The following is a review of the Credit Risk Measurement and Management principles designed to address the learning objectives set forth by GARP®. This topic is also covered in:

Default Probability, Credit Spreads, and Credit Derivatives

Topic 30

Exam Focus

This topic discusses the theory of default probability and its practical application to credit spreads and credit derivatives. For the exam, be able to explain the difference between cumulative and marginal default probabilities. Also, be able to calculate risk-neutral and real-world default probabilities in pricing derivative contracts. Finally, understand how recovery rates are estimated, and the underlying mechanics of credit default swaps (CDS) and portfolio credit derivatives.

Default Probability

LO 30.1: Distinguish between cumulative and marginal default probabilities.

The **cumulative default probability**, *F(t)*, represents the likelihood of counterparty default between the current time period and a future date, *t*. Intuitively, the cumulative probability of default must be an increasing function. Further, the probability of default at the current point in time can be interpreted as zero and increases over time, reaching a maximum of 100%, which implies that all counterparties will eventually default. That is, given a sufficiently long period of time, some unforeseen event or extreme economic circumstance will cause even the most creditworthy companies to become insolvent.

The **marginal default probability** denotes the likelihood of counterparty default between two future points in time denoted t_1 and t_2. Marginal default probabilities must be non-negative to make economic sense. In equation form, marginal default probability can be expressed as follows:

$$q(t_1, t_2) = F(t_2) - F(t_1)$$

where:
$t_1 \leq t_2$

Risk-Neutral vs. Real-World Default Probabilities

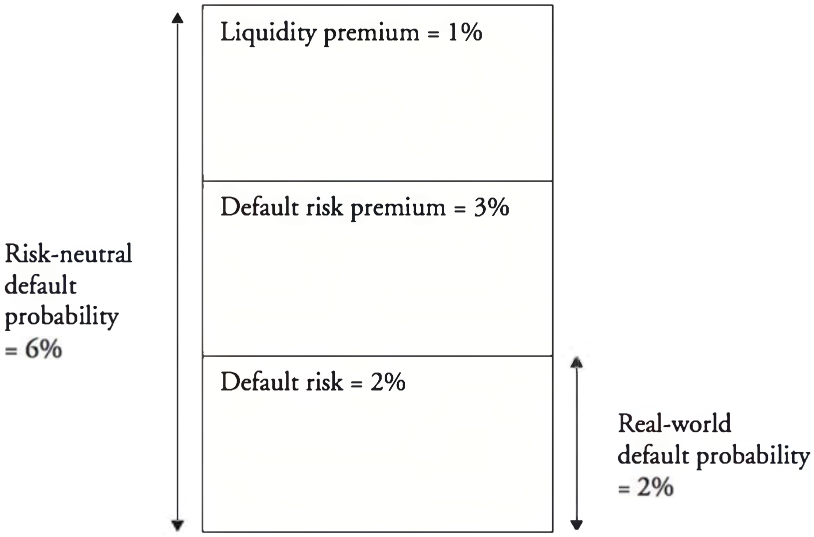
LO 30.2: Calculate risk-neutral default probabilities, and compare the use of risk-neutral and real-world default probabilities in pricing derivative contracts.

Risk-neutral default probabilities are calculated from market information, while **real-world default probabilities** are based on historical data. Typically, real-world default probabilities are less than risk-neutral default probabilities. Although the difference between risk-neutral and real-world default probabilities may seem to be just semantics, the difference is extremely important.

Risk-neutral default probabilities represent the estimated parameter value determined from an observable market price. If the pricing model is assumed correct, the unknown parameter can be determined by solving for the parameter value that makes the model price equal to the market price. A good example is the implied volatility from an observed option price using the Black-Scholes-Merton model. The risk-neutral probability of default is the estimated parameter value that forces the observed pricing model to equal the market price. However, there may be other factors in addition to real-world default probability, such as a liquidity or default risk premium that are aggregated into the risk-neutral default probability calculation. Hence, the risk-neutral default probability is likely to overstate the actual probability of default.

A simple numerical example can further illustrate this point. Suppose there is a one-period, zero-coupon bond that will mature with face value of \$100. The obligation will default with 2% probability. For simplicity, assume no recovery in the event of default. This scenario is illustrated in Figure 1. Ignoring the time value of money, the expected value of the cash flows would be (\$100 × 0.98) + (\$0 × 0.02) = \$98. However, a rational investor would never pay \$98 because there is chance of zero recovery due to default. Hence, the investor will price the bond lower at, for example, \$95 to compensate for the uncertainty of the return. This \$3 reduction represents the **default risk premium**. Further, suppose the investor feels that market conditions may impact the ability to sell the bond in a timely fashion and imposes an additional \$1 reduction (i.e., **liquidity premium**) for such liquidity concerns. The final price is then \$94. Because \$94 is the observed market price, the risk-neutral probability of default is computed as 6%, which is in sharp contrast to the actual real-world probability of default of 2%.

Figure 1: Default Probabilities



The risk-neutral probability can be displayed in equation form as follows:

risk-neutral default probability = liquidity premium + default risk premium + real-world default probability

It is important to note the appropriate use of each calculation. The real-world default probability (i.e., actual probability of default by a counterparty) should be incorporated into quantitative risk and return assessment conducted during the risk management process. Risk-neutral default probabilities should be incorporated into hedging decisions because they are derived from actual market prices.

Estimation Approaches

LO 30.3: Compare the various approaches for estimating price: historical data approach, equity based approach, and risk neutral approach.

Historical Data Approach

The most direct assessment of default probabilities is to use historical default data to forecast future default probabilities. In this case, a transition matrix is helpful in calculating default probabilities because it identifies the historical probabilities of credit rating migration between periods. Cumulative default probabilities can be estimated by matrix multiplication of the transition matrix with itself. This methodology assumes the transition matrix is constant over time and hence unaffected by the business cycle, an observation not supported by empirical evidence. In general, credits are more likely to be downgraded than upgraded. In addition, the cumulative probability of default for investment-grade credits increases more rapidly than for noninvestment grade credits over a given period. This is simply a case of mean-reversion.

Equity-Based Approaches

Equity-based approaches for estimating real-world default probabilities include the Merton model, the KMV approach, and CreditGrades™. Equity-based approaches allow for a dynamic estimation of default probability as opposed to the static estimate provided by the historical approach.

The **Merton model** uses equity market data to estimate default probabilities. In this model, the equity value is viewed as a call option with a strike price equal to the firm's debt level. This model assumes the firm has a single-period, zero-coupon bond outstanding and hence can only default at maturity. Therefore, the estimation of default probabilities is reduced to assessing where the firm's asset value will fall below its outstanding debt level.

The **KMV approach** uses a proprietary approach built on the Merton model, but it relaxes several of its assumptions. The steps to the KMV approach are as follows: (1) volatility and market value estimates are calculated, (2) the **distance to default** (the number of standard deviations between current asset values and the debt repayment amounts) is calculated, and (3) historical default data and distance to default are used to estimate the expected default probability.

CreditGrades™ uses observable market data and balance sheet information to create a model that is simpler (due to fewer model parameters) and easier to replicate than other equity-based approaches. Importantly, empirical data is not utilized in this model.

Risk-Neutral Approach

The risk-neutral probability of default is derived from the observed credit spread and the market price of a traded credit security. In practice, this is challenging because there is no single credit spread but several possible estimates, including credit default swap (CDS) premiums, bond prices relative to a benchmark Treasury curve, and spreads on asset swaps.

To model this process, consider a credit with a constant 9% probability of default per year. Hence, the default probability in the first year is 9%, 8.2% in year 2 [= probability of no default in prior year × probability of default in current year = (100% – 9%) × 9% = 91% × 9%], 7.5% in year 3 (= 91% × 91% × 9%), and so on. It follows that the cumulative default probabilities for these periods are 9%, 17.2%, and 24.6%, respectively, and that the conditional default probability (i.e., the default probability in a period assuming no default in prior periods) is 9%.

Using the Poisson process, the default probability for future time period *u* is expressed as follows:

$$F(u) = 1 - \exp(-h \times u)$$

where h is the hazard rate of default (i.e., the default probability for an infinitesimally small time period).

Professor's Note: The notation exp(x) *is equivalent to* e^x. *Therefore, use the exponential function on your calculator for these calculations.*

For example, assume h = 4.7% and u = 2. In this case, default probability can be solved as follows:

$$9\% = 1 - \exp(-0.047 \times 2)$$

This result matches the previous discrete example very closely. Utilizing the observation that h ≈ spread / (1– recovery) yields the approximate formula for risk-neutral probability:

$$F(u) = 1 - \exp\left[-\frac{\text{spread}}{1 - \text{recovery}} \times u\right]$$

While this derivation is simple and elegant, a significant problem remains, namely, two parameters (recovery rate and probability of default) must be estimated based on only one observation of the credit spread. Standard procedure is to assume a fixed recovery rate, typically around 40%, to derive market-based default probabilities.

Finally, the marginal probability of default can be approximated as:

$$q\left(t_{i-1}, t_i\right) \approx \exp\left[-\frac{\text{spread}_{t_{i-1}}}{1 - \text{recovery}} \times t_{i-1}\right] - \exp\left[-\frac{\text{spread}_{t_i}}{1 - \text{recovery}} \times t_i\right]$$

Empirical evidence indicates that risk-neutral default probabilities are significantly larger than real-world default probabilities. Perhaps counterintuitively, the difference is larger for higher-quality credits and has meaningful impacts on hedging. For practical purposes, real-world default probabilities are more appropriate if counterparty risk is ignored (or considered negligible). Conversely, if one wants to hedge against counterparty risk, then risk-neutral probabilities must be considered.

Recovery Rates

LO 30.4: Describe how recovery rates may be estimated.

Recovery rates refer to the percentage of par (i.e., notional) value that is realized (i.e., recovered) after default. Generally, ex-ante recovery rates are not directly observable because credit products are priced jointly, factoring in default probabilities and recovery rates. Hence, the calculation of one depends on an estimate of the other.

In a perfect world, recovery rates would be derived from observed market prices of **recovery swaps** where the counterparties agree to pay/receive the difference between ex-post actual recovery and ex-ante agreed-upon fixed recovery rate. The problem is that these swaps are not typically traded.

As an alternative, historical recovery rates from defaulted securities can be utilized. This simple approach is complicated by several factors. First, recovery rates vary by industry and time periods. That is, there is strong evidence of clustering of defaults during economic downturns and, within a given industry, generally lower recovery rates. Second, higher default rates have a negative relation with recovery. In other words, recovery amounts tend to be lower during periods of above-average defaults. Third, recovery rates are clearly related to the capital structure whereby more senior claims will have higher recovery rates than subordinated or junior claims. Fourth, the potentially long, drawn-out process in bankruptcy proceedings can lead creditors to selling claims prematurely in the market. Hence, the realized (settled) recovery may be different than the eventual (actual) recovery.

Credit Default Swaps

LO 30.5: Describe credit default swaps (CDS) and their general underlying mechanics.

The most well-known credit derivative is the **credit default swap** (CDS). The CDS is an insurance-like security that transfers credit risk from the protection buyer to the protection seller for a pre-specified premium. The contract must specify the reference entity (e.g., corporate credit, sovereign borrower), reference obligation, settlement procedures, and the notional amount of protection. Note that the reference entity is not a counterparty in the CDS. In addition, the CDS must specify the universe of credit events (e.g., bankruptcy, insolvency, restructuring) for the reference entity that will trigger a payment from the party long the credit risk to the party short the credit risk at the initiation of the agreement.

The dramatic rise in popularity of CDS contracts throughout the 2000s led to some standardization of CDS contracts. Typically, high-quality issuers will trade with fixed coupons of 100 bps per annum while high-yield issuers will trade with coupons of 500 bps per annum. An additional up-front, one-time payment may be made from the buyer of protection to the seller of protection (or vice versa) if the actual premium is higher or lower than the fixed coupon.

In case of default, CDS may settle in physical terms or in cash terms. For physical settlement, the required number of bonds with par value equal to the notional is delivered to the counterparty in exchange for a cash payment also equal to the notional principal. This method requires the protection buyer to physically deliver the bonds. Hence, if the buyer does not actually own the bonds, the buyer will have to purchase them in the open market. This creates an additional risk that the sudden demand for the defaulted securities will raise the price as many protection buyers will need to purchase the bond. This event is known as a **delivery squeeze**. However, an advantage of physical delivery is that there is no need to determine the size of the loss because the full notional is transferred in default.

The cash settlement for default has some important differences relative to physical settlement. Because the bonds are not transferred from the protection buyer to the protection seller under cash settlement, there is no need to own or purchase the defaulted securities. Rather, the protection seller makes a single compensatory payment of par (i.e., the post-event market price). A problem arises because the market price is fluid based on the demand for the defaulted debt. To further standardize the process, an auction is held approximately 30 days after default, at which point the settlement price is determined.

The Credit Spread Curve

LO 30.6: Describe the credit spread curve and explain the motivation for curve mapping.

The **credit spread curve** is essentially a yield curve of credit spreads for different maturities. The first step to creating the curve is to plot the most liquid credit spreads observable in the market for a single credit or credit rating, generally from CDS premiums or bond spreads, for all available maturities. While this concept is appealing, implementation is challenging because of data limitations. Even if the aforementioned securities (across several maturities) have sufficient liquidity, there are still many gaps in the curve that require a subjective estimation procedure to generate a smooth curve.

Plotting the curve is further complicated by the choice of reference. For example, construction of a AA-rated credit curve would have a relatively large choice of securities to infer credit spreads. Conversely, a more narrowly defined credit curve based on a particular industry sector or geography would limit the available data points, introducing more subjectivity into the curve.

An alternative method uses the credit spread around a single, liquid observation (e.g., credit spread with five years to maturity) to map the entire curve. For illustration, suppose the relevant five-year bond yield is 6%, and the maturity-matched benchmark is yielding 5%. This observation is considered to be one data point on the "mapped" credit curve. The remaining points on the credit curve are "mapped" by adjusting the index upward for all other maturities. In our example, the entire mapped curve would be estimated to be 120% of the index curve. A secondary question raised is the identification of an appropriate index.

Portfolios of Credit Derivatives

LO 30.7: Describe types of portfolio credit derivatives.

Credit derivatives can be combined into portfolios to form new products. The most popular of these products is the CDS index, which is typically structured as an equally weighted index of the underlying credit default swaps. Interestingly, the CDS index will not price exactly as an equally weighted basket of the underlying credits due to institutional factors such as variation in the bid-offer, credit event triggers, and up-front payments.

Index composition varies based on geography (e.g., North American, European, Asian markets) and other factors such as maturity. The two most popular (and liquid) indices are the CDX NA IG and iTraxx Europe. Both indices consist of 125 equally weighted, investment grade CDSs, with the primary difference being that the CDX NA IG uses North American entities and the iTraxx Europe uses European entities.

In contrast to traditional indices such as the S&P 500, CDS indices are created with a fixed maturity and static constituents. That is, if there is a significant credit event, the affected credit entity will be removed from the index and replaced with another name that meets the requirements. The index will continue to trade based on the remaining non-defaulted credits, and the new notional principal of the index would be based on the remaining entities.

In addition, credit indices roll every six months. That is, a new on-the-run CDS index series is created every six months with new constituents based on credit events, rating changes, and CDS premium changes. However, previous index series continue to trade. Series maturities are typically five, seven, and ten years, with the five-year index being the most popular. The goal is to ensure that the newly created indices are homogenous with the overall credit quality of the previous portfolio and reflective of current market conditions. Lastly, the indices trade with a fixed coupon (e.g., 100 bps for investment grade indices and 500 bps for speculative grade indices), which simplifies the trading and marking-to-market of the indices.

LO 30.8: Describe index tranches, super senior risk, and collateralized debt obligations (CDOs).

Index tranches create a capital structure for the credit index whereby the entire loss distribution is divided into mutually exclusive ranges. The losses are absorbed sequentially by the equity, mezzanine, senior, and super-senior tranches. Each tranche is described by its attachment point (X%) and detachment point (Y%), denoted [X%, Y%], and the width of each tranche is Y% – X%. It follows that the subordination level for each tranche is X%. That is, there is no loss experienced by the tranche until X% of losses has occurred in the index. Lower-level tranches receive higher returns and possess higher risk than higher level tranches. Lastly, the CDX NA IG and iTraxx Europe have predefined equity tranche levels of 0% – 3%, but they differ on the size of the mezzanine and senior tranches.

Super-senior tranches represent the portion of the capital structure for credit indices that has the highest subordination level and lowest probability of incurring losses. Informally, these tranches are termed *super triple-A* and *quadruple A tranches* to distinguish their lower relative risk from AAA-rated tranches. For practical purposes, the likelihood of sufficient defaults to reach the super-senior attachment point is highly unlikely. To gain some insight into this process, the required defaults to breach a tranche with a subordination level of X% can be expressed in general form by:

$$\text{number of defaults} = n\left(\frac{X\%}{1 - \text{recovery}}\right)$$

Note that both the subordination level and recovery rate assumptions are implicit in this calculation. As an illustration, suppose a super-senior tranche has an attachment point of 30% (which happens to be the subordination level for CDX), 100 underlying credits, and an assumed recovery rate of 40%. This tranche will require 50 defaults to cause economic loss to the super-senior tranche, shown as follows:

$$\text{number of defaults} = 100\left(\frac{30\%}{1 - 40\%}\right) = 50$$

In summary, the probability of impairments to the super-senior tranche is extremely small due to the high level of subordination. Hence, the credit risk of these tranches is not a major concern. The primary risk of these tranches is counterparty risk (termed *super-senior* *risk*) as this risk is positively correlated to tranche seniority. That is, higher seniority tranches have higher levels of counterparty risk. Unfortunately, it is nearly impossible for institutions to efficiently hedge this super-senior risk.

Collateralized debt obligations (CDOs) can be thought of as customized baskets of debt instruments segmented broadly into senior, mezzanine, and equity tranches. Because the underlying portfolio is not necessarily equally weighted, the specific tranche attachment and detachment points are not standardized, but similar to index tranches, the credit risk is concentrated in the equity tranche and the senior tranches are unlikely to suffer losses.

CDOs are typically divided into two broad categories: synthetic CDOs and structured finance securities. **Synthetic CDOs** are custom-made instruments for a specific transaction. From a trading perspective, each tranche may trade separate from the rest of the capital structure. **Structured finance securities**, including collateralized loan obligations (CLOs), mortgage-backed securities (MBSs), cash CDOs, and related instruments, typically involve more complex waterfall structures to determine payouts to different tranches. As a result, the individual tranches cannot be traded separately.

Key Concepts

LO 30.1

Cumulative default probability is the probability a counterparty will default before time *t*. The cumulative default probability function, *F(t)*, increases over time, eventually reaching 100%. The marginal default probability is the probability of default between two future dates: $q(t_1, t_2) = F(t_2) - F(t_1)$, where $t_1 \leq t_2$.

LO 30.2

Risk-neutral probabilities represent estimates of default probability based on observed market prices of securities (e.g., bonds, credit default swaps). However, the market price aggregates actual real-world default probabilities with credit premiums, liquidity discounts, and possibly other factors. Hence, the risk-neutral probability overstates the actual real-world default probability. Risk-neutral probabilities are useful for hedging considerations, while real-world default probabilities are useful for quantitative risk assessment.

LO 30.3

There are three approaches to estimate default probabilities: (1) the historical data approach, (2) equity-based models (Merton, KMV, and CreditGrades™), and (3) the risk-neutral approach. Historical data uses transition matrices based on historical credit migration and is limited by the static nature of the data. Equity models view firm equity as a call option with a strike price equal to debt level. Risk-neutral models use observed credit spreads to estimate hazard rates used in a Poisson process. An important limitation is that market-observed spreads jointly factor into default probability and recovery rate (i.e., an implicit recovery rate must be assumed).

LO 30.4

Recovery rates represent the percentage of principal available to creditors after default. Recovery rates depend on overall market conditions, industry, and seniority in the capital structure. Historically, there is a strong negative correlation with default frequency and recovery rates.

LO 30.5

Credit default swaps (CDSs) are liquid contracts that transfer credit risk from protection buyers to protection sellers. Predefined credit events include bankruptcy, insolvency, and restructuring to reduce post-event disputes. Settlement may be physical (i.e., deliver par value of notional principal in exchange for cash payment in the amount of notional principal) or in cash (cash transfer from seller to buyer of protection). Premium payments are fixed (e.g., 100 bps for strong credits and 500 bps for weak credits), plus a one-time, up-front payment to adjust for the specific credit quality of the reference entity.

LO 30.6

The credit spread curve is a term structure plot of credit spreads against maturity. The lack of liquid securities may create large gaps in the curve. The mapped curve can be created via estimation techniques or by adjusting a chosen index upward to match the credit spread of a single, liquid observed credit.

LO 30.7

Credit derivatives can be structured into portfolios to simplify trading and marking-to-market of broad credit movements. Indices are equally weighted, have fixed maturity, and trade with fixed coupons (e.g., 100 bps for high-quality issuers and 500 bps for high-yield issuers). In addition, standardized indices, such as the CDX NA IG and iTraxx Europe, potentially reconstitute their indices every six months.

LO 30.8

Index tranches are standardized slices of the capital structure from a portfolio of CDSs. The tranches have predefined attachment and detachment points where equity, mezzanine, and senior tranches represent increasingly safe securities. Super-senior tranches represent the safest portion of the capital structure in a securitization. While the risk of default for super-senior tranches is low, counterparty risk is a concern. Collateralized debt obligations (CDOs) are pools of credits and can be separated into synthetic (custom-made tranches) CDOs or structured finance securities, including MBSs, CLOs, and similar instruments (rules-based cash flow distribution).

Concept Checkers

1. Which of the following statements about cumulative and marginal default probabilities is most accurate?
   A. Both functions increase over time.
   B. Neither function increases over time.
   C. Only the cumulative default probabilities increase over time.
   D. Only the marginal probabilities increase over time.

2. Based on the following information, what are the the risk-neutral and real-world default probabilities?
   - Market price of bond is 92.
   - Liquidity premium is 1%.
   - Credit risk premium is 2%.
   - Risk-free rate is 2.5%.
   - Expected inflation is 1.5%.
   - Recovery rate is 0%.

	Risk-neutral probability	Real-world probability
A.	5%	8%
B.	8%	5%
C.	6%	8%
D.	5%	6%

3. Robin Hudson, FRM, was discussing the various methods to estimate default probabilities with her colleague Kate Alexander, FRM. Hudson made the following comments:
   I. Transition matrices are an important component of the risk-neutral approach.
   II. Hazard rates measure the instantaneous conditional default probability.
   III. Risk-neutral default probabilities are downward biased estimates of real-world default probabilities.

   How many of these statements should Alexander agree with?
   A. None of the statements.
   B. One statement.
   C. Two statements.
   D. Three statements.

4. Which of the following statements is most likely correct about recovery rates?
   A. Recovery rates vary inversely with capital structure seniority.
   B. Historical recovery rates are fairly constant across industries.
   C. Recovery rates are highest during economic downturns.
   D. Actual recovery rates may differ substantially from settled recovery rates.

5. Which of the following statements about credit default swaps is most accurate?
   A. CDSs transfer credit risk and market risk from the protection buyer to the protection seller.
   B. CDSs transfer credit risk from the protection buyer to the issuer of the underlying credit.
   C. Physical settlement requires knowledge of the post-default market price.
   D. Cash settlement avoids the problem of a delivery squeeze.

Concept Checker Answers

1. **C** The cumulative default probability function begins at zero and eventually reaches 100% and must therefore increases over time. Marginal probabilities of default are always positive but are not necessarily increasing over time.

2. **B** The risk-neutral default probability is approximately 8% because the market price is 92% of par.

   risk-neutral probability = real-world probability + credit risk premium + liquidity premium

   8% = real-world probability + 2% + 1%

   real-world probability = 8% – 3% = 5%

3. **B** Only statement II is correct. Transition matrices are more likely to be used in the historical approach. Empirical evidence shows that real-world default probabilities are significantly lower than risk-neutral default probabilities.

4. **D** Settled recovery occurs fairly soon after the credit event (e.g., CDS auction or sale of defaulted bond), while actual recovery can occur years later based on the bankruptcy resolution. Recovery rates increase with capital structure seniority, are lowest during economic downturns, and vary significantly across industries.

5. **D** One advantage of the cash settlement procedure is that no securities are actually traded so the risk of delivery squeeze (i.e., rising price as protection buyers purchase reference entities in the open market) is negligible.

The following is a review of the Credit Risk Measurement and Management principles designed to address the learning objectives set forth by GARP®. This topic is also covered in:

Credit Value Adjustment

Topic 31

Exam Focus

The pricing of counterparty risk is a function of the credit exposure and default probability of a counterparty. For the exam, know how to calculate a credit value adjustment (CVA) in the presence of unilateral contracts. Also, understand the concepts of incremental and marginal CVA and know how to estimate CVA as a spread.

Pricing Counterparty Risk

LO 31.1: Explain the motivation for and the challenges of pricing counterparty risk.

The pricing of counterparty risk (i.e., how much to charge a counterparty for the risk that it may default) is a function of the credit exposure and default probability of a counterparty. Accurate pricing of a counterparty's risk generates reserves to absorb potential losses due to that counterparty's default. Pricing counterparty risk needs to account for risk mitigants (e.g., netting, collateralization).

The price of counterparty risk approximates to the value of the risk of all outstanding positions with a counterparty and exists in addition to the price of the financial instrument itself that the counterparties use (e.g., a swap). Best practices will organize responsibilities as to who should calculate counterparty risk within the financial institution. The challenge in pricing this type of risk arises with bilateral derivatives contracts (e.g., swaps with fixed and floating components) rather than one-way payment instruments such as bonds.

Credit Value Adjustment

LO 31.2: Describe credit value adjustment (CVA).

LO 31.3: Calculate CVA and the CVA spread with no wrong-way risk, netting, or collateralization.

The **credit value adjustment** (CVA) is defined as the expected value or price of counterparty credit risk. A positive value represents a cost to the counterparty that bears a greater propensity to default. A risky security transaction has a risk-free price with no counterparty risk and an adjustment for counterparty risk (i.e., risky value = risk-free value – CVA).

The adjustment for counterparty risk is the credit value adjustment. CVA is calculated as follows:

$$\text{CVA} \approx \text{LGD} \times \sum_{i=1}^{m} d(t_i) \times \text{EE}(t_i) \times \text{PD}(t_{i-1}, t_i)$$

where:
LGD = loss given default or how much of the exposure one expects to lose in the event of a counterparty default; equal to 1 minus the recovery rate (1 – RR)
EE = expected exposure for future dates
PD = marginal default probability
d(t) = discount factors or the risk-free rate component of the CVA at time *t*; future losses are discounted back to the present with these terms

Speed and simplicity are the hallmarks of this calculation, which aggregates components from different departments of the risk management organization. The resulting amount may be expressed as a percentage of the notional value of the transaction on which it is based. Additionally, the formula assumes no wrong-way risk and does not require simulation default events, which simplifies the calculation.

CVA as a Spread

To approximate the CVA as a spread, divide the CVA by the unit premium of a risky annuity [e.g., credit default swap (CDS)] for the contract in question, producing an annual spread in basis points. This would be a charge to the weaker counterparty. The left-hand side of the following calculation represents the CVA as a running spread:

$$\frac{\text{CVA}(t,T)}{\text{CDS}_{\text{premium}}(t,T)} = X^{\text{CDS}} \times \text{EPE}$$

where:
$\text{CDS}_{\text{premium}}(t, T)$ = unit premium value of a credit default swap
X^{CDS} = CDS premium at maturity date *T*; this amount can be thought of as a credit spread
EPE = expected positive exposure that is the average of the expected exposure over a preset time period, typically from the present to the maturity date of the transaction

Assumptions for this calculation include (1) EPE is constant over the entire profile, (2) default probability is constant over the entire profile, and (3) EE or default probability is symmetric over the entire profile.

Example: Computing CVA spread

A trader needs a quick approximation of the CVA spread on a swap. The exposure management group comes up with an EPE of 6%. The counterparty's credit spread is around 375 basis points (bps) per year. **Calculate** the CVA as a running spread.

Answer:

The CVA as a running spread would be computed as:

$6\% \times 3.75\% = 23$ bps

This is the amount the trader may add to or subtract from the leg of the trade as the CVA or credit charge, and it is a common way to represent CVA as a risk charge to the client in a swap transaction.

Impact of Changes in Credit Spread and Recovery Rates

LO 31.4: Evaluate the impact of changes in the credit spread and recovery rate assumptions on CVA.

When evaluating the impact of the probability of default and recovery on CVA, the following factors must be considered: credit spread levels, the shape of the credit spread curve, the impact of the recovery rate, and the basis risk that arises between different recovery rate assumptions.

Regarding the impact of changes in the credit spread, the CVA will most often increase given an increase in the credit spread. However, the impact will not be linear because default probabilities are limited to 100%. If a counterparty is very close to default, the CVA will actually decrease slightly, and in default the CVA will fall to zero. When considering the shape of the credit spread curve, the CVA will be lower for an upward-sloping curve compared to a flat and a downward-sloping curve, and the CVA will be higher for a downward-sloping curve compared to a flat and an upward-sloping curve.

Regarding the impact of changes in recovery rate assumptions, increasing the recovery rate will increase the implied probability of default but reduce the resulting CVA. Differences in settled versus actual recovery rates may also be considered. The settled recovery is the recovery at default, while the actual recovery is the claim amount that will be received. As an example, consider a settled recovery rate of 10% and an actual recovery rate of 40%. In this situation, the higher actual recovery rate will produce a lower CVA compared to a 40% recovery assumption for both settled and actual recovery rates.

Incorporating Netting and Collateralization

LO 31.5: Explain how netting can be incorporated into the CVA calculation.

LO 31.7: Explain the impact of incorporating collateralization into the CVA calculation.

Netting reduces the CVA price as it nets (i.e., reduces) exposure when trades are settled. One must evaluate the change in CVA before and after a trade has been executed. The new trade should be sufficiently profitable to offset any increase in CVA at a minimum. This expression is shown as follows:

$$V(i) = \Delta CVA_{NS,i} = CVA(NS, i) - CVA(NS)$$

where:
V(i) = risk-free value of new trade *i*
CVA(NS, i) = CVA included in new trade in the netting set
CVA(NS) = CVA on all current trades within the netting set

Collateralization reduces the CVA, changing only the counterparty's expected exposure (EE), but not its default probability. Inclusion of minimum transfer and threshold amounts would correspondingly increase the CVA as they increase exposure linearly.

Incremental and Marginal CVA

LO 31.6: Define and calculate incremental CVA and marginal CVA, and explain how to convert CVA into a running spread.

The practicality of CVA lies in its ability to take into account risk mitigation provided by collateralization and netting. The usefulness of standalone CVA is limited to giving the risk manager a quick appraisal of the CVA charge.

Incremental CVA is the change (or increment) in CVA that a new trade will create, taking netting into account (i.e., the difference between CVA with and without the new trade). The formula differs from the original CVA only in the change in expected exposure. The ΔEE is the incremental change in EE at each point in time caused by the new trade, which impacts the original exposure.

Incremental CVA is important for pricing a new trade with respect to existing ones. CVA with netting will never be higher than CVA without netting because netting cannot increase exposure. The benefits of netting are a function of the transaction size. The larger the transaction, the smaller the benefit to the point where the value of incremental CVA will approach standalone CVA.

Marginal CVA enables the risk manager to break down netted trades into trade level contributions that sum to the total CVA. The calculation is identical to that for the standalone CVA, except for the substitution of marginal EE for initial EE. This metric allows for more rigorous analysis, as it is useful for better understanding which trades have the greatest impact on a counterparty's CVA. It provides an ex-post view of the trades.

Converting CVA into a Running Spread

Converting an upfront CVA into a running spread CVA is also worth considering. Given an interest rate swap, the rate paid on the swap would need to change when charging a CVA to a client. This transformation would occur by dividing the CVA by the risky duration for the maturity under consideration. For example, assuming a five-year payer interest rate swap with a notional amount of 100M, a risky duration of 3.75, and a standalone CVA of 90,000, the additional spread would be calculated as:

$$90{,}000 / (3.75 \times 100{,}000{,}000) = 2.40 \text{ bps}$$

However, the addition of this spread will also impact the CVA. Therefore, the correct value should be computed in a recursive fashion until the risky MtM value declines to zero. This is accomplished by solving the following equation: $V_{C'} = CVA_{C'}$, where $V_{C'}$ is the contract value given the adjusted rate C'. This method ensures that the CVA is offset by the initial value and allows the adjusted rate (C') to become the hurdle rate for profitability.

Applying CVA to Exotic Products and Path Dependency

Applying CVA to exotic products and in the presence of path dependency presents special challenges.

Regarding **exotic products**, valuation may require techniques such as Monte Carlo simulation. Thus, value approximations to such products may be necessary to estimate their CVA values given the complexity in pricing the products themselves (e.g., swaptions may be treated as forward swaps, Bermudan option payoffs may be treated as European option payoffs).

Regarding **path dependency**, in order to assess future exposure at a given point in time, one must have information on the entire path from the present to that future date. As with exotic products, approximation of the probability calculation of path-dependent events will suffice when dealing with exotic derivative prices.

Key Concepts

LO 31.1

Motivations for pricing counterparty risk include (1) organization of responsibilities within the institution with respect to the pricing calculation and (2) determining whether a trade is sufficiently possible when factoring in counterparty risk charge.

LO 31.2

A credit value adjustment is the price of counterparty risk. A positive value is a cost to the counterparty bearing the risk. The basic CVA formula assumes no wrong-way risk.

LO 31.3

CVA is calculated as follows:

$$\text{CVA} \approx \text{LGD} \times \sum_{i=1}^{m} d(t_i) \times \text{EE}(t_i) \times \text{PD}(t_{i-1}, t_i)$$

CVA as a spread is CVA divided by the risky annuity for the maturity of the contract in question, producing an annual spread or charge expressed in basis points:

$$\frac{\text{CVA}(t,T)}{\text{CDS}_{\text{premium}}(t,T)} = X^{\text{CDS}} \times \text{EPE}$$

LO 31.4

Credit spread levels, the shape of the credit spread curve, the impact of the recovery rate, and the basis risk that arises from different recovery rate assumptions must all be considered when evaluating the impact of the default probability and recovery on CVA.

LO 31.5

Netting reduces the CVA price because it nets exposure when trades are settled.

LO 31.6

Incremental CVA is used to calculate the cost of a new trade versus an existing one to determine the effect that the new trade has on CVA. Standalone CVA cannot do this. The formula for the incremental CVA calculation is identical to that for standalone CVA, except for the incremental expected exposure.

Marginal CVA is used for trade level attribution (i.e., to discover the determinants of the CVA). The formula for the calculation of marginal CVA is identical to that for standalone CVA, except for the substitution of marginal expected exposure for expected exposure.

LO 31.7

Collateralization reduces the CVA, changing only the counterparty's expected exposure.

Concept Checkers

1. Which of the following statements is not a motivation for pricing counterparty risk?
   A. Accurate pricing should only account for the cost of the trade.
   B. Counterparty risk pricing should account for risk mitigants.
   C. Best practices organize pricing responsibilities in the organization.
   D. Pricing bilateral derivatives contracts.

2. With respect to the CVA calculation, which of the following statements is correct when a risk manager wishes to understand which trades have the greatest impact on a counterparty's CVA? The manager would use:
   A. incremental CVA because it accounts for the change in CVA once the new trade is priced, accounting for netting.
   B. marginal CVA because he could break down netted trades into trade level contributions.
   C. incremental CVA because he could break down netted trades into trade level contributions.
   D. marginal CVA because it accounts for the change in CVA once the new trade is priced, accounting for netting.

3. A trader wants to know the approximate CVA for a counterparty in a swap transaction. The counterparty's expected potential exposure (EPE) is 7%, and its credit spread is 475 basis points. What is the CVA as a running spread?
   A. 0.33%.
   B. 1.48%.
   C. 2.25%.
   D. 9.75%.

4. Regarding the impact of changes in the credit spread and recovery rate assumptions on the CVA, which of the following statements is true?
   A. A decrease in the credit spread will most often increase the CVA.
   B. For an upward-sloping curve, the CVA will be higher compared to a downward-sloping curve.
   C. Increasing the recovery rate will reduce the CVA.
   D. If the actual recovery rate is higher than the settled recovery rate, the CVA will most likely be higher compared to a situation where both recovery assumptions are the same for both rates.

5. When incorporating netting and collateralization into the CVA calculation, which of the following statements is incorrect?
   I. Netting increases the CVA price because it reduces exposure when trades are settled.
   II. Collateralization does not change the CVA because it only changes the counterparty's expected exposure.
   A. I only.
   B. II only.
   C. Both I and II.
   D. Neither I nor II.

Concept Checker Answers

1. **A** Accurate pricing should account for not only the cost of the trade, but also the cost of counterparty risk.

2. **B** Understanding which trades have the greatest impact on a counterparty's credit value adjustment requires use of the marginal CVA. Incremental CVA, by contrast, is useful for pricing a new trade with respect to an existing one.

3. **A** Calculation of the CVA as a running spread entails multiplying the counterparty's EPE by its credit spread:

   $7\% \times 4.75\% = 33$ bps

4. **C** Increasing the recovery rate will increase the implied probability of default but reduce the resulting CVA. The CVA will most often increase given an increase in the credit spread. When considering the shape of the credit spread curve, the CVA will be lower for an upward-sloping curve compared to a downward-sloping curve. Finally, a higher actual recovery rate will most likely lead to a lower CVA compared to a situation where the recovery assumptions are the same for both actual and settled rates.

5. **C** Both statements are incorrect. Netting reduces the CVA price as it reduces exposure when trades are settled. Collateralization also reduces the CVA, changing only the counterparty's expected exposure (EE), but not its default probability.

The following is a review of the Credit Risk Measurement and Management principles designed to address the learning objectives set forth by GARP®. This topic is also covered in:

Wrong-Way Risk

Topic 32

Exam Focus

The recent global financial crisis and European sovereign debt crisis illustrated the significance of wrong-way risk and right-way risk. For example, buyers of protection against bond defaults may witness an impressive gain in their position due to falling bond prices as a result of some macroeconomic events. However, at the same time, falling bond prices increase the risk exposure and default probability of a counterparty due to the adverse impact of macroeconomic events, resulting in an overall increase in counterparty risk. This is an example of wrong-way risk (WWR). Normal derivatives markets are characterized as possessing right-way risk (RWR), in which hedges produce successful expected results. Macroeconomic events affect risk exposure and default probability in a favorable manner such that the overall expected counterparty risk declines. For the exam, be able to explain both wrong-way risk and right-way risk as well as identify these risks in transactions such as put options, call options, credit default swaps, foreign currency transactions, interest rate and currency swaps, and commodities.

Wrong-Way Risk vs. Right-Way Risk

LO 32.1: Describe wrong-way risk and contrast it with right-way risk.

Wrong-way risk (WWR) is an outcome of any association, dependence, linkage, or interrelationship between exposure and counterparty creditworthiness that generates an overall increase in counterparty risk and, therefore, an increase in the amount of the credit value adjustment (CVA). WWR also results in a reduction of the debt value adjustment (DVA). WWR can be hard to determine due to difficulties assessing the relationship among variables and the lack of relevant historical data.

Right-way risk (RWR) is just the opposite of WWR. That is, any dependence, linkage, or interrelationship between the exposure and default probability of a counterparty producing an overall decrease in counterparty risk is described as RWR. RWR decreases the CVA and increases the DVA.

It is also worth mentioning that WWR has been the center of attention in historical context, while RWR has been paid relatively little attention. However, both risks are important, and financial institutions should strive to increase RWR and decrease WWR.

Another way to contrast WWR and RWR is to think that "normality" in derivatives markets is an example of RWR. That is, derivatives transactions produce intended results if the market is functioning in an expected manner. For instance, a coffee producer would sell (i.e., short) forward or futures contracts in order to protect against the downside risk of falling prices in the future, and a textile owner (that manufactures cotton cloth) would go long in cotton derivatives contracts if she anticipates a rise in cotton prices. Thus, RWR produces a favorable relation between default probability and exposure, reducing overall counterparty risk. Hedges, in normal functioning markets, should automatically generate RWR because the fundamental purpose of hedges is to curtail counterparty risk.

Professor's Note: We are using derivatives markets just for illustration of wrong-way and right-way risks. By no means are these risks confined only to derivatives.

Markets and numerous interactions (e.g., market credit interaction) do not always produce normal behavior, as evidenced by the recent global financial crisis. Those who were seeking protection against the default of debt issuers (e.g., on collateralized debt obligations) became victims of WWR when unfavorable interaction between exposures and insurers' default probabilities (which were supposed to provide protection) intensified the amount of counterparty credit risk.

The amount of counterparty risk is roughly equal to the product of exposure and the counterparty's default probability at a specified loss rate given default. Counterparty risk is a kind of credit risk that is estimated as loss reserve for loans, and in over-the-counter (OTC) derivatives markets, it is similar to estimating loan reserves.

Loan exposure, however, is normally assumed to be a fixed amount for a specified time period, whereas in OTC derivatives, the exposure fluctuates depending on market conditions. An example of WWR (RWR) would be a change in exposure and counterparty credit quality, producing an unfavorable (favorable) dependence in exposure and counterparty credit quality and resulting in an increase (decrease) in the amount of overall counterparty risk. The change in exposure and credit quality could be due to numerous external factors such as interest rates, inflation, exchange rate movements, and global events. Note that credit quality increases actually increase WWR. This is because counterparties with high credit quality are less likely to default. As a result, the occurrence of a default by a counterparty with high credit quality is less expected than a default by a counterparty with low credit quality.

Examples of Wrong-Way Risk and Right-Way Risk

LO 32.2: Identify examples of wrong-way risk and examples of right-way risk.

For this LO, we'll create a few hypothetical examples of WWR and RWR. For example, what if Company XYZ (the borrower) and the guarantor on XYZ's loan, Company ABC, share ownership in a business (or are in the same industry)? Due to some market or economic factors, both may default together (WWR), whereas if the guarantor and the borrower are not in the same industry (nor have shared ownership), XYZ's loan guarantee may still be valid, even if XYZ defaults (RWR).

What if ABC has sold protection much higher than its capital in a concentrated area (business or industry) and XYZ has bought protection (insurance) from ABC? Macro factors may increase the "exposure" for the guarantor (ABC), and due to positive interaction between exposure and credit quality, the overall counterparty (guarantor) risk increases to the extent that XYZ's protection becomes meaningless (WWR). In contrast, the reverse of the situation may generate a favorable state—an increase in exposure may be sufficiently offset by an increase in creditworthiness.

The CVA, which is based on the amount of counterparty risk, is generally approximated by the product of exposure and the default probability of the counterparty (for a given recovery rate). This estimation is based on an underlying assumption that these events are independent. However, they may not be independent (as evidenced in the recent financial crisis). Unfavorable (favorable) association between default probability (credit risk) and exposure (market risk) may produce WWR (RWR), increasing (decreasing) the overall CVA.

Quantifying WWR and RWR involves estimation of the CVA based on expected exposure, conditional on counterparty default (under the more realistic scenario of the presence of interconnected markets with systemic risk), whereas under the independence assumption, we use unconditional default probability.

It is estimated that conditional expected exposure will increase if the exposure (e.g., value of a forward contract) and the default probability of the counterparty are positively correlated, exhibiting WWR. On the other hand, negative correlation in this instance will lower the conditional expected exposure, showing RWR.

As discussed earlier, the overall counterparty risk stems from a situation in which the counterparty credit quality is linked with macro (and global) factors that also impact the exposure of transactions. The transaction can be any of the following: put options, call options, foreign currency transactions, forward contracts, credit default swaps, or interest rate and currency swaps. Let us examine WWR and RWR as they relate to some of these transactions.

Over-the-Counter Put Option

A put option gives the right to the long (buyer) to sell an underlying instrument at a predetermined price whereas the short (counterparty) is obligated to buy if the option is exercised. Out-of-the money put options have more WWR than in-the-money put options.

Macroeconomic events (such as interest rates, inflation, industry- and sector-specific factors, or global factors) may deteriorate the creditworthiness of the counterparty, increasing the default probability. The same factors may trigger a fall in the underlying (e.g., stock) asset's price, generating positive payoffs for the long but increasing the counterparty risk exposure. Before the long gets too excited to see an increase in payoffs, he is hit by the realization of increasingly becoming a victim of WWR, due to positive correlation between the risk exposure of the counterparty and probability of default of the counterparty producing an overall increase in counterparty risk. The payoffs may not materialize, although they are increasing. On the other hand, normalcy of the transaction would be termed as RWR if the counterparty is able to fulfill its obligation despite an increase in its position obligation.

Professor's Note: We are assuming in the previous put option example that the counterparty and the underlying issuer are the same in order to clearly illustrate WWR. The positive association between default probability and exposure will still give rise to WWR if the counterparty and underlying issuer are not the same.

Over-the-Counter Call Option

A call option gives the right to the long (buyer) to buy an underlying instrument at a predetermined price whereas the short (counterparty) is obligated to sell at the agreed-upon price if the option is exercised. Like the put option, we are assuming the counterparty and the underlying issuer are the same.

Assume that due to changes in some macroeconomic and global factors, the default probability of the counterparty declines, and the price of the underlying asset (e.g., stock) increases, producing higher payoffs for the call buyer. In this instance, his excitement of making money will be appropriate because the counterparty will be in a strong position to pay off its obligation (due to the overall increase in creditworthiness). Such an outcome will be considered the "normalcy" of the transaction, and it is termed RWR. The short is able to fulfill its obligation despite the increase in its position obligation. On the other hand, if the counterparty is unable to fulfill its obligation due to the increase in its position obligation (higher value of underlying for the long, but higher obligation for the short—an increase in counterparty risk exposure), it would be an example of WWR (from the standpoint of the long position).

Credit Default Swaps (CDSs)

The 2007–2009 credit crisis offers a classic example of WWR from the perspective of the longs (i.e., the buyers) who had bought protection on issuers default on collateralized debt obligations (CDOs) or bonds backed by mortgage-backed securities (MBSs) via credit default swaps (CDSs).

As the real estate bubble burst and the market started taking a downward freefall, the value of MBSs started exhibiting a freefall as well. The monoline insurers, such as AMBAC and MBIA, had taken highly concentrated positions in offering protection against MBSs and CDOs. As the issuers of MBSs and CDOs started defaulting, the insurers were flooded by claims from the ones who had bought the protection (i.e., holders of CDSs).

The value of CDSs was rising, but this gain was generating an increase in risk exposure to the counterparty. Both the probability of default and the risk exposure of the insurers were rising. The unfortunate buyers of protection soon found out that the macrocredit and exposure linkage had produced unfavorable results for them. Despite huge gains on their positions, nothing materialized due to the deteriorating creditworthiness of the issuers, an example of WWR.

The normalcy of the transaction would be if the counterparty could fulfill its obligation despite an increase in position exposure (perhaps due to a negative association between risk exposure and probability of default). This would be an example of RWR. If insurance company ABC, for example, had taken a nonconcentrated exposure, it might not have experienced a decline in its creditworthiness (due to fewer claims) and would have been able to satisfy its obligations despite increasing risk exposure in the CDSs.

Foreign Currency Transactions

Consider a commercial bank in a developed economy (e.g., the United States) that enters into a cross currency agreement with a commercial bank (counterparty) in an emerging market (e.g., Uzbekistan), under which the counterparty will deliver developed market currency in return for local currency.

Macro conditions in the emerging country, such as a sovereign debt crisis, generate credit stress for the local bank, as well as a decline (depreciation) of local currency. The value of the transaction increases substantially for the financial institution in the developed economy due to the declining currency of the emerging economy. At the same time, the counterparty risk exposure increases as the gain for the financial institution in the developed economy increases.

Increases in default probability (due to credit stress) and risk exposure (due to declining currency) increase counterparty risk, resulting in WWR for the financial institution in the developed economy.

If the counterparty risk exposure and the credit quality are not unfavorably associated, then the risk exposure may increase, but the probability of default may decline (due to improvement in creditworthiness), producing a reduction in overall counterparty risk. This would be an example of RWR.

Foreign Currency Swaps

A real-world example will further clarify WWR in the foreign currency swaps market. Prior to the recent credit crisis in the United States, numerous financial institutions in Japan had entered into swap agreements with U.S. financial institutions to obtain dollar funding by using yen. They pledged yen to get U.S. dollars. After the default of Lehman Brothers, the financial crisis reached its peak, raising grave concerns about the economic slowdown of the U.S. and European economies. The yen significantly appreciated against the U.S. dollar, resulting in a substantial gain to Japanese bank positions (the pledged yen will buy more dollars, and U.S. banks will have to surrender more dollars for the pledged yen), increasing the counterparty risk exposure for Japanese banks. At the same time, deteriorating macro conditions had a negative impact on U.S. banks and the economy. In addition, the default probabilities of the U.S. financial institutions increased. Positive (unfavorable) association between counterparty risk exposure and default probability generated an overall increase in counterparty risk for Japanese banks, and they experienced WWR.

If the risk exposure and default probabilities are not positively associated, the normalcy of the transaction would balance out the increase in risk exposure by improving the creditworthiness of the financial institutions (macro factors may be related to both events in a different manner), lowering overall counterparty risk. The counterparty is able to meet its obligation despite an increase in risk exposure (due to an appreciating yen). This would be an example of RWR.

Interest Rate Transactions

Interest rate swaps provide another good illustration of WWR. In an interest rate swap, one party (i.e., the long or fixed-rate receiver) enters into an agreement with a counterparty (i.e., the fixed-rate payer) to receive a fixed rate and pay a floating rate. The fixed-rate receiver gains if the market interest rate (the swap rate) falls.

Assume due to macroeconomic conditions (e.g., an economic downturn), policy interest rates are lowered. The fixed-rate receiver experiences a value gain to the extent that the swap rate declines against the counterparty with the fixed-rate payer and floating-rate receiver. However, this gain for the fixed-rate receiver also produces an increase in its counterparty risk exposure. Furthermore, if the economic downturn would also increase the default probability, then overall counterparty risk will increase, generating WWR for the fixed-rate receiver.

This is exactly what happened during the recent European sovereign debt crisis. Due to lower inflation and an economic recession, the policy interest rates were lowered. The euro (interest rate) swap rate declined, producing a gain for those who were holding fixed interest rate receiver positions against Italian financial institutions (fixed-rate payer). However, the decline in the euro swap rate also increased the counterparty risk exposure. Deteriorating economic conditions also increased the default probability of Italian financial institutions. An increase in both the risk exposure and default probability resulted in an overall increase in counterparty risk, generating WWR for the holder of fixed-rate receiver swaps.

In the absence of a positive association between risk exposure and default probability, the Italian financial institutions might have been able to fulfill their obligations comfortably, despite the increase in exposure, generating RWR.

Commodities

Airlines hedge against the risk of rising oil prices. For example, assume an airline is long an oil forward contract at a fixed price. The counterparty is a dealer who has taken heavy concentrated positions. If oil prices rise, the gains for the airline will rise. The airline will buy cheap oil because the spot price will be higher than the locked-in forward price, but at the same time, the risk exposure for the dealer will increase. Because the dealer had concentrated positions, there may be a flood of claims (several forward contract claims brought by various airlines), putting intense pressure on the credit quality of the counterparty. Thus, an increase in both the risk exposure and the default probability will increase overall counterparty risk, producing WWR.

On the other hand, a dealer with a nonconcentrated position may continue to have sound creditworthiness despite rising exposure. Thus, the dealer will be able to fulfill her obligation, lowering the overall expected amount of risk exposure from the standpoint of the airline. This would be an example of RWR.

Key Concepts

LO 32.1

Financial institutions should pay more attention to wrong-way risk and right-way risk for planning purposes. The recent global financial crisis and European sovereign debt crisis have illustrated the significance of these risks.

Numerous macroeconomic events can impact exposure risk and default probability, producing an overall increase in counterparty credit risk. Position gains may not materialize due to an increase in the counterparty's overall risk. This is an example of wrong-way risk.

On the other hand, favorable associations between exposure risk and default probability resulting from changes in macro factors may produce a decline in overall counterparty credit risk. This is an example of right-way risk.

LO 32.2

Wrong-way risk and right-way risk can be identified in numerous investment products and transactions, such as call options, put options, credit default swaps, foreign currency transactions, interest rate products, currency swaps, and forward contracts.

The key to identify wrong-way and right-way risk is to assess the impact on overall counterparty risk. If the co-movement between risk exposure and default probability generates an overall increase (decrease) in counterparty risk, it would be an example of wrong-way risk (right-way risk).

During the recent global financial crisis, credit default swaps offered a classic example of wrong-way risk. The buyers of credit default swaps (protection against the default of bond issuers) experienced a substantial gain as the values of the bonds backed by mortgage-backed securities started tumbling. However, the collapse of the mortgage market not only increased the risk exposure but also the default probability, leading to an overall increase in counterparty risk. There were many buyers of credit default swaps whose gains remained paper gains due to the deteriorating creditworthiness of the counterparty.

Concept Checkers

1. How many of the following statements regarding wrong-way risk (WWR) and right-way risk (RWR) are correct?
   I. Co-movement in risk exposure and default probability producing a decline in overall risk is an example of wrong-way risk.
   II. Co-movement in risk exposure and default probability producing an increase in overall counterparty risk is an example of right-way risk.
   III. Co-movement in risk exposure and default probability producing neither a decline nor an increase in the overall counterparty risk is an example of wrong-way risk.
   IV. Co-movement in risk exposure and default probability producing a decline in risk exposure but an increase in counterparty default probability is an example of right-way risk.
   A. None.
   B. All.
   C. Two.
   D. Three.

2. Which of the following events would likely lead to an increase in WWR?
   I. The borrower and the guarantor are business partners.
   II. A monoline insurer sold protection concentrated in a business or industry.
   A. I only.
   B. II only.
   C. Both I and II.
   D. Neither I nor II.

3. Which of the following statements regarding WWR and RWR is correct?
   A. A long put option is subject to WWR if both risk exposure and counterparty default probability decrease.
   B. A long call option experiences RWR if the interaction between risk exposure and counterparty default probability produces an overall decline in counterparty risk.
   C. Declining local currency can decrease the position gain in a foreign currency transaction, while increasing risk exposure of the counterparty.
   D. The 2007–2009 credit crisis provides an example of WWR from the perspective of a long who had sold credit default swaps (CDSs) as protection against bond issuers' default.

4. How many of the following statements regarding counterparty risk are correct?
   I. Speculation in normal-functioning derivatives markets automatically produces RWR.
   II. RWR has been the center of attention in historical context, whereas WWR has not been paid much relative attention.
   III. The counterparty default probability does not enter into the equation for estimating the overall counterparty risk.
   IV. Unlike exposure to OTC derivatives, which is normally assumed to be a fixed amount for a specified time period, exposure to bank loans fluctuates depending on market conditions.
   A. None.
   B. All.
   C. Two.
   D. Three.

5. Which of the following statements is correct?
   I. Depreciation of the yen after the default of Lehman Brothers gave a substantial gain to Japanese bank foreign currency swaps positions to obtain dollar funding in interest rate swaps.
   II. Fixed-rate receivers experience a value gain to the extent that the swap rate increases.
   A. I only.
   B. II only.
   C. Both I and II.
   D. Neither I nor II.

Concept Checker Answers

1. **A** A decline in overall counterparty risk is an example of right-way risk. An increase in overall counterparty risk is an example of wrong-way risk. An increase in overall counterparty risk is a condition for the emergence of wrong-way risk. A decline in risk exposure but increase in counterparty default probability may or may not lower overall counterparty risk.

2. **C** WWR will increase if the borrower and guarantor are business partners. The guarantees offered by a monoline insurer may turn out to be worthless if the risk exposure increases and the guarantor is hit by a flood of claims due to a concentrated position in an industry or business.

3. **B** A long call option experiences RWR if risk exposure and counterparty default probability results in decreased counterparty risk. A long put option is subject to WWR if both risk exposure and counterparty default probability *increase*. Declining local currency can *increase* the position gain in a foreign currency transaction, while increasing counterparty risk exposure. The 2007–2009 credit crisis provides an example of WWR from the perspective of a long who had *bought* CDSs as protection against bond issuers' default.

4. **A** Hedging, and not speculation, in normal functioning markets automatically produces RWR. Historically, RWR was relatively neglected by institutions for planning purposes. The counterparty default probability is one of the key elements in estimating overall counterparty risk. OTC exposures fluctuate based on market conditions.

5. **D** Appreciation, and not depreciation, of the yen generated a substantial gain for Japanese banks with foreign currency swaps positions. A fixed-rate receiver experiences a value gain to the extent that the swap rate declines.

The following is a review of the Credit Risk Measurement and Management principles designed to address the learning objectives set forth by GARP®. This topic is also covered in:

The Evolution of Stress Testing Counterparty Exposures

Topic 33

Exam Focus

In this topic, we take a detailed look at counterparty credit risk measurement and management. We begin by differentiating between the various measures of exposure. Next, we look at the treatment of counterparty credit risk, both as a credit risk and as a market risk. We then review the credit valuation adjustment (CVA) and stresses to the CVA. For the exam, be able to describe a stress test that can be performed on both a loan portfolio and a derivatives portfolio. In addition, ensure that you are able to calculate the stressed expected loss. Finally, be able to calculate stressed CVA and understand how the debt value adjustment (DVA) differs from the CVA.

Counterparty Credit Risk Exposure Measures

LO 33.1: Differentiate among current exposure, peak exposure, expected exposure, and expected positive exposure.

The concept of **counterparty credit risk** (CCR) and its measurement and management gained prominence in the 1990s, and it now forms a critical part of most organizations' risk governance. Financial institutions incorporated CCR through analyzing their derivatives exposures and by tracking the current exposure to their counterparties. Institutions measured regulatory capital for CCR as add-ons to current exposures, calculated as a percentage of gross notional derivatives values.

With the rise in importance of measuring CCR, modeling CCR also evolved. Initially, potential exposure models were used to measure and limit CCR. This approach evolved into expected positive exposure models, which allowed derivatives to be incorporated into portfolio risk models along with loans. The measurement of CCR also formed the basis for regulatory capital under Basel II and allowed for the incorporation of credit mitigants into risk modeling, including netting agreements.

There are four important definitions of exposure measures:

- **Current exposure**. Also called replacement cost, current exposure is the greater of (1) zero or (2) the market value of a transaction (or a portfolio of transactions) that would be lost if the counterparty defaulted and no value was recovered during bankruptcy.
- **Peak exposure**. Peak exposure measures the distribution of exposures at a high percentile (95% or 99%) at a given future date prior to the maturity of the longest maturity exposure in the netting group. Peak exposure is usually generated for many future dates.

- **Expected exposure**. Expected exposure measures the mean (average) distribution of exposures at a given future date prior to the maturity of the longest maturity exposure in the netting group. Expected exposure is also typically generated for many future dates.
- **Expected positive exposure (EPE)**. EPE is the weighted average of expected exposures over time. The weights represent the proportion of individual expected exposures of the entire time interval. For the purposes of calculating the minimum capital requirement, the average is measured over the first year or over the length of the longest maturing contract.

One of the issues with CCR is **wrong-way risk**. Wrong-way risk is the risk that the exposure from a counterparty grows at the same time that the risk of default by the counterparty increases. Note that wrong-way risk does not arise with fixed-rate loans.

CCR Treatment

LO 33.2: Explain the treatment of counterparty credit risk (CCR) both as a credit risk and as a market risk and describe its implications for trading activities and risk management for a financial institution.

The treatment of CCR as a market risk was historically done through pricing in a **credit valuation adjustment** (CVA). CVA represents the market value of the CCR. Before the 2007–2009 financial crisis, institutions saw stable credit spreads and CVAs that made up only a small component of a derivatives portfolio. When the financial crisis resulted in unusual losses and gains, institutions began to pay closer attention to risk managing the CVA.

Financial institutions may view CCR as either a credit risk or a market risk and may manage the credit portfolio accordingly, but looking at it as only one type of risk (in a silo) exposes the institution to the risk from the other side.

Treating CCR as a credit risk exposes the institution to changes in CVA; therefore, CVA must be included when valuing a derivatives portfolio. Not including the CVA could lead to large swings in market value. Credit risk is managed at inception or typically through collateral arrangements, but it is not actively managed once the trades are set up. Since at default all trades need to be replaced in the market, emphasis is on risk mitigation and credit evaluation.

Treating CCR as a market risk allows an institution to hedge market risk losses but leaves it exposed to declines in counterparty creditworthiness and default. However, CCR can be hedged through replacing contracts with a counterparty instead of waiting for default to occur. This can be achieved by buying positions in proportion to the counterparty's probability of default (PD). A counterparty with a low PD will only have a small component of its trades replaced this way, while counterparties with deteriorating credit quality will see their trades replaced faster and moved to other counterparties.

The treatment of CCR as both a credit risk and a market risk creates a large variety of measurements that can be complex to interpret. For example, credit risk uses current exposure, peak exposure, and expected exposure, while market risk uses CVA and variability in CVA (measured by VaR of CVA). When stress testing the portfolio, the number of stress results can be very large. By classifying CCR as both a credit risk and a market risk, the number of stress results would equal twice the number of counterparties plus one, and would be double that amount if instantaneous shocks were considered in addition to stressed risk measures.

Stress Testing Current Exposure

LO 33.3: Describe a stress test that can be performed on a loan portfolio and on a derivative portfolio.

Stress testing current exposure is the most common stress test. Financial institutions apply current exposure stresses to each counterparty by repricing portfolios under a scenario of risk-factor changes. Counterparties with the largest current exposures and largest stressed current exposures are typically reported to senior management.

For example, an institution that is stress testing current exposure using an equity crash involving a 25% decline in equity markets may create a table of the top counterparties with the largest stressed current exposure and include their credit ratings, mark-to-market values, collateral values, and current exposures. In effect, the table would indicate to management which counterparties are most vulnerable to a large scale equity market decline and how much the counterparties would owe the financial institution. Of course, financial institutions could construct tables for other stresses as well, including credit events and interest-rate shocks. The different stress scenarios would likely include different counterparties.

However, stress tests of current exposure suffer from two main shortcomings: (1) aggregating results is challenging and (2) it does not provide information on wrong-way risk.

Aggregating stress results needs to incorporate additional information for it to be meaningful. Simply taking the sum of all exposures only looks at a loss that would occur if all counterparties were to simultaneously default, which is an unlikely scenario. In addition, the stressed current exposures do not factor in the credit quality of the counterparty. The stress results, therefore, only look at the trade values and not the counterparty's capacity or willingness to repay its obligations. This difference becomes especially relevant when comparing the exposures between high-risk early stage companies and highly rated mature companies. Nevertheless, the task of incorporating counterparty credit quality into each stress scenario is onerous.

The stress results of current exposure also do not provide information on wrong-way risk. Since the stress measures already omit the credit quality of the counterparty, they cannot provide meaningful information on the correlation of exposure with credit quality.

Stress Testing Expected Loss

LO 33.4: Calculate the stressed expected loss, the stress loss for the loan portfolio and the stress loss on a derivative portfolio.

Loan Portfolios

The **expected loss** (EL) for any counterparty in a loan portfolio is a function of the probability of default (PD_i), exposure at default (EAD_i), and loss given default (LGD_i). The EL for a portfolio is the sum of the individual exposures:

$$EL = \sum_{i=1}^{N} PD_i \times EAD_i \times LGD_i$$

Stress testing the EL could involve stressing the PD, which is a function of several other variables, including the unemployment rate or a relevant exchange rate. The **stressed expected loss** (EL_S) is, therefore, conditional on the impact of these variables on the PD. The EL_S can be expressed as:

$$EL_S = \sum_{i=1}^{N} PD_i^S \times EAD_i \times LGD_i$$

The *stress loss* for the loan portfolio is the difference between EL_S and EL. The financial institution could create different stress scenarios by increasing the PDs or by stressing the various variables. Note that the variables tend to be macroeconomic or balance sheet values.

Derivatives Portfolios

The EL and EL_S for a derivatives portfolio are derived similarly to the loan portfolio in that they both use the PD and LGD. However, exposure at default, which is stochastic and depends on market factors, is replaced with the expected positive exposure (EPE_i) multiplied by an alpha factor (α). This allows CCR exposures to be used in a portfolio credit model. We can then measure EL and EL_S for derivatives portfolios as:

$$EL = \sum_{i=1}^{N} PD_i \times (EPE_i \times \alpha) \times LGD_i$$

$$EL_S = \sum_{i=1}^{N} PD_i^S \times \left(EPE_i^S \times \alpha\right) \times LGD_i$$

Stress losses are done on a portfolio of derivatives counterparties. Similar to the loan portfolio, the financial institution could create different stress scenarios by increasing the PDs, or by stressing macroeconomic variables, balance sheet values, or values of financial instruments.

In the context of EPE, institutions could also stress market variables including swap rates and equity prices. The stresses to these variables may either increase or decrease EL. Their overall impact will depend in part on the directional bias of the financial institution's portfolio, which counterparties are margined, and which have excess margin. This differs from stresses on the loan portfolio, which tend to be directionally the same and, therefore, have similar effects across counterparties. It is important to note that an institution that conducts EPE stresses does not need to separately consider aggregating them with its loan portfolio, since loans are not sensitive to market variables and will not change exposures due to changes in these variables.

Financial institutions typically shock a series of market variables instantaneously. During these instantaneous shocks, the institution shocks the initial value of a derivative prior to running the EPE simulation. How much this affects EPE will depend in part on the degree of collateralization and the portfolio's moneyness. A series of shocks could also be performed over time; however, the common approach is to perform shocks to current exposure only.

Financial institutions could also consider joint stresses between credit quality and market variables. Although this is conceptually easy, it is challenging in practice since the variables are not tied by any meaningful connection. Equity-based approaches may be the closest to modeling joint stresses; however, the link between a shock to exposure and the equity-based default probability is unclear. It is also difficult to model the connection between exposure and PD in calculating wrong-way risk. Currently, the best way to identify wrong-way risk is to stress current exposure and identify the counterparties most exposed to wrong-way risk.

Treating CCR as a credit risk allows an institution to improve the management of its loan portfolio. Performing stress tests to CCR allows aggregating losses with loan portfolios and allows considering counterparty credit quality. On the other hand, treating CCR as a market risk allows for easier joint stresses of credit quality and exposure, and allows an institution to derive the PD from market variables.

Stress Testing Credit Valuation Adjustment

LO 33.5: Describe a stress test that can be performed on CVA.

LO 33.6: Calculate the stressed CVA and the stress loss on CVA.

Stress testing CCR for market risk events looks at the losses in market value of a counterparty exposure due to market risk events or credit spread changes. Financial institutions typically only consider the **unilateral CVA** for stress testing, which looks at a counterparty's default to the institution under various market events. However, financial institutions should also consider the possibility that they could default to their counterparties, and, as a result, should consider their **bilateral CVA** (BCVA), which is discussed in LO 33.7.

To calculate the stressed CVA and the stress loss, let's first look at the formula for calculating CVA. The following is a simplified formula for CVA that does not factor in wrong-way risk:

$$CVA_n = LGD_n^* \times \sum_{j=1}^{T} EE_n^*(t_j) \times q_n^*(t_{j-1}, t_j)$$

where:

LGD_n^* = risk-neutral loss given default
$EE_n^*(t_j)$ = risk-neutral discounted expected exposure
$q_n^*(t_{j-1}, t_j)$ = risk-neutral marginal default probability

When aggregating across *N* counterparties in a portfolio, the formula for CVA becomes:

$$CVA = \sum_{n=1}^{N} LGD_n^* \times \sum_{j=1}^{T} EE_n^*(t_j) \times q_n^*(t_{j-1}, t_j)$$

The components of this formula all depend on market variables, including credit spreads, market spreads, and derivatives values. Calculating a stressed CVA involves applying an instantaneous shock to these market variables, which could affect the discounted expected exposure or the risk-neutral marginal default probability. The **stressed CVA** can then be calculated as:

$$CVA_S = \sum_{n=1}^{N} LGD_n^* \times \sum_{j=1}^{T} EE_n^S(t_j) \times q_n^S(t_{j-1}, t_j)$$

The *stress loss* is simply the difference between CVA_S and CVA.

Stress testing CCR in a credit-risk framework has similarities with stress testing in a market-risk framework. Both rely on EL as a function of LGD, exposure, and PD. Nevertheless, their values will differ depending on whether the view is from a market-risk or credit-risk perspective. The two primary differences include the use of risk-neutral values for CVA (versus physical values for ELs), and the use of ELs over the transaction's life for CVA (versus a specific time horizon for ELs).

In addition, CVA uses a market-based model for calculating the PD. The market-based approach has the advantage of being able to incorporate a correlation between the exposure and the PD. This correlation can significantly influence the CVA. Because there is uncertainty regarding the correlation, financial institutions should run stress tests to determine the effects on profit and loss from incorrect correlation assumptions.

Stress Testing Debt Value Adjustment

LO 33.7: Calculate the debt value adjustment (DVA) and explain how stressing DVA enters into aggregating stress tests of CCR.

Financial institutions should include the liability effects in their stress calculations to properly calculate the CVA profit and loss. As a result, institutions could adequately incorporate the value of their option to default to a counterparty through the bilateral CVA, often called the **debt value adjustment** (DVA).

The BCVA formula is similar to the CVA formula with two differences. First, BCVA incorporates **negative expected exposure** (NEE), which is calculated from the counterparty's perspective. Second, the option that the financial institution can default on its counterparty is dependent on the counterparty surviving first; therefore, the probability of the counterparty's survival must be included in the BCVA formula (we denote this as S_I, with *I* representing the financial institution). This change must also be reflected in the CVA formula. The BCVA formula can therefore be set up as:

$$\begin{aligned} \text{BCVA} = &+\sum_{n=1}^{N} \text{LGD}_n^* \times \sum_{j=1}^{T} \text{EE}_n^*(t_j) \times q_n^*(t_{j-1}, t_j) \times S_I^*(t_{j-1}) \\ &-\sum_{n=1}^{N} \text{LGD}_I^* \times \sum_{j=1}^{T} \text{NEE}_n^*(t_j) \times q_I^*(t_{j-1}, t_j) \times S_n^*(t_{j-1}) \end{aligned}$$

The probability of survival depends on credit default swap (CDS) spreads, and the losses depend on the financial institution's own credit spread. Institutions should be aware that this may result in counterintuitive results, for example, implying that losses occur because the institution's credit quality has improved. In any case, the financial institution should consider stress results for the BCVA and calculate stress losses by subtracting the current BCVA from the stressed BCVA.

The benefit of incorporating BCVA is that it allows CCR to be treated as market risk, which enables CCR to be included in market risk stress testing consistently. Any gains or losses from the BCVA stress could then be added to the institution's stress tests from market risk.

Shortcomings of Stress Testing CCR

LO 33.8: Describe the common pitfalls in stress testing CCR.

Stress testing CCR includes the following pitfalls:

- Stress testing CCR is a relatively new method, and institutions typically do not aggregate CCR with loan portfolio or trading position stress tests.
- Institutions typically stress test *current exposure* when incorporating the losses with loan or trading position. This is a mistake, because institutions should instead use *expected exposure* or *positive expected exposure*.
- Using current exposure can lead to significant errors, which is particularly evident in at-the-money exposures when measuring derivatives market values.
- When calculating changes in exposures, using delta sensitivities is also challenging for CCR since delta is nonlinear. The linearization of delta sensitivities in models can lead to significant errors.

Key Concepts

LO 33.1

The four definitions of counterparty credit risk (CCR) exposure measures are:

- Current exposure, or replacement cost, is the greater of zero or the market value of a transaction (or transactions) upon counterparty default, assuming no recovery in value.
- Peak exposure measures the distribution of exposures at a high percentile (95% or 99%) at a given future date before the maturity of the longest maturity exposure in the netting group.
- Expected exposure measures the mean distribution of exposures at a given future date prior to the maturity of the longest maturity exposure in the netting group.
- Expected positive exposure (EPE) is the weighted average of expected exposures over time, where the weights represent the proportion of individual expected exposures of the entire time interval.

LO 33.2

Credit valuation adjustment (CVA) represents the market value of the CCR. Financial institutions could view CCR as either credit risk or market risk, although it should consider both risks.

Treating CCR as credit risk exposes an institution to changes in CVA. CVA should, therefore, be included in valuing a derivatives portfolio, otherwise the portfolio could experience large changes in market value.

Treating CCR as market risk allows an institution to hedge market risk losses; however, it leaves the institution exposed to declines in counterparty creditworthiness and default.

Treating CCR as both credit risk and market risk is prudent, but this approach is complex and difficult to interpret.

LO 33.3

The most common stress test is stress testing current exposure. Stresses may include equity crash simulations, other credit events, or interest-rate shocks. Counterparties with the largest current exposures are generally reported to senior management.

Stress tests of current exposure have two primary shortcomings. First, aggregating results is challenging and stresses do not factor in the credit quality of the counterparty. Second, they do not provide information on wrong-way risk.

LO 33.4

In a loan portfolio, the expected loss (EL) for any one counterparty is a function of the probability of default (PD_i), exposure at default (EAD_i), and loss given default (LGD_i). The EL for a portfolio is the sum of the individual exposures.

The stressed expected loss (EL_S) is determined by stressing the PD. The stress loss for the loan portfolio is, therefore, the difference between the stressed EL and EL.

In a derivatives portfolio, the EL for any counterparty is a function of PD_i, LGD_i, and expected positive exposure (EPE_i) multiplied by an alpha factor (α).

LO 33.5

Currently, institutions typically only consider a counterparty's probability of default (PD) to the institution (i.e., unilateral CVA). A financial institution should instead consider its bilateral CVA, or the possibility that counterparties could default to the institution and the possibility that the institution could default to its counterparties.

LO 33.6

The formula for calculating CVA across all counterparties is a function of the discounted expected exposure, the risk-neutral marginal probability for a counterparty, and the risk-neutral LGD. The formula depends on market variables, including credit spreads, market spreads, and derivatives values. To calculate a stressed CVA (CVA_S), an instantaneous shock is applied to these market variables. The stress loss is the difference between CVA_S and CVA.

LO 33.7

Financial institutions should incorporate the value of their option to default to a counterparty through the bilateral CVA, also known as the debt value adjustment (DVA).

The BCVA formula differs from the CVA formula in that BCVA incorporates negative expected exposure (NEE) and the probability of the counterparty's survival.

The probability of survival depends on credit default swap spreads, and the losses depend on the institution's own credit spread. The financial institution should consider stress results for the BCVA. Stress losses are calculated by subtracting the value of the current BCVA from the stressed BCVA.

LO 33.8

Shortcomings of stress testing CCR include:

- CCR is not aggregated with loan portfolio or trading position stress tests.
- Stress testing current exposure is not optimal. Instead, institutions should use expected exposure or positive expected exposure.
- Using current exposure can lead to significant errors, especially for at-the-money exposures, when measuring derivatives market values.
- The linearization of delta sensitivities in models can lead to significant errors.

Concept Checkers

1. Which of the following exposure measures reflects the average distribution of exposures at a specific future date prior to the maturity of the longest maturity transaction within a netting set?
   A. Peak exposure.
   B. Current exposure.
   C. Expected exposure.
   D. Expected positive exposure.

2. Is the following statement on the treatment of counterparty credit risk (CCR) correct?

   "Treating CCR as a market risk does not allow an institution to hedge market risk losses, and it exposes the institution to declines in counterparty creditworthiness and default."

   A. The statement is correct with regard to both hedging market risk losses and counterparty creditworthiness and default.
   B. The statement is incorrect with regard to both hedging market risk losses and counterparty creditworthiness and default.
   C. The statement is correct with regard to hedging market risk losses only.
   D. The statement is correct with regard to counterparty creditworthiness and default only.

3. An analyst notes that stress testing current exposure is problematic because aggregating results is typically not meaningful, although it is easy to account for the credit quality of the counterparty. Are the analyst's statements correct?
   A. The analyst is correct with regard to both aggregating results and credit quality.
   B. The analyst is correct with regard to aggregating results only.
   C. The analyst is correct with regard to credit quality only.
   D. The analyst is incorrect with regard to both aggregating results and credit quality.

4. Which of the following statements best reflects the reason why a financial institution does not need to consider aggregating stresses to the expected positive exposure (EPE) with its loan portfolio?
   A. Loans are not sensitive to market variables.
   B. Stresses to EPE are not sensitive to market variables.
   C. The EPE and the loan portfolio are negatively correlated.
   D. The EPE and the loan portfolio are positively correlated.

5. Is the following statement on bilateral credit valuation adjustment (BCVA) correct?

   "The formula for BCVA is similar to the formula for CVA, except that the BCVA formula uses expected positive exposure (EPE) and it incorporates the probability of the counterparty's survival."

   A. The statement is correct with regard to both EPE and probability of survival.
   B. The statement is correct with regard to EPE only.
   C. The statement is correct with regard to probability of survival only.
   D. The statement is incorrect with regard to both EPE and probability of survival.

Concept Checker Answers

1. **C** Expected exposure measures the mean distribution of exposures at a given future date prior to the maturity of the longest maturity exposure in the netting group.

2. **D** Treating CCR as a market risk allows an institution to hedge market risk losses; however, it leaves the institution exposed to declines in counterparty creditworthiness and default. CCR can be hedged by the ongoing replacement of contracts with a counterparty instead of waiting for default to occur.

3. **B** The analyst is correct to state that aggregating stress results is not meaningful. Simply taking the sum of all exposures only considers the loss that would occur if all counterparties were to simultaneously default. This is an unlikely scenario. The analyst's statement on credit quality of the counterparty is incorrect since stresses do not factor in the credit quality of the counterparty.

4. **A** A financial institution does not need to consider aggregating stresses to the EPE with its loan portfolio, because loans are not sensitive to market variables and, therefore, will not have any exposure changes from changes in market variables.

5. **C** The BCVA formula differs from the CVA formula in that BCVA incorporates negative expected exposure (NEE), and the probability of the counterparty's survival must be included in the BCVA formula.

The following is a review of the Credit Risk Measurement and Management principles designed to address the learning objectives set forth by GARP®. This topic is also covered in:

Credit Scoring and Retail Credit Risk Management

Topic 34

Exam Focus

This topic examines credit risk management, primarily from the perspective of the retail credit lender. For the exam, focus on the risks incurred by a lender and how credit scoring models can be used to incorporate variables into an effective risk evaluation model. While estimating risk and evaluating model performance is critical, assessing credit applicants for potential profitability is also important. Be familiar with the role of a credit applicant as both a borrower and a potential client for other lender products. Also, understand the concept of risk-based pricing and how it has changed the way that lenders price their products to different customers.

Retail Banking Risks

LO 34.1: Analyze the credit risks and other risks generated by retail banking.

The retail banking industry revolves around receiving deposits from and lending money to consumers and small businesses. Loans can take the form of home mortgages, home equity lines of credit (HELOCs), installment loans (revolving loans covering automobiles, credit cards, etc.), and small business loans (SBLs). From the perspective of the lending institution, these individual loans constitute small pieces of large portfolios designed to reduce the incremental risk to any one exposure.

The biggest risk associated with retail banking is **credit risk**, which is the likelihood that a borrower will default on debt. Throughout the five years preceding the 2007 subprime mortgage crisis, banks offered customers products they could not afford with risks that were more than customers could bear. **Loan-to-value** (LTV) **ratios** on mortgaged properties were very high and borrowers with weaker credit were given mortgages. These strategies backfired when housing prices collapsed, which resulted in mortgages often exceeding the value of the properties themselves.

Although credit risk is the primary risk in retail banking, several other risks also impact the industry. These risks include:

- **Operational risks**: day-to-day risks associated with running the business.
- **Business risks:** strategic risks associated with new products or trends and volume risks associated with measures like mortgage volume when rates change.
- **Reputation risks:** the bank's reputation with customers and regulators.

- **Interest rate risks**: the bank provides specific interest rates to its assets and liabilities and rates change in the marketplace.
- **Asset valuation risk**: a form of market risk associated with the valuation of assets, liabilities, and collateral classes. An example includes prepayment risk associated with mortgages in decreasing rate environments. Valuation risk also exists in situations when car dealers assume a residual value for a vehicle at the end of the life of a lease.

Retail Credit Risk vs. Corporate Credit Risk

LO 34.2: Explain the differences between retail credit risk and corporate credit risk.

There are several features that distinguish retail credit risk from **corporate credit risk**. As mentioned earlier, retail credit exposures are relatively small as components of larger portfolios such that a default by any one customer will not present a serious threat to a lending institution. A commercial credit portfolio often consists of large exposures to corporations that can have a significant impact on their industry and the economy overall.

Due to the inherent diversification of a retail credit portfolio and its behavior in normal markets, estimating the default percentage allows a bank to effectively treat this loss as a cost of "doing business" and to factor it into the prices it charges its customers. A commercial credit portfolio is subjected to the risk that its losses may exceed the expected threshold, which could have a crippling effect on the bank.

Banks will often have time to take preemptive actions to reduce retail credit risk as a result of changes in customer behavior signaling a potential rise in defaults. These preemptive actions may include marketing to lower risk customers and increasing interest rates for higher risk customers. Commercial credit portfolios typically don't offer these signals, as problems might not become known until it is too late to correct them.

The Dark Side of Retail Credit Risk

LO 34.3: Discuss the "dark side" of retail credit risk and the measures that attempt to address the problem.

An unexpected, systematic risk factor may cause losses to rise beyond an estimated threshold, damaging a bank's retail portfolio through declines in asset and collateral values and increases in the default rate. This represents the "dark side" of retail credit risk.

Primary causes include:

- The lack of historical loss data due to the relative newness of specific products.
- An across the board increase in risk factors impacting the economy overall that causes retail credit products to behave unexpectedly.
- An evolving social and legal system which may inadvertently "encourage" defaults.
- An operational flaw in the credit process due to its semi-automated structure that results in credit granted to higher risk individuals.

The **Consumer Financial Protection Act** (CFPA), in an attempt to manage the dark side of retail credit risk, requires credit originators to evaluate **qualified mortgages** and **ability to repay**.

A borrower with a "qualified mortgage" is assumed to have the capacity to repay. A qualified mortgage will put a limit on the amount of income allocated to debt repayments (e.g., debt-to-income ratio < 45%). A qualified mortgage cannot have excess upfront fees and points, may not be balloon payment loans or interest-only loans, may not be for longer than 30 years, and may not be negative amortization loans.

When a lender is evaluating a customer's "ability to repay," the following underwriting standards must be considered:

- Credit history.
- Current income and assets.
- Current employment status.
- Mortgage monthly payments.
- Monthly payments on mortgage-related items such as insurance and property taxes.
- Monthly payments on other associated property loans.
- Additional debt obligations of the borrower.
- The monthly debt-to-income ratio resulting from the mortgage.

Due to the predictable and relative safety of retail credit, banks must set aside a relatively small amount of risk capital compared to requirements associated with corporate loans. Banks must provide regulators with specific statistics associated with differentiated segments of their portfolios. These statistics include: **probability of default** (PD), **exposure at default** (EAD), and **loss given default** (LGD).

Credit Risk Scoring Models

LO 34.4: Define and describe credit risk scoring model types, key variables, and applications.

A **credit risk scoring model** takes information about an applicant and converts it into a number for the purpose of assessing risk; the higher the number, the higher the probability of repayment by the borrower and the lower the overall risk. Credit scoring models facilitate the gathering of an enormous amount of information into a single automated process.

A credit risk scorecard will gather information from applications and credit bureau reports and weight it depending on the type of questions answered. The question/entry will ask for a specific characteristic like "number of years with current employer," and the attribute will be the response (e.g., 10 years). Credit scoring models will determine positive and negative values and weight each attribute according to past history and the associated probability of repayment.

Three model types exist in regard to scoring applications for consumer credit:

- **Credit bureau scores:** this refers to an applicant's FICO score, and is very fast, easy, and cost effective to implement and evaluate. Scores will typically range from a low of 300 to a high of 850, with higher scores associated with lower risk to the lender and lower interest rates for the borrower.

- **Pooled model**: this model, built by outside parties, is more costly than implementing a credit bureau score model; however, it offers the advantage of flexibility to tailor it to a specific industry.
- **Custom model**: created by the lender itself using data specifically pulled from the lender's own credit application pool. This model type allows a lender to evaluate applicants for their own specific products.

Every individual with a credit history will have credit files containing the following information:

- Personal (identifying) information which doesn't factor into scoring models.
- Records of credit inquiries when a file is accessed. Requests for new credit will be visible to credit grantors.
- Data on collections, reported by entities that provide credit or agencies that collect outstanding debts.
- Legal (public) records on bankruptcies, tax liens, and judgments.
- Account and trade line information gathered from receivables information sent to credit bureaus by grantors.

Mortgage Credit Assessment

LO 34.5: Discuss the key variables in a mortgage credit assessment and describe the use of cutoff scores, default rates, and loss rates in a credit scoring model.

In assessing an application for mortgage credit, the key variables include:

- **FICO score**: a numerical score serving as a measure of default risk tied to the borrower's credit history.
- **Loan-to-value** (LTV) **ratio**: the amount of the mortgage divided by the associated property's total appraised value.
- **Debt-to-income** (DTI) **ratio**: the ratio of monthly debt payments (mortgage, auto, etc.) to the monthly gross income of the borrower.
- **Payment** (pmt) **type**: dictates the type of mortgage (adjustable rate, fixed, etc.)
- **Documentation** (doc) **types**, which include:
  - *Full doc*: a loan which requires evidence of assets and income.
  - *Stated income*: employment is verified but borrower income is not.
  - *No ratio*: similar to stated income, employment is documented but income is not. The debt-to-income ratio is not calculated.
  - *No income/no asset*: Income and assets are provided on the loan application but are not lender verified (other than the source of income).
  - *No doc*: no documentation of income or assets is provided.

Cutoff Scores

Cutoff scores represent thresholds where lenders determine whether they will or will not lend money (and the terms of the loan) to a particular borrower. As noted earlier, the higher the score, the lower the risk to the lending institution. Setting the cutoff score too low presents a higher risk of default to the lender. Setting the cutoff score too high may limit potential profitable opportunities by unintentionally eliminating low risk borrowers.

Once the cutoff score is established, historical experience can be used to establish the estimated profitability for a specific product line and the associated loss rate. As estimates are made from longer time horizons (which hopefully capture a full economic cycle), a bank may adjust its cutoff score to maximize the appropriate balance between risk and profitability.

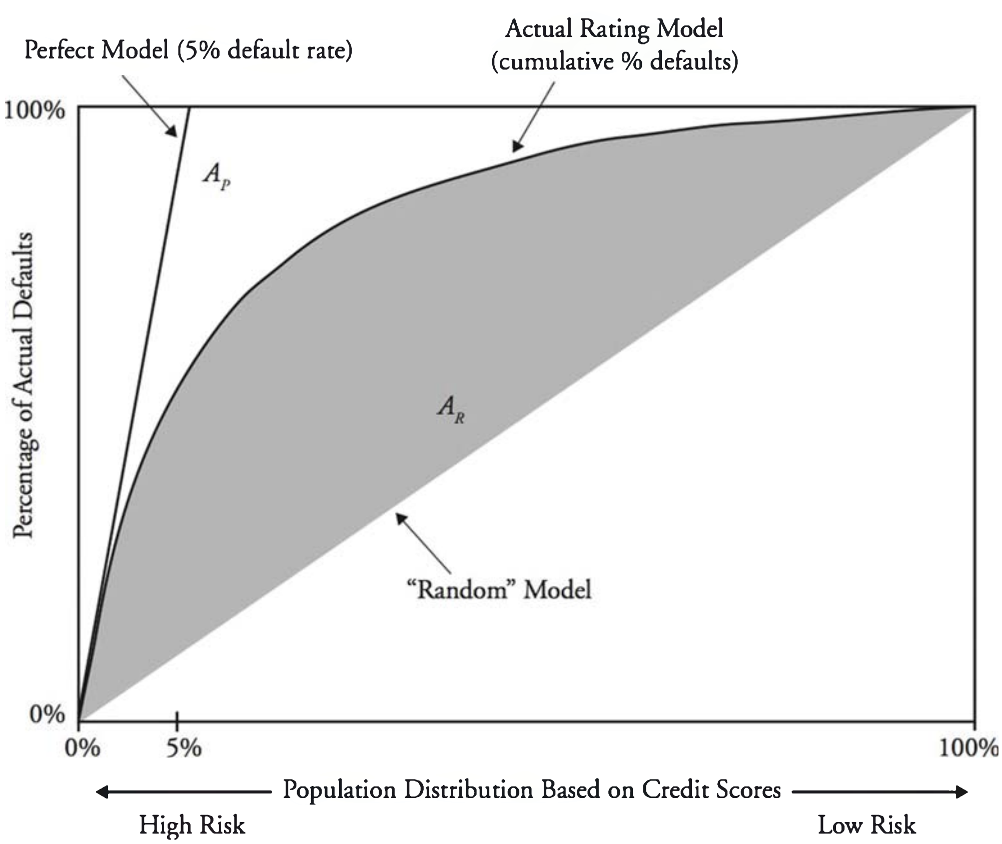
Banks are required by the Basel Accord to group their portfolios into subgroups that share similar loss attributes, with score bands used to differentiate the groups by risk levels. For each of these subgroups, banks are required to estimate the PD and the LGD. The implied PD is a by-product of the historical loss rate and the LGD such that if a portfolio has a loss rate of 3% with a 75% LGD, then the PD is 4% (i.e., 3%/75% = 4%).

Scorecard Performance

LO 34.6: Discuss the measurement and monitoring of a scorecard performance including the use of cumulative accuracy profile (CAP) and the accuracy ratio (AR) techniques.

Credit scoring is used as a means of predicting default risk, such that high (low) scores on the scorecard are assigned to strong (weak) credits. In assessing the performance of the scorecard, a **cumulative accuracy profile** (CAP) and the **accuracy ratio** (AR) are often used. The CAP shows the population distribution based on credit scores (and therefore risk) versus the percentage of actual defaults.

Figure 1: Cumulative Accuracy Profile and Accuracy Ratio



Lines plotted on the graph include the perfect model line, random model line, and observed cumulative default percentage line defined as follows:

- In a perfect model, if the bank predicts, for example, 5% of its accounts will default over a specific period, 100% of those defaults will come from the riskiest 5% of the population.
- A random model will assume 5% of the defaults will come from the riskiest 5%, 20% will come from the riskiest 20%, etc.
- The observed cumulative default line represents the actual defaults observed by the bank.

The area between the perfect model and the random model is represented by A_P, while the area between the observed cumulative default percentage line and the random line is represented by A_R. The accuracy ratio (AR) is defined as A_R/A_P, with a ratio close to 1 implying a more accurate model.

A scoring model must be monitored on a regular basis due to underlying changes in the population as well as potential product changes.

Tradeoff between Creditworthiness and Profitability

LO 34.7: Describe the customer relationship cycle and discuss the trade-off between creditworthiness and profitability.

Entities in the business of loaning money do not focus entirely on risk and creditworthiness; they also have to evaluate customers from the perspective of profitability. If a credit card is issued to a customer with a very high FICO score who pays their bill in full every month, the bank will not earn any interest from that customer on borrowed funds. At the same time, issuing that same credit card to a customer with a low FICO score is a greater risk because the customer may be unable to pay back loaned funds. Along with credit default scoring, lenders are using product and customer profit scoring measures to evaluate the potential profitability of a specific product and the potential profitability of a specific customer.

In utilizing scorecards to evaluate customers, there are several variations beyond just the credit bureau (FICO) scores. These additional scorecards can be used to evaluate both creditworthiness and profitability. They include:

- *Revenue scores*: used to evaluate existing customers on potential profitability.
- *Application scores*: used to support the decision to extend credit to a new applicant.
- *Response scores*: assign a probability to whether a customer is likely to respond to an offer.
- *Insurance scores*: assign a probability to potential claims by the insured.
- *Behavior scores*: assess existing customer credit usage and historical delinquencies.
- *Tax authority scores*: predict where potential audits may be needed for revenue collection.
- *Attrition scores*: assign a probability to the reduction or elimination of outstanding debt by existing customers.

The **customer relationship cycle** involves the process a lender goes through to market its products/services, screen applications from customers, manage customer accounts, and then cross-sell to those customers. Marketing efforts will focus on selling new or tailoring existing products to meet the needs of both new and existing customers. Applicant screening involves the acceptance or rejection of an application based on scorecards noted above, as well as ultimately determining the appropriate price to charge for accepted applicants. Managing the customer account will primarily involve product pricing, credit line authorizations, modifications, renewals, and principal or interest collections. Cross-selling efforts will target existing customers by offering other lender products to meet their needs.

Risk-Based Pricing

LO 34.8: Discuss the benefits of risk-based pricing of financial services.

Recognizing that charging a single price for a product to all customers regardless of risk levels may lead to adverse selection (i.e., high-risk customers attracted to a relatively low price relative to their risk profile and low-risk customers pushed away by the higher price relative to their risk profile), lenders have been moving toward **risk-based pricing** (RBP). RBP involves lenders charging different customers different prices based on their associated risks. Although RBP is still in the early stages of implementation in the financial retail sector, it has been utilized more frequently in credit card, home mortgage, and auto loan lines.

Key external and internal factors which account for risk and play into the interest rates and prices charged by lenders include:

- The probability of **take-up** (i.e., acceptance by the customer of the offered product).
- The probability of default (PD).
- The loss given default (LGD).
- The exposure at default (EAD).
- The cost of equity capital to the lender.
- Capital allocated to the transaction.
- Operating expenses of the lender.

Prices may be set on a tiered level based on score bands allocating risks from high to low. The lender can then map pricing strategies to metrics such as profit/loss, revenue, market share, and risk-adjusted return at the various score bands. Utilizing RBP effectively allows management to evaluate the inevitable tradeoffs among profitability, market share, and risk with the short and long-term goal of increasing shareholder value.

Key Concepts

LO 34.1

Retail banking involves the acceptance of deposits and lending of money to customers. Credit risk (the probability that a borrower will default on debt obligations) represents the biggest risk in retail banking. Other risks include operational risks, business risks, reputation risks, interest-rate risks, and asset valuation risk.

LO 34.2

Retail credit risk differs from corporate credit risk in the following significant ways:

- Retail exposures are relatively small such that one default has minimal impact, whereas commercial exposures are much larger and single defaults can have a significant impact.
- Losses exceeding expected thresholds can have a much greater impact for corporate portfolios than retail portfolios.
- Lenders can take preemptive actions to reduce retail credit risks, whereas commercial portfolios often send warning signals after it is too late.

LO 34.3

The "dark side" of retail credit risk occurs when a large scale risk factor causes a decline in asset values coupled with an increase in default rates. The end result is losses which exceed an estimated threshold. Lenders offering mortgage loans must evaluate customers' ability to pay as well as determining whether a mortgage is "qualified." In addition, banks must segment their portfolios and set aside risk capital as well as assess exposures and probabilities of default along with potential losses.

LO 34.4

A credit risk scoring model assigns (to each credit applicant) a score which serves as a measure of borrower risk; the higher (lower) the score, the lower (higher) the risk that the borrower won't be able to pay the debt obligation. Models include credit bureau scores, pooled models, and custom models which all use applicant data and weight them based on their historical relationship to potential defaults.

LO 34.5

Key variables associated with mortgage credit applications include FICO scores, loan-to-value ratios, debt-to-income ratios, payment types, and documentation types. Cutoff scores are thresholds set by lenders which dictate whether credit will or will not be extended, as well as terms associated with the loans. Probability of default and loss given default metrics are critical to assessing the risk associated with various lender portfolios.

LO 34.6

The cumulative accuracy profile (CAP) and the accuracy ratio (AR) are used to assess the performance of a credit scorecard. The closer the accuracy ratio is to 1, the more accurate the CAP model is at predicting the distribution of defaults relative to the risk levels of the associated population.

LO 34.7

For new and existing credit applicants, lenders may use a variety of scorecards to evaluate both creditworthiness and potential profitability. The customer relationship cycle involves marketing products, screening applicants, managing customer accounts, and eventual cross-selling to an existing customer base.

LO 34.8

Risk-based pricing (RBP) involves charging different prices for the same product such that higher (lower) prices can be charged to higher (lower) risk customers. Several external and internal factors are used to determine the prices charged, which are then evaluated in conjunction with various key performance metrics at each score (risk) band in order to maximize the tradeoff between risk and profitability.

Concept Checkers

1. Which of the following statements is most accurate regarding risks incurred by retail lenders?
   A. Reputation risk is more of a concern for the borrower rather than the lender.
   B. Business risk relates to the day-to-day operational risks of the business.
   C. Credit risk relates to the potential for a lender to default on their obligation.
   D. Refinancing a mortgage when rates decrease is an example of asset valuation risk.

2. The dark side of retail credit risk is perpetuated by all of the following factors except:
   A. capital set aside to protect a bank in the event of default.
   B. process flaws resulting in high risk applicants receiving credit.
   C. new products which do not have sufficient historical loss data.
   D. a social acceptance of bankruptcy and borrowers "walking away" from their obligations.

3. Which of the following statements is correct regarding credit risk scoring models?
   A. A pooled model will result in scores ranging from 300 to 850.
   B. A custom model is cheaper to implement than credit bureau scores.
   C. Multiple requests for new credit will reduce an applicant's credit score.
   D. An example of a characteristic in a scoring model is the applicant's current gross salary of $50,000.

4. In assessing the key variables associated with a potential mortgage loan, a bank will charge a higher interest rate if the borrower has a relatively:
   A. high FICO score.
   B. high loan-to-value ratio.
   C. low debt-to-assets ratio.
   D. low debt-to-income ratio.

5. By implementing risk-based pricing on its mortgage products, a bank will likely charge a:
   A. higher interest rate to a customer with a higher FICO score.
   B. lower interest rate to a customer with a lower credit bureau score.
   C. higher interest rate to a customer with a higher probability of default.
   D. lower interest rate to a customer positioned on a lower relative score band.

Concept Checker Answers

1. **D** Refinancing a mortgage is considered a prepayment risk to the lender, which is a component of asset valuation risk. When rates decrease, borrowers are more likely to refinance their existing (higher rate) mortgage into a lower rate obligation. The lender then earns less in interest on the debt obligation than they would have previously. Reputation risk is primarily a concern for the lender. Business risk relates to strategic risks tied to new products and volume, while credit risk is the risk that the borrower (rather than the lender) will default.

2. **A** Capital must be set aside to protect banks in the event of default, but this is a response to the dark side of retail credit risk rather than a perpetuating factor. A process flaw which grants credit to high risk individuals, a new product which doesn't have historical loss data, and the social "acceptance" of failing to meet debt payments are all considered perpetuating factors of retail credit risk.

3. **C** An individual's credit file will show a history of credit requests, with multiple requests causing an applicant's credit score to decline. A credit bureau score model (rather than pooled model) will result in scores ranging from 300 to 850. A custom model is more expensive to implement than credit bureau scores. "Gross salary with current employer" is an example of a characteristic, with the actual salary number itself representing an attribute.

4. **B** The loan-to-value ratio represents the amount of the mortgage versus the appraised value of the property. The higher this ratio is for a property and an associated borrower, the more risk there is to the lender. In order to protect their position, a lender will charge a higher interest rate. Each of the other scenarios will result in a lower interest rate.

5. **C** The more likely it is that a customer will default, the higher the interest rate the bank will charge. A customer with a higher (lower) FICO/credit bureau score will be offered a lower (higher) interest rate. A customer positioned on a lower relative score band will be offered a higher interest rate.

The following is a review of the Credit Risk Measurement and Management principles designed to address the learning objectives set forth by GARP®. This topic is also covered in:

The Credit Transfer Markets—and their Implications

Topic 35

Exam Focus

Securitized financial products became very popular prior to the 2007–2009 financial crisis. Although it is important for investors to understand the inner workings and risk potential inherent in any investment before adding it to a portfolio, more complex assets such as securitized products demand even more scrutiny. For the exam, be able to identify flaws in the securitization of subprime mortgages, and be able to explain the different techniques used to mitigate credit risk. Also, be able to describe the different types and structures of credit derivatives, including credit default swaps (CDSs), first-to-default puts, total return swaps (TRSs), and asset-backed credit-linked notes (CLNs). It is also important to be familiar with the structures of collateralized debt obligations (CDOs), synthetic CDOs, and single-tranche CDOs.

Flaws in the Securitization of Subprime Mortgages

LO 35.1: Discuss the flaws in the securitization of subprime mortgages prior to the financial crisis of 2007.

The financial credit crisis of 2007 is thought by some to have been caused by the process of transferring credit risk. However, during the credit crisis, the credit risk transfer mechanism did perform its intended function. The true issue was not the credit risk transfer process itself, but rather the underlying flaws in the pre-crisis securitization process.

Securitization in its most basic form is simply using financial engineering to repackage a pool of assets into a new asset that can be sold to investors. This innovation enables banks to transfer the credit risk inherent in mortgage lending to investors through mortgage-backed securities and similar investments. This process enhances the availability of loanable funds for borrowers, expands the pool of diversification options for investors, and minimizes the borrowing costs for a given risk-class of borrowers.

The securitization process enabled an active **originate-to-distribute model** where banks could originate a loan for the sole purpose of turning a quick profit and selling the securitized product to investors. This creates a conflict of interest because every link in the securitization chain, from the originator to the lender to the investment banker to the credit rating agency, had the potential to earn a relatively quick, short-term profit through securitization without retaining any of the risk, which was ultimately outsourced to investors. The gains in the securitization supply chain were linked solely to deal completion and not to the potential risk of the borrowers. In this process, U.S. financial institutions misjudged the liquidity and credit concentration risks inherent in mortgage lending. This paradoxical deviation from the traditional risk-reward tradeoff created less incentive to monitor the creditworthiness of borrowers and reduced accountability. It is one of the key flaws in the securitization process.

Professor's Note: According to the Joint Center for Housing Studies at Harvard University, from 2001 to 2006, conventional mortgages (30-year, fixed rate mortgages) fell from 57.1% of all loan originations to 33.1%. Subprime loans rose from 7.2% to 18.8%! Approximately 40% of all mortgages purchased by Fannie Mae and Freddie Mac, from 2005 to 2007, were subprime loans. Demand increased substantially for loans built with adjustable interest rates, zero down payments, and no documentation of income sources.

Another flaw in the securitization process is the opaqueness of the end product. Neither investors nor the rating agencies, whom the investors relied upon, fully understood how to evaluate the multilayered securitized products. Investors did not fully understand either the credit quality of the underlying loans or the potential correlation within the loan pool should an unexpected shock occur. This created a very fragile system based on trust, which was later broken when the expected low default rates exceeded a margin of safety.

A third flaw is that as time progressed without any initial problems, many banks elected to start retaining the risk of structured products. In fact, in mid-2007, U.S. financial institutions directly held $900 billion of subprime mortgage-backed products on their books. They used rolling short-term debts to finance purchases of long-term mortgage-backed structured products in off-balance-sheet entities known as **structured investment vehicles** (SIVs) partly because mortgages earned much higher returns than corporate bonds. Banks thought that they were earning a riskless spread over corporate bonds with comparable ratings. By using a leveraged SIV instead of holding the actual loans on their balance sheets, banks were able to use far less capital to hold a pool of mortgages. On one hand, this flaw appears to be a partial correction for the first flaw. Banks did start to retain some risk, but they used a mechanism that still prevented investors from evaluating the full extent of the risk.

In fairness, banks sometimes used SIVs as a warehouse for unsold structured products that were waiting to be matched with a willing buyer, but more often, the securitized products were seen as a sound investment by themselves. Some of the largest buyers of securitized U.S. subprime loans were European banks. For example, in 2006, subprime securities accounted for 90% of the profits of Sachsen Landesbank in Leipzig, Germany. This bank probably does not sound familiar, because it is no longer in existence. The bank ceased operations in 2007 due to its excessive level of leveraged risk exposure.

When structured with transparency, the credit risk transfer mechanism should assist the price discovery process for credit risk. If the three flaws identified can be adequately addressed, then financial institutions can once again use the credit transfer process to effectively manage risk.

Credit Risk Mitigation Techniques

LO 35.2: Identify and explain the different techniques used to mitigate credit risk, and describe how some of these techniques are changing the bank credit function.

When conducted properly, the credit risk transfer process can be revolutionary for financial institutions. Proper techniques can include bond insurance, collateralization, termination, reassignment, netting, marking-to-market, syndication of loan origination, or outright selling of a loan portfolio in the secondary market.

As its name suggests, **bond insurance** is a formal process of purchasing insurance against the potential default of an issuer. In the corporate debt market, it is the lender who needs to purchase default protection. However, in the municipal bond market, insurance is purchased by the issuer of the municipal obligation. Approximately one third of all municipal bond offerings are covered by insurance. This insurance coverage enables these municipalities to issue debt at reduced rates. Some issuers also need to utilize guarantees and letters of credit, which are both de facto forms of insurance. These tools involve a third party with a higher credit rating than the issuer agreeing to make good on any deficiencies should the issuer default.

The use of **collateralization** is perhaps the longest running form of credit risk mitigation. The losses sustained by the lender will be offset by the value of the collateral in the event of a default. One issue that needs to be considered is liquidity of the collateral. Liquidity is the ability to turn an asset into cash quickly while retaining reasonable value. In the 2007–2009 financial crisis, we learned that mortgage lending, while secured with real estate as collateral, is riskier than it sounds because the same risk event that triggered the default of securitized loans also caused the value of the collateral to deteriorate.

Another risk mitigation option is **termination**. Using this tool means that the debt obligation is canceled prior to maturity at a mid-market quote. Usually, this means that a certain trigger event, such as a downgrade, has occurred and the issuer was obligated to repay the loan early. An alternative to outright termination is known as **reassignment**, which gives the right to assign one's position as a counterparty to a third party if a trigger event occurs.

Sometimes a counterparty will enter into numerous derivative transactions with the same financial institution. Some of these derivatives will have a positive replacement value while others will have a negative replacement value. All over-the-counter (OTC) derivatives transactions between common counterparties can be aggregated together so that the net replacement value represents the true credit risk exposure. This process is known as **netting**.

Marking-to-market is another option. This tool involves periodically acknowledging the true market value of a transaction. This transparency will result in immediately transferring value from the losing side to the winning side of the trade. This process is extremely efficient, but it does require sophisticated monitoring technology and back-office systems for implementation.

Some financial institutions also utilize **loan syndication** when an issuer needs to raise a significant amount of capital or perhaps the credit risk is more than a single lender would choose to absorb. The syndication process will involve multiple lenders all working together as a team to provide funding to a given borrower. The lead syndicator will receive a fee from the issuer for arranging the syndicate.

Professor's Note: According to the Federal Reserve Bank of New York, the syndicated loan market grew from $339 billion in 1988 to $2.2 trillion in 2007.

Typically, syndicated loans end up being traded on the secondary markets, and there is an emerging trend for certain entities (e.g., insurance companies) to match the duration of their long-term liabilities with loan pools purchased from banks. These are secondary market transactions. This innovation can mitigate risk for the loan-originating bank and also the insurance company at the same time. The risk reduction is not limited to insurance companies. Secondary market transactions are being used for risk mitigation at all financial institutions.

The traditional model of the **bank credit function** is changing as a result of these credit risk mitigation techniques. Traditionally, banks would hold credit assets, like loans, until they matured. As such, banks focused on estimating the expected loan losses using the notional value of the loan and the probability of default (PD). These expected losses formed the basis of loan loss reserves held on the bank's balance sheet and were explicitly priced into the spread charged on the loan over the bank's funding costs. However, the real world has proven that there are many unexpected events that are not captured by normal probability estimates.

Sometimes unexpected events materialize because of credit concentration in loan pools. Many banks become highly concentrated either in their geographic dispersion of loans, their industry exposure, or even in a small number of issuers due to a special relationship with the bank. One of the credit department's key responsibilities is to increase the velocity of capital by using lower cost borrowing to facilitate more profitable opportunities. Credit mitigation techniques enable banks to continue extending credit to riskier borrowers and to more concentrated pools of issuers and then transfer the credit risk to keep overall risk within an acceptable margin.

The Originate-to-Distribute Model of Credit Risk

LO 35.3: Describe the originate-to-distribute model of credit risk transfer and discuss the two ways of managing a bank credit portfolio.

Over the last two decades, portfolios of loans in the banking industry have become much more concentrated in less creditworthy borrowers. During periods of crisis, default rates increase and this creates significant losses for debtholders. In 1990, defaults cost approximately $20 billion, while in 2009 they cost $628 billion. At the same time, banks have developed strong relationships with large corporate borrowers and robust distribution networks for securitized loan transactions. These realities coupled with Basel capital adequacy standards have led financial institutions to switch from traditional, originate-to-hold, lending models to the portfolio-based, originate-to-distribute (OTD), model.

OTD models have produced three primary benefits. The first benefit is that loan originators enjoy increased capital efficiency and decreased earnings volatility because the credit risks have been largely outsourced. The second benefit is that investors have a wider array of diversification options for the fixed income portion of their portfolios. The third benefit is that borrowers have expanded access to credit and lowered borrowing costs. From one vantage point, the 2007–2009 financial crisis occurred partly because banks did not pursue these three benefits through a pure OTD model, but instead held very concentrated risks on their balance sheets through SIVs.

Professor's Note: According to the Federal Reserve Bank of New York, in 1988, 21% of term loans originated by a lead syndicator were held on their balance sheet. This percentage declined to 6.7% in 2007 and 3.4% in 2010.

Under the traditional originate-to-hold (OTH) lending model, credit assets are retained at the business unit level. Loans are originated using a binary (accept or reject) approval process. At loan origination, risk is measured based on notional value and then left unmonitored thereafter. The compensation structure in the OTH system is based on loan volume. More loans mean more profit potential.

At its core, the OTD model involves dividing loans into two groups: core loans and non-core loans. The bank will typically hold the core loans and either securitize or outright sell the non-core loans it has originated. Here, loan origination focuses on charging a sufficient risk-adjusted spread over the bank's hurdle rate. After origination, the OTD model transfers credit assets to the credit portfolio management group who monitors the apparent risks until the asset is transferred off the originator's books. One key function of the credit portfolio management group is to monitor credit risk concentrations and to outsource any risks that could potentially threaten bank solvency. Some credit portfolio strategies are therefore based on defensive risk mitigation and not solely on a profit motive. Ultimately, all returns are measured in a risk-adjusted format and compensation is based on risk-adjusted performance.

The OTD model enables financial institutions to provide access to capital for less creditworthy borrowers and then subsequently sell or hedge their lending risks through the use of credit risk mitigation techniques and credit derivatives.

Credit Derivatives

LO 35.4: Describe the different types and structures of credit derivatives including credit default swaps (CDS), first-to-default put, total return swaps (TRS), asset-backed credit-linked note (CLN), and their applications.

One critique of traditional credit risk mitigation techniques is that they do not unbundle the credit risk from the underlying asset. Credit derivative products, such as credit default swaps, first-to-default puts, total return swaps, and asset-backed credit-linked notes, are over-the-counter financial contracts that respond directly to this critique. Payoffs for these instruments are contingent on changes in the credit performance or quality of a specific underlying issuer. Therefore, these tools directly enable one party to transfer the credit risk of a reference asset to another party without ever selling the asset itself. In doing so, credit derivative products also aid in price discovery aimed at isolating the economic value of default risk.

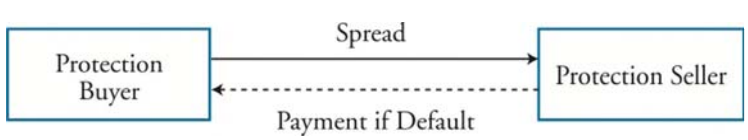
Consider an example of the usefulness of credit derivatives. Bank A specializes in lending to the airline industry, while Bank B specializes in lending to energy firms. When energy prices are high the energy firms tend to do well, while airlines languish. The reverse is true when energy prices are low. Bank A and Bank B could mitigate their credit risk by either directly selling 50% of their loans to each other, or they could use credit derivatives to more cost effectively meet the same need.

Investors and financial institutions can use credit derivatives to accomplish several different goals. Credit derivatives can provide access to specialized risk factors for both risk mitigation and for speculation. As previously mentioned, these credit products also unbundle credit risk from ownership of an underlying asset, effectively creating two unique tradable assets. Credit derivatives also provide yield enhancement and a mechanism to hedge industry-specific and country-specific risks born by an investor or institution. Hedge funds, and other speculative investors, also use credit derivatives to exploit arbitrage opportunities.

Credit Default Swaps

The most popular form of credit derivative is the **credit default swap** (CDS). A CDS is customizable insurance against the default of some underlying asset. It is a de facto put option on the underlying asset. The protection buyer is trying to outsource credit risk, while the protection seller is actually buying credit risk by providing the insurance. Think of the protection buyer like a put buyer and the protection seller like a put seller. The protection buyer will make pre-specified payments to the protection seller over a pre-specified time period and the protection seller is liable for making the protection buyer "whole" if a credit event occurs. Hence, a single-name CDS operates essentially as an insurance contract but a key difference is that the protection buyer need not actually own the underlying asset. Figure 1 illustrates the mechanics of the single-name CDS.

Figure 1: CDS Structure



For example, if an institutional investor owned $100 million of a certain company's debt and wanted to protect himself from a potential default, the investor could enter into a CDS contract with 150 basis points with quarterly payments. That means that the investor would pay $375,000 [(1.5% × $100,000,000) / 4] every quarter for the length of the contract. The length of a CDS contract is usually much less than the duration of the underlying asset. If this debt instrument matured in 15 years, then the CDS contract might have a 2–3 year tenure. If this debt issuance has a yield of 4.5% then this protection buyer has enabled a 3.0% annual return without any default risk for the tenure of the CDS contract.

Professor's Note: According to the Bank for International Settlements (BIS), credit default swaps were virtually non-existent in 1997, ballooned to $62.2 trillion in 2007, and subsequently fell to approximately $16 trillion of notional value by the end of 2014.

Why would an investor pay for credit default protection using a CDS contract? Obviously, they are concerned about a negative credit event impacting the value of the underlying asset. Payment to the protection buyer is triggered with several potential credit events. The first potential trigger event is bankruptcy. Payment can also be triggered by a specified drop in the value of the underlying asset that does not include bankruptcy. Downgrade below a certain threshold and unfavorable debt restructure can also result in a payment. The International Swaps and Derivatives Association (ISDA) has the final say on whether a credit event has officially triggered a CDS payment.

If a payment is triggered, the payment could be made in one of three ways. The first payment option is the par value of the underlying asset minus the post-default price. This is essentially a "make me whole" payment. The second payment option is par value minus a stipulated recovery factor. Most corporate bonds have a contractually stipulated 40% recovery rate. This means that the CDS was priced so that the most that a protection buyer could recover is 60% of the notional principal. The third payment option is the full payment of the par value, without any subtractions, but the protection buyer must also physically deliver the underlying asset to the protection seller. This is also a "make me whole" payment.

Credit default swaps can be used for risk management, but they can also be used for direct speculation. During the months and years leading up to the 2007–2009 financial crisis, some savvy investors who saw trouble on the horizon purchased CDS contracts against the default of various companies. In this way, these investors were using CDS contracts to replicate put options. However, the CDS contract is only as good as the creditworthiness of the counterparty. This risk should be considered as well. Lehman Brothers and American International Group (AIG) were two significant counterparties that did not weather the financial crisis very well.

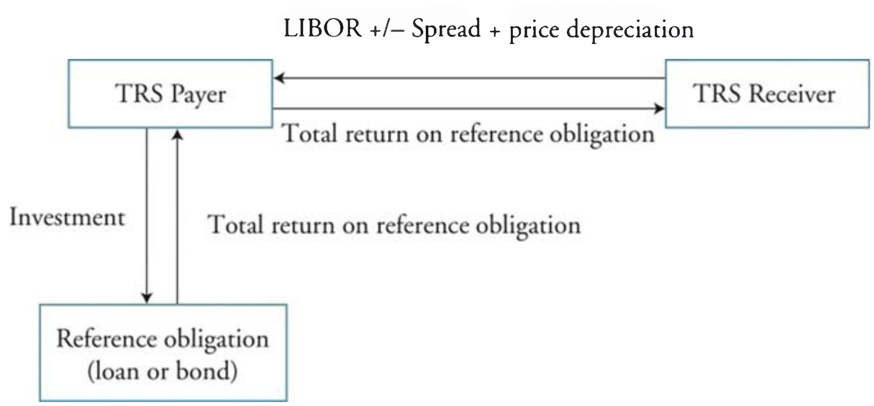
First-to-Default Puts

A variation of the CDS is known as a **first-to-default put**. To explain this innovation, it will be easiest to consider a bank that holds four different B-rated high yield loans. Each loan has notional principal of $100 million, a five-year maturity, and an annual coupon of LIBOR plus 250 basis points. The idea is that this pool of loans has very low default correlations. The bank could purchase a first-to-default put for two years at perhaps 400 basis points. This means that the bank would pay $4 million annually for two years. In return for this "insurance" premium, the bank would be made whole in the event that any one of the four bonds defaulted. If two bonds default, then they still are only paid for the first bond and the second becomes a loss event. This is a much more cost effective option for the bank if the loans truly have uncorrelated default risks. The cost of the first-to-default put will lie between the cost of a CDS on the riskiest bond and the total cost for a CDS on all bonds.

Total Return Swaps

While a CDS contract outsources only the credit risk, a **total return swap** (TRS) outsources both credit risk and market risk. A TRS is designed to mirror the return on an underlying investment, such as a loan, a floating rate note, a coupon bond, a stock, or a basket of assets. There are two parties to a TRS contract. The "payer" is the owner of the underlying asset. The payer will agree to pay the underlying asset's total return, including any price appreciation and coupon or dividend payments, to a "receiver." The receiver is responsible to pay the payer for any depreciation in the asset. The receiver will also pay LIBOR plus a predetermined spread to the payer regardless of what happens with the reference asset.

Figure 2: Total Return Swap Structure



In essence, the receiver is taking a synthetic long position in the underlying asset without actually owning the underlying. Tremendous leverage can be applied by the receiver because they do not need to invest the notional principal. They only need enough money to make payments when due. Hedge funds are one common receiver counterparty in TRS contracts. Banks are usually the payer counterparties because they have access to capital to purchase the underlying assets but are looking to remove credit and market risk exposure from their balance sheets.

Asset-Backed Credit-Linked Notes

A further innovation called an **asset-backed credit-linked note** (CLN) embeds a default swap into a debt issuance. A CLN is a debt instrument with its coupon and principal risk tied to an underlying debt instrument, like a bond, a loan, or a government obligation. Unlike a CDS contract, principal is exchanged when a CLN is sold to an investor, although the CLN seller retains ownership of the underlying debt instrument.

A CLN is best understood with an example. Assume there is a hedge fund that wants to capture $125 million of exposure to a fixed income instrument, but it only wants to invest $25 million as collateral. A bank agrees to help in the process. The bank will borrow $125 million at LIBOR and purchase the reference asset, which is currently yielding LIBOR plus 250 basis points. The reference asset is placed in a trust, which then issues a CLN to the hedge fund. The hedge fund will then give the bank $25 million, which is invested in a risk-free U.S. government obligation yielding 4%. This investment now represents the collateral on the bank's borrowing. That means there is 20% ($25 million / $125 million) of collateral and a leverage multiple for the hedge fund of 5 times ($125 million / $25 million).

Remember that the reference asset is yielding LIBOR plus 250 basis points. The bank will keep LIBOR plus 100 basis points, using the LIBOR return to fund the cost of acquiring the reference asset and the additional 100 basis points as compensation for assuming the risk of default above the collateral of $25 million. The hedge fund will receive the 4% earned on the $25 million of collateral ($1 million) and will also receive the additional 150 basis point spread over the funding cost on the full $125 million ($1.875 million in additional return). This means that the hedge fund has captured an 11.5% leveraged return [($1 million + $1.875 million)/$25 million initial investment]!

There are no margin calls with a CLN, but there is still risk on the table for the hedge fund and for the bank. Should the reference asset lose more value than the $25 million in collateral, the hedge fund will default on its CLN obligation and lose the full $25 million investment. The bank will be responsible for any losses greater than the $25 million of hedge fund collateral. Thus, the bank will likely look to outsource this risk using a CDS contract.

The Credit Risk Securitization Process

LO 35.5: Explain the credit risk securitization process and describe the structure of typical collateralized loan obligations (CLOs) or collateralized debt obligations (CDOs).

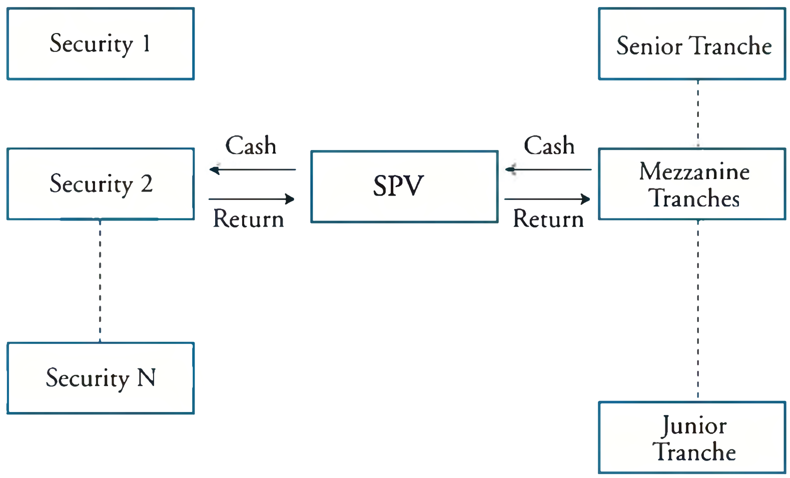
The credit risk securitization process is a technique that uses financial engineering to combine a segregated pool of assets into one tradable security with various inherent risk levels. The company that starts this process is called the **originator**. The originator will purchase a series of different assets, like corporate bonds, leveraged loans, mortgages, auto loans, or perhaps credit card loans. These assets are held on the originator's balance sheet until they have a sufficient quantity of assets to repackage this pool into a security.

The actual repackaging process occurs in an off-balance-sheet entity, like a **special purpose vehicle** (SPV). Once assets are transferred to the SPV, securities must be issued, based on this reference pool of assets, to fund the purchase of the assets. The securitized asset is structured in such a way that the originator has no recourse for losses sustained after an investor purchases a securitized asset.

Part of the securitization process also involves establishing various risk layers within the new investment product. These layers are called **tranches**. The senior tranches have the lowest risk of loss. There are several mezzanine tranches as well. The idea is that in the event of default by the underlying assets, the most junior tranches will realize the loss first. In fact, the senior tranches will not experience any loss unless the more junior tranches all experience 100% losses. This cash loss process is sometimes called the "waterfall" structure of securitized products and it provides an apparent safety margin for the senior tranches.

There is a very broad category of securitized products known as **collateralized debt obligations** (CDOs). In general, a CDO is an asset-backed security that can branch into corporate bonds, emerging market bonds, residential mortgage-backed securities (RMBS), commercial mortgage-backed securities (CMBS), real estate investment trust (REIT) debts, bank loans, other forms of asset-backed securities backed by auto and credit card loans, and even other CDOs.

Figure 3: A CDO With *N* Underlying Securities



Perhaps the most well-known form of a CDO is called a **collateralized loan obligation** (CLO). CLOs focus on repackaging high-yield bank loans. With a CLO, below-investment-grade bonds are restructured into tranches, which include investment-grade senior tranches, a junior equity tranche, and possibly intermediate-quality tranches between the senior and junior tranches (i.e., mezzanine tranches). The senior tranches achieve investment-grade ratings by effectively outsourcing the default risk to the equity tranche. This allows the originator of the high-yield loans to sell the senior tranches to insurance companies and pension funds, which are required to own investment-grade debt instruments. It is also important to note that bank loans are amortizing, which means they have a shorter duration than corporate bonds with similar maturities.

Consider an example of the CLO repackaging process. A bank compiles $1 billion in high-yield loans that are below investment-grade. This group of loans will meet certain parameters, such as the number of industries represented in the loan pool, the maximum percentage in any given industry, and the maximum percentage in any given issuer. This data will communicate risk to potential investors. The bank will securitize this CLO into perhaps three tranches. A senior secured tranche class A, a senior secured tranche class B, and a residual or equity tranche that is subordinate. The weighted average life of the loans in the CLO is six years with an average coupon of LIBOR plus 250 basis points. The senior class A notes will have a face value of $850 million, a 12-year maturity, a coupon of LIBOR plus 40 basis points, and a robust investment-grade rating. The senior class B notes will have a face value of $60 million, a 12-year maturity, a coupon of LIBOR plus 150 basis points, and a low-end investment-grade rating. The subordinated equity tranche will have a face value of $90 million, a 12-year maturity, a residual claim on any CLO assets, and a non-investment-grade rating.

During the first six years of this example CLO, loans begin to mature. However, the tranches all have a 12-year maturity. The CLO originator will reinvest the maturing proceeds in additional six-year loans adhering to the initial industry and concentration risk stipulations. After this initial rebalancing, the CLO investors will begin to receive principal repayments as the loans mature. The first in line will be the senior class A notes. Since the underlying high-yield loans are paying such a high spread over what the senior tranches will receive, the equity tranche has the potential to earn a very substantial return if defaults do not materialize. Typically, the originating bank will retain the equity tranche to keep a small amount of skin in the game.

Synthetic CDOs and Single-Tranche CDOs

LO 35.6: Describe synthetic CDOs and single-tranche CDOs.

In a traditional CDO, which is also called a "cash CDO," the credit assets owned by the SPV are fully funded with cash, and the repayment of the obligation is tied directly to cash flow from the underlying debt instruments. There is an alternative form of CDO called a **synthetic CDO**, which takes a different approach. With a synthetic CDO, the originator retains the reference assets on their balance sheet, but they transfer credit risk, in the form of credit default swaps, to an SPV which then creates the tradable synthetic CDO. This process is typically used to provide credit protection for 10% of the pool of assets held on the originator's balance sheet. The other 90% of the default risk is hedged with a highly-rated counterparty using a senior swap. This complex derivative is a way of betting on the default prospects of a pool of assets rather than on the assets themselves.

There is also a form of CDO that is highly customizable. This is called a **single-tranche CDO**. With this credit derivative, an investor is trying to earn a better spread than on comparably rated bonds by selecting a specific reference asset with customizable maturity, coupon, collateral, subordination level, and target rating. This customization feature creates open dialogue between the single-tranche CDO buyer and seller, and by default will help prevent the seller from dumping unwanted risks on the buyer without prior knowledge. One key customizable feature is the attachment point, which is the point at which default begins to be the financial responsibility of the single-tranche CDO buyer.

Rating CDOs Before the Credit Crunch

LO 35.7: Assess the rating of CDOs by rating agencies prior to the 2007 financial crisis.

The average investor has a very difficult time understanding securitized financial products, like collateralized debt obligations (CDOs). As such, they have come to rely on the stamp of approval from a third party that is thought to be independent. Rating agencies, like Moody's Investors Service, Standard & Poors, and Fitch Ratings, have profited from investors' need for supposedly independent ratings on complex financial products. From 2000 to 2007, Moody's rated nearly 45,000 mortgage-linked securitized products. Over half of this group of 45,000 received a AAA stamp of approval. By comparison, only six U.S. private sector companies had such a rating during this same time period.

Professor's Note: The Financial Crisis Inquiry Commission (FCIC), which was established by Congress, found that 73% of the pool of securitized products rated AAA by Moody's had been downgraded to junk bond status by April 2010.

Part of the push for solidly investment-grade ratings is that insurance companies, pensions, and money market funds have regulatory and internal requirements that only allow investments in investment-grade assets. Based on this level of demand and the fact that the rating agencies all had a profit motive, they were very willing to provide high ratings for many securitized products. The process would start with rating any tranche possible with a AAA rating. Then the typical next step was to repackage below-AAA rated tranches into new CDOs whereby another group emerged as AAA-rated because the default risk kept being pushed down further and further to the lowest equity tranches. This process would be repeated a few times until a substantial portion of securitized products received the coveted AAA stamp of approval.

When adjustable rates loans reached their reset periods and default rates rose well above any previously considered margin of safety, downgrades ensued en masse. By their very nature, the downgrades drove down prices, but this cycle was further compounded because once the assets were downgraded below investment-grade, every insurance company, pension fund, money market, and bank with capital constraints had to sell as well. Investors were not so much buying an income stream as they were buying a AAA-rated income stream, and once default rates began rising, the downward spiral of prices began.

In fairness to the rating agencies, it is also important to understand an alternate interpretation beyond merely a profit motive that caused the inaccurate ratings. The Financial Crisis Inquiry Commission (FCIC) found that the rating agencies were influenced by "flawed computer models, the pressure from financial firms that paid for the ratings, the relentless drive for market share, the lack of resources to do the job despite record profits, and the absence of meaningful public oversight."

The competitive pressure between these rating agencies, two of which are publicly traded, was intense. However, the competition did not translate into substantial salaries for key employees in the rating process. The result was that the best employees would leave the rating agencies and go to work for the financial firms who were actively securitizing products. The benefit to the originators was that the converted employees knew the internal ratings guidelines at the ratings agencies. For example, in order to achieve a AAA rating, a securitized product needs to have an average FICO score of 615 for all borrowers in the pool. Equipped with this knowledge, the originators could then package pools of loans with mostly 550 scores and just enough 680s to bring the average up to 615. This translated into higher default probabilities than should have naturally existed for a 615 rated borrower. There should have been more focus on the dispersion of credit scores and not just the average for the pool.

As the FCIC uncovered more details, they found many flaws in the system. The profit motive was paramount, but it drove creative packaging by the originators. The profit motive was also influenced by the competitive landscape of the industry. The profit motive will always exist in the world of high finance. What investors need to understand is that they need to dive deeply into the risk profile of any asset before adding it to their portfolios.

Key Concepts

LO 35.1

There were three key underlying flaws in the securitization process that led to the 2007–2009 financial crisis. The first is that members of the securitization supply chain were incentivized to find borrowers, sell them a loan, and package that loan for resale without retaining any default risk. This led to lax lending standards. Second, the securitized products themselves were very opaque. Neither investors nor the rating agencies that they relied upon fully understood how to evaluate their potential risks. Third, financial institutions' use of off-balance-sheet techniques to hold securitized loans further disguised the risk spectrum from investors.

LO 35.2

The traditional bank credit function can remain robust in a world of concentrated risks by utilizing credit risk transfer techniques, including bond insurance, collateralization, termination, reassignment, netting, marking-to-market, syndication of loan origination, or the outright sale of a loan portfolio in the secondary market.

LO 35.3

The originate-to-hold model involves originating a loan using a binary approval process and then holding the loan until maturity. In this case, the lender retains all credit risk and the loan origination process will therefore be more stringent. The originate-to-distribute model enables lenders to originate a loan based on risk-reward pricing and then outsource the risk through various channels. This provides better access to capital for less creditworthy borrowers and more diversification options for investors.

LO 35.4

Credit derivative products, such as credit default swaps, first-to-default puts, total return swaps, and asset-backed credit-linked notes are all innovations that separate default risk from the underlying security. They offer the ability to insure and transfer specific risks to both investors and insurance sellers.

LO 35.5

A collateralized debt obligation (CDO) is an asset-backed security that can branch into corporate bonds, emerging market bonds, residential mortgage-backed securities (RMBS), commercial mortgage-backed securities (CMBS), real estate investment trust (REIT) debts, bank loans, other forms of asset-backed securities backed by auto and credit card loans, and even other CDOs. A collateralized loan obligation (CLO) is a specialized form of CDO that only invests in bank loans.

LO 35.6

With a synthetic CDO, the originator retains the reference assets on their balance sheet, but they transfer credit risk, in the form of credit default swaps, to an SPV which then creates the tradable synthetic CDO. This derivative product is used to bet on the default of a pool of assets, not on the assets themselves. A single-tranche CDO is a highly customizable offshoot from synthetic CDOs. Investors can customize their maturity, coupon, collateral, subordination level, and target rating.

LO 35.7

Rating agencies were at the core of the selling process of securitized products, such as CDOs. The average investor could not understand the complex products, so they relied on the stamp of approval from the ratings agencies, who were biased by their profit motive and were often unable to fully understand the securitized products themselves.

Concept Checkers

1. Which of the following statements was not one of the flaws in the securitization process prior to the start of the credit crisis in 2007?
   A. An active originate-to-distribute model where a strong profit motive took precedence over ethical lending and underwriting.
   B. The securitized products were so opaque that investors could not evaluate the true risks of the investment.
   C. Structured investment vehicles (SIVs) were used to enhance the risk discovery process for investors and regulators.
   D. Banks held securitized assets in off-balance-sheet entities, thus further masking the true risks in the system.

2. Which of the following statements is not correct regarding total return swaps (TRS)?
   A. A TRS is designed to mirror the return on an underlying asset like a loan, stock, or even a portfolio of assets.
   B. The payer pays any depreciation in the underlying asset to the receiver.
   C. The payer pays any dividends or interest received to the receiver.
   D. The receiver is creating a synthetic long position in the underlying asset.

3. XYZ Hedge Fund wants to get exposure to a high-yield pool of commercial loans without actually investing in the loans. It wants a leverage ratio of 7.5. If the hedge fund is willing to invest $35 million in this investment, which credit derivative is best for them and what is their expected return given that the reference asset earns LIBOR plus 285 basis points, the counterparty earns LIBOR plus 150 basis points, and the required collateral earns 3.5%?
   A. Total return swap with a 13.63% return.
   B. Asset-backed credit-linked note with an 11.34% return.
   C. Total return swap with an 11.34% return.
   D. Asset-backed credit-linked note with a 13.63% return.

4. Which of the following statements describe part of the risk mitigation process for a collateralized debt obligation (CDO)?
   I. Default risk is restructured in such a way that previously lower-rated issues can be re-formulated into highly rated debt instruments.
   II. The equity tranche has no certain return and bears the highest level of default risk.
   A. I only.
   B. II only.
   C. Both I and II.
   D. Neither I nor II.

5. Which of the following was not a cause of the misalignment between investors' and rating agencies' incentives prior to the credit crisis of 2007–2009?
   A. Profit motive of the rating agencies.
   B. Pressure from the originators of securitized products.
   C. Manipulation of the ratings process by the originators.
   D. Investors' lack of understanding of the products they were purchasing.

Concept Checker Answers

1. C Structured investment vehicles (SIVs) were actually used to create further layers of opaqueness. These are the off-balance-sheet entities used by banks to hold securitized products in a way that made them very difficult for investors to scrutinize.

2. B A total return swap transfers both credit and market risk. The payer only pays any appreciation and any dividends or interest connected with the underlying asset. The receiver is responsible to pay the payer any depreciation in the underlying asset.

3. D The best credit derivative for this hedge fund is an asset-backed credit-linked note. With leverage of 7.5 and an investment of $35 million, we know that the notional value of the pool of commercial loans is $262.5 million. The hedge fund will earn 3.5% on their $35 million in collateral. This translates into $1.225 million. They will also earn the 135 basis point spread on the entire $262.5 million. This translates into $3.54375 million. The hedge fund's percentage return is 13.63% [($1.225 million + $3.54375 million) / $35 million]).

4. C The default risk in a CDO is structured through various tranches in such a way that a pool of assets that were once lower rated could be AAA rated after the securitization process. The equity tranche is the most junior tranche. Therefore, it offers the highest return potential but with no certain return. The equity tranche also bears the highest level of default risk.

5. D According to the findings of the congressionally formed Financial Crisis Inquiry Commission, the root causes of the misalignment were the flawed computer models at the rating agencies, the profit motive of the rating agencies, pressure from the originators, the drive for market share coming from the rating agencies, the rating agencies lack of provided (not available) resources to conduct the proper due diligence, and the absence of meaningful public oversight. A thorough post-audit of the crisis will also reveal that originators also manufactured the securitized products to specifically arrive at a AAA rating given their acquired knowledge of the rating agencies' decision flow charts.