The following is a review of the Credit Risk Measurement and Management principles designed to address the learning objectives set forth by GARP®. Cross-reference to GARP assigned reading—Hull, Chapter 25.

READING 30

CREDIT DERIVATIVES

Study Session 5

EXAM FOCUS

Credit derivatives are financial instruments that are used to hedge credit risk exposures. This topic focuses on the main types and structures of credit derivatives, including credit default swaps (CDSs), total return swaps (TRSs), and collateralized debt obligations (CDOs). For the exam, understand the applications of these credit derivative products, and be able to explain how to value a CDS by computing the CDS spread. Also, be familiar with the process for valuing synthetic CDOs. In addition, understand the role that default correlation plays in CDO valuation.

MODULE 30.1: CREDIT DEFAULT SWAPS

LO 30.a: Describe a credit derivative, credit default swap (CDS), total return swap, and collateralized debt obligation (CDO).

Credit Derivative Products

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, total return swaps, and collateralized debt obligations 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.

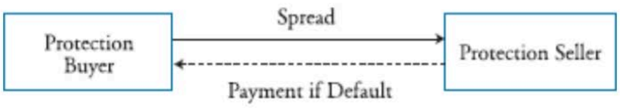
Consider an example of the usefulness of credit derivatives. Bank A specializes in lending to the airline industry, while Bank B specializes in lending to energy firms. When energy prices are high, the energy firms tend to do well, while airlines languish. The reverse is true when energy prices are low. 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 goals. Credit derivatives can provide access to specialized risk factors for both risk mitigation and speculation. As 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 borne 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)**. It is a contract that involves a *protection buyer* (insured) paying a periodic CDS spread to a *protection seller* (insurer) for protection against default on a reference obligation. The protection buyer makes these CDS spread premiums until the maturity of the swap or until default, whichever comes first. Unlike regular insurance policies, CDS premiums are paid in arrears (i.e., at the end of the settlement period) as opposed to the start of a settlement period.

Figure 30.1: Credit Default Swap Structure



In case of a default, because the premium is paid in arrears, an accrual payment for the period between the last settlement date and the default date is due from the protection buyer, and the protection seller makes the payment for losses due to default. For example, a 5-year CDS with annual settlement would have the first payment due at the end of the first year. If default occurs three months after the first settlement, the protection buyer owes the pro rata premium for three months as the accrual payment.

The CDS underlying instrument can be a single company or country or a credit index. Many CDS contracts are standardized per ISDA terms and have common maturities of 1, 3, 7, and 10 years with quarterly settlements on March 20, June 20, September 20, and December 20. For example, if a CDS is initiated on April 15 under these terms, the first payment on June 20 will cover the period April 15–June 20.

The *N*-year CDS premium should be approximately equal to the risk premium on a *N*-year risky bond over the benchmark rate (i.e., the market reference rate). Suppose an investor purchases a 7-year corporate bond yielding 7% (3% higher than the benchmark rate). Simultaneously, the investor purchases protection at a cost of 3%. The net return to the investor is 4%, which is the benchmark rate. In the event of default, the investor is made whole by the protection seller (i.e., the bond is exchanged for par value). The **CDS-bond basis** is computed as:

$$\text{CDS-bond basis} = \text{CDS spread} - \text{bond yield spread}$$

The bond yield spread is calculated relative to the market reference rate. To prevent arbitrage, the CDS-bond basis should be close to zero for swaps with the same maturity as the reference obligation.

The **recovery rate** is the percentage of the par value of a bond that the bond trades at immediately after default. CDS contracts specify any number of bonds with the same seniority issued as the reference obligation (and issued by the same issuer) that can be delivered upon default by the protection buyer to the protection seller for full face value. So, the protection buyer will deliver the **cheapest-to-deliver (CTD) bond**, and the recovery rate is based on the price of the CTD. For example, if the CTD trades at a price of $53 for a $100 par value bond, the recovery rate is 53%.

CDS Valuation

LO 30.b: Explain how to account for credit risk exposure in valuing a CDS.

The **CDS spread** or credit spread on a reference obligation is the compensation for bearing credit risk. The CDS spread (*s*) is calculated using the following inputs: (1) swap maturity, (2) risk-free rate, (3) hazard rate (i.e., default intensity), and (4) recovery rate.

While the hazard rate, λ, is a constant parameter, the probability of default (PD) at time *t* declines with the **probability of survival (PS)** over time:

- Probability of survival at time $t = PS_t = e^{-\lambda \times t}$
- Probability of default in year $t = PD_t = (PS_{t-1} - PS_t)$

As an example, suppose that a 3-year CDS has a hazard rate of 3%. The recovery rate is assumed to be 35%, and the continuously compounded risk-free rate is equal to 4%. In this case, we assume annual settlement and that default occurs in the middle of the year.

The probabilities of survival for each year of the swap are computed as follows:

- Year 1: $e^{-1\times0.03} = 0.97045$
- Year 2: $e^{-2\times0.03} = 0.94176$
- Year 3: $e^{-3\times0.03} = 0.91393$

The probability of survival at $t = 0$ = 100%, or 1. Therefore, the PD in Year 1 = 1 − 0.97045 = 0.0296. Similarly, the PD in Year 2 = 0.97045 − 0.94176 = 0.0287, and the PD in Year 3 = 0.94176 − 0.91393 = 0.0278.

Figure 30.2: Probabilities of Survival and Default, Hazard Rate = 3%

Year	Probability of Survival	Probability of Default
1	0.97045	0.0296
2	0.94176	0.0287
3	0.91393	0.0278

Suppose that the CDS spread = s%. Figure 30.3 shows the expected payment for each of the three years in the swap. Note that the payment is made only if there is no default:

expected payment = probability of survival × notional principal × s

Figure 30.3: Calculation of PV of Expected Payment ($1 Notional)

Year	Probability of Survival	Expected Payment	Discount Factor	PV of Expected Payment
1	0.97045	0.97045s	0.9608	0.9324s
2	0.94176	0.94176s	0.9231	0.8693s
3	0.91393	0.91393s	0.8869	0.8106s
			Total PV	**2.6123s**

We discount the expected payment at the risk-free rate of 4%. For example, the discount factor at $t = 1$ is: $e^{-0.04 \times 1} = 0.9608$. The PV of the expected payment is then computed as:

PV of expected payment = discount factor × expected payment

Therefore, the total PV of expected payment over the life of the swap = 2.6123s.

Because the protection buyer makes the payments in arrears and because the default is assumed to occur in the middle of the year, there is a final payment (i.e., accrual payment) that the protection buyer needs to make in the year of the default (representing the CDS spread for half the year or $s/2$). Figure 30.4 shows the calculation of the PV of the expected value of these accrual payments. Note that the probabilities used now are probabilities of default as the accrual payment is made only upon default.

Figure 30.4: Calculation of PV of Expected Accrual Payment ($1 Notional)

Year	Probability of Default	Expected Accrual Payment	Discount Factor	PV of Expected Accrual
0.5	0.0296	0.0148s	0.9802	0.0145s
1.5	0.0287	0.0143s	0.9418	0.0135s
2.5	0.0278	0.0139s	0.9048	0.0126s
			Total PV	**0.0406s**

Therefore, over the life of the swap, the total PV of expected payments made by the protection buyer = 2.6123s + 0.0406s = 2.6529s.

Now, we turn our attention to calculating the PV of the expected payoff paid by the protection seller under the assumption of a 35% recovery rate. Recall the assumption that default occurs in the middle of the year and the payoff would occur at that time. Figure 30.5 shows these calculations.

Figure 30.5: Calculation of PV of Expected Payoff ($1 Notional)

Year	Probability of Default	Recovery Rate	Expected Payoff	Discount Factor	PV of Expected Payoff
0.5	0.0296	35%	0.0192	0.9802	0.0188
1.5	0.0287	35%	0.0187	0.9418	0.0176
2.5	0.0278	35%	0.0181	0.9048	0.0164
				Total PV	**0.0528**

The expected payoff for the protection seller is computed as:

expected payoff = (1 – recovery rate) × PD × notional principal

Assuming default in Year 2 (or Year 1.5, because default is assumed to occur in the middle of the year):

expected payoff = 0.65 × 0.0287 × $1 = 0.0187

The PV of the expected payoff is then equal to the expected payoff multiplied by the discount factor.

The CDS spread for this 3-year deal is computed using the following equation and solving for *s*:

PV of E(payments) = PV of E(payoff)

$2.6529s = 0.0528$

$s = 0.0528 / 2.6529 = 0.0199$, or 1.99%, or 199 bps

MODULE QUIZ 30.1

1. Modus Corp's 7-year, 5% coupon bond is rated AA. The annual CDS spread on a 7-year bond is 3%. The swap spread is flat at 25 bps, while the swap fixed rate is 3% for 5 years and 4% for 7 years. To prevent arbitrage, Modus Corp's bond should most likely yield:
   A. 7.00%.
   B. 7.25%.
   C. 7.75%.
   D. 8.00%.

2. Xeta Corp's hazard rate is estimated to be 2% over the next five years. The probability of default in Year 2 for Xeta is closest to:
   A. 1.94%.
   B. 1.98%.
   C. 2.00%.
   D. 2.23%.

3. CDS spreads are calculated such that the PV of:
   A. accrual payments is zero.
   B. expected payoff is less than the PV of expected payments during the life of the CDS.
   C. expected payoff is equal to the PV of expected payments during the life of the CDS.

D. expected payoff is greater than the PV of expected payments during the life of the CDS.

MODULE 30.2: CDS EXTENSIONS AND CREDIT INDICES

LO 30.c: Identify the default probabilities used to value a CDS.

The PD used in the previous example is not the true PD. Rather, it is the **risk-neutral (RN) probability of default**. The RN probability of default is the probability implied in the CDS spread quoted in the market. Suppose in the previous example that the actual market CDS spread is 2.75%. In this case, the hazard rate assumption of 3% is too low. By using trial and error (or SOLVER in Excel), the hazard rate should actually be closer to 4.15%.

The other input needed in calculating CDS is the recovery rate (RR). If we calculate the RN probability of default (implied by the market price), then our estimate of the RR does not matter (we still will get to the market spread in our calculations).

The RN probability of default is approximately proportional to 1 / (1 – RR). If we assume a high RR, then the RN probability of default will also be high (keeping the actual market CDS spread quote constant).

Marking a CDS to Market

CDS contracts are *marked to market* (MtM) daily. If the CDS spread narrows (widens), the protection buyer loses (gains) while the protection seller gains (loses) an equal amount. The MtM value of the swap to the protection seller is computed as:

$$\text{MtM value to protection seller} = \text{PV of expected payments} - \text{PV of expected payoff}$$

EXAMPLE: MARK TO MARKET OF A CDS

Suppose the 3-year swap in the previous example was originally a 3.5-year swap initiated six months ago at a spread of 1.50%. Recall that with three years remaining, the PV of expected payments and the PV of payoff were 2.6529*s* and 0.0528, respectively, and *s* was equal to 1.99%. **Calculate** the mark-to-market value of the swap to the protection seller with a notional principal of $1 million.

Answer:

Using the 1.50% original spread, the PV of expected payments = 2.6529 × 0.015 = 0.0398 per $1 notional. The PV of the expected payoff with three years remaining is unchanged at 0.0528 per $1 notional.

Value to protection seller = PV of expected payments − PV of expected payoff

$= 0.0398 - 0.0528 = -0.013$ per \$1 notional principal

Swap value to protection seller $= -0.013 \times 1{,}000{,}000 = -\$13{,}000$

Swap value to protection buyer $= +\$13{,}000$

Because the swap spread has widened from 1.50% to 1.99% in the six months since inception, the protection buyer gains, and the protection seller suffers a loss.

Binary CDS

Binary CDS are like regular CDS, except that the payoff on default is the full notional, regardless of the recovery rate (RR). The CDS calculations only change for Figure 30.5 (because RR is changed to 0%). Figure 30.6 shows the new calculations using the data from the previous example. The sum of the PV of expected payments remains 2.6529*s*.

Figure 30.6: PV of Expected Payoff on Binary CDS ($1 Notional)

Year	Probability of Default	Expected Payoff	Discount Factor	PV of Expected Payoff
0.5	0.0296	0.0296	0.9802	0.0290
1.5	0.0287	0.0287	0.9418	0.0270
2.5	0.0278	0.0278	0.9048	0.0252
			Total PV	**0.0812**

The spread on this binary CDS to computed as:

$s = 0.0812 / 2.6529 = 0.0306 = 3.06\%$

Using the original RR of 35%, the spread on a binary CDS could also be calculated as:

binary CDS spread = vanilla CDS spread / (1 − RR)

$= 1.99 / (1 - 0.35) = 3.06\%$

As expected, with a 0% recovery assumption, the calculated spread of 3.06% for a binary CDS is higher than the 1.99% spread for a vanilla (or regular) CDS. Therefore, the price to purchase protection in a binary CDS is higher.

Credit Indices

LO 30.d: Evaluate the use of credit indices and fixed coupons in pricing CDS transactions.

CDS indices cover multiple issuers, allowing market participants to take on an exposure to the credit risk of several companies simultaneously in the same way that stock indices allow investors to take on an equity exposure to several companies at once. In this case, the protection for each issuer is equal (i.e., equally weighted), and the total notional principal is the sum of the protection on all issuers.

CDX NA IG (North American issuers) and **iTraxx Europe** (European issuers) each have an equally-weighted exposure to 125 investment-grade companies. Similar indices representing high-yield issuers also exist.

Suppose that the CDX NA IG CDS spread is 50 bps. A trader can obtain $100,000 notional amount protection on each of the 125 companies for the following amount:

$$\text{annual payment} = 125 \times 0.005 \times 100{,}000 = \$62{,}500, \text{ or } \$500 \text{ per company}$$

If one of the companies in the index defaults, the following occurs: the contract continues with 124 remaining companies, a payoff based on (1 – RR) on $100,000 notional is made by the protection seller, and the annual payment is adjusted to 124 × 0.005 × 100,000 = 62,000 (a reduction of $500 going forward accounting for the one default).

The CDS index spread is approximately equal to the average credit spread on the index constituents. The index itself is updated twice a year (applicable only for new contracts signed after the update) whereby the companies whose ratings drop below investment grade are replaced by other investment-grade companies.

Fixed Coupons

Standardization of CDS contracts improves the liquidity of the CDS market. Standardized contracts have a fixed coupon rate payable by the protection buyer instead of the actual CDS spread. The difference between the coupon rate and the spread is settled up front using the following payment:

$$\text{up-front premium \%} = D \times (s - c)$$

where:
D = CDS payment duration (equal to 2.6529 in the previous example)
s = CDS spread
c = coupon rate

The price of the CDS contract computed from the quoted spread is expressed as:

$$\text{price} = 100 - [100 \times D \times (s - c)]$$

EXAMPLE: UP-FRONT PAYMENT

The 5-year CDX NA IG CDS have a fixed coupon rate of 100 bps. If the CDS spread is 65 bps, and the duration of the 5-year CDS is 4.125, **calculate** the up-front premium for a contract with $100,000 notional per company.

Answer:

$$\text{Price} = 100 - [100 \times 4.125 \times (0.0065 - 0.01)] = 101.44, \text{ or}$$
$$\text{up-front premium} = 1.44\%$$

Because the price is > 100, the protection seller pays the protection buyer. This makes sense, given that the protection buyer is committing to paying a higher coupon of 100 bps compared to the justified spread of 65 bps. The amount that the protection seller pays to the buyer is computed as:

up-front payment by seller = $125 \times 100{,}000 \times 0.0144 = \$180{,}000$

CDS Forwards and Options

LO 30.e: Define CDS forwards and CDS options.

CDS forwards allows a party to enter into a specific CDS as a protection buyer or seller at a fixed CDS spread for a fixed term, but starting at a specified future time period. For example, a party can enter into a forward contract on a 5-year CDS at a spread of 100 bps starting one year from today. The counterparty similarly agrees to be a protection seller in that CDS. If the reference entity defaults, the forward contract ceases to exist.

CDS options allow the holder to enter into a CDS at a strike CDS spread as a protection buyer or seller in exchange for the payment of an option premium. An option to enter into a 2-year CDS as a protection buyer at a strike price of 100 bps would be exercised if the CDS spread is higher than 100 bps. Just like forwards, if the reference entity defaults before the maturity of the option, the option ceases to exist.

MODULE QUIZ 30.2

1. Banko, Inc., entered into a \$5 million notional, 5-year CDS as a protection buyer two years ago at a spread of 1.85%. The current 3-year CDS spread for the same reference entity is 2.30% based on the PV of expected payoff of 0.0312 per \$1 notional. The value of the CDS to Banko, Inc., is closest to:
   A. −\$45,000.
   B. −\$30,900.
   C. +\$30,500.
   D. +\$53,000.

2. If one of the entities in the CDX NA IG index defaults, the CDS index would most likely:
   A. make a payoff and be discontinued.
   B. continue with a replacement entity, with no change to the notional principal.
   C. continue with 99 entities, and the notional principal of each entity would be reduced by 1%.
   D. continue with 124 entities, and the notional principal of each entity would remain the same.

3. Which of the following statements about CDS forwards and CDS options is most accurate?
   A. CDS forwards entered at market rates require a premium payment, while CDS options do not.
   B. CDS options entered at market rates require a premium payment, while CDS forwards do not.
   C. Both CDS forwards entered at market rates as well as CDS options require a premium payment.

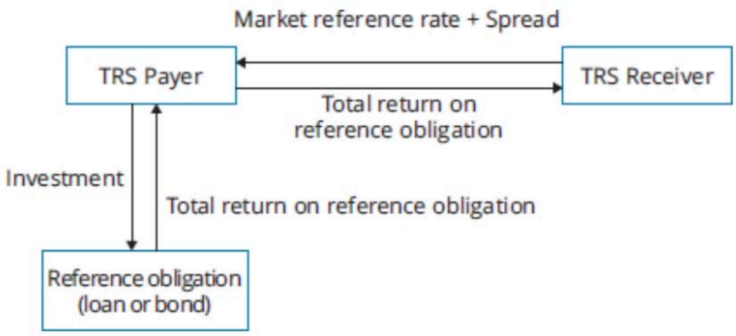
D. Neither CDS forwards entered at market rates nor CDS options require a premium payment.

MODULE 30.3: TOTAL RETURN SWAPS AND COLLATERALIZED DEBT OBLIGATIONS

Total return swaps (TRSs) entail one party paying the total return (i.e., coupon/dividend plus change in price) of an asset in exchange for a fixed or floating rate. For risky bonds, TRSs are not a pure credit derivative as they hedge both credit risk and interest rate risk. As a financing tool, TRSs allow an investor to indirectly fund the purchase of a risky bond.

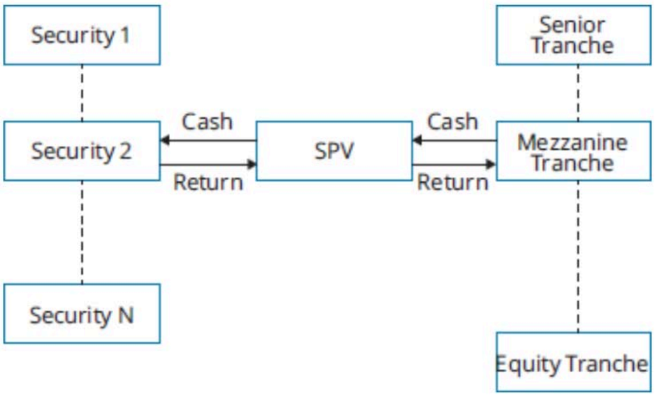
Consider an investor wanting to purchase $20 million worth of a corporate bond. The investor enters into a TRS to receive the total return on that bond with a notional amount of $20 million and pays the market reference rate plus 50 bps. Effectively, the investor has borrowed $20 million at the market reference rate plus a spread of 50 bps to finance the purchase of the corporate bond. The 50 bps spread compensates the TRS payer for the credit risk of the TRS receiver as well as the correlation between the credit risk of the corporate bond and the credit risk of the TRS receiver. At swap maturity, the TRS payer is responsible for paying any bond price *appreciation* to the TRS receiver. In turn, the TRS receiver is responsible for paying any bond price *depreciation* to the TRS payer.

Figure 30.7: Total Return Swap Structure



Collateralized debt obligations (CDOs) are claims against a portfolio of risky debt securities. These claims are divided into tranches, with the senior tranche bearing lower credit risk relative to the junior tranches. A distribution waterfall specifies the distribution of cash flow generated from the portfolio to various tranches of the CDO.

Figure 30.8: A CDO With *N* Underlying Securities



Synthetic CDOs

LO 30.f: Describe the process of valuing a synthetic CDO using the spread payments approach and the Gaussian copula model of time to default approach.

A **synthetic CDO** has similar credit risk exposure to that of a cash CDO, but is instead assembled using CDS rather than actual debt securities. A protection seller effectively gains exposure to credit risk without purchasing the specified bonds. The CDO notional principal is equal to the sum of notional principals of all of the CDS contracts on different bonds for which protection is sold. The originator then receives CDS spreads from the protection buyers and pays out any default losses.

Consider a $100 million notional synthetic CDO representing $4 million each in 25 bonds with an average CDS spread of 2%. Annual spread cash flow equals $2 million. The CDO has three tranches, which are equity, mezzanine, and senior:

1. The *equity tranche* representing 5% of the CDO notional ($5 million) absorbs the highest level of credit risk and is responsible for the first 5% of credit losses due to swap payouts. In return, the equity tranche investors receive 10% per year ($0.5 million). As losses are absorbed, the tranche principal is reduced, and the return is paid on the reduced principal. Once the losses exceed 5%, the equity tranche gets wiped out.
2. The *mezzanine tranche* bears credit losses from 5% to 25% (i.e., 20% of total notional or $20 million) after the equity tranche is exhausted. In return, the mezzanine tranche earns a return of 5.625% ($1.125 million) per year.
3. Finally, the remainder of the credit losses in excess of 25% of the total notional of the CDO is borne by the *senior tranche* representing 75% of the notional ($75 million), and in return, this tranche receives a 0.5% return ($0.375 million) per year.

Note that at inception, the total spread payment equals 2%, or $2 million, which is allocated to the three tranches. The distribution waterfall is set such that the senior tranche obtains a very high credit rating.

Because there is no actual cash outlay to purchase risky debt, synthetic CDOs do not need to be funded. If there are credit losses that need to be paid due to the protection seller position, the appropriate tranche investors would need to make deposits to meet the obligation. Typically, the tranche investors post collateral to ensure compliance.

Individual tranches in a CDO trade separately. Liquid markets exist for standard tranches on synthetic CDOs based on credit indices.

Synthetic CDO Valuation

The two approaches for valuing synthetic CDOs (i.e., calculation of the CDS spread) are (1) based on the PV of expected payments and the PV of expected payoff and (2) the Gaussian copula model.

Spread Payments Approach

According to the previous discussion on the CDS spread computation, we can calculate the spread on a single tranche of a synthetic CDO by setting the PV of expected inflow equal to the PV of expected outflow. For a single tranche, the PV of expected inflow depends on the spread payment—which, in turn, depends on the principal outstanding. For simplicity, we assume that the settlement is annual, but the model can be generalized for other settlement time periods. As losses are experienced by the tranche, its outstanding notional principal declines. As before, we assume that losses occur midway through the settlement period.

The expected loss at time t is computed as:

$$EL_t = E(NP_{t-1}) - E(NP_t)$$

The CDO tranche expected payoff is:

$$C = \sum_t EL_t \times DF_{t-0.5}$$

The DF_t = PV of $1 received at time t. We subtract 0.5 from t to account for losses occurring midway through the time period. For example, if a loss occurs in the second year, we are discounting the loss for 1.5 years.

The total spread payments to be received during the life of the CDO is equal to: A × s, where:

$$A = \sum_t E(NP_t) \times DF_t$$

The final accrual period (because of the assumption of a loss midway through the settlement period) is equal to B × s, where:

$$B = \sum_t EL_t \times DF_{t-0.5}$$

Note that the accrual period payment is only for the loss amount. The remaining notional was already accounted for as part of the calculation for A.

The total PV of expected cash inflow to tranche investors = s × (A + B), and the total PV of expected cash outflows on account of credit losses = C

Setting these equations equal results in the *breakeven spread* calculation:

$$s = \frac{C}{A + B}$$

For tranches with a standard coupon (spread) s^*, the up-front premium of NP is:

$$[C - s^* \times (A + B)]$$

Gaussian Copula Approach

Because a CDO collateral pool comprises numerous debt obligations, a multivariate distribution of time to default would be applicable. A copula joins a multivariate distribution to its one-dimensional marginal distribution functions. The one-factor **Gaussian copula model** is a popular methodology for pricing CDS tranches. The Gaussian copula model is homogenous in that it assumes that the time to default probability distribution is same for all reference entities (i.e., probability Q(t) for default at time *t* is the same for all companies in the CDO collateral pool). The correlation between different reference entities is modeled using a Gaussian copula function. The correlation of time to default for any pair of companies in the CDO (i.e., the **copula correlation)** is assumed to be a constant ρ.

The unconditional PD is given by Q(t). In a one-factor Gaussian copula model, the *conditional PD*, Q(t|F), is expressed as:

$$Q(t \mid F) = N\left(\frac{N^{-1}[Q(t)] - \sqrt{\rho}F}{\sqrt{1 - \rho}}\right)$$

Using a constant hazard rate, λ, calculated as a risk-neutral probability implied in the market price, the *unconditional PD* is computed as:

$$Q(t) = 1 - e^{-\lambda \times t}$$

In any given period, there are two possible outcomes: default or no default. Using the binomial distribution, the probability of exactly *k* defaults out of *n* companies by time period *t* is given as:

$$P(k,t \mid F) = \frac{n!}{(n - k)!k!} Q(t \mid F)^k [1 - Q(t \mid F)]^{n-k}$$

The expected values of the notional principals (hence, the losses absorbed) in each time period for each of the tranches can then be computed using the PD estimated earlier.

Implied Correlation

LO 30.g: Define the two measures of implied correlation: compound (tranche) correlation and base correlation.

If we use the industry standard recovery rate of 40%, the only missing input in estimating the tranche spread is the copula correlation. Similar to calculating implied volatility in option pricing using the Black-Scholes-Merton option pricing model, we can calculate the **implied correlation** priced by the market.

There are two alternative measures of implied correlation. The first is **compound (or tranche) correlation**. For tranche q, this is the value of the correlation that leads to the tranche spread calculated from the model being the same as the spread quoted in the market. It is found using an iterative search. The second is **base correlation**. Starting with the compound correlation for each tranche, an iterative process is used to determine the PV of expected loss for each tranche of the CDO that is consistent with its current market price.

The compound implied correlations exhibit a "correlation smile" pattern whereby the correlation starts out high for junior tranches and declines initially before rising again. Implied base correlations exhibit a "correlation skew" where the correlations rise with tranche seniority. If the market prices were consistent with the one-factor Gaussian copula model, the implied correlations should be the same for all tranches. A pronounced smile or skew pattern is, therefore, inconsistent with market pricing, and is a limitation of the one-factor model.

Gaussian Copula Model Alternatives

LO 30.h: Discuss alternative approaches used to estimate default correlation.

The one-factor Gaussian copula model has some limitations. Namely, it does not account for fat tails in real-world probability distributions for time to default and the evidenced correlation smile/skew.

Alternative models include the following:

1. *Heterogenous models*. These allow for specification of different distributions for time to default for different reference entities included in the collateral pool. However, this model gets significantly more complicated, and we cannot use a binomial model for determining the probability of k defaults at time t.
2. *Other copulas*. These include the Student's t copula, Archimedean copula, the Clayton copula, and Marshall-Olkin copula.
3. *Random recovery rates and factor loadings*. These are based on the negative relationship between default rates and recovery rates.
4. *Implied copula model*. This is simply derived from market prices.
5. *Dynamic models*. These include structural and reduced-form models, which measure the evolution of loss on a collateral pool over time.

MODULE QUIZ 30.3

1. At inception, the tranches in a synthetic CDO are priced to earn a spread that is:
   A. equal for each tranche.
   B. consistent with their seniority.
   C. aggregate in amount to the premium paid to binary CDSs.
   D. higher for senior tranches, as they represent a larger notional principal.

2. Base correlation and compound correlation are both:
   A. tranche correlations.
   B. implied correlations.

C. not relevant for synthetic CDOs.
D. exhibiting a skew with correlations rising with tranche seniority.

3. The structural model of credit risk is most likely a(n):
A. dynamic model.
B. heterogenous model.
C. implied copula model.
D. random recovery rate model.

KEY CONCEPTS

LO 30.a

Credit derivative products, such as credit default swaps (CDSs), are 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.

A CDS is a contract whereby a protection buyer (insured) pays a periodic CDS spread (insurance premium) to the protection seller (insurer) for protection against default on a reference obligation. CDS premiums are paid in arrears until the maturity of the swap or until default, whichever comes first. CDS premiums are set equal to the credit spread on the underlying to prevent arbitrage.

Total return swaps (TRSs) entail one party paying the total return on a bond and receiving a fixed or floating rate in return. TRSs hedge both credit risk and interest rate risk of the bond.

Collateralized debt obligations (CDOs) are claims on a collateral pool comprising risky debt securities. CDO tranches have a defined distribution waterfall whereby the cash flow/losses from the CDO are allocated among different tranches.

LO 30.b

Two factors influence the credit spread: (1) the probability of default (PD) and (2) the recovery rate (RR). The higher (lower) the PD (RR), the higher the credit spread. The credit spread on a CDS is set at the inception of the contract such that the PV of spread payments = PV of payoff (or expected losses).

LO 30.c

CDS pricing models use the risk-neutral (RN) probability of default, which is the PD implied in the CDS spread quoted in the market assuming a certain RR. The RR assumption is not critical as the RN probability will adjust consistent with the market price (if we assume a high RR, the implied PD would also be high, keeping the market price constant).

LO 30.d

CDSs on credit indices allow purchasing (or selling) protection on an equally-weighted portfolio of credit risky bonds. The CDS index spread is approximately equal to the average credit spread on the index constituents.

Standardized CDS contracts have a fixed coupon rather than a market spread payable by the protection buyer. The difference between the coupon rate and the spread is settled up front using the following payment:

$$\text{up-front premium \%} = \text{duration} \times (\text{spread} - \text{coupon})$$

LO 30.e

Forward contracts on a CDS allow parties to lock in a fixed spread for a CDS to commence in the future. For CDS options, the option holder has a right, but not the obligation, to enter into a CDS contract at a fixed price at maturity of the option. The option holder pays an option premium to the option writer to acquire this right.

LO 30.f

A CDO is a debt instrument backed by a collateral pool such that the cash flows from the pool are distributed to various tranches of the CDO based on a prespecified distribution waterfall. A synthetic CDO mimics the cash flows of a regular CDO by selling CDS protection on a collateral pool. The premium income from the CDS serves as the credit spread earned on the pool, while CDS loss payoffs mimic the losses suffered by the collateral pool upon default.

There are two approaches to determining the CDS spread in a CDO:

1. One approach is setting the PV of expected spread payments equal to the PV of expected payoffs.
2. The other approach is the one-factor Gaussian copula model, which models the time to default of each of the securities in the collateral pool using a homogenous distribution. A key factor is the correlation between time to default of the individual bonds in the collateral pool.

LO 30.g

The correlation between the time to default of collateral pool constituents can be estimated as follows:

- There is implied correlation in the current market price of the CDS tranche.
- The implied correlation can be a compound correlation that uses an iterative approach to estimating correlation consistent with the market price of each of the CDO tranches. Alternatively, implied correlation can be a base correlation that starts with the compound correlation and then re-estimates it by setting the PV of expected spread payments equal to the PV of expected losses.

Compound correlations in practice exhibit a “correlation smile” pattern whereby the implied correlations start out high for junior tranches, fall, and then rise again as they move toward more senior tranches. Implied base correlations, on the other hand, exhibit a “correlation skew” rising with tranche seniority. If estimated correctly, correlations should be the same regardless of tranche. This smile/skew pattern is a limitation of the one-factor Gaussian model.

LO 30.h

Alternatives to the one-factor Gaussian copula model include the following:

1. *Heterogenous models*. These allow for specification of different distributions for time to default for different reference entities included in the collateral pool.
2. *Other copulas*. These include the Student's *t* copula, Archimedean copula, the Clayton copula, and Marshall-Olkin copula.
3. *Random recovery rates and factor loadings*. These are based on the negative relationship between default rates and recovery rates.
4. *Implied copula model*. This is derived from market prices.
5. *Dynamic models*. These include structural and reduced-form models, which measure the evolution of loss on a collateral pool over time.

ANSWER KEY FOR MODULE QUIZZES

Module Quiz 30.1

1. **A** Arbitrage-free conditions indicate that:

   CDS-bond basis = CDS spread – bond yield spread = 0

   Thus, CDS spread = bond yield spread = 3% (given).

   Bond yield spread = bond yield – swap fixed rate

   3% = bond yield – 4% (make sure to use the 7-year swap fixed rate)

   Therefore, the bond yield = 7%.

   (LO 30.a)

2. **A** The probability of survival in Years 1 and 2 = $e^{-0.02 \times 1}$ = 0.9802 and $e^{-0.02 \times 2}$ = 0.9608.

   The probability of default in Year 2 = 0.9802 – 0.9608 = 0.0194, or 1.94%.

   (LO 30.b)

3. **C** The CDS spread is set such that the PV of expected payoff is equal to the PV of expected payments during the life of the swap. The PV of expected payments includes the PV of expected periodic swap spread payments plus the PV of expected accrual payments. (LO 30.b)

Module Quiz 30.2

1. **C** Recognize that the value of the CDS is calculated such that:

   current PV of expected payments = current PV of expected payoff = 0.0312

   Using the current spread of 2.30%, the current PV of expected payments = 0.023 × s.

   s = 0.0312 / 0.023 = 1.3565

Applying this value to the initial CDS spread of 1.85% yields:

PV of expected payments (based on 1.85%) $= 0.0185 \times 1.3565 = 0.0251$

Value to the protection buyer = PV of expected payoff - PV of expected payments

$= 0.0312 - 0.0251 = 0.0061$ per \$1 notional

The swap value for the \$5 million notional = 0.0061 × 5,000,000 = \$30,500.

Because the spread has widened, the protection buyer gains. (LO 30.c)

2. **D** The CDX NA IG index has 125 equally-weighted entities. When one of these entities defaults, the existing CDS would continue with 124 entities with the same notional per entity. (LO 30.d)

3. **B** CDS forwards entered at market rates do not require a premium payment. However, CDS options do require a premium payment to the option writer who is willing to take the risk of option exercise. (LO 30.e)

Module Quiz 30.3

1. **B** At inception, the tranches in a synthetic CDO are priced to earn a spread that is consistent with their risk level (i.e., seniority in the distribution waterfall). The aggregate spread amount is set equal to the premium received as a protection seller in a vanilla CDS. While senior tranches normally have a higher notional principal, the spread (as a rate) is lower due to the lower credit risk of the senior tranches. (LO 30.f)

2. **B** Compound (or tranche) correlation and base correlation are implied correlations that are calculated differently. While compound correlations exhibit a smile pattern, base correlations show a skew pattern. (LO 30.g)

3. **A** Dynamic models, including structural and reduced-form models, capture the evolution of loss on a collateral pool over time. Heterogenous models allow for specification of different distributions for time to default for different reference entities included in the collateral pool. Random recovery rates and factor loadings are based on the negative relationship between default rates and recovery rates. The implied copula model is derived from market prices. (LO 30.h)

The following is a review of the Credit Risk Measurement and Management principles designed to address the learning objectives set forth by GARP®. Cross-reference to GARP assigned reading—Gregory, Chapter 2.

READING 31

DERIVATIVES

Study Session 6

EXAM FOCUS

Traditional, noncleared markets rely on bilateral trades that leave both counterparties open to credit (mainly default) risk. By contrast, centrally cleared derivatives use collateralization and margining to reduce counterparty risk. This topic focuses on the differences between exchange-traded and over-the-counter (OTC) derivatives as well as the differences between cleared and noncleared transactions. For the exam, understand the structure of derivatives markets and the different market players, and the role of the central counterparty (CCP) and central clearing in reducing systemic risk. Also, be prepared to explain how entities use different mechanisms to reduce counterparty risk, and be able to identify both their strengths and shortfalls. Finally, be able to discuss the different approaches used for modeling derivatives risk.

MODULE 31.1: TYPES OF DERIVATIVES AND DERIVATIVES MARKETS

LO 31.a: Define derivatives and explain how derivative transactions create counterparty credit risk.

A **derivative** represents a contractual agreement between two parties to buy or sell an underlying security, or to make a payment in the future. Derivatives like many futures contracts may expire in the short term (few weeks), while others, such as long-dated swaps, may expire in several years. The value for derivatives changes over the life of the contract, but many are valued to have zero value at inception for both parties.

Derivatives have existed for a long time, with some of the earliest types dating back centuries. They offer an important tool for entities to hedge their various risk exposures, including interest rate risk (via an interest rate forward or swap), foreign exchange risk (via FX forwards), or commodity price risk (via commodity futures or swaps). They also offer entities a way to gain or reduce their exposure to an underlying security. Consider a farmer who is worried that the price of wheat could decline over the next six months when the crop is harvested. In this case, price risk could be hedged by taking the short side in (selling) wheat futures that expire in six months, which locks in a known future price for the farmer.

Derivatives are used by a wide range of entities, including corporations, wealth managers, banks, insurance companies, and various forms of governments as well as central banks. Some derivatives (like futures) are standardized, while others (like forwards and swaps) are custom instruments that can be tailored to the specific needs of the parties. Some markets are dominated by large and important derivatives dealers, often large systemically important banks.

Although a key use of derivatives is to hedge risk, they create their own risk: **counterparty credit risk** (a combination of market and credit risk). This is the risk that as the value of the contract changes over time given changing security prices and market conditions, the other party to the transaction will not meet its contractual obligations and will not deliver the security or make a payment. Counterparty risk can be managed bilaterally where each party manages its own risk, or centrally via a central counterparty (CCP).

Derivatives Markets

LO 31.b: Compare and contrast exchange-traded derivatives and over-the-counter (OTC) derivatives, and discuss the features of their markets.

Derivative contracts may be *exchange traded*, which are standardized and created and traded on an exchange, or *over-the-counter (OTC)*, which are customized.

Exchange-traded derivatives, like futures and many options, include terms and conditions that are specified by the exchange, and include specific prices, expiry dates, and notional value of the underlying securities they represent. Standardized contracts facilitate clearing and settlement and promote transparency and accessibility, but their terms generally cannot be altered. Most derivatives exchanges are very liquid.

By contrast, **OTC derivatives** trade on informal global networks often through dealers, and the contracts are private and customized between two counterparties. As a result, these contracts facilitate transferring risks in very precise ways and improve flexibility. Consider a computer manufacturer that needs to buy 1,241 ounces of copper for circuit boards in 133 days. A custom contract can be created in the OTC market as long as the manufacturer can find a counterparty, or a dealer is willing to take the sell side of the transaction.

The main disadvantage is that unwinding a custom, private contract can be very difficult, or could only be done at unfavorable terms. If the counterparty is the dealer, the dealer cannot buy (sell) the derivative at one price and simultaneously sell to (buy from) another party at a better price. Some contracts may be *novated* (assigned to another party), but typically, this can only be done with the permission of the original counterparty. While many OTC derivatives markets are illiquid, some markets (including FX) can be very liquid.

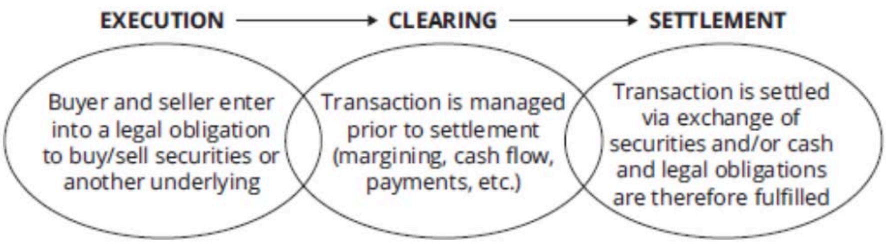
Clearing Derivative Transactions

LO 31.c: Describe the process of clearing a derivative transaction.

Both clearing and settlement are critical functions in derivatives markets. **Clearing** is the process before the settlement of recording the counterparties' identities and computing and facilitating margin and payment obligations. **Settlement** is the related process of facilitating payment and transferring money from one counterparty to the other when the contract is closed out to satisfy their legal obligations. Clearing can be viewed as the period between executing and settling a transaction. Both clearing and settlement are important for managing counterparty credit risk—the risk of a failure in contractual obligations (nonpayment, or nondelivery of an asset). Because derivatives may have very long time horizons, OTC clearing is of growing importance.

In a **bilateral market**, the original counterparty remains unchanged as long as the contract remains in effect, and risk management is done by each counterparty. In a **centrally cleared market**, the original counterparty is replaced by the CCP, which steps into the middle of the transaction and becomes the new counterparty to each side, as well as performs the risk management functions. Figure 31.1 illustrates the relationship between execution, clearing, and settlement.

Figure 31.1: Clearing Financial Transactions



Source: Jon Gregory, *The xVA Challenge: Counterparty Credit Risk*, Funding, Collateral, and Capital (West Sussex, UK: John Wiley & Sons, 2020). Chapter 2.

While OTC markets have historically been primarily bilaterally cleared, central OTC clearing has been gaining prominence. However, because central clearing needs some level of standardization, it is not feasible for all OTC derivatives.

Market Participants and Collateralization in Derivatives Markets

LO 31.d: Identify the participants and describe the use of collateralization in the derivatives market.

Market participants for derivative trades fall into three broad groups, where the groups are segmented based on the size of the derivatives portfolio (but not necessarily the size of the participants).

These three groups are (1) large player, (2) medium-sized player, and (3) end user:

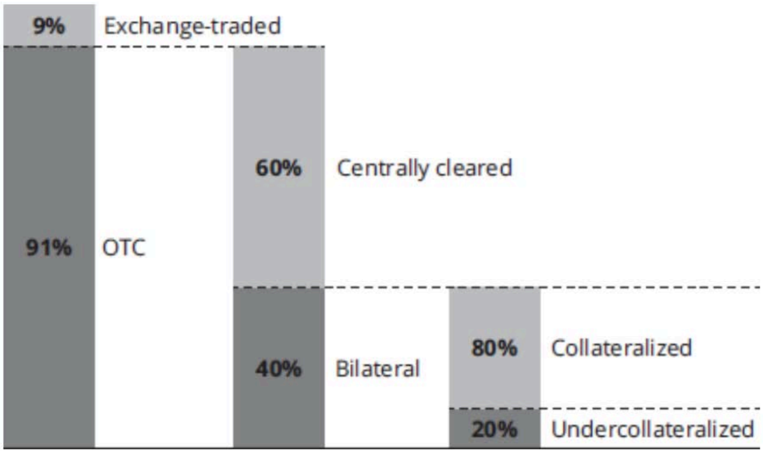
- *Large player*. These are typically large global banks that have a significant derivatives portfolio with a large volume of trades. They trade most types of derivatives, including FX, interest rate, equities, commodities, and credit derivatives, and they provide significant liquidity to the derivatives markets. Large players are members of most exchanges and CCPs and participate as dealers in the OTC markets, controlling around 80% of the notional value of OTC trades.
- *Medium-sized player*. These are usually small banks and financial institutions that have a fair amount of OTC trades across a range of derivative types and are often members of exchanges and CCPs. A typical player is a local or regional bank that needs to hedge its interest rate or various FX exposures. However, they do not trade the whole spectrum of derivatives; for example, they typically do not participate in credit derivatives or commodity or exotic derivatives markets.
- *End user*. End users can be small financial institutions, large corporations, and even sovereign governments that have relatively small or specific derivatives needs, often to hedge a single type of exposure. For example, a pension fund may only need interest rates swaps to hedge its floating rate exposure, while a mining company may only need commodity forwards to hedge its price exposure. End users typically only transact with a small number of counterparties and tend to avoid posting collateral frequently or only post illiquid collateral. Counterparty credit risk is a significant risk in these markets. Nevertheless, some large regional and sovereign governments or supranational entities (which have very high credit quality) can dictate better terms when trading with counterparties (usually banks), including requiring the counterparty to post collateral but not posting collateral themselves, or having favorable rating triggers or other contract terms.

Derivatives can also be classified based on the way they are transacted and collateralized, and fall into four groups: (1) exchange traded, (2) OTC centrally cleared, (3) OTC collateralized, and (4) OTC uncollateralized. Exchange-traded derivatives represent less than 10% of the market and are settled daily with margin. OTC derivatives represent the bulk of the market and are usually not settled daily, but they may be centrally cleared and collateralized. Posting collateral reduces counterparty risk, but it introduces legal and operational risk and funding costs:

- *Exchange traded.* These encompass simple, short-dated, and highly liquid derivatives. All exchange-traded markets are centrally cleared and collateralized, greatly minimizing counterparty credit risk. Counterparties post margin and trades are marked-to-market.
- *OTC centrally cleared*. These include more complex and less liquid OTC derivatives trades that are not well suited for trading on exchanges. However, they are centrally cleared and collateralized with daily variation margin.
- *OTC collateralized*. These are bilateral OTC trades where each counterparty posts cash or security collateral to reduce counterparty credit risk.
- *OTC uncollateralized*. These are bilateral OTC trades that are not collateralized by the counterparties, usually because they do not have or cannot lock up cash or securities. As a result, these are the riskiest derivatives markets.

Figure 31.2 provides a visual representation of the size of these markets.

Figure 31.2: Types of Derivatives by Market Size



Source: Jon Gregory, *The xVA Challenge: Counterparty Credit Risk*, Funding, Collateral, and Capital (West Sussex, UK: John Wiley & Sons, 2020). Chapter 2.

MODULE QUIZ 31.1

1. The process under which margin transactions are facilitated and computed is best referred to as:
   A. clearing.
   B. settlement.
   C. execution.
   D. collateralization.

MODULE 31.2: CENTRAL CLEARING OF DERIVATIVES AND MODELING DERIVATIVES RISKS

ISDA Master Agreement

LO 31.e: Define the International Swaps and Derivatives Association (ISDA) Master Agreement, the risk-mitigating features it provides, and the default events it covers.

Because OTC derivatives trades are privately negotiated between two parties, it was necessary to develop legal documentation that governs the general terms of these contracts. The industry standard is the **ISDA Master Agreement**, introduced in 1985 and widely used since 1992, which was developed by the International Swaps and Derivatives Association (ISDA). Negotiating ISDA Master Agreements can be a time-consuming process, but it is intended to help standardize terms and reduce overall risk to counterparties through the following: (1) contractual terms for posting collateral, (2) events of default and termination, (3) netting of obligations, and (4) defining the closeout process. The main agreement is standard, but it has a schedule that contains adjustable terms. The law governing these agreements is usually English or New York law.

From the perspective of counterparty credit risk, events of default are critical because a default causes the termination of the agreement and initiates the closeout process. **Events of default** include the following forms, with failure to pay and bankruptcy being the most common:

- Failure to pay or deliver
- Breach of agreement
- Credit support default
- Misrepresentation
- Default under a specified transaction
- Cross-default (i.e., a default on another obligation of the same counterparty)
- Bankruptcy
- Merger without assumption

PROFESSOR'S NOTE
ISDA Master Agreements contain four main parts: a master agreement, a schedule, credit support, and confirmation. Credit support defines the terms of collateral and is typically included under a credit support annex, commonly referred to as the *ISDA CSA* (or just *CSA*).

Credit Derivatives

LO 31.f: Describe the features and use of credit derivatives and discuss potential risks they may create.

Credit derivatives are derivatives that hedge the exposure to credit risk. The most common credit derivative is the credit default swap (CDS), with other common types including total return swaps and credit spread options. Credit derivatives can be an efficient way to transfer credit risk, although speculation in the credit derivatives market (e.g., leading up to the global financial crisis [GFC]) has introduced significant risk—and as a result, growth has slowed in recent years.

A CDS involves one side as the credit protection buyer (seeking protection against the default of a third party) and the other side as the credit protection seller. However, while the CDS is intended to protect against the credit risk of a third party, it introduces credit risk between the two counterparties to the CDS. This credit risk is one of the key reasons for the push toward central clearing of OTC derivatives.

Central Counterparties

LO 31.g: Describe central clearing of OTC derivatives and discuss the roles, mandate, advantages, and disadvantages of the central counterparty (CCP).

Central Clearing and the Role of CCPs

In the wake of the 2007–2009 financial crisis, central clearing of derivatives trades and the role of the **central counterparty (CCP)** became significantly more important to ensure systemic risk mitigation. CCPs provide clearing services for many different types of financial transactions between member firms, and they stand between counterparties as the buyer for every seller and the seller for every buyer.

CCPs perform several critical roles, including:

- setting standards and rules for clearing members;
- closing out the positions of defaulting clearing members;
- requiring initial margin, variation margin, and contributions to a default fund to mutualize losses; and
- establishing a plan for extreme events (e.g., requiring top-ups to the default fund, or haircutting variation margins).

Benefits of CCPs

The CCP structure provides significant credit benefits because it changes the traditional risk landscape, with the CCP being in the middle of all trades. In a traditional bilateral counterparty structure, default risk is directly borne by the individual counterparties. With central clearing, trades are netted and the original counterparties no longer represent credit risk, as the CCP becomes the new counterparty.

CCPs remain market neutral by netting all buy-side transactions with offsetting sell-side transactions. This multilateral netting process requires counterparties to post collateral through a margin account. The end result is less theoretical risk in the system due to mark-to-market collateralization.

In the event of a default of one of the clearing members, the CCP must replace nonperforming transactions not by closing out transactions, but by substituting the defaulted member with another clearing member. Within the CCP structure, counterparty losses are mutualized among all member firms by spreading losses across clearing members. CCPs also facilitate the closeout process by auctioning the defaulting member's obligations with netting—and, therefore, reducing the overall position value and minimizing volatility.

Shortfalls of CCPs

For central clearing to be effective, CCPs must be of extremely strong credit quality. The failure of a CCP could result in a systemic shock. Furthermore, while CCPs help reduce credit risk (and thus, prioritize derivatives counterparties), this could be done at the expense of other market participants like bondholders. Finally, because CCPs often have cross-border activities, they need to deal with conflicting legal frameworks and regulations.

Margin Requirements for Derivatives

LO 31.h: Explain the margin requirements for both centrally-cleared and non-centrally-cleared derivatives.

As mentioned, clearing members using centrally cleared derivatives must post *initial margin* and *variation margin* and contribute to a default fund to cover the losses of a defaulting clearing member. Initial margin is required on all trades, and variation margin is needed to cover market value changes in the derivatives.

By contrast, noncentrally cleared, bilateral trades historically had no or only limited margin requirements—but in recent years, to mitigate systemic risk, regulators globally have been moving to introduce similar margin requirements for bilateral derivatives trades as those under central clearing.

Counterparty Risk Intermediaries

LO 31.i: Define special purpose vehicles (SPVs), derivatives product companies (DPCs), monolines, and credit derivatives product companies (CDPCs) and describe the limitations of using them as risk mitigating methods.

A **special purpose vehicle (SPV)**, also called a special purpose entity (SPE), is an off-balance sheet, bankruptcy-remote entity that is separate from its sponsor. SPVs are created to reduce counterparty risk, with SPV investors having priority as creditors (known as a *flip provision*). Because of their bankruptcy remoteness and often low leverage, SPVs received high credit ratings from rating agencies. An SPV, in essence, transforms counterparty risk into a type of legal risk.

The legal risk is that a bankruptcy court might consolidate the assets of an SPV with their sponsor in the event of default, which would treat the SPV assets as if they had never been physically transferred off the sponsor's books. This treatment will depend on the jurisdiction, but United States courts have a history of consolidation rulings. Under this scenario, the goal of isolating the originator from counterparty risk with the SPV is often not realized. Other courts, including in the United Kingdom, tend to avoid consolidation rulings unless it involves fraud. In the case of the Lehman Brothers bankruptcy, the U.S. courts ruled that the flip provision was unenforceable. This contradicted the U.K. courts, which ruled that they were.

A **derivatives product company (DPC)** is another entity that evolved out of a need for OTC derivatives markets to manage counterparty risk. A DPC is set up by a financial institution to obtain a very high (typically AAA) credit rating with separate capitalization from the parent. This puts further distance between a DPC and its parent. In this way, if the DPC parent were to fail, the DPC would not suffer losses, which provides a measure of enhanced protection for DPC counterparties.

The credit rating of a DPC depends on the following three factors:

1. *Minimizing market risk*. A DPC will often remain market neutral by trading offsetting contracts. Ideally, these mirrored trades will occur on both sides of every trade so that the counterparty risk is negligible.
2. *Support from the parent*. Similar to an SPV, a DPC is established to be bankruptcy remote from the parent. However, in the event of the parent's failure, a DPC is pre-arranged to either pass to another institution with strong capital, or to gradually unwind all mirrored transactions in an orderly fashion.
3. *Internal credit risk management and operational guidelines*. These guidelines provide another layer of risk mitigation in a DPC, and they generally involve daily marking to market and collateral posting to limit risk exposures.

The concept of an orderly unwinding of a DPC's book does not always hold true in real-world application. When both Lehman Brothers and Bear Stearns failed during the global financial crisis, DPCs from these institutions did not experience orderly unwindings. Two Lehman Brothers DPCs filed for Chapter 11 bankruptcy, while the Bear Stearns DPCs were wound down by JPMorgan. As a result, it is clear that DPCs have significant risks, including legal risk (similar to SPVs) as well as market and operational risk.

Monoline insurance companies (monolines) are highly leveraged insurance companies with a single business line to insure bond repayments, typically under guarantees provided to bond issuers (known as *credit wraps*) to enhance bond ratings. They offer credit enhancements, often in the form of CDSs, for various structured credit products. Unlike DPCs, monolines do not post collateral against their transactions when business conditions are normal, and they retain their very high (usually AAA) credit ratings. However, as insurance valuation losses mounted during the global financial crisis, monolines lost their high credit ratings and were forced to post collateral just at the time that their insured losses increased. This led to the failure of several monolines during 2007–2009.

Credit derivative product companies (CDPCs) are similar to DPCs, but they have business models similar to monolines to provide credit derivative protection, and to profit from offering such protection. As with monolines, CDPCs do not post collateral against their transactions when business conditions are normal, and they retain their AAA credit ratings. CDPCs are usually highly leveraged and carry a great deal of market risk because they do not use offsetting risk positions. Similar to monolines, many CDPCs failed during or shortly after the global financial crisis.

Modeling Derivatives Risk

LO 31.j: Describe the approaches used and the challenges faced in modeling derivatives risk.

The need for a more quantitative assessment of derivatives has led to the introduction of derivatives models like value at risk, potential future exposure, and expected shortfall, as well as correlations and dependency calculations.

Value at risk (VaR) measures the worst loss over a specified period (typically short term) using a given confidence level (conversely, the minimum loss using a given significance level). For example, a one-month VaR of $100,000 at a 99% confidence level means that there is a 99% probability that the maximum loss in a month is $100,000 (or, there is a 1% probability that the minimum loss will be $100,000). **Potential future exposure (PFE)** is the credit risk equivalent of VaR and has a long time horizon, often measured in years. Because PFE measures counterparty credit risk, it measures credit exposure due to a gain.

VaR has the advantage of summarizing risk in a single number, and it does not depend on the shape of the loss distribution. However, it does not reveal anything about the possible loss beyond the confidence level (i.e., is it $100,001 or $5,000,000?). Furthermore, VaR may not be subadditive. Subadditivity would imply that the risk of two portfolios is the sum of their individual risks.

Expected shortfall (ES) is a modification of VaR that measures the average loss beyond VaR, meaning the average loss knowing that the loss is at least equal to VaR. Both VaR and ES are typically implemented using historical simulation using real, historical data, where the data is then recalculated under different scenarios. The outcomes are then backtested *ex post* to check the models' predictive power.

Most financial institutions combine VaR and ES calculations with other complex quantitative models—using correlation, volatility, and dependence factors—to assess risk in making investment decisions. Modeling of risks has also been increasingly required by regulators. However, many models tend to be viewed on a binary basis (either as good or bad), whereas in reality, their effectiveness or success depends not on the model itself, but on how institutions use them.

Incorporating correlations and dependence into modeling further reveals the shortfalls of models like VaR. Using historical correlations is often a poor predictor of future outcomes. In addition, correlations often change significantly, especially during periods of greater volatility and stress. Dependence between financial variables can also change, where assessing the codependence of various risk factors (credit risk, market risk, collateral) becomes critical.

MODULE QUIZ 31.2

1. Which of the following statements is not an improvement that centrally cleared markets offer relative to bilateral markets? Centrally cleared markets:
   A. remain market neutral by netting trades.
   B. offer more flexibility in contract selection.
   C. formalize the default closeout process by mutualizing losses.
   D. improve counterparty risk by replacing the original counterparty with a series of new counterparties.
2. Which of the following actions is not an advantage of the central counterparty (CCP) in the centralized clearing process?
   A. Loss mutualization.
   B. Eliminate counterparty risk.

C. Improve operational efficiency.
D. Risk reduction through multilateral netting.

3. Which of the following statements is an enhancement offered by the central counterparty (CCP) structure relative to the special purpose vehicle (SPV), the derivative product company (DPC), and the monoline insurance models? The CCP structure:
   A. enables financial institutions to remove assets from their balance sheets.
   B. enables counterparty risk to be outsourced, but in a nondiversified format.
   C. spreads losses over a group of counterparties to minimize potential systemic risk.
   D. enables a counterparty transaction originator to fail and not affect the other member firms.

4. A risk manager at MAB Funds estimates that the fund's one-week value at risk (VaR) is \$1 million using a 95% probability. The fund can, therefore, be expected to lose:
   A. an average of \$1 million in a week 5% of the time.
   B. an average of \$1 million in a week 95% of the time.
   C. no more than \$1 million in a week 5% of the time.
   D. no more than \$1 million in a week 95% of the time.

KEY CONCEPTS

LO 31.a

A derivative is a contractual agreement between two parties to buy or sell an underlying security, or to make a payment in the future. Derivatives are exposed to counterparty risk, which is a combination of market and credit risk, reflecting market value changes and the risk that the other side will not meet its contractual obligations. Counterparty risk can be managed bilaterally or centrally involving a central counterparty (CCP).

LO 31.b

Exchange-traded derivatives include futures and many options. The exchange specifies the terms and conditions, prices, expiry dates, and notional value, and transactions are centrally cleared and settled.

OTC derivatives include forwards and swaps, and they trade on informal global (dealer) networks. Contracts can be customized (which improves flexibility), unwinding a custom contract can be very difficult or costly, and each side is subject to credit risk.

LO 31.c

Clearing is the process of recording counterparties' identities and calculating margin and payment obligations. Settlement is the process of facilitating payment and transferring money when the contract is closed out. Clearing is the period between execution and settlement of a transaction.

In a bilateral market, each counterparty remains unchanged, and risk management is done by each counterparty. In a centrally cleared market, the CCP becomes the new counterparty to each side of the transaction, and it performs the risk management functions.

LO 31.d

Market participants for derivatives can be segmented into the following groups:

1. *Large players* (global banks) have significant derivatives portfolios and large volumes of trades across a broad spectrum of derivatives.
2. *Medium-sized players* (smaller financial institutions or regional banks) have a fair amount of OTC derivatives trades across a slightly more limited range of derivatives types.
3. *End users* (small financial institutions, large corporations, and sovereign or other governments) have relatively small or specific derivatives needs (e.g., to hedge a single type of exposure). End users generally do not post collateral, and they face significant counterparty risk.

Derivatives can be exchange traded (centrally cleared and collateralized with margin requirements), OTC centrally cleared, OTC collateralized, or OTC uncollateralized.

LO 31.e

OTC derivatives are typically governed under a standardized ISDA Master Agreement, which includes (1) contractual terms for posting collateral, (2) events of default and termination, (3) netting of obligations, and (4) defining the closeout process.

Default causes the termination of the agreement leading to the closeout process. The most common events of default are failure to pay or deliver, and bankruptcy.

LO 31.f

Credit derivatives hedge the exposure to credit risk and include credit default swaps (CDSs), total return swaps, and credit spread options. The two parties to a CDS are the credit protection buyer and the credit protection seller, where both counterparties are exposed to credit risk.

LO 31.g

Central clearing is the process by which the CCP performs trade verifications and netting and margining functions. Overall, the role of the CCP includes the following:

- Setting standards and rules for clearing members
- Closing out the positions of defaulting clearing members
- Requiring initial and variation margin, and default fund contributions
- Planning for extreme events

Benefits of CCPs include the following:

- With the CCP as the counterparty to each trade, default risk is minimized
- CCPs perform multilateral netting and posting collateral, which reduces credit risk
- CCP help mutualize counterparty losses across clearing members
- CCPs facilitate the closeout process

Shortfalls of CCPs include the following:

- The potential failure of a CCP could result in a systemic shock
- CCPs prioritize derivatives counterparties at the expense of other market participants
- CCPs are often exposed to conflicting legal frameworks and regulations in different jurisdictions

LO 31.h

Central clearing requires members to post initial margin and variation margin as well as contribute to a default fund. Noncentrally cleared, bilateral trading historically had no or limited margin requirements, although there is a move toward central clearing of these trades.

LO 31.i

Special purpose vehicles (SPVs) are bankruptcy-remote entities separate from the sponsor. SPVs reduce counterparty risk for investors, and investors have priority as creditors. SPVs transform counterparty risk into legal risk. The legal risk is that a bankruptcy court might consolidate the assets of an SPV with their sponsor in the event of default.

Derivatives product companies (DPCs) are set up by their parent institutions to obtain very high credit ratings and are separately capitalized by the parent so that if the DPC parent were to fail, the DPC would not suffer losses. The credit rating of a DPC depends on the (1) minimizing market risk, (2) support from the parent, and (3) internal credit risk management and operational guidelines.

Monoline insurance companies (monolines) are highly leveraged insurance companies with a single business line to insure bond repayments. They offer credit enhancements for various structured credit products. Monolines do not post collateral against their transactions.

Credit derivative product companies (CDPCs) are similar to both DPCs and monolines. They provide credit derivative protection while also profiting from offering such protection. CDPCs do not post collateral, are highly leveraged, and carry a great deal of market risk.

LO 31.j

Financial institutions use many models to assess risk. Value at risk (VaR) measures the worst loss over a specified short period using a given confidence level. VaR is simple and intuitive and does not depend on the shape of the loss distribution, but it does not reveal anything about the possible loss beyond the confidence level. Potential future exposure (PFE) is the credit risk equivalent of VaR relating to gains using a long time horizon. Expected shortfall (ES) measures the average loss knowing that the loss is at least equal to VaR.

Financial institutions often combine these model types with other complex quantitative models using correlations, volatility, and dependence factors. However, historical correlations are often poor predictors of future outcomes, and they can change significantly during periods of stress.

ANSWER KEY FOR MODULE QUIZZES

Module Quiz 31.1

1. **A** *Clearing* is the process of recording counterparties' identities and calculating margin and payment obligations. *Settlement* is the process of facilitating payment and transferring money when the contract is closed out. *Execution* is the initial step of entering into a derivatives contract. *Collateralization* is the process of posting assets as security to minimize credit risk. (LO 31.c)

Module Quiz 31.2

1. **B** Bilateral markets permit any type of customized financial contract and customized collateral that is freely negotiated between the two bilateral parties. In a centrally cleared market, flexibility is reduced because contracts must be standardized, and collateral rules are fixed and nonnegotiable. (LO 31.g)

2. **B** The centralized clearing process used by a CCP does not fully eliminate counterparty risk, but it significantly reduces or minimizes this risk relative to bilateral transactions. (LO 31.g)

3. **C** Through the collateralization and loss mutualization processes, a CCP spreads losses over a group of counterparties—and, in the process, reduces potential systemic risk. SPVs and DPCs are entities that remove assets from a financial institution's balance sheet. Monolines enable counterparty risk outsourcing in a nondiversified format. In the event that a member fails in the CCP structure, all other member firms are impacted through loss mutualization. It is the DPC that protects itself from the failure of the transaction originator. (LO 31.i)

4. **D** VaR measures the worst loss over a specified short period using a given confidence level. As a result, the risk manager expects that the fund will lose no more than $1 million in a week 95% of the time (or, it will lose at least $1 million 5% of the time). (LO 31.j)

The following is a review of the Credit Risk Measurement and Management principles designed to address the learning objectives set forth by GARP®. Cross-reference to GARP assigned reading—Gregory, Chapter 3.

READING 32

COUNTERPARTY RISK AND BEYOND

Study Session 6

EXAM FOCUS

This reading examines the concept of counterparty credit risk and introduces techniques for mitigating and managing counterparty risk. For the exam, know the basic terminology related to counterparty risk and the definitions and differences among the various credit exposure metrics that are discussed. Also, be familiar with the types of institutions that take on counterparty risk through trading, and have an understanding of how institutions can mitigate and manage this risk.

MODULE 32.1: COUNTERPARTY RISK

Counterparty Risk and Lending Risk

LO 32.a: Describe counterparty risk and differentiate it from lending risk.

Counterparty risk is the risk that a counterparty is unable or unwilling to live up to its contractual obligations (i.e., counterparty defaults). Within the context of derivatives contracts, default occurs at some point after inception but prior to the end of the contract term (i.e., presettlement). If default occurs, current and future payments required by the contract will not be made.

Lending risk has two notable characteristics: (1) the principal amount at risk is usually known with reasonable certainty (e.g., mortgage at a fixed rate) and (2) only one party (unilateral) takes on risk.

Counterparty risk goes further than lending risk because it takes into account that the value of the underlying instrument is uncertain in terms of absolute amount and in terms of which party will have a subsequent gain or loss. In addition, counterparty risk is bilateral in that each party takes on the risk that the counterparty will default; the party that is "winning" takes on the risk that the party that is "losing" will default.

PROFESSOR'S NOTE

Counterparty risk is typically used to refer to risk that occurs prior to settlement (i.e., presettlement risk). However, the term may occasionally be used with regard to settlement risk, which is the risk stemming from the fact that there may be a difference in timing between when each counterparty performs its contractual obligations at settlement. During this period, default can occur, resulting in a large loss for one party as credit exposure is at its highest level during the settlement process. If not specifically defined, assume counterparty risk refers exclusively to presettlement risk.

Transactions With Counterparty Risk

LO 32.b: Describe transactions that carry counterparty risk and explain how counterparty risk can arise in each transaction.

Exchange-traded derivatives do not carry counterparty risk because the exchange is usually the counterparty. Therefore, the focus of this reading will be on securities financing transactions and over-the-counter (OTC) derivatives.

Securities financing transactions include repos and reverse repos, and securities borrowing and lending.

Repos are short-term lending agreements (as short as one day) secured by collateral. The agreement involves a party (the seller or borrower) selling securities to another party (the buyer or lender) for cash, with the seller/borrower buying back the securities at a later date. The lender receives the repo rate, calculated as a risk-free interest charge, plus a counterparty risk charge. Collateral is usually in the form of liquid securities. A haircut is applied to mitigate against the counterparty risk that the borrower will not repay the cash and to mitigate against a decline in the value of the collateral. To illustrate the use of a haircut, assume a 2% haircut on a $100 million loan amount. This means that approximately $102.04 million of securities is required as collateral on a $100 million loan [$100 million / (1 – 0.02) = $102.04 million].

Although reduced by collateral on the loan, counterparty risk still exists in both a repo transaction and a reverse repo transaction (which is a repo, from the perspective of the other party) due to the fact that the seller may fail to repurchase the security at the maturity date (forcing the buyer to liquidate the collateral to recover the cash that was loaned). If securities are used as collateral, risk exists that the market value of the securities will have declined prior to maturity.

Securities borrowing and lending are repos, just with securities involved rather than cash. The associated counterparty risk is similar to that of repos.

OTC derivatives include interest rate swaps (the bulk of the transactions), foreign exchange transactions, and credit default swaps (CDSs).

When comparing an interest rate swap to a regular loan, counterparty risk is reduced for the interest rate swap because there is no exchange of principal. The risk lies in the exchange of floating cash payments versus fixed cash payments. The notion of "netting" further reduces counterparty risk because only the difference between the two payments (the net amount) is exchanged periodically. As soon as the counterparty defaults on payments, there is no need for the other party to continue making payments.

Foreign exchange forwards carry large counterparty risk due to the need to exchange notional amounts and due to long maturities (thereby increasing the probability that a default will occur at least once).

Credit default swaps carry large counterparty risks due to wrong-way risk and significant volatility (thereby increasing the probability that there will be a "losing" party that will default). Wrong-way risk refers to an increase in exposure when counterparty credit quality worsens. It can be illustrated in a very simplified example whereby a firm invested in Greek sovereign debt wishes to protect its position by purchasing a CDS on Greek sovereign debt from a Greek bank. Assuming a reduction in the rating of Greek sovereign debt, the buyer of the CDS is "winning." However, the ability of the "losing" counterparty (the Greek bank) to meet its obligations will further be impaired as a result of the credit rating decrease.

Institutions That Take on Counterparty Risk

LO 32.c: Identify and describe institutions that take on significant counterparty risk.

The institutions that take on counterparty risk through trading activities vary in size, volume, coverage of asset classes, and their willingness (and ability) to post collateral against their positions. At a high level, these institutions (called "derivatives players" in this context) fall into three categories: large, medium, and small.

Large derivatives players are large banks (dealers) that trade with each other and with a large number of clients. They tend to have high numbers of OTC derivatives on their books and cover a very wide range of assets, including commodities, equity, foreign exchange, interest rate, and credit derivatives. In addition, they will post collateral against their positions.

Medium derivatives players are often smaller banks or financial institutions that also have a large number of clients and conduct a high volume of OTC derivatives trades. While they also cover a wide range of assets, they are not as active in all of them as large players. In addition, it is likely (but not definite) that they will post collateral against positions.

Small derivatives players are sovereign entities, large corporations, or smaller financial institutions with specific derivatives requirements that determine the trades they undertake. Trades are done with only a small number of counterparties, and, as expected, they have few OTC derivatives trades on their books. Unlike large and medium players, small players are likely to specialize in just one asset class. They will also differ from larger players in terms of collateral—which, if posted, will often be illiquid.

While the entities described here take on counterparty risk through trading activity, third parties exist that offer products and services used by market participants to reduce counterparty risks and improve efficiency. These products and services include clearing services, software, trade compression, and collateral management.

Counterparty Risk Terminology

LO 32.d: Describe credit exposure, credit migration, recovery, mark-to-market, replacement cost, default probability, loss given default, and the recovery rate.

Credit exposure (or simply *exposure*) is the loss that is "conditional" on the counterparty defaulting. It can be illustrated with a financial instrument contract between two parties. After inception, assume Counterparty A has a positive value (it is the creditor and is owed money), and Counterparty B has a negative value (it is the debtor and owes money). If Counterparty B defaults, Counterparty A will suffer a loss on the amount owed.

In quantifying exposure, it is not always the case that the full principal amount is at risk. Therefore, a more relevant calculation is replacement cost, together with an assumption of a zero recovery value. Furthermore, calculations must consider current exposure (current claims and commitments), future exposure (potential future claims), and contingent liabilities.

Regarding **credit migration**, the counterparty may default or its credit rating may deteriorate over the term of the contract, especially for long-time horizons. Alternatively, there may be an improvement in credit rating over time. To assess credit migration, we must consider the term structure of **default probability**:

- Future default probability will likely decrease over time, especially for periods far into the future. This is due to the higher likelihood that the default will have already occurred at some earlier point.
- An expected deterioration in credit quality suggests an increasing probability of default over time.
- An expected improvement in credit quality suggests a decreasing probability of default over time.

Empirically, there is mean reversion in credit quality, so the implication is that counterparties with strong credit ratings tend to deteriorate (increasing default probability over time), and those with weak credit ratings tend to improve (more likely to default earlier and less likely later). Default probability of a counterparty can be computed in two ways: a real (historical) measure (identifying the actual default probability) and a risk-neutral measure (computing the theoretical market-implied probability).

Recovery is measured by the recovery rate, which is the portion of the outstanding claim actually recovered after default. For example, a recovery rate of 70% suggests a 30% loss. As discussed earlier in the definition of exposure, recovery is not usually considered when pricing credit risk. Related to the concept of recovery is **loss given default (LGD)**, which is calculated as 1 − recovery rate.

Mark to market (MtM) is an accrual accounting measure that is equal to the sum of the MtM values of all contracts with a given counterparty. Although in theory it represents the current potential loss, it fails to consider other factors such as netting, collateral, or hedging. MtM is equal to the present value of all expected inflows less the present value of expected payments (positive if in favor of the party and negative if not). MtM is a measure of replacement cost. However, although generally close, current **replacement cost** is not theoretically the same as the MtM value due to factors such as transaction costs and bid-ask spreads.

MODULE QUIZ 32.1

1. When considering counterparty credit risk, which of the following financial products has the largest outstanding notional amount in the marketplace?
   A. Credit default swaps.
   B. Foreign exchange forwards.
   C. Interest rate swaps.
   D. Repos and reverse repos.

2. Liz Parker is a junior quantitative analyst who is preparing a report dealing with credit migration. An excerpt of her report contains the following statements:
   I. Future default probability will likely increase over time, especially for periods far into the future.
   II. When computing the default probability of a counterparty under a risk-neutral measure, we need to first determine the actual default probability.

   Which of Parker's statements is (are) correct?
   A. I only.
   B. II only.
   C. Both I and II.
   D. Neither I nor II.

3. Which of the following statements regarding counterparty credit risk is most accurate?
   A. Counterparty risk is unilateral.
   B. Over-the-counter (OTC) derivatives contain less counterparty risk than exchange-traded derivatives because the counterparty is known.
   C. The precise future value of the contract is uncertain, but the counterparties are aware of whether the future value will be positive or negative.
   D. Counterparty risk is typically associated with counterparty default prior to the settlement rather than default during the settlement process.

MODULE 32.2: MANAGING, MITIGATING, AND QUANTIFYING COUNTERPARTY RISK

LO 32.e: Describe credit value adjustment (CVA) and compare the use of CVA and credit limits in evaluating and mitigating counterparty risk.

LO 32.f: Identify and describe the different ways institutions can quantify,

manage, and mitigate counterparty risk.

Managing Counterparty Risk

Methods to manage counterparty risk include the following: trading only with high-quality counterparties, cross-product netting, close-out, collateralization, walkaway features, diversifying counterparty risk, and exchanges and centralized clearinghouses.

Trading only with **high-quality counterparties** is a simple and straightforward method for managing counterparty risk. All of these counterparties would have AAA credit ratings and may not be required to provide collateral.

Cross-product netting works with derivative transactions that can have both a positive and a negative value. In the case of a default by either counterparty, a netting agreement will allow transactions to be aggregated and reduce the risk for both parties. The legal and operational risks that accompany netting must be considered. For example, legal risk materializes if a netting agreement is found to be legally unenforceable. An example of cross-product netting is as follows (from Counterparty A's perspective):

	Counterparty A	Counterparty B
Trades with positive MtM	+$20 million	–$20 million
Trades with negative MtM	–$17 million	+$17 million
Exposure with no netting	+$20 million	+$17 million
Exposure with netting	+$3 million	$0

Close-out is the immediate closing of all contracts with the defaulted counterparty. When combined with netting of MtM values, an institution may offset what it owes to the counterparty (a negative amount) against what it is owed by the counterparty (a positive amount). If the net amount is negative, the institution will make a payment, but if the net amount is positive, it will make a claim. This results in an immediate realization of net gains or losses for the institution.

Collateralization (i.e., margining) occurs in the form of a collateral agreement between two counterparties that reduces exposure by requiring sufficient collateral to be posted by either counterparty to support the net exposure between them. Sufficient collateral does theoretically reduce the net exposure to zero. Posting collateral is done on a periodic basis to minimize transaction costs. However, collateralization does come with market, operational, and legal risks as well as significant work requirements to ensure the process is done properly.

A **walkaway feature** allows a party to cancel the transaction if the counterparty defaults. It is advantageous if a party has a negative MtM and the counterparty defaults.

Diversification of counterparty risk limits credit exposure to any given counterparty consistent with the default probability of the counterparty. When an institution trades with more counterparties, there is much less exposure to the failure of any given counterparty.

As described previously, exchanges and centralized clearinghouses take on the role of the counterparty and guarantee all trades by removing all counterparty risk from trades. However, this may simply redistribute counterparty risk as opposed to completely eliminating the risk.

Mitigating Counterparty Risk

As mentioned, **netting** is commonly used to mitigate counterparty risk. Each party's required payment is computed and then offset so that only the party that "owes" a net amount is required to make that payment to the counterparty. The success of netting depends on the nature of the payments involved and whether they are easy to offset.

A second way to mitigate counterparty risk is the use of **collateralization**. Taking collateral equal to or greater than the notional amount of principal should theoretically eliminate all counterparty risk. However, by taking collateral, there are some administrative costs involved in addition to taking on liquidity risk (i.e., collateral may have to be sold at a significant discount in the short term) and legal risk (i.e., attempting to take title on the collateral may be a long and drawn out legal process).

A third way to mitigate counterparty risk is through **hedging**. Using credit derivatives allows an organization to reduce counterparty exposure to its own clients in exchange for increasing counterparty exposure to clients of a competitor. Therefore, hedging generates market risk.

Central counterparties (e.g., exchanges and clearinghouses) frequently take on the role of the counterparty, which offers another way to mitigate counterparty risk. They are a convenient way to centralize counterparty risks, settle transactions, and reduce the bilateral risks inherent in many derivatives contracts. However, the use of central counterparties does reduce the incentive of parties to carefully assess and monitor counterparty risks. Therefore, using central counterparties generates operational, liquidity, and systemic risks.

Quantifying Counterparty Risk

In general, counterparty risk for a given transaction is quantified on the following levels:

- *Trade level*: considers the nature of the trade and related risk factors.
- *Counterparty level*: takes into account risk mitigating factors such as netting and collateral for each individual counterparty.
- *Portfolio level*: considers overall counterparty risk in that only a small percentage will likely default in a given time period.

Within the context of derivatives pricing, there is a portion that assumes no counterparty risk and a portion that accounts for counterparty risk. The portion that accounts for counterparty risk is known as the **credit value adjustment (CVA)**. A trader's objective is to earn a return greater than the CVA.

The CVA examines counterparty risk at both the trade and counterparty levels. Credit limits, on the other hand, limit exposures at the portfolio level. Thus, the CVA and credit limits complement each other and are often both used to quantify and manage counterparty risk. The CVA aims to minimize the number of counterparties in an effort to maximize netting benefits, while credit limits aim to maximize the number of counterparties in an effort to achieve greater diversification benefits.

PROFESSOR'S NOTE

The credit value adjustment calculation will be examined in Reading 37.

OTC Derivatives Costs

LO 32.g: Identify and explain the costs of an OTC derivative.

Assessing the lifetime economic costs of OTC derivatives involves identifying whether the transaction has positive or negative MtM. Positive MtM results when a transaction is in the money. In this case, counterparty risk and funding costs arise from any uncollateralized component. For the MtM that is collateralized, the counterparty chooses the type of collateral to post. Negative MtM results when a transaction is out of the money. In this case, counterparty risk arises from the party's own potential for default. A funding benefit will also arise for any collateral that is not posted. For MtM that is collateralized, the party itself chooses the type of collateral to post. In either a positive or negative MtM scenario, there will be funding costs associated with the capital needed for the transaction and the initial margin.

X-Value Adjustment (xVA) Terms

LO 32.h: Explain the components of the X-Value Adjustment (xVA) term.

The impact of counterparty risk, collateral, funding, and capital can be captured with a variety of xVA terms. In general, these components represent a cost, but some components may provide a benefit. One component of xVA is the credit value adjustment (CVA). A related component to CVA is known as the **debt value adjustment (DVA)**. The DVA defines counterparty risk from the party's point of view. Additional xVA components include the following:

- **Funding value adjustment (FVA).** This is the cost and benefit resulting from funding a transaction.
- **Collateral value adjustment (ColVA).** This is the cost and benefit resulting from embedded options in collateral agreements as well as any additional collateral terms.
- **Capital value adjustment (KVA).** This is the cost of holding capital over the duration of a transaction.
- **Margin value adjustment (MVA).** This is the cost of posting margin over the duration of a transaction.

MODULE QUIZ 32.2

1. Ondine Financial, Inc., (Ondine) uses a variety of techniques to manage counterparty risk. It has entered into an interest rate swap with Scarbo, Inc. (Scarbo). Currently, Ondine's position in the swap has a –$1 million mark-to-

market value. Based on the information provided, which of the following credit risk mitigation techniques would be most advantageous to Ondine if Scarbo defaults?

A. Close-out.
B. Collateralization.
C. Netting.
D. Walkaway.

2. Which of the following methods of mitigating counterparty risk is most likely to generate systemic risk?

A. Netting.
B. Collateral.
C. Hedging.
D. Central counterparties.

KEY CONCEPTS

LO 32.a

Counterparty risk is the risk that a counterparty is unable or unwilling to live up to its contractual obligations. Counterparty risk is different than lending risk because the future value of the contract is highly uncertain; for lending risk, the value is quite certain. In addition, counterparty risk is bilateral, whereas lending risk is unilateral.

LO 32.b

Securities financing transactions, such as securities borrowing and lending and repos and reverse repos, carry counterparty risk. Over-the-counter (OTC) derivatives such as interest rate swaps, foreign exchange forwards, and credit default swaps also carry counterparty risk.

LO 32.c

Institutions that take on counterparty risk through trading activities fall into three size categories: large, medium, and small. They vary based on the volume of trades, coverage of asset classes, and their willingness and ability to post collateral.

LO 32.d

Important terminology relating to counterparty risk includes the following: credit exposure, credit migration, recovery, mark-to-market (MtM), replacement cost, default probability, recovery rate, and loss given default.

LO 32.e

Counterparty risk is quantified at the trade, counterparty, and portfolio levels. Within the context of pricing a derivative, there is a portion that assumes no counterparty risk and a portion that accounts for counterparty risk. The latter portion is the credit value adjustment (CVA). The CVA acts at both the trade and counterparty levels, while credit limits act at the portfolio level. Thus, the CVA and credit limits are complementary.

LO 32.f

Methods to manage counterparty risk include the following: trading only with high-quality counterparties, cross-product netting, close-out, collateralization, walkaway features, diversifying counterparty risk, and exchanges and centralized clearing houses.

Netting, collateralization, hedging, and central counterparties are some common ways to mitigate counterparty risk.

LO 32.g

The lifetime economic costs of OTC derivatives examine if the transaction has positive or negative MtM. Positive MtM results when a transaction is in the money, and negative MtM results when a transaction is out of the money.

LO 32.h

The economic impact of counterparty risk, collateral, funding, and capital can be captured with a variety of xVA terms. These terms include the credit value adjustment (CVA), debt value adjustment (DVA), funding value adjustment (FVA), collateral value adjustment (ColVA), capital value adjustment (KVA), and margin value adjustment (MVA).

ANSWER KEY FOR MODULE QUIZZES

Module Quiz 32.1

1. **C** There are two classes of financial products where counterparty risk exists: over-the-counter (OTC) derivatives and securities financing transactions such as repos and reverse repos. OTC derivatives are significantly larger with interest rate swaps comprising the bulk of the market. (LO 32.b)

2. **D** Future default probability will likely decrease over time, especially for periods far into the future. This is because of the higher likelihood that the default will have already occurred at some earlier point. In computing the default probability of a counterparty under a risk-neutral measure, one needs to compute the theoretical market-implied probability; the actual default probability applies under a real (historical) measure. (LO 32.d)

3. **D** Counterparty risk is a bilateral risk in that both parties are unaware of the eventual value of the contract and they do not know whether they will earn a profit or loss. For exchange-traded derivatives, the counterparty is the exchange, which effectively mitigates counterparty risk. While counterparty default can happen presettlement and during settlement, counterparty risk typically applies to the risk of default prior to settlement. (LO 32.a)

Module Quiz 32.2

1. **D** Because Ondine currently has a negative mark-to-market value and the counterparty is defaulting, Ondine is able to cancel the transaction while it is "losing." Netting and close-out would require Ondine to make a payment because it would owe a net amount of $1 million. Collateralization is not relevant in this scenario. (LO 32.e)

2. **D** Mitigating counterparty risk often leads to the generation of other types of risk. In the case of central counterparties, systemic risk is created as counterparty risk has been centralized with a limited amount of groups. If one of these groups fails, a substantial shock may be experienced by the financial system as a whole. (LO 32.e)

The following is a review of the Credit Risk Measurement and Management principles designed to address the learning objectives set forth by GARP®. Cross-reference to GARP assigned reading—Gregory, Chapter 6.

READING 33

NETTING, CLOSE-OUT, AND RELATED ASPECTS

Study Session 6

EXAM FOCUS

In this reading, we further discuss ways to mitigate counterparty risk and credit exposure. Specifically, we will address the different methods of reducing current and potential future credit exposure. These methods include termination features and netting and close-out features. For the exam, understand the advantages and disadvantages of netting and termination features. Also, be able to explain reset agreements, break clauses, walkaway clauses, and trade compression and how they are used.

MODULE 33.1: MITIGATING COUNTERPARTY RISK AND CREDIT EXPOSURE

ISDA Master Agreement

LO 33.a: Explain the purpose of an International Swaps and Derivatives Association (ISDA) master agreement.

The International Swaps and Derivatives Association (ISDA) Master Agreement standardizes over-the-counter (OTC) agreements to reduce legal uncertainty and mitigate credit risk. This is accomplished by creating a framework that specifies OTC agreement terms and conditions related to collateral, netting, and termination events. The Master Agreement can cover multiple transactions by forming a single legal contract with an indefinite term.

Netting and Close-Out Procedures

LO 33.b: Summarize netting and close-out procedures (including multilateral netting), explain their advantages and disadvantages, and describe how they fit

into the framework of the ISDA master agreement.

Netting and Close-Out Between Two Counterparties

Netting, often called set-off, generally refers to combining the cash flows from different contracts with a counterparty into a single net amount. This is referred to as **payment netting**, which acts to reduce settlement risk while enhancing operational efficiency. A related concept is **close-out netting**, which refers to the netting of contract values with a counterparty in the event of the counterparty's default. The concepts of both netting and close-out incorporate two related rights under a single contract: (1) the right to terminate contracts unilaterally (by only one side) under certain conditions (close-out) and (2) the right to offset (net) amounts due at termination into a single sum.

Before we examine close-out closer, it is important to discuss netting in more detail. Netting has enabled an explosive growth in credit exposures and notional values of trades, and it now covers most derivatives transactions. Institutions often have multiple trades with a counterparty, and these trades can constitute hedges whose values move in opposite directions, or they may constitute unwinds where a reverse trade of equal and opposite value has been executed with the same counterparty. Without netting, an entity's exposure of two equal and opposite trades is the positive mark-to-market exposure. For example, if an entity has two equal and opposite trades with a counterparty with mark-to-market values of +10 and –10, without netting the total exposure is +10. This means that if the counterparty defaults, the value of the two trades is not netted, with the surviving entity having to make a settlement under the negative mark-to-market trade, while unable to collect on the positive one. Therefore, without netting, overall exposure is additive as the sum of the positive mark-to-market values. With netting, exposures of trades are not additive, which significantly reduces risk.

Netting has several advantages and disadvantages:

- *Exposure reduction*: By offsetting exposures with parties managing net positions only, netting reduces risk and improves operational efficiency. Nevertheless, netted exposures can be volatile, which may result in difficulty in controlling exposure.
- *Unwinding positions*: If an entity wishes to exit a less liquid OTC trade with one counterparty by entering into an offsetting position with another counterparty, the entity will remove market risk; however, it will be exposed to counterparty and operational risk. Netting removes these risks through executing a reverse position with the initial counterparty, removing both market and counterparty risk. The downside is that the initial counterparty, knowing that the entity is looking to exit a trade, may impose less favorable terms for the offsetting transaction.
- *Multiple positions*: An entity can reduce counterparty risk, obtain favorable trade terms, and reduce collateral requirements by trading multiple positions with the same counterparty.
- *Stability*: Without netting, entities trading with insolvent or troubled counterparties would be motivated to cease trading and terminate existing contracts, exacerbating

the financial distress of the counterparty. With netting, this risk is significantly reduced, and an agreement with a troubled counterparty is more achievable.

Netting agreements (specifically close-out netting) are legal agreements that become effective in the event of a counterparty's bankruptcy. As mentioned, netting agreements are often governed by the ISDA Master Agreement, which serves to eliminate legal uncertainties and reduce counterparty risk under a single legal contract with an indefinite term. A single universal agreement also helps avoid problems that may arise from different treatments of bankruptcy in different jurisdictions. For example, ISDA has obtained legal opinions for the Master Agreement in most jurisdictions. Agreements often cover bilateral netting, which is used for OTC derivative and repo transactions, and balance sheet loans and deposits. When no legal agreement exists that allows netting, exposures do not offset each other and are considered additive.

Close-out and netting become advantageous in derivatives transactions following the default of a counterparty when cash flows cease because these rights allow an entity to execute new replacement contracts. It is clear then that close-out arrangements protect the solvent, or surviving, entity. Note that close-out differs from an **acceleration clause**, which allows the creditor to accelerate (i.e., make immediately due) future payments given a credit event, such as a ratings downgrade. In contrast to acceleration, **close-out clauses** allow all contracts between a solvent and insolvent entity to be terminated, which effectively cancels the contracts and creates a claim for compensation. If the solvent entity has a negative mark-to-market exposure (it owes the insolvent entity), then the full payment is made to the insolvent entity. If the mark-to-market exposure is positive, the solvent entity becomes a creditor for that amount and can terminate and replace the contracts with another entity.

Both acceleration and close-out clauses have been criticized for making a debtor's refinancing more difficult. Both clauses cause payment amounts to be immediately due and may speed up the financial distress of the insolvent entity. For this reason, courts may impose a stay (temporary suspension) on the agreements to allow for a short period of "time out" while maintaining the validity of the termination clauses.

Despite these criticisms, close-out clauses can be very advantageous to parties. Close-out limits the uncertainty in the value of an entity's position with an insolvent counterparty. Without close-out, an entity would have difficulty estimating to what degree positions offset each other because recovery of exposure is not known. With close-out, however, the solvent entity can fully re-hedge transactions with the insolvent entity while waiting to receive a claim. As a result, although the solvent entity may experience some risk loss, it would minimize market risk and trading uncertainty. In addition, close-out allows entities to freeze their exposures. Because these exposure amounts are known and will not fluctuate, the solvent entity can then better hedge this exposure.

Netting and Close-Out Between Multiple Counterparties

Up until this point, we have been discussing **bilateral netting**; that is, netting arrangements between two entities. Bilateral netting is important in reducing credit exposure; however, it is limited to two entities only. In reality, trades are often structured in a way where an entity trades with multiple counterparties (known as **multilateral netting**). For example, Entity A can have exposure to B, Entity B has the same exposure to Entity C, and Entity C has an identical exposure to Entity A. The default of any of these entities would give rise to questions on how to allocate losses.

Under multilateral netting, netting arrangements would involve multiple counterparties to mitigate counterparty and operational risk. Typically, multilateral netting is achieved with a central entity, such as an exchange or clearinghouse, handling the netting process, including valuation, settlement, and collateralization. A disadvantage, however, is that this type of netting arrangement mutualizes counterparty risk and results in less incentive for entities to monitor each other's credit qualities. In addition, multilateral netting can enable redundant trading positions to accumulate in the system, resulting in higher operational costs (this risk is reduced by firms that use algorithms to detect and reduce redundant positions). Finally, multilateral netting requires trading disclosure, which may be disadvantageous to firms wishing to keep proprietary information confidential.

Netting Effectiveness

LO 33.c: Describe the effectiveness of netting in reducing credit exposure under various scenarios.

As we have previously discussed, netting can either reduce exposure to a counterparty or have no effect on exposure, but it can never increase it. We now look at netting in more detail, including the relationship between netting and exposure.

A trading instrument will have a beneficial effect on netting if it can have a negative mark-to-market (MtM) value during its life. For instruments whose MtM value can only be positive during their life, the effect on netting will not be as beneficial. Instruments with only positive MtM values include options with up-front premiums such as equity options, as well as swaptions, caps and floors, and FX options. Other instruments can have negative MtM value during their life; however, there is a greater likelihood that MtM will be positive. These instruments include long options without up-front premiums, certain interest rate swaps, certain FX forwards, cross-currency swaps, off-market instruments, and wrong-way instruments.

Despite these instruments having either only positive or mostly positive MtM values, it may still be worthwhile for an entity to include them under a netting agreement for the following reasons:

- Future trades with negative MtM values could offset the positive MtM of these instruments.
- Inclusion of all trades is necessary for effective collateralization.
- Netting is beneficial as it ensures that if these positions need to be unwound in the future and an offsetting (mirror) trade is required, there will be no residual counterparty risk.

Termination Features

LO 33.d: Describe the mechanics of termination provisions and trade compressions and explain their advantages and disadvantages.

LO 33.f: Identify and describe termination events and discuss their potential effects on parties to a transaction.

Termination events allow institutions to terminate a trade before their counterparties become bankrupt. A **reset agreement** readjusts parameters for trades that are heavily in the money by resetting the trade to be at the money. Reset dates are typically linked with payment dates, but they could also be triggered after a certain market value is breached. As an example, consider a resettable cross-currency swap. With this trade, the MtM value of the swap is exchanged at each reset date. In addition, the foreign exchange rate, which influences the swap's MtM value, is reset to the current spot rate. This reset will end up changing the notional amount for one leg of the swap.

Additional termination events (ATEs), which are sometimes referred to as break clauses, are another form of a termination event, which allow an institution to terminate a trade if the creditworthiness of their counterparty declines to the point of bankruptcy. More specifically, a **break clause** (also called a liquidity put or early termination option) allows a party to terminate a transaction at specified future dates at its replacement value. Break clauses are often bilateral, allowing either party to terminate a transaction, and are useful in providing an option to terminate transactions —particularly long-dated trades—without cost when the quality of the counterparty declines. Events to trigger a break clause generally fall into three categories:

- Mandatory. The transaction will terminate at the date of the break clause.
- Optional. One or both counterparties have the option to terminate the transaction at the pre-specified date.
- Trigger-based. A trigger, like a ratings downgrade, must occur before the break clause may be exercised.

Despite their advantages, break clauses have not been highly popular. One explanation is that break clauses, in effect, represent a discrete form of collateralization; however, collateralization can be better achieved by the continuous posting of collateral. Another explanation is known as "banker's paradox," which implies that for a break clause to be truly useful, it should be exercised early on, prior to the substantial decline in a counterparty's credit quality. Entities, however, typically avoid early exercise to preserve their good relationships with counterparties.

Walkaway clauses allow an entity to benefit from the default of a counterparty. Specifically, under these clauses an entity can walk away from, or avoid, its net liabilities to a counterparty that is in default, while still being able to claim in the event of a positive MtM exposure. Walkaway clauses were popular prior to 1992, but they have been less common since the 1992 ISDA Master Agreement. They have also been criticized for creating additional costs for a counterparty in the event of a default, for creating moral hazard, and, because a walkaway feature may already be priced in a transaction, hiding some of the risks in a transaction. For these reasons, these clauses should be ultimately avoided.

LO 33.e: Provide examples of trade compression of derivative positions, calculate net notional exposure amount, and identify the party holding the net contract position in a trade compression.

As mentioned, multilateral netting is achieved with a central entity, such as an exchange or clearinghouse, handling the netting process—including valuation, settlement, and collateralization. An approach for using multilateral netting without the need for a membership organization is **trade compression**. Because portfolios often have redundancies among trades with multiple counterparties, compression aims to reduce the gross notional amount and the number of trades (e.g., OTC derivatives transactions). Thus, trade compression can reduce net exposure without the need to change an institution's overall risk profile.

Trade compression requires participants to submit applicable trades for compression along with their desired risk tolerance. The submitted trades are then matched to each counterparty and netted into a single contract. For example, consider an institution with three credit default swap (CDS) contracts for the same reference entity and maturity, but with different counterparties. In this case, the three trades can be compressed into a single net contract by netting out the long and short contracts and using the weighted average of the three contract coupons as the net contract coupon. Figure 33.1 illustrates trade compression for single-name CDS contracts.

Figure 33.1: Trade Compression Example

Reference Entity	Notional	Position	Maturity	Coupon	Counterparty
XYZ index	200	Long	March 20, 2025	100	Counterparty X
XYZ index	100	Short	March 20, 2025	100	Counterparty Y
XYZ index	75	Short	March 20, 2025	100	Counterparty Z
Net contract	**25**	**Long**	**March 20, 2025**	**100**	**Counterparty X**

In this example, Counterparty X holds the net contract position with a notional exposure amount of 25. Note that trade compression services, such as TriOptima, help reduce OTC derivatives exposures for various products, such as interest rates, commodities, and credit derivatives. In addition, recent changes to the CDS market, such as standard coupons and maturity dates, also help promote the benefits of trade compression.

MODULE QUIZ 33.1

1. Riggs Resources, LLC, (Riggs) is a commodity trading firm. Riggs has numerous trades outstanding with several counterparties; however, it is concerned with presettlement risk. In order to reduce presettlement risk (the risk that Riggs's counterparties would default before settlement), it would be most beneficial for Riggs to:
   A. have payment netting.
   B. have close-out netting.

C. analyze potential losses as the sum of exposures.
D. have netting but not set-off.

2. Entity XYZ is netting its trades with Entity ABC. Which of the following techniques best describe this type of netting arrangement?
A. Multilateral netting.
B. Bilateral netting.
C. Close-out netting.
D. Additive exposure netting.

3. Assume the following current MtM values for five different transactions for Entity ABC: +5, −4, +2, +3, and −6. What is the total exposure with and without netting, respectively?
A. 0, 10.
B. 20, 10.
C. 10, 0.
D. 10, 20.

4. Which of the following trading instruments would have the most beneficial effect on netting?
A. Options with up-front premiums.
B. Equity options.
C. FX options.
D. Futures.

5. Leverage, Inc., an investment bank, has numerous credit default swaps with XYZ Corp. Leverage has established a break clause with XYZ Corp. to reduce risk. The break clause is trigger-based and may be exercised once the trigger is satisfied. The CEO of Leverage is concerned about a banker's paradox. Which of the following statements best describe the CEO's concern?
A. To be effective, the break clause option should not be used too early.
B. The weak firm often recovers after the use of the break clause.
C. The break clause option is used too late, and the weak firm gets weaker.
D. The break clause option is used too early, and is unlikely to avoid systemic risk issues.

KEY CONCEPTS

LO 33.a

Standardization of terms of OTC derivatives through the ISDA Master Agreement is a key way to mitigate credit risk to improve liquidity and reduce transaction costs.

LO 33.b

Netting involves combining the cash flows from different contracts with a counterparty into a single net amount (payment netting). Close-out netting refers to netting contract values with a counterparty if the counterparty defaults. Without netting, exposures are additive; with netting, exposures of trades are not additive.

Bilateral netting is limited to two entities only. Multilateral netting involves netting between multiple parties, usually with a central entity, such as an exchange or clearinghouse, handling the netting process.

LO 33.c

Netting arrangements are beneficial as long as trading instruments can have negative mark-to-market (MtM) values during their life. Netting for trades with the possibility of only positive exposures is generally not beneficial, although benefits can arise if future trades with negative MtM values could offset the positive MtM of these instruments.

LO 33.d

Walkaway clauses allow an entity to walk away from its liabilities to a counterparty that is in default, while still being able to make a claim on its own exposure.

LO 33.e

Trade compression reduces net exposure without the need to change the overall risk profile.

LO 33.f

Termination events allow institutions to terminate a trade before their counterparties become bankrupt. A break clause allows a party to terminate a trade at specified future dates at replacement values.

ANSWER KEY FOR MODULE QUIZZES

Module Quiz 33.1

1. **B** To minimize presettlement risk, Riggs should have close-out netting. Under close-out, contracts between solvent and insolvent counterparties are terminated and netted.

   Payment netting would reduce settlement and operational risk, but not presettlement risk. Netting also means individual positive exposures are nonadditive. The terms netting and set-off are synonymous. (LO 33.b)

2. **B** Bilateral netting is a netting arrangement between two entities and is limited to two entities. Trades with multiple counterparties is known as multilateral netting. Close-out netting refers to netting contract values with a counterparty if the counterparty defaults. (LO 33.b)

3. **A** The total exposure with netting is 0 (5 − 4 + 2 + 3 − 6 = 0), and the total exposure without netting is 10 (5 + 2 + 3 = 10). (LO 33.b)

4. **D** A trading instrument will have a beneficial effect on netting if it can have a negative mark-to-market (MtM) value during its life. For instruments whose MtM value can only be positive during their life, the effect on netting will not be as beneficial. Instruments with only positive MtM values include options with up-front premiums such as equity options, as well as swaptions, caps and floors, and FX options. Futures can have negative MtM values. (LO 33.c)

5. **C** A break clause (also called a liquidity put or early termination option) allows a party to terminate a transaction at specified future dates at its replacement value. Despite their advantages, break clauses have not been highly popular. One explanation is known as banker's paradox, which implies that for a break clause to be truly useful, it should be exercised early on, prior to the substantial decline in a counterparty's credit quality. Entities, however, typically avoid early exercise to preserve their good relationships with counterparties. (LO 33.f)

The following is a review of the Credit Risk Measurement and Management principles designed to address the learning objectives set forth by GARP®. Cross-reference to GARP assigned reading—Gregory, Chapter 7.

READING 34

MARGIN (COLLATERAL) AND SETTLEMENT

Study Session 6

EXAM FOCUS

This reading examines collateral and introduces the types of collateral, the features of a collateralization agreement and a credit support annex (one-way and two-way), and the reconciliation of collateral disputes. For the exam, be familiar with the key parameters associated with collateral (e.g., threshold, initial margin, and minimum transfer amount). In addition, understand the risks associated with collateralization, focusing on market risk, operational risk, and funding liquidity risk.

MODULE 34.1: COLLATERAL

Collateral Management

LO 34.a: Describe the rationale for collateral management.

LO 34.b: Describe the terms of a collateral agreement and features of a credit support annex (CSA) within the ISDA Master Agreement including threshold, initial margin, minimum transfer amount and rounding, haircuts, credit quality, and credit support amount.

The concept behind collateralization is straightforward. When two parties execute certain trades (e.g., OTC forwards, swaps), one will have a negative MtM (mark-to-market) exposure, and the other party will have a positive MtM exposure at any given time. The party with the negative exposure will then post collateral in the form of cash or securities to the party with the positive exposure. In essence, *collateral is an asset supporting a risk in a legally enforceable way*. **Collateral management** is often bilateral, where either side to a transaction is required to post or return collateral to the side with the positive exposure.

Firms can manage credit exposures and mitigate counterparty credit risk by either limiting the notional value of trades with counterparties or offsetting trades that limit exposure though netting. There are essentially four motivations for managing collateral: (1) reduce credit exposure to enable more trading, (2) have the ability to trade with a counterparty (e.g., restrictions on credit ratings may preclude an entity from trading on an uncollateralized basis), (3) reduce capital requirements, and (4) allow for more competitive pricing of counterparty risk.

Collateral management has evolved over the last few decades from having no legal standards to being highly standardized through the introduction of ISDA documentation in 1994. The purpose of a **credit support annex (CSA)** incorporated into an ISDA Master Agreement is to allow the parties to the agreement to mitigate credit risk through the posting of collateral. Because collateral can vary greatly in terms of amount, liquidity, and risk levels (as well as many other elements), a CSA is created to govern issues such as collateral eligibility, interest rate payments, timing and mechanics associated with transfers, posted collateral calculations, haircuts to collateral securities (if applicable), substitutions of collateral, timing and methods for valuation, reuse of collateral, handling disputes, and collateral changes that may be triggered by various events. In order to work as intended, CSAs must define all collateralization parameters and account for any scenarios that may impact both the counterparties and the collateral they are posting.

Parameters established with CSAs (and collateralized agreements in general) include the following:

- **Threshold**. Collateral will be posted when the level of MtM exposure exceeds this threshold level.
- **Initial margin** (also known as **independent amount** in bilateral markets). The amount of extra collateral that is required independent of the level of exposure.
- **Minimum transfer amount**. The minimum amount of collateral that can be called at a given time.
- **Rounding**. Collateral calls or collateral returns may be rounded to specific sizes to avoid working with inconvenient quantities.
- **Haircut**. This reduces the value of collateral to account for the possibility that its price may fall between the previous collateral call and a counterparty default.
- **Credit quality**. As counterparty credit quality declines, the importance of collateral increases.
- **Credit support amount**. The amount of collateral that may be called (by either counterparty) at a certain point in time.

PROFESSOR'S NOTE

The terms of a collateral agreement as well as descriptions of threshold, initial margin, minimum transfer amount, rounding, haircuts, and credit quality will be addressed in LO 34.g when we explain the features of a collateralization agreement.

Valuation Agents

LO 34.d: Describe the role of a valuation agent.

The valuation agent is responsible for calling for the delivery of collateral and handles all calculations. The valuation agent's role is to calculate (1) credit exposure, (2) market values, (3) credit support amounts, and (4) the delivery or return of collateral. Larger entities often insist on being valuation agents when dealing with smaller counterparties. When the size difference between counterparties is small, both counterparties may be valuation agents. In this case, each entity would call for collateral when they have positive exposure; however, this could lead to disputes and delays in processing collateral movements. One remedy is to use a third-party valuation agent that would handle the collateral process, processing collateral substitutions, resolving disputes, and producing daily valuation reports.

Collateral Agreements and Types of Collateral

LO 34.e: Describe the mechanics of collateral and the types of collateral that are typically used.

The process of collateralization is typically done through legal documents under which parties negotiate collateral supporting documents that state the terms and conditions of the process. Collateral agreements should quantify parameters and specify the currency, type of agreement (one-way or two-way), what collateral is eligible, timing regarding delivery and margin call frequency, and interest rates for cash collateral. Trades between counterparties are then marked-to-market (MtM) on an ongoing basis (typically daily), and valuations including netting are determined. The party with the negative MtM exposure then delivers collateral to the other side of the transaction, and the collateral position is updated.

There are many types of collateral used, depending on the riskiness of the credit exposures. Collateral can include cash, government and government agency securities, mortgage-backed securities, corporate bonds and commercial paper, letters of credit, and equity. The most common type of collateral is cash; however, during extreme market events, the supply of cash collateral can be limited. Other collateral types, including agency securities, are often preferred for liquidity; however, recent market events have led to questioning the true riskiness of these securities. In addition, noncash collateral may give rise to problems with rehypothecation (defined later in this reading) and create price uncertainty.

Collateral Coverage, Disputes, and Resolutions

LO 34.f: Explain the process for the reconciliation of collateral disputes.

To mitigate risk, it is generally preferred to include the maximum number of trades in collateral agreements. However, if even a single trade cannot be properly valued, it can