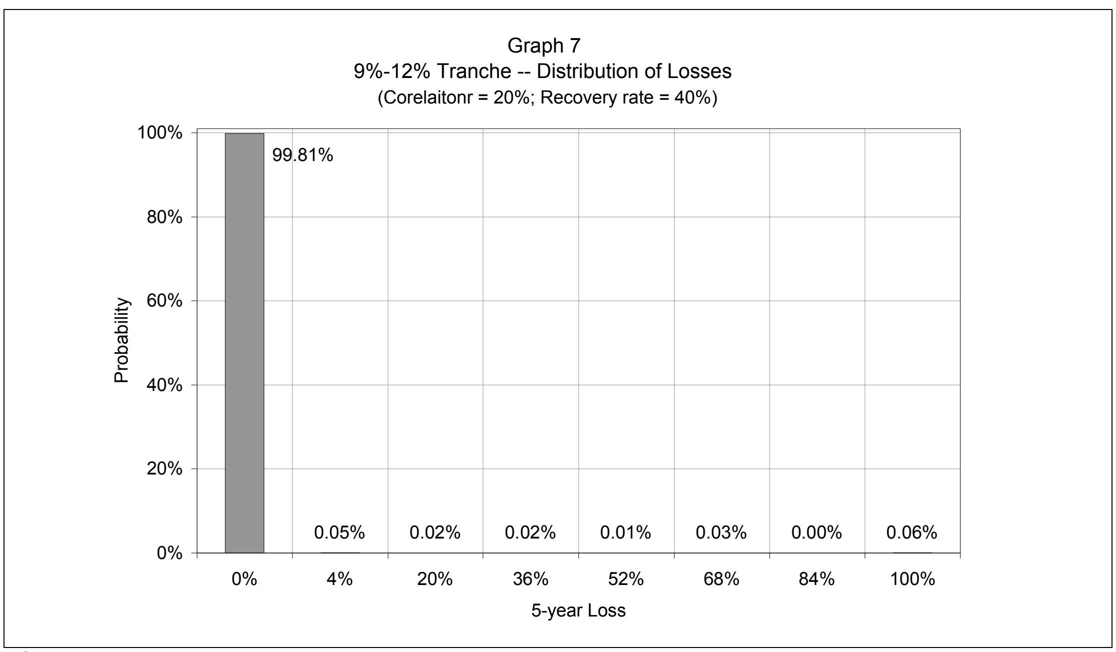
The 6%-9% tranche suffers losses only after the 3%-6% tranche is wiped out. Because the probability of such outcome is very small, the loss distribution of the 6%-9% is concentrated at zero, as shown in Graph 6. Graph 6 shows that the 6%-9% tranche would suffer no loss with the likelihood of over 99%. The breakeven spread for the tranche is about 10 bps.



Source: Nomura

5. 9%-12% Tranche

Based on the default probabilities in our simulation, there is only miniscule likelihood that the number of defaults exceeds 18 out of 125 names, where the portfolio losses reach the 9%-12% tranche. Similar to Graph 6, Graph 7 shows that the 9%-12% tranche would suffer no loss with the likelihood of over 99%. The breakeven spread for the tranche is less than 5 bps.



Source: Nomura

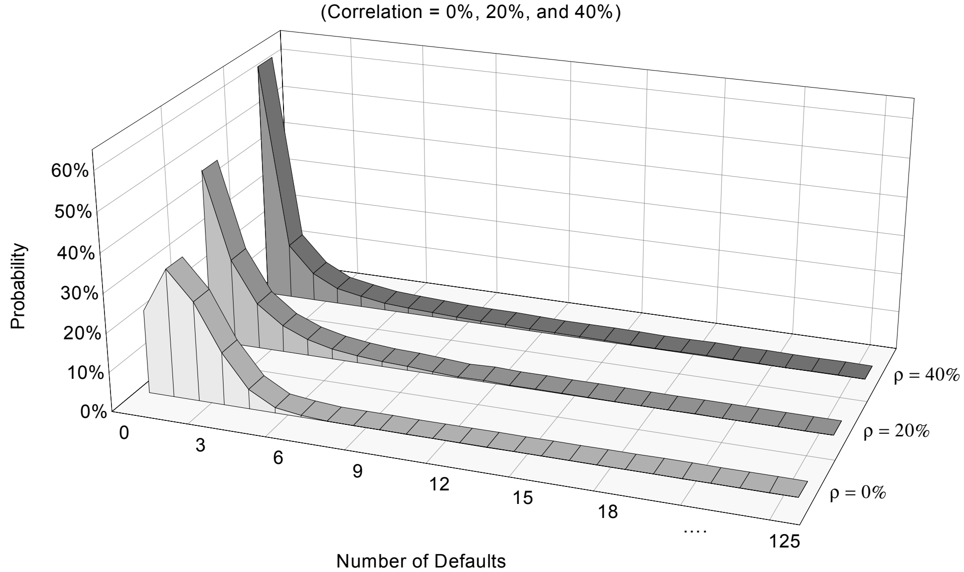
Graphs 4 through 7 above illustrate how tranching of a portfolio disproportionately allocates risk among different tranches. The key implication is that when the portfolio's loss distribution shifts it affects individual tranches in very different ways. In the following sections, we examine how adjusting different simulation parameters (*e.g.*, correlation, default probability, or recovery rate) in the overall portfolio affect each tranche.

IV. Effects of Changing Correlation

Correlation affects the likelihood of extreme events. A higher level of correlation causes defaults to cluster and increases the probability of very few defaults (*i.e.* most credits surviving) and very many defaults (*i.e.* most defaulting). *While correlation does not affect the level of expected losses to the overall portfolio, it significantly affects tranche losses.* In general, a higher correlation tends to benefit the equity tranche and hurt the senior tranche. Effects of the level of correlation on each tranche are as follows.

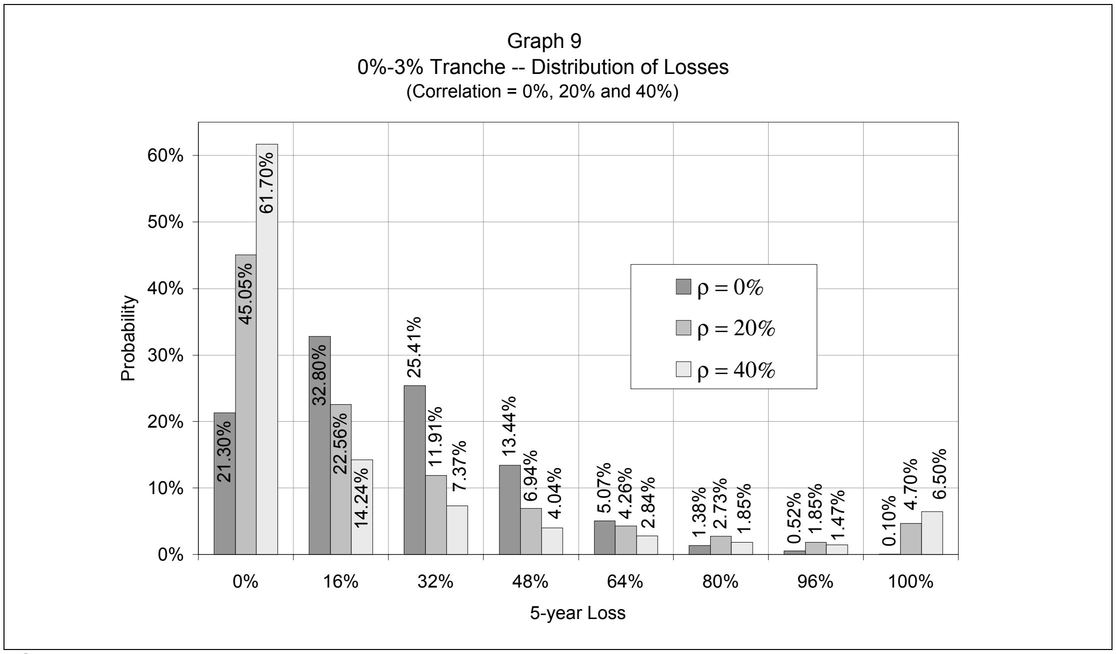
1. **Overall Portfolio:** The average losses to the portfolio are roughly unchanged for different levels of correlation. Accordingly, the breakeven spread is almost identical at around 15 bps. However, the shape of loss distribution changes with correlation. The loss distribution peaks at one default for the zero-correlation case, but it peaks at no defaults for the 20%- and 40%-correlation scenarios. On the other hand, the downside tails (particularly in the range of between three and nine defaults) are slightly fatter for 20%- and 40%-scenarios, indicating the slightly higher probability of large numbers of defaults. Graph 8 compares the distributions of portfolio defaults for varying correlation levels.

Graph 8
Effect of Correlation on Distribution of Portfolio Defaults
(Correlation = 0%, 20%, and 40%)



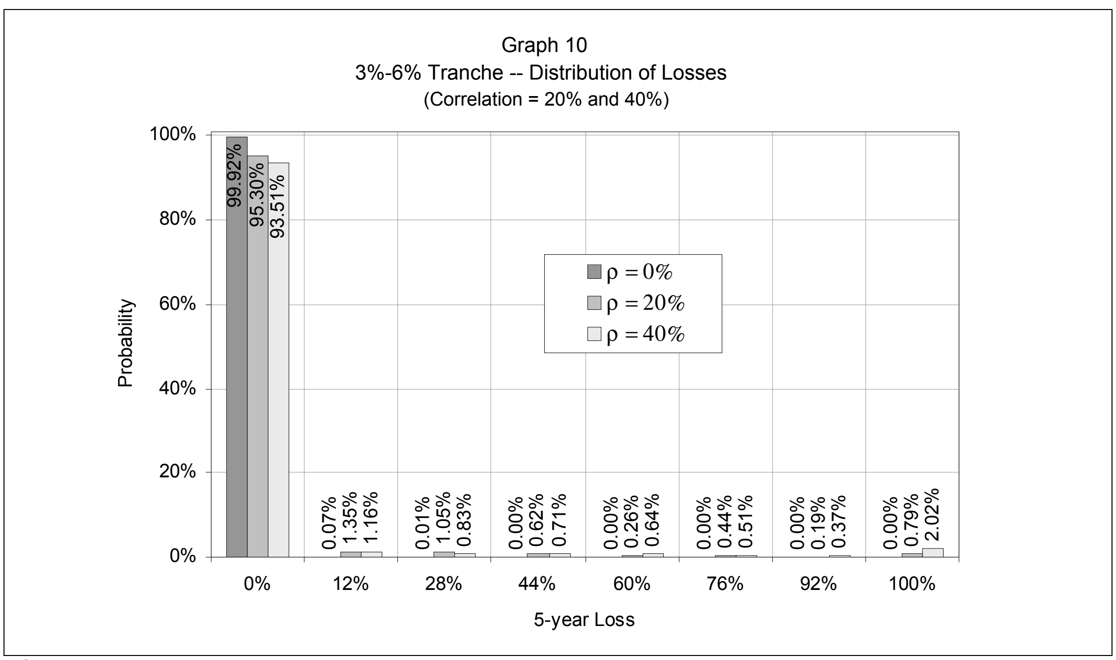
Source: Nomura

2. **0%-3% Tranche:** The first loss (equity) tranche benefits from higher correlation, which increases the probability of zero defaults (and, therefore, zero losses). Accordingly, the breakeven spread declines for this tranche as correlation increases. For the zero correlation case, the tranche's loss distribution peaks at 16% (one default). In contrast, for correlations of either 20% or 40%, the tranche's loss distribution peaks at 0% (no defaults). The downside tails exhibit a greater contrast, where the tail declines much more quickly for 20%- and 40%-scenarios than for 0%-scenario.



Source: Nomura

3. **3%-6% Tranche:** Lower correlation is beneficial to the distribution of simulated losses on the 3%-6% tranche. In the zero correlation case, the tranche avoids losses more than 99.9% of the time. When correlation is 20%, the tranche avoids losses 95.3% of the time and when correlation is 40%, the tranche avoids losses only 93.5% of the time. In other words, at zero correlation, the 3%-6% tranche suffers losses with a frequency of less than 0.1% — but at 40% correlation the tranche suffers losses with a frequency of roughly 6.5%. (See Graph 10)



Source: Nomura

4. **6%-9% Tranche:** The 6%-9% tranche also benefits from low correlation, but the effect of changing correlation is more muted for this tranche than for the 3%-6% tranche. At zero correlation, the 6%-9% avoids losses virtually 100% of the time. At 40% correlation, the tranche avoids losses only 97.7% of the time. Thus, the frequency of losses increases from 0% to more than 2% as correlation increases from 0% to 40%.

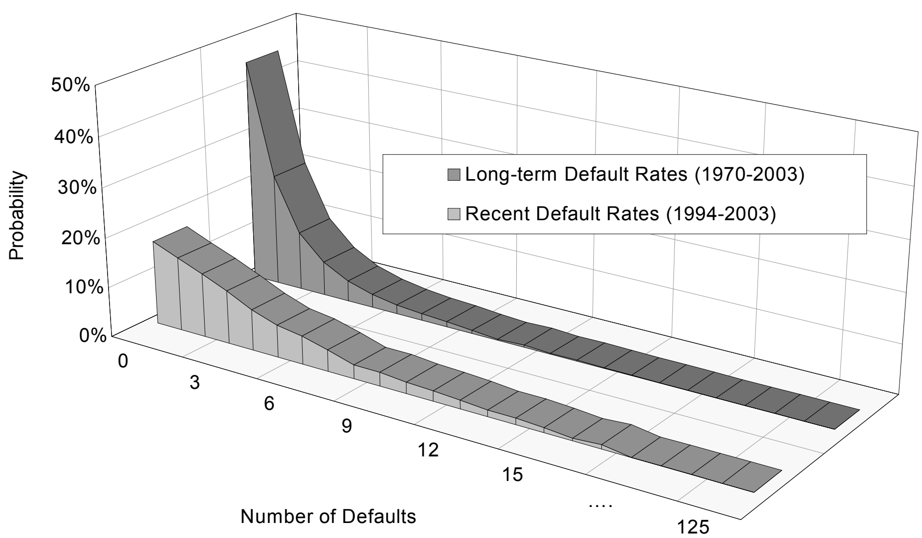
5. **9%-12% Tranche:** In our basic simulation, correlation has little affect on the distribution of losses on the 9%-12% tranche. However, if the underlying reference entities had higher default probabilities, the sensitivity of the 9%-12% tranche to correlation would increase. Higher correlation would hurt the 9%-12% tranche because high correlation increases the likelihood of extreme outcomes such as a sufficiently large number of defaults to reach the attachment point (*i.e.*, 9%) of the tranche.

V. Effects of Changing Default Probability

As noted on page 3, one of the key assumptions underlying the simulation results shown above was the use of Moody's long-term default rates as the assumed default rates for the individual reference entities that compose the index. A reasonable alternative assumption is to use the somewhat higher recent default rates reported by Moody's for the period 1994-2003. Using the higher default frequencies changes the simulated distribution of defaults on the portfolio.

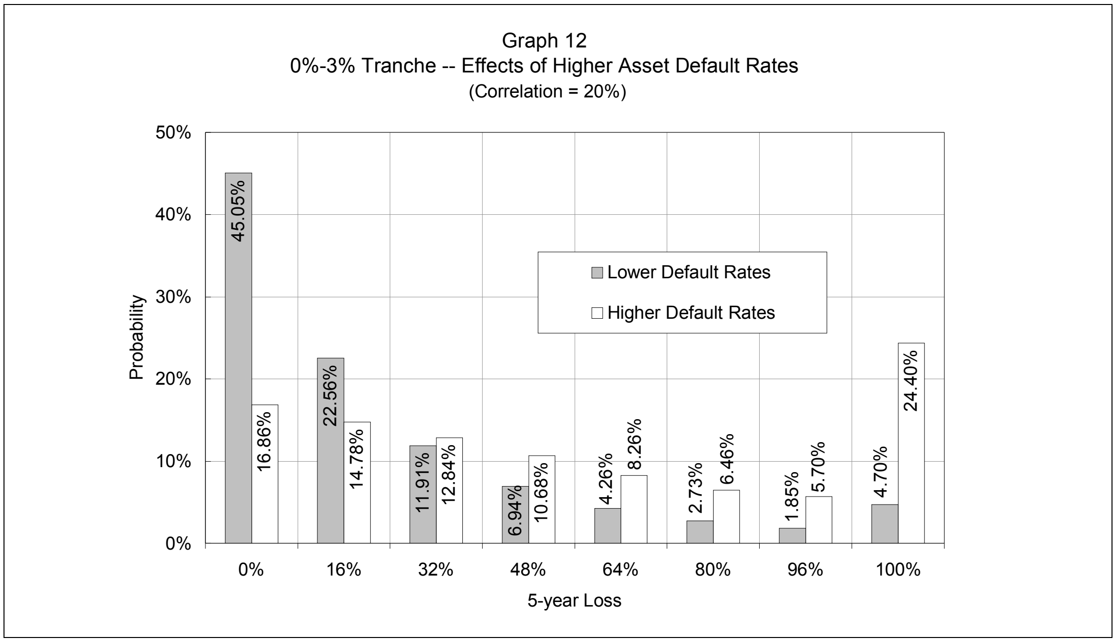
We ran a new simulation (5,000 runs) using higher default probabilities and assuming 20% correlation. We used 5-year default rates of 0.24% (same as before), 2.75%, and 5.86% for Aa, A, and Baa, respectively. (The figures for A and Baa ratings are consistent with Moody’s default rates for 1994-2003.) Graph 11 shows that the increased default rates increase the frequency of many defaults occurring simultaneously, giving the distribution of portfolio defaults a fatter tail to the right-hand side.

Graph 11
Distribution of Portfolio Defaults
at Different Assumed Asset Default Rates
(Recent Default Rates vs. Long-term Default Rates)



Source: Nomura

As shown in Graph 12, using higher asset default rates has a strong impact on the distribution of losses on the 0%-3% tranche. It makes the tranche riskier. The darker series of bars is the same as previously shown in Graph 4. The lighter series shows the distribution of losses on the tranche using the higher default rates. Using the higher asset default rates, the 0%-3% tranche would get wiped out 24.4% of the time (reflecting the fact that the probability of seven or more defaults increases to 24.4%). The tranche's breakeven spread goes up from 500 bps to over 1400 bps.

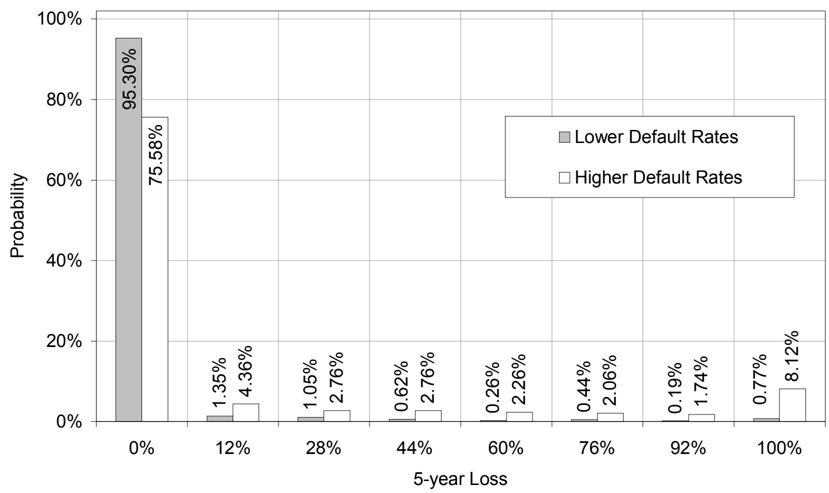


The 3%-6% tranche is less sensitive than the 0%-3% tranche to raising the simulated default rates of the underlying assets. As shown in Graph 13, the distribution of losses on the 3%-6% tranche changes somewhat from using higher asset default rates, but the change is less drastic than for the 0%-3% tranche.

In Graph 13, the darker series of bars shows the distribution of losses using the lower assumed default probabilities based on Moody's long-term observations. These bars show the same results that are displayed in Graph 5. The lighter bars in Graph 13 show the distribution of losses on the 3%-6% tranche using the higher assumed default rates based on Moody's recent observations.

With higher default rates, the most likely outcome for the 3%-6% tranche remains zero loss. However, the likelihood of suffering some loss grows from less than 5% to nearly 25%. The breakeven spread for the 3%-6% tranche increases from about 45 bps to more than 300 bps.

Graph 13
3%-6% Tranche -- Effects of Higher Asset Default Rates
(Correlation = 20%)

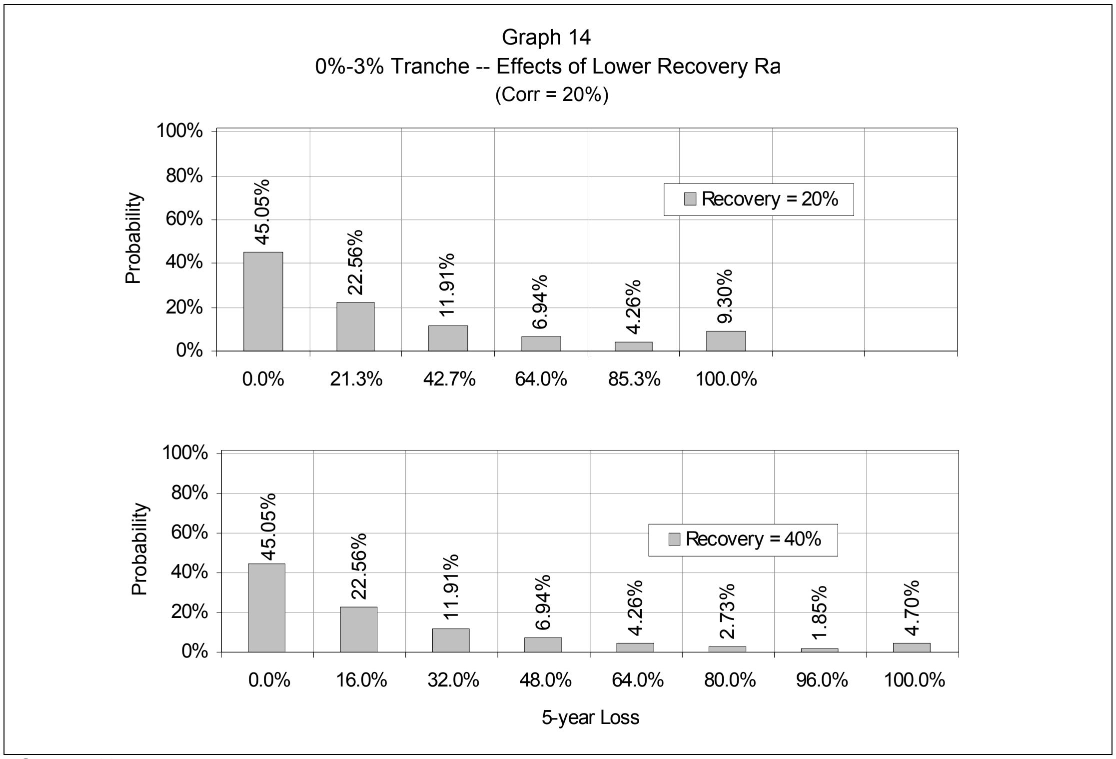


The impact of using higher default rates is much more subdued for the 6%-9% tranche and the 9%-12% tranche (not shown). For the 6%-9% tranche and the 9%-12% tranche, the probability of zero loss goes down from 99.2% to 91.5% and from 99.8% to 97.0%, respectively.

Obviously, using the "correct" default probability is essential to assessing the risk profile of individual tranches. However, the risk of wrongly assuming a lower default probability is greater for more junior tranches. In other words, a more junior tranche, the equity tranche in particular, is more sensitive to changes in the default probability. This sensitivity is associated with a tranche's "delta," which measures the sensitivity of a tranche's value to change in the credit spreads.

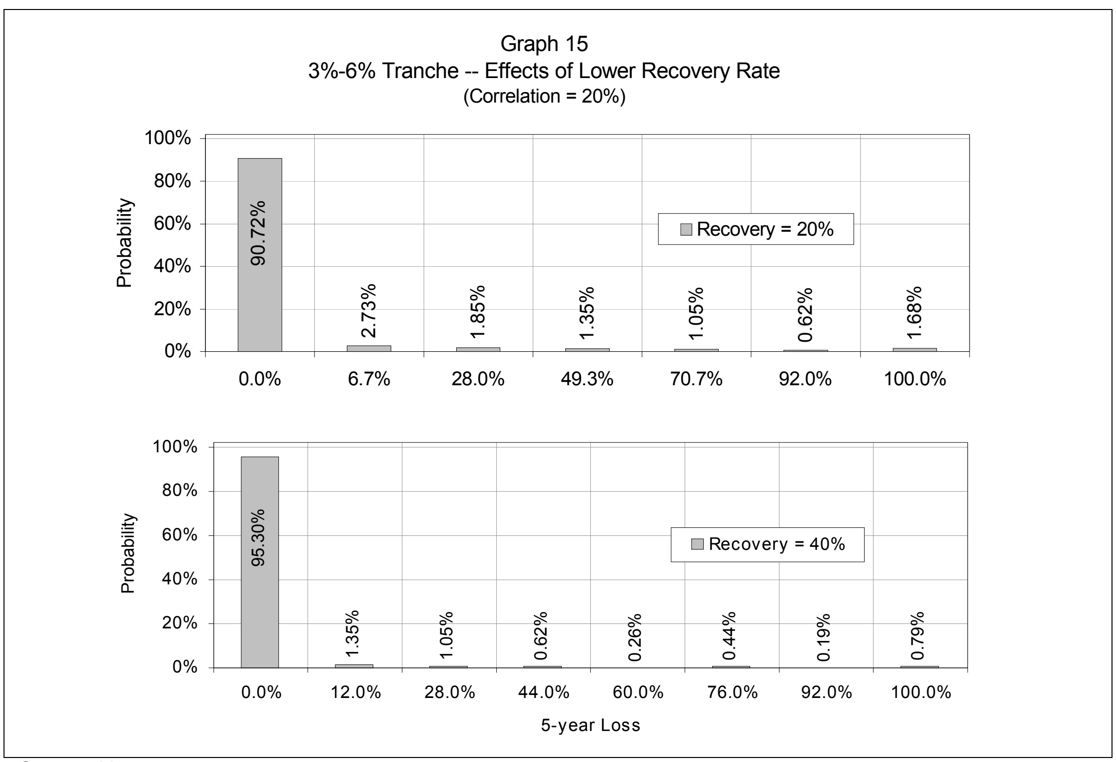
VI. Effects of Changing Recovery Rates

When we assume a lower recovery rate, each default causes higher dollar losses. This causes losses to move up from junior tranches to senior tranches more quickly. If the recovery rate is just 20%, each default would result in losses of 80¢. The impact on the 0%-3% tranche is shown in the upper portion of Graph 14. While the probability of zero loss is the same at 45.05%, the tranche has a greater likelihood of suffering larger losses when the recovery rate is just 20%. The breakeven spread for the tranche increases from about 500 bps to over 630 bps.



Source: Nomura

The impact on the 3%-6% tranche of the lower recovery rate is much more subdued, as shown in Graph 15. Now, as losses quickly move up to reach more senior tranches, the probability of zero loss for the 3%-6% tranche declines from 95.3% to 90.7%. More senior tranches are less sensitive to changing the level of assumed recovery rate. The breakeven spread for the 3%-6% tranche increases from 44 bps to 89 bps.



Source: Nomura

VII. Some Comments on Tranche Characteristics

The risk profile of a CDO tranche depends, in addition to the portfolio characteristics, on the tranche size and subordination. A tranche's size affects the degree of leverage, while subordination (*i.e.,* attachment point) determines the tranche's absolute level of risk. In other words, the particular tranche's attachment point defines when losses start to reach the tranche. Interestingly, different tranches of a CDO may have different sizes and subordination and yet offer similar spreads. This is possible because spreads tend to be determined from the "average" level of tranche losses, rather than by the distribution (*i.e.*, dispersion) of losses. For example, in August 2004, a CDS trader quoted similar spread levels for customized tranches of the iTraxx index with attachment/detachment points of 3%-27%, 6%-17%, and 9%-14%, respectively, and the iTraxx index itself!

Why can different tranches be priced at similar spread levels? From a given reference portfolio, we can readily create many tranches that have the same expected loss but different size and subordination levels. However, the variability of losses for such tranches might differ significantly. Much of the time, the market prices the tranches based primarily on their modeled expected losses. If the pricing (spread) on the tranches is the same, investors arguably should favor the ones with less variability in their loss distributions. Accordingly, investors have good reason to focus on the whole distribution of losses in tranched credit situations.

VIII. Return Profiles

Based on the simulated loss distributions, we can apply market spread levels to calculate the return distribution of the whole index portfolio and individual tranches. (See Table 2.) For simplicity, we assume that all defaults occur at the middle of the term (2.5 years). Once default occurs, the notional amount of the portfolio and the particular tranche is reduced by the loss amount, or 60¢ in our example. For example, if no loss occurs to the portfolio, the investor receives 42.4 bps per year for the entire 5-year term on the notional of $125. This is the equivalent of a 5-year return of +2.12%, excluding the funding cost. We calculate the 5-year returns of the index portfolio as well as individual mezzanine tranches. Table 3 offers a summary of return distributions of the portfolio, the 0%-3%, the 3%-6%, and the 9%-12% tranches.

Table 2: Sample Market Spread Levels
(As of August 17, 2004)

iTraxx Europe 125 Index	42.4 bps
0%-3% tranche	27.5% upfront + 500 bps running
3%-6% tranche	172.5 bps
6%-9% tranche	72.0 bps
9%-12% tranche	45.0 bps

Table 3: Comparison of Risk-Return Profile of Index Portfolio and Tranches
(Simulation results; 5-year return; 20% correlation)

	Portfolio			0%-3%			3%-6%			9%-12%		
Market spread (bps)	42.4			1433.5[8]			172.5			45.0		
Likelihood of negative return	9.3%			13.5%			4.7%			0.2%		
	Return	Prob.	# of defaults	Return	Prob.	# of defaults	Return (%)	Prob.	# of defaults	Return (%)	Prob.	# of defaults
Max return	+2.1%	45.1%	0	+71.7%	45.1%	0	+8.63%	95.3%	6 or less	+2.25%	99.8%	18 or less
	+1.6%	22.6%	1	+50.0%	22.6%	1	-3.89%	1.4%	7	-1.80%	0.1%	19
	+1.1%	11.9%	2	+28.2%	11.9%	2	-20.6%	1.1%	8	-18.0%	0%	20
...	...	...	...	...	...	...	...	...	...	...	...	...
Min. return	-58.9%	0%	125	-64.2%	4.7%	7 or more	-95.7%	0.8%	13 or more	-98.9%	0.1%	25 or more

At 20% correlation, the mezzanine tranches have very small probabilities of suffering negative returns (shaded boxes). In particular, while the index portfolio and the 9%-12% tranche trade at similar spread levels (42.4 bps and 45.0 bps), the 9%-12% tranche's return profile appears much more favorable than that of the whole portfolio. The likelihood of "best case" (*i.e.*, maximum) returns is just 45% for the portfolio, while it is over 99% for the 9%-12% tranche. This is due to the leverage available in single-tranche structure, where the tranche takes advantage of amplified arbitrage gains resulting from the high levels of the market-implied default probabilities (*i.e.* those implied by CDS spreads).

IX. Conclusion

In this paper, we show how the simulated distribution of losses of a CDO tranche is affected by various factors such as subordination, the assumed degree of correlation among reference entities, and assumed default rates of reference entities. The tranching process drives not only the expected losses for individual tranches, but also the distribution of losses for each one. However, the level of expected losses for a tranche usually is the dominant pricing consideration – ignoring the dispersion of losses.

Moreover, today's pricing on CDS implies higher default rates than suggested by Moody's long-term default measurements. If an investor believes that the market is mis-pricing default risk, CDS Index tranches are an optimal vehicle allowing the investor to act on that view. Likewise, if an investor believes that the market is mis-pricing correlation, he can act on that view by using synthetic single-tranche CDOs.

However, a word of caution. It remains unclear whether today's market pricing is a better indicator of future default rates than long-term rating agency measurements. Moreover, quantifying correlation of default risk remains an imprecise exercise, at best. Fortunately, sensitivity analyses can help investors understand when small changes in a simulation assumption can translate into big changes in a security's performance. Alternatively, investors can try to avoid such issues altogether by favoring tranches that display relatively less vulnerability to mistakes in assumptions.

— E N D —

[8] The equity tranche in the CDS indices is typically quoted on "points upfront" plus a fixed running spread, such as 500 bps. Here we recalculated 1433 bps as the equivalent of having all spreads paid over the term of the transaction.

X. Recent Nomura Fixed Income Research

Fixed Income General Topics

- U.S. Fixed Income 2004 Mid-Year Outlook/Review (1 July 2004)
- Report from Arizona 2004: Coverage of Selected Sessions of the Winter Securitization Conferences (10 February 2004)
- U.S. Fixed Income 2004 Outlook/2003 Review (18 December 2003)

ABS/CDO

- Correlation Primer (6 August 2004)
- ABS/MBS Disclosure Update #5: Reactions to the Comment Letters (4 August 2004)
- ABS/MBS Disclosure Update #4: Issues from ASF Sunset Seminar (13 May 2004)
- ABS/MBS Disclosure Update #3: Start Your Engines – Get Ready to Comment (10 May 2004)
- CDS Primer (12 May 2004)
- ABS/MBS Disclosure Update #2 (5 May 2004)
- ABS/MBS Disclosure Update (29 April 2004)

MBS

- Nomura GNMA Project Loan Prepayment Report - June 2004 Factors (10 June 2004)
- Monthly Update on FHA/VA Reperforming Mortgages: Historical Prepayment Speeds, Default Losses, and Total Returns (3 June 2004)
- Nomura GNMA Project Loan Prepayment Report – May 2004 Factors (14 May 2004)
- Monthly Update on FHA/VA Reperforming Mortgages: Historical Prepayment Speeds, Default Losses, and Total Returns (14 May 2004)
- GNMA Project Loan REMIC Factor Comparison (20 April 2004)

Strategy

- Agency Hybrid ARMs: Sector Overview (24 August 2004)
- U.S Consumer Chartbook (24 August 2004)
- CMBS IOs – Maybe Not As Tight As They Appear (24 August 2004)
- Using the Call/Call Trade to Enhance MBS Returns (19 August 2004)
- Update on Commercial Bank Holdings (17 August 2004)
- Reviewing the “J” and “I” Curves for CMBS (12 August 2004)
- MBS Market Check-up: Mid August Update (11 August 2004)
- Commercial Real Estate Sector Update - Hotels (10 August 2004)
- Commercial Real Estate Sector Update - Industrial (4 August 2004)
- Value in Two-Tiered Index Bonds (TTIBs) (30 July 2004)
- Commercial Real Estate Sector Update - Multifamily (30 July2004)
- Commercial Real Estate Sector Update - Retail (29 July 2004)
- Commercial Real Estate Sector Update - Office (22 July 2004)
- GNMA II Premiums Continue to Look Cheap (22 July 2004)
- Trade Idea: A “Positive Carry” Flattener (16 July 2004)
- FICO Scores: A Quick Refresher (13 July 2004)
- CMBS: Loan Extensions – Not a Near Term Problem (1 July 2004)
- Partial Duration: A Portfolio Strategy Tool (10 June 2004)
- Corporate Bonds - A 30,000 Foot View (7 June 2004)
- Facts about PACs (11 May 2004)
- Using Interest Rate Swaps as a Portfolio Duration Tool (19 April 2004)
- Z Spread: An Important Tool in Shifting Yield Curve (15 April 2004)

Corporates

- Corporate Weekly - For the week ended 20 August 2004
- Corporate Weekly - For the week ended 13 August 2004
- Corporate Weekly - For the week ended 6 August 2004
- Corporate Weekly - For the week ended 30 July 2004
- Corporate Weekly - For the week ended 23 July 2004
- Corporate Weekly - For the week ended 16 July 2004
- US Corporate Sector Review - July (4 August 2004)
- US Corporate Sector Review - June (7 July 2004)
- US Corporate Sector Review - May (6 June 2004)

NOMURA

NEW YORK	TOKYO	LONDON
Nomura Securities International	Nomura Securities Company	Nomura International PLC
2 World Financial Center, Building B	2-2-2, Otemachi, Chiyoda-Ku	Nomura House
New York, NY 10281	Tokyo, Japan 100-8130	1 St Martin's-le-grand
(212) 667-9300	81 3 3211 1811	London EC1A 4NP
		44 207 521 2000

Nomura Fixed Income Research

David P. Jacob	212.667.2255	International Head of Research			
David Resler	212.667.2415	Head of U.S. Economic Research	James Manzi	212.667.2231	AVP
Mark Adelson	212.667.2337	Securitization/ABS Research	Elizabeth Hoyt	212.667.2339	Analyst
John Dunlevy	212.667.9298	Structured Products Strategist	Edward Santevecchi	212.667.1314	Analyst
Arthur Q. Frank	212.667.1477	MBS Research	Tim Lu		Analyst
Louis (Trey) Ott	212.667.9521	Corporate Bond Research	Diana Berezina		Analyst
Parul Jain		Deputy Chief Economist	Jeremy Garfield		Analyst
Weimin Jin		Quantitative Research	Kumiko Kimura		Translator
Michiko Whetten	212.667.2338	Quantitative Credit Analyst	Tomoko Nago-Kern		Translator
Nobuyuki Tsutsumi	81.3.3211.1811	ABS Research (Tokyo)			
John Higgins	44.207.521.2534	Head of Research – Europe (London)			

I Michiko Whetten, a research analyst employed by Nomura Securities International, Inc., hereby certify that all of the views expressed in this research report accurately reflect my personal views about any and all of the subject securities or issuers discussed herein. In addition, I hereby certify that no part of my compensation was, is, or will be, directly or indirectly related to the specific recommendations or views that I have expressed in this research report.