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

Defining Counterparty Credit Risk

Topic 25

Exam Focus

This topic 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.

Counterparty Risk

LO 25.1: 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 25.2: 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 topic 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 25.3: 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 25.4: 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 continent 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.

Managing and Mitigating Counterparty Risk

LO 25.5: Identify and describe the different ways institutions can 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.

KEY CONCEPTS

LO 25.1

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 25.2

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 25.3

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 25.4

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 25.5

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.

Concept Checkers

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. 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.

4. 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.

5. 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.

Concept Checker Answers

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.

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.

3. **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.

4. **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.

5. **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.

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

Netting, Compression, Resets, and Termination Features

Topic 26

Exam Focus

In this topic, 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.

ISDA Master Agreement

LO 26.1: Explain the purpose of an 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 26.2: 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 26.3: 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 26.4: Describe the mechanics of termination provisions and trade compressions and explain their advantages and disadvantages.

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.

As mentioned previously, 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 utilizing 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. Trade compression services, such as TriOptima, help reduce OTC derivatives exposures for various 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.

Key Concepts

LO 26.1

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 26.2

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 26.3

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 26.4

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

Concept Checkers

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 relations with the counterparty suffer.

Concept Checker Answers

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.

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.

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).

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.

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.

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

Collateral

Topic 27

Exam Focus

This topic 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, independent amount, and minimum transfer amount). In addition, understand the risks associated with collateralization, focusing on market risk, operational risk, and funding liquidity risk.

Collateral Management

LO 27.1: Describe the rationale for collateral management.

LO 27.2: Describe features of a credit support annex (CSA) within the ISDA Master Agreement.

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 (discussed in the following) and account for any scenarios that may impact both the counterparties and the collateral they are posting.

There are three key parameters established with any CSA (and collateralized agreements in general). These parameters include the following:

- **Threshold**. Collateral will be posted when the level of MtM exceeds this threshold level.
- **Minimum transfer amount**. This represents the minimum amount of collateral that can be called at a given time.
- **Independent amount**. Not often used in CSAs currently, but represents the amount of extra collateral that is required independent of the level of exposure.

Valuation Agents

LO 27.3: 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 27.4: Describe 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) and create price uncertainty.

Collateral Coverage, Disputes, and Resolutions

LO 27.5: 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 complicate collateral calls and may lead to collateral disputes. If trades include potentially problematic assets, it may be optimal to only focus on a subset of trades that make up the majority of credit exposure and leave out asset classes that are hard to value either due to complexity (e.g., exotic options) or illiquidity (e.g., credit derivatives). Global considerations are also important, especially as counterparties trade with each other over many time zones and geographical locations. It may be optimal to handle trades separately with regions that are problematic and make up only a small portion of trades. Finally, if an entity expects one of its counterparties to have difficulty valuing certain trades or assets, it may be preferred to leave those trades uncollateralized rather than face potential and frequent disputes. Given that collateral agreements typically require that undisputed amounts be transferred immediately, it is generally advantageous to collateralize the majority of products.

If disputes do arise, they can relate to the trade population, trade valuation, netting rules, market data and market closing time, and valuing collateral that was previously posted. If the disputed amount or valuation difference is small, counterparties may simply split the difference. If the disputes involve larger differences, the exposure will remain uncollateralized until the dispute is resolved. Disputes include the following steps: (1) the disputing party notifies the counterparty of its intent to dispute the exposure by the end of the day following the collateral call; (2) all undisputed amounts are transferred, and the reason for the dispute is identified; and (3) for unresolved disputes, the parties will request quotes from several market makers (usually four) for the MtM value.

Reconciling trades minimizes the chance of disputes. Parties may also find it beneficial to perform dummy (practice) reconciliations prior to trading and periodic reconciliations during trading (weekly or monthly) to preempt future disputes.

Collateralization Agreement Features

LO 27.6: Explain the features of a collateralization agreement.

Collateral agreements are typically negotiated prior to any trading, and they are often updated prior to an increase in trading. Parameters must be clearly defined, and parties must balance the work involved in calling and returning collateral with the benefits of risk mitigation.

Terms of a collateral agreement may be linked to the credit quality of counterparties in order to minimize operational workload while maintaining the ability to tighten collateral

terms when a party's credit quality declines. Counterparties most commonly link a tightening of collateral terms to changes in credit rating (e.g., to a downgrade in rating to below investment grade). While this approach is easy to set up, it can lead to issues by requiring the downgraded counterparty to post collateral exactly at a time when it is experiencing credit issues. This can lead to a "death spiral" of the affected counterparty, as the counterparty faces multiple collateral calls. As a result, it may be preferable to link collateral terms not to the credit rating of entities, but to credit spreads, the market value of equity, or net asset values.

Margin calls should be done at least daily. Products like repos and swaps that are cleared via central counterparties most often have intraday margining. While longer margin frequencies likely reduce operational workloads, daily margining has, more or less, become the market norm.

Threshold in margining refers to the level of exposure below which collateral will not be called. As a result, threshold represents the level of uncollateralized exposure, and only the incremental amount above the threshold would be collateralized. Thresholds generally aim to reduce the operational burden of calling collateral too frequently. A threshold of zero means any exposure is collateralized, while a threshold of infinity means all exposure is uncollateralized. Thresholds are most often linked to credit ratings in a tiered manner, with lower credit ratings corresponding to lower or zero threshold amounts.

Independent amount, or initial margin, is the collateral amount that is posted upfront and is "independent" of any subsequent collateralization and is often used to mitigate the widening of credit spreads or declines in equity values. An independent amount is typically required by stronger credit quality counterparties or by the counterparty more likely to have positive exposures and represents a level of **overcollateralization**. Independent amounts are also typically linked to the credit rating of counterparties in a tiered manner; however, as opposed to thresholds, the level of independent amount *increases* with lower ratings. Independent amounts can be thought of as converting counterparty risk into gap risk, ensuring that the less risky counterparty always remains overcollateralized by this amount without incurring losses, even when the risky counterparty defaults. Independent amounts should, therefore, be large enough to minimize the gap from large value movements of trades should the risky counterparty default.

A **minimum transfer amount** represents the smallest amount of collateral that can be transferred. A minimum transfer amount is used to reduce the operational workload of frequent transfers for small amounts of collateral, which must be balanced against the benefits of risk mitigation. It is important to note that the threshold and minimum transfer amount are additive; that is, exposure must exceed the sum of *both* before a collateral call can be made. Minimum transfer amounts are also typically tied to credit ratings, with higher ratings corresponding to higher amounts.

Collateral amounts typically use **rounding** (e.g., to the nearest thousand) to avoid transferring very small amounts during collateral calls or returns.

A **haircut** is essentially a discount to the value of posted collateral. In other words, a haircut of x% means that for every unit of collateral posted, only (1 – x)% of credit will be given. This credit is also referred to as valuation percentage. Cash typically has a haircut of 0%

and a valuation of 100%, while riskier securities have higher haircut percentages and lower corresponding valuation percentages.

For example, if a particular sovereign bond has a haircut of 2% and a collateral call of $100,000 is made, only 98% of the collateral's value is credited for collateral purposes. That is, in order to satisfy a $100,000 collateral call, $102,041 ($100,000 / 0.98) of the sovereign bond must be posted (or $100,000 in cash).

It is easy to see that riskier securities have greater haircuts to account for their volatility, which may lead to a decline in their value. In the order of increasing riskiness and higher haircuts, cash typically has no haircuts, followed by high-quality government bonds, triple-A rated corporate bonds, structured notes or products, and, finally, equities and commodities. Key factors to consider when assessing haircuts are time to liquidate collateral, volatility of the collateral's underlying market, and the default risk, maturity, and liquidity of the security. Assessing haircuts will often depend on current market conditions using sophisticated value at risk (VaR) calculations.

Entities usually pay interest, coupons, dividends, and other cash flows to counterparties posting collateral as long as the counterparty is not in default. Interest on cash collateral is paid at an overnight market rate. During times of high volatility and illiquid markets, cash collateral is generally preferred, and entities may pay higher-than-market interest rates as an incentive to the entity posting collateral.

We will now look at substitution, reuse, and rehypothecation of collateral. Counterparties sometimes require that the original posted collateral be returned to them for various reasons, including meeting certain delivery commitments. In this case, they can make a **substitution** request by posting an equivalent value of some other eligible collateral. Substitution requests cannot be refused by the other party if the substituted collateral meets all eligibility criteria. Noncash collateral may also be sold, used in repo transactions, or rehypothecated.

Rehypothecation refers to transferring posted collateral to other counterparties as collateral. While widespread, rehypothecation carries two related risks. Consider a scenario where party A pledges collateral to party B; party B rehypothecates this collateral to party C. If party C defaults, then party B will not only have a loss from not receiving the collateral from party C, it will also have a liability to party A for not returning its collateral. The practice of rehypothecation was relatively widespread prior to the 2007–08 credit crisis; however, it has been significantly less popular following the crisis. Parties now increasingly prefer cash collateral.

CSA Agreements

LO 27.7: Differentiate between a two-way and one-way CSA agreement and describe how collateral parameters can be linked to credit quality.

There may be instances when CSAs are not used. Institutions may be unable or unwilling to post collateral. This may be because their credit quality is far superior to their counterparty or they cannot commit to the operational and liquidity requirements that arise from committing to a CSA.

A **two-way CSA** is often established when two counterparties are relatively similar, as it will be beneficial to both parties involved. It is important to note that the two sides may not be treated equally, as certain key parameters (like threshold and independent amounts) may differ depending on the respective risk levels of each party.

A **one-way CSA** differs from a two-way CSA in that the former only requires that one counterparty post collateral (either immediately or after a specific event, such as a ratings downgrade). As a result, the CSA will be beneficial to the receiver of the collateral and at the same time will present additional risk for the counterparty posting the collateral. These types of CSAs are established when two counterparties are significantly different in size, risk levels, et cetera.

The terms of a collateral agreement are usually linked to the credit quality of the counterparties in a transaction. This is beneficial when a counterparty's credit quality is strong because it minimizes operational workload. However, it is also beneficial when a counterparty's credit quality is weak as it allows the other party to enforce collateralization terms triggered by a quality downgrade. Although credit ratings are the most common quality linked, others include market value of equity, net asset value, and traded credit spread. The benefits of linking to credit ratings must be weighed against the costs associated with the requirement of collateral when a ratings downgrade occurs.

Collateral Agreement Risks

LO 27.8: Explain how market risk, operational risk, and liquidity risk (including funding liquidity risk) can arise through collateralization.

Collateralization may improve asset recovery in the event of a counterparty default, but it should be viewed as a supplement to, not a replacement for, ongoing due diligence review of credit quality and exposure. Use of collateral may be viewed as a double-edged sword. When managed properly, it can mitigate risks, but when managed poorly, it may well give rise to additional risks. Collateral agreements could potentially cause the following risks.

Market Risk

Market risk relates to the degree of market movements that have occurred since the last posting of collateral. It is relatively small compared to the risk of an uncollateralized situation, but market risk is a challenge to hedge and to quantify.

Even though collateral is in place to mitigate counterparty risk, there will always be some residual risk due to parameters such as minimum transfer amounts and thresholds that delay the collateral process. In addition, even when collateral is called, there will be a normal delay in sending/receiving the collateral. This delay is represented as the margin period of risk, which is the effective time between a collateral call and the receipt of the collateral.

Operational Risk

Potential pitfalls in the handling of collateral include missed collateral calls, failed deliveries, computer error, human error, and fraud. Proper controls must be in place to reduce the

likelihood of the occurrence of any one of the foregoing items. Examples of proper controls would be the existence of accurate and enforceable legal agreements, robust IT systems capable of automating many steps in the process, timely and accurate valuation of the collateral, current information on independent amounts, minimum transfer amounts, rounding, a requirement that collateral types and currencies must be available for each counterparty, and careful observation of the failure to deliver collateral.

Liquidity and Liquidation Risk

Transaction costs may result when having to liquidate collateral to mitigate counterparty risk. These are often in the form of a bid-ask spread or selling costs. Liquidating a security in an amount that is large relative to its typical trading volume may negatively impact its price, leading to a substantial loss. The alternative is to liquidate a position slowly. With this approach, the counterparty is exposed to market volatility during the period of liquidation. Additional considerations regarding liquidity risk include:

- How large is the market capitalization of the issue posted as collateral?
- Is there a link between the value of the collateral and the counterparty's credit quality? This would be an example of wrong-way risk (when credit exposure and default risk both increase at the same time).
- Would the liquidity of the collateral change due to a default by the counterparty?

Funding Liquidity Risk

Funding liquidity risk refers to the ability of an institution to settle its obligations quickly when they become due, which results from the funding needs established in a CSA. For various reasons, collateral agreements are not in place for many OTC derivatives transactions. When a counterparty does not have the operational capacity or liquidity to handle frequent collateral calls (required under a CSA), the counterparty will be vulnerable to funding implications. This risk is relatively small when markets are liquid and funding costs are low. However, when markets are illiquid, the risks become higher because funding costs can increase considerably.

Default Risk

The default of a security posted as collateral will lower its value (when the loss in value is unlikely to be covered by a haircut). Cash or high-quality fixed-income securities are usually the preferred type of collateral. Should the collateral's credit rating fall below what the collateral agreement specifies, then it would need to be replaced. Poor collateral may fail to mitigate counterparty risk.

Foreign Exchange Risk

Foreign exchange risk occurs when counterparties have different currencies. Collateral carrying foreign exchange risk can be hedged in spot and forward markets. The process must be done carefully due to the dynamic and changing value of the collateral.

Key Concepts

LO 27.1

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.

LO 27.2

A credit support annex (CSA) allows parties to mitigate credit risk through the posting of collateral. The CSA provides governance on many issues related to the collateral itself, including what may be used, when and how it should be valued and transferred, and any changes that must be made upon the occurrence of certain events. A CSA will also define key parameters such as the threshold, minimum transfer amount, and independent amount.

LO 27.3

The role of the valuation agent is to call for the delivery of collateral and handle any collateral-related calculations, including credit exposure, market values, credit support amounts, and the delivery/return of collateral. One or both parties to an agreement may be the valuation agent, or alternatively, a third party agent may be used.

LO 27.4

Collateralization involves the party with the negative exposure posting collateral in the form of cash or securities to the party with the positive exposure. 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.

LO 27.5

Collateral disputes may arise due to the valuation and population of trades, market data and market closing time, netting rules, and valuing collateral previously posted. Managing disputes include the following steps: (1) the disputing party notifies the counterparty of its intent to dispute the exposure by the end of the day following the collateral call; (2) all undisputed amounts are transferred and the reason for the dispute is identified; and (3) for unresolved disputes, the parties will request quotes from several market makers (usually four) for the MtM value. Reconciling trades on a regular basis can minimize potential disputes.

LO 27.6

Threshold is the level of exposure below which collateral will not be called and represents the level of uncollateralized exposure.

Independent amount, or initial margin, is the collateral amount that is posted upfront and is independent of any subsequent collateralization. It represents a level of overcollateralization and can be thought of as converting counterparty risk into gap risk to always maintain an overcollateralized position by the stronger credit quality party.

A minimum transfer amount represents the smallest amount of collateral that can be transferred and is used to reduce operational workload. The threshold and minimum transfer amounts are additive.

A haircut is a discount to the value of posted collateral, with cash having the lowest discount (highest credit given). The riskier the security, the higher the haircut and the lower the credit given.

Substitution refers to posting an equivalent value of other eligible collateral. Rehypothecation refers to transferring posted collateral to other counterparties as collateral.

LO 27.7

A one-way CSA requires one counterparty to post collateral, while a two-way CSA requires both sides to post collateral. For a two-way CSA, certain key parameters may differ if the parties' have different risk levels.

Collateral agreements are often linked to the credit quality of the counterparties in a transaction, in particular credit ratings. While this linking can be beneficial to one party if the other party's credit rating declines, there are costs associated with requiring collateral when a ratings downgrade occurs.

LO 27.8

Key risks involved as a result of entering into a collateral agreement include the following: market risk (unfavorable market movements since the last collateral posting), operational risk (operational issues in the handling of collateral transactions), liquidity and liquidation risk (the ability to liquidate collateral without an unexpected or substantial loss in value), and funding liquidity risk (the ability to meet funding obligations as they come due).

Concept Checkers

1. Which of the following features is least likely a benefit of collateralization?
   A. Reduces capital requirements.
   B. Allows for more competitive pricing of counterparty risk.
   C. Reduces market, operational, and liquidity risk.
   D. Reduces credit exposure.

2. Collateral agreements could potentially create multiple risks, including liquidity and liquidation risks. Which of the following is most accurate regarding liquidity and liquidation risk?
   A. Liquidation risk occurs when the amount of a security sold is large relative to its outstanding volume, which may affect the price of that security.
   B. Liquidity risk must be hedged in spot and forward markets.
   C. Liquidation risk embodies a transaction cost when collateral is liquidated in accordance with an independent amount.
   D. Liquidity risk occurs when there are potential pitfalls in the handling of collateral, including human error.

3. When dealing with a hedge fund, a bank would most likely negotiate a(n):
   A. one-way agreement in the bank's favor given the bank's stronger credit rating.
   B. one-way agreement in the bank's favor agreeing to post collateral to the hedge fund.
   C. two-way agreement given the relatively small difference in credit quality between the two entities.
   D. two-way agreement where both parties agree to post collateral.

4. Assume a sovereign bond has a haircut of 5% and is used for a collateral call of $100,000. What amount is credited if a $100,000 bond is submitted, and what amount of bond is needed for $100,000 to be credited, respectively?
   A. $100,000; $106,263.
   B. $95,000; $100,000.
   C. $95,000; $105,263.
   D. $105,263; $95,000.

5. Which of the following statements is least accurate regarding a credit support annex (CSA) and/or an ISDA Master Agreement?
   A. ISDA Master Agreements help standardize collateral management.
   B. CSAs must define all collateralization parameters in order to work as intended.
   C. Compared to the ISDA Master Agreement, CSAs were first to establish collateral standards.
   D. CSAs are incorporated into an ISDA Master Agreement.

Concept Checker Answers

1. **C** Collateralizing trades reduces credit exposure (credit risk) and capital requirements, and allows for more competitive pricing of counterparty risk. However, collateralization also creates other risks including market risk (negative equity leaving exposures partially or fully uncollateralized), operational risk (legal obstacles to take possession of collateral), and liquidity risk (difficulty in selling collateral at a fair market value).

2. **A** Liquidating a security in an amount that is large relative to its typical trading volume may negatively impact its price, leading to a substantial loss.

3. **A** The bank would most likely negotiate a one-way agreement in its own favor given the higher credit quality of the bank. This type of negotiation is typical when there are large differences in credit quality between two entities.

4. **C** A haircut is essentially a discount to the value of posted collateral. In other words, a haircut of x% means that for every unit of collateral posted, only (1 – x)% of credit will be given. This credit is also referred to as valuation percentage. If a particular sovereign bond has a haircut of 5% and a collateral call of $100,000 is made, only 95% of the collateral's value is credited for collateral purposes. That is, in order to satisfy a $100,000 collateral call, $105,263 ($100,000 / 0.95) of the sovereign bond must be posted.

5. **C** 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. 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 they are intended to work, CSAs must define all collateralization parameters and account for any scenarios that may impact both the counterparties and the collateral they are posting.

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

Central Counterparties

Topic 28

Exam Focus

This topic focuses on the strengths, weaknesses, and possible unintended consequences of central clearing through a central counterparty (CCP). For the exam, understand fundamental issues related to multilateral netting, OTC clearing, wrong way risk, loss mutualization, margin requirements, and CCP failure. Multilateral netting offers benefits of reduced counterparty and systemic risks. However, there are challenges related to standardization, complexity, liquidity, and wrong-way risk that make it difficult for over-the-counter (OTC) derivatives to clear centrally. Be prepared to explain how setting adequate initial and variation margins play a key role in ensuring that loss mutualization is efficiently obtained through the CCP loss waterfall. In addition, be able to discuss how volatility, trading volumes, and price movements in stressed markets impact the determination of the initial margin. Finally, understand how the number of CCPs and credit quality may result in moral hazard, information asymmetries, and severe systemic risk.

Objectives and Functions of Central Counterparties

LO 28.1: Explain the objectives and functions of central counterparties (CCPs).

A **central counterparty** (CCP) is designed to mitigate systemic risk. Systemic risk refers to the "domino effect" in which the failure of a large financial institution leads to successive financial crises for other financial intermediaries. Systemic risk during the financial crisis of 2007–2009 resulted in part from embedded wrong-way risks (i.e., when default risk and credit exposure to a counterparty are positively correlated) in the over-the-counter (OTC) credit derivatives markets. The financial crisis emphasized the need to expand the role of CCPs. Starting in 2010, both the European Commission and U.S. regulators began requiring all standardized OTC derivatives to be cleared through CCPs. Thus, the CCP now plays a major role in pricing OTC derivatives.

A CCP helps mitigate risk for members by reducing counterparty risk, increasing transparency, collateralizing positions with reserves and margins, and providing valuation and settlement of derivative products. The CCP provides centralization for settling and valuing derivative transactions. This pricing information is also necessary for setting margins and loss reserves. In addition, centralized clearing reduces counterparty risks and increases transparency through regulatory reporting.

In the event that a key market participant defaults, the CCP initiates predetermined plans to minimize and contain the losses and restore confidence in the market. The CCP is responsible for guaranteeing financial contracts for large financial institutions that are in default. In order to mitigate systemic risk, a CCP is responsible for stepping in and managing markets following the default of a key financial institution. If a key participant

defaults, the CCP manages and controls the losses through a loss mutualization process. **Loss mutualization** refers to distributing losses from one CCP member to all CCP members. This loss sharing helps contain the damage and reduces the probability of a domino effect.

The following six functions summarize the role of the CCP in containing financial disasters and guaranteeing financial obligations during a financial crisis in a controlled and orderly way:

- Valuation and settlement in OTC derivative markets.
- Trade compression and netting.
- Collateral management through margin calls.
- Increase transparency through reporting to regulators.
- Loss mutualization to absorb losses through all CCP members.
- Auction process for defaulted CCP members.

Strengths and Weaknesses of CCPs

LO 28.2: Discuss the strengths and weaknesses of CCPs.

The financial crisis of 2007–2009 demonstrated the ability of a CCP to efficiently restore markets in the short term following the default of large financial institutions. However, the long-term impacts of the CCP structure are unknown. The strengths and weaknesses of a CCP using a centralized clearing process are summarized below.

Strengths of the CCP central clearing process include:

- **Multilateral netting**. Multilateral netting is an important benefit the CCP provides by settling all contracts with its members. Multilateral netting mitigates counterparty risk and eliminates the need for members to monitor the creditworthiness of other members. Netting the contracts together lowers margin costs and reduces the number of replacement positions in the event a member defaults.
- **Liquidity**. Multilateral netting also improves market liquidity because values are set daily to adjust variation margins.
- **Transparency**. The process of daily valuation greatly enhances the transparency of the market. In addition, the CCP has access to private information of its members' positions and can understand aggregate exposures among members. This reduces the probability of panic by members in the event of a default or financial downturn.
- **Legal and operational efficiency**. A CCP can work directly with regulators and provide legal efficiency and operational efficiency. Managing margins and settling contracts provides operational efficiency and reduces costs.
- **Loss mutualization**. In the event that a CCP member defaults, the CCP is responsible for the loss mutualization process where excess losses beyond the defaulted member's margins and reserves are absorbed by the CCP and the surviving members. This process reduces systemic risk as losses are distributed through a network of members.
- **Default management through auction process**. The CCP also manages default through an auction process of a defaulted member's position to help bring stability to the market in crisis periods. The defaulted positions are auctioned off to surviving members. The auction process managed by the CCP is a major advantage of multilateral netting over bilateral netting.

Weaknesses of the CCP central clearing process include:

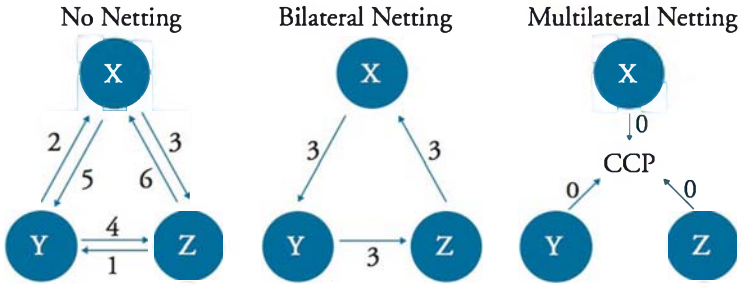
- **Inability to eliminate counterparty risk.** A CCP only reduces counterparty risk and cannot eliminate it altogether.
- **Undesirable consequences of CCP features and roles.** The advantages of loss mutualization can potentially lead to *moral hazard* and *adverse selection* as more creditworthy members pay higher costs for less creditworthy members' actions. There is also less incentive for end users to monitor the creditworthiness of the members because they know their position will be transferred in the event of a default.
- **CCPs can potentially increase systemic risk.** While the CCP structure provides many advantages in the short run, there is concern that in the long run if a CCP defaults the result could be severe systemic problems.

CCP Netting Schemes

LO 28.3: Describe the different CCP netting schemes, the benefit of netting, and distinguish between bilateral netting and multilateral netting.

Figure 1 illustrates how counterparty risk exposures are reduced through the use of a CCP in a multilateral netting scheme. Suppose X, Y, and Z in Figure 1 represent three different entities such as a financial institution, asset manager, or hedge fund. The arrows in the figure represent the amount of money owed (i.e., counterparty risk exposure) between the entities. For example, under the no netting scheme, entity X has an exposure of 2 to entity Y and entity Y has an exposure of 5 to entity X.

Figure 1: Reduction of Risk Exposure through Multilateral Netting



Suppose entity X defaults under the *no netting* framework. This will result in a loss of 5 for entity Y and a loss of 3 to entity Z. Under the no netting framework entity X still claims a total of 8 from both entities Y and Z (i.e., 2 + 6). With *bilateral netting*, trades between two entities are cleared reducing the total exposure in the market. If entity X defaults under the bilateral framework, then entity Y will have a reduced loss of 3 and entity Z will have no loss because there is no risk exposure remaining from entity X for entity Z.

If entity X defaults under the *multilateral netting* framework, entities Y and Z do not have losses because there is no outstanding counterparty risk exposure from other CCP members. All trades are cleared through the CCP in the multilateral netting framework.

Clearly both the bilateral and multilateral netting frameworks significantly reduce risk exposures compared to the no netting framework. However, the biggest advantage of a CCP is the ability to mitigate systemic risk through multilateral netting. Figure 1 implies that

systemic risk exposures are reduced more under multilateral netting than bilateral netting. However, the reduction in risk exposures for the multilateral netting framework as opposed to the bilateral framework are only possible if a relatively small number of CCPs clear a relatively large number of transactions.

Research suggests that the number of dealers, the number of asset classes, and correlation play important roles in achieving the benefits of reductions in risk exposures with CCP clearing. For example, in order for a multilateral netting market to be efficient, it may require 7 dealers with two asset classes that have a correlation of zero. However, if the number of asset classes increases, more dealers are required to reach the same level of efficiency. A multilateral netting market would require 15 dealers to be efficient with four asset classes that have zero correlation between the classes. As the correlation between asset class exposures increases to 50%, the number of dealers required in a four asset class market falls to around three. Thus, the number of asset classes and the degree of correlation between classes impact the number of dealers required for a CCP to efficiently reduce risk exposures.

The weighting of exposure to different asset classes is also an important variable. The previous examples of 7 and 15 required dealers were based on research that assumed asset classes were equally weighted. Another study suggests that if there are high concentrations in a single asset class, fewer dealers are required to achieve the same efficiency in a multilateral netting scheme compared to a bilateral market. To compensate for the uncertainty regarding reductions in risk exposures, collateral requirements are higher for a multilateral netting framework than a bilateral netting framework.

The total number of CCPs in a global market must be small enough to be efficient, but large enough to mitigate concerns of severe systemic risk or political issues. There are some advantages of allowing fewer CCPs to have monopolistic control over clearing. Competition between CCPs could lead to concerns regarding the credit quality of the CCPs. This would suggest a monopolistic structure is favorable. However, this increases the risk of severe systemic risk that could result from the collapse of a CCP when there are few to absorb the impact. Multilateral netting benefits such as reducing risk exposures and gaining economies of scale suggest a small number of CCPs. However, jurisdictional fragmentation, variety of products, need for competition, and risk of severe systemic risk are all factors suggesting the number of CCPs should be greater. Jurisdictional fragmentation refers to the fact that regulators in a global market require local clearing of financial assets.

Another concern related to the number of CCPs stems from the issue that some products are more liquid than others. This is a problem for CCPs clearing more than one type of product. In a severe financial crisis, dealers with claims to more liquid asset classes would obtain most of the initial margin and reserve funds of a defaulted member. Thus, many argue CCPs should focus on a single product, which would necessitate more CCPs.

Challenges in Clearing OTC Derivatives

LO 28.4: Discuss the key challenges in relation to the clearing of over-the-counter (OTC) derivative products.

There are a number of characteristics of over-the-counter (OTC) derivative products that make them difficult for central clearing through a CCP. In order for the OTC

derivative products to clear in a CCP setting the following challenges must be addressed: *standardization, complexity, liquidity,* and *wrong-way risk*.

In order for a CCP to compute the variation margin it must be able to properly value positions. OTC derivative products such as credit default swaps (CDS) need to be **standardized** before they can be cleared through a CCP. Similarly, exotic or more **complex derivatives** are problematic for CCPs because their unique features make them difficult to value (even if they are standardized). CCPs also face pricing issues related to **liquidity**. Illiquid products have less information and historical data that can be used for calculating initial and variation margins. Furthermore, the illiquidity and complexity of products makes it difficult to calibrate valuation models, which increases the risk for CCPs in the event of default. Illiquid products will also increase the time horizon needed for replacing defaulted trade positions. This leads to higher costs and a higher probability of depleting CCP equity and surviving member reserves. Products with **wrong-way risk** are also more complex and create additional problems for CCPs in the event of default. The presence of wrong-way risk can lead to an increase in risk exposures resulting from the default of a CCP member.

Given these challenges, there are few OTC derivatives that meet the criteria required for central clearing. Unfortunately, many OTC derivative products, such as the tranches of bespoke mortgage-backed products, are too highly structured to work well in a CCP structure. Thus, some of the most risky products that contributed to the 2007–2009 financial crisis are the most difficult to clear through a CCP. This brings into question the ability of a CCP to reduce systemic risk when the most complex products are not centrally cleared and could be the catalyst for the next crisis.

It also should be noted that the standardization of a product does not necessarily imply that the product will become less complex or more liquid. This is the case for CDS products that continue to be illiquid and complex even after they are standardized. In addition, information asymmetries may make CCP structures less effective than bilateral markets, where participants are incentivized to obtain information from counterparties. The concern arises that a CCP may suffer from "winner's curse" where the low cost CCP provider ends up with more risky products and less creditworthy members.

Professor's Note: In 2009, CDSs were standardized to achieve the benefits of central clearing and restore market confidence after the financial crisis. Interest rate swaps are also a very large market that could benefit from a CCP.

Another key challenge for OTC derivatives to centrally clear is acceptance of members. Financial institutions, corporations, asset managers, hedge funds, and sovereign funds need to be persuaded that the benefits of a CCP outweigh the extra costs related to holding large cash reserves and higher margins.

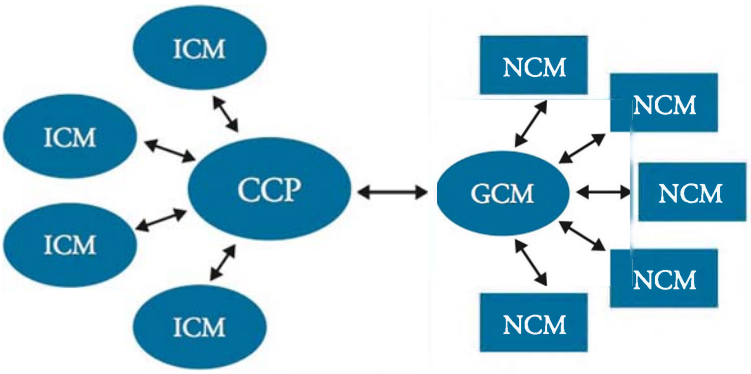
Commingled collateral from all CCP members in omnibus accounts create another challenge in the event a member defaults. The lack of segregation of margin creates moral hazard where members with high creditworthiness suffer losses based on the actions of low creditworthy members. Furthermore, the ability of a defaulted member to transfer positions to a surviving member also creates moral hazard from clients who are less likely to monitor their clearing member.

CCP Trade Participants

LO 28.5: Describe the three types of participants that channel trade through a CCP.

Three types of members that trade through a CCP are **general clearing members** (GCMs), **individual clearing members** (ICMs), and **non-clearing members** (NCMs). Each member's relationship to the CCP is illustrated in Figure 2. An ICM clears its own trades directly with the CCP. A GCM has the authority to clear trades for third parties, known as NCMs, in addition to its own trades. A GCM is typically a large financial institution but in some cases may actually be another CCP. An NCM has no relationship with the CCP and can only trade through a GCM. NCMs are typical end-users of OTC derivatives such as a smaller financial institution or hedge fund. An NCM who trades with a counterparty that is a GCM, benefits from reduction in risk exposures without being an actual member of the CCP.

Figure 2: Network of CCP, GCM, ICM, and NCM



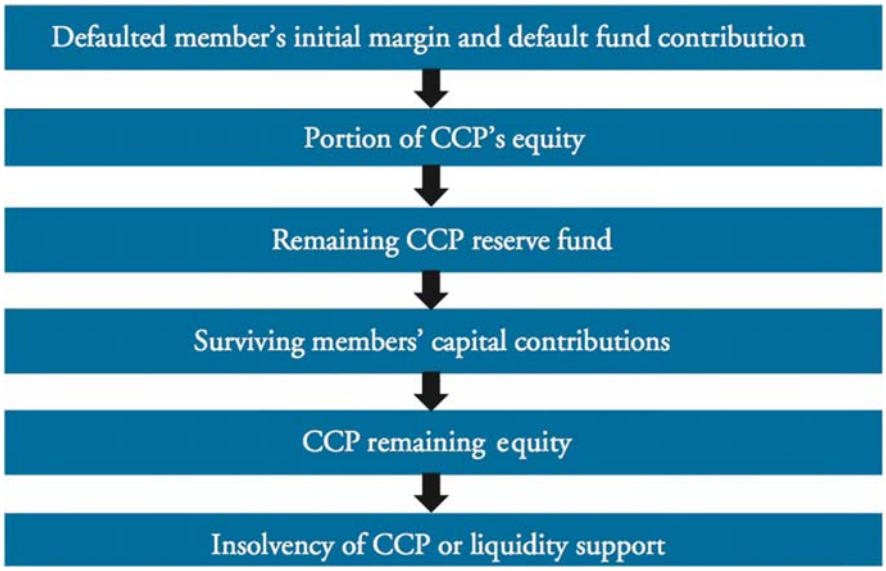
CCP Loss Waterfall

LO 28.6: Explain the loss waterfall in a CCP structure.

CCP structures contain a loss waterfall that defines how losses are absorbed in the event that a member defaults. As illustrated by Figure 3, losses are first absorbed by the defaulted member's initial and variation margins. Thus, the CCP structure is designed such that a defaulting member covers its own losses. This is similar to the default process used in bilateral markets where all positions are closed out for a defaulted member and margins are used to cover any losses. If margins are not sufficient to cover the losses, the defaulted member's **default fund contribution** is used to make up the deficiency. In theory, the initial and variation margins of the defaulting member should cover the defaulted positions. However, if the CCP is exposed to the position for a long period of time, the margins and defaulted member's default reserve fund contributions may not be sufficient. Thus, the amount of loss is also a function of the time required to auction the defaulted member's positions and to transfer positions to surviving clearing members.

If the defaulted member is unable to pay for the losses, the CCP proceeds through the subsequent steps of the loss waterfall to cover losses. The first step beyond the defaulter's funds involves the CCP covering losses with CCP equity in the form of current annual profits. Next, the remaining reserve funds from surviving member contributions are used. Events where losses exceed the reserve funds are highly unlikely. However, if such an event occurs, then surviving members are required to provide additional support to the CCP. In order to reduce the impact of moral hazard this additional required support is capped. Losses in excess of the cap are covered by the remaining equity of the CCP. Without liquidity support from a central bank, the CCP will become insolvent if the remaining equity is not sufficient to cover the losses.

Figure 3: CCP Loss Waterfall in the Event of Member Default



Initial and Variation Margin

LO 28.7: Define initial margin and variation margin and describe the different approaches and factors in calculating initial margin.

Initial and variation margins play important roles in the CCP loss waterfall process. **Initial margin** is the beginning deposits required from all members to cover future potential default losses in a worst case scenario. The calculation of initial margin is difficult to standardize due to the complexity of valuing positions and quantifying the probability of worst case events. The time period a CCP could be exposed to the position after default as well as the required confidence level (i.e., the percentage of default scenarios the margin will cover) of the CCP are also important factors in determining the initial margin level, which is generally high enough to overcollateralize the counterparty risk.

Interestingly, the initial margin depends primarily on market risk rather than the credit quality of the clearing member. If initial margins are set too high, trading volumes passing through the CCP will fall because of the higher costs of holding high cash positions faced by members. Conversely, if initial margins are too low they may fail to mitigate systemic risk and the creditworthiness of the CCP will be reduced.

Calculation of the initial margin is a function of volatility, tail risk, and dependency. The volatility of the position is related to the volatility of the underlying asset. Tail risk refers to large losses that result from large price jumps due to gaps in the market of the underlying asset for some products (e.g., credit default swaps). Lastly, the correlation or dependency of movements in product prices with other trades held by the CCP is also relevant. The portfolio is less risky if positions have lower correlations. Lower risk reduces the initial margin requirement. Thus, a CCP clearing in several markets provides benefits to members in the form of lower initial margins.

Variation margin is the additional margin required to account for daily price changes in asset positions. Variation margins are typically held in cash or highly liquid assets. The variation margin is intended to cover losses of a member in the event of default on a position. CCPs calculate the variation margins daily. Intraday margin calls are used during periods with large market movements. The standardization of underlying asset positions helps simplify the calculation of variation margins.

There are several different approaches to calculating initial margins. The Standard Portfolio Analysis of Risk (SPAN) was used in the past by U.S. and London futures clearinghouses. SPAN was similar to stress tests used today that are based on confidence levels and price movements. Initial margins are determined by the worst-case scenario as they are used to cover default losses in excess of the variation margin. This approach works well for portfolios of options and futures, but it is difficult to model when there are large numbers of dimensions or combinations of movements.

The value at risk (VaR) approach is a more advanced way to calculate the initial margin. Studies suggest that the VaR approach does a good job of setting initial margins at the 95% confidence level. However, at the 99% confidence level the initial margin would need to be much higher. The parameters for volatility and correlation are determined based on historical data. An advantage of the VaR approach is the ability to calculate initial margins for CCPs with multi-assets that have netting benefits. A down-side concern related to this is that model risk is more problematic with more complex multi-asset models incorporating a large number of assets.

Lastly, there is a **procyclicality** problem that occurs when initial margins are calculated during normal markets when volatility and correlations are low. This leads to insufficient margins in volatile times. During volatile markets the initial margin may need to be increased. This contradicts the term "initial" which implies it is a fixed margin.

LO 28.8: Discuss the impact of initial margin on prices, volume, volatility, and credit quality.

In order to mitigate systemic risk, initial margins need to be set high enough to cover extreme *price movements* in stressed markets. However, setting initial margins too high can damage market liquidity and decrease the use of CCPs. Studies indicate that high initial margins reduce *trading volumes*. Increasing the initial margin during more *volatile* markets may actually cause a domino effect and increase systemic risk by using up liquidity when it is needed most by market participants. Thus, in order to reduce the need to increase initial margins during volatile times, initial margins should originally be set with stressed market data. It is important to note that initial margins are not based on the *credit quality*

of clearing members as all CCP members have the same requirements. Thus, CCP members have similar credit qualities to avoid asymmetric information problems that might occur where riskier members benefit at the expense of more creditworthy members.

CCP Failure

LO 28.9: Explain factors that can lead to failure of a CCP and discuss measures to protect CCPs from default.

CCP failures can be quite dramatic with significant impacts on financial markets. The following examples are types of historical events that led to CCP failures:

- The inability of a large trading firm to post margin following a sharp drop in sugar prices in 1973 led to the failure of the French Caisse de Liquidation.
- The default of several brokers who could not meet margin calls following the fall in palm oil futures in 1983 led to the failure of the Commodity Clearinghouse in Kuala Lumpur.
- The stock market crash in October of 1987 resulted in defaults that led to the failure of the Hong Kong Futures Exchange Clearing Corporation.
- Many U.S. CCP firms also came close to failure but survived the 1987 crash.

In order to protect CCPs from default in the future, it is important to learn from past mistakes. We can draw the following conclusions based on observations of past failures and near failures.

- Operational risk must be controlled to prevent a market breakdown like the one that occurred with electronic trading in October of 1987.
- Variation margins must be calculated daily, and intraday calculations are required during more volatile times.
- Initial margin and reserve calculation models must use extreme events to calibrate the impact of correlations and other market variables.
- A loss mutualization plan is required to mitigate systemic risk.

Even when using 99% confidence levels in models to protect the solvency of CCPs, a catastrophic event that may lead to a CCP failure is still possible. Thus, the use of variation margins, initial margins, reserve funds, and loss mutualization in the loss waterfall structure are critical. CCP chances of survival are greatly enhanced by calibrating models and calculating margin and reserve levels based on extreme tail events.

In addition, the accumulation of reserves over a longer period of time creates an added buffer for excess losses. Experts estimate the probability of using reserve funds is less than 1%. However, tail events are still possible and unpredictable. It is difficult to estimate the degree of loss or even the event that would require the use of reserve funds. For these reasons, it is even more difficult to calculate the appropriate reserve amount than it is to calculate initial margins. Loss mutualization in a CCP structure helps cover excess losses beyond the defaulting member by using surviving member reserves to collectively absorb the loss. After all reserves are exhausted additional funds from surviving members are collected. However, these capital calls are capped and the CCP can still become insolvent without liquidity support from a central bank.

Key Concepts

LO 28.1

The main role of a central counterparty (CCP) is to manage and control systemic risk. The CCP performs the following six functions: valuation and settlement, trade netting, collateral management, transparency, loss mutualization, and auction process.

LO 28.2

Strengths of a CCP central clearing process include: multilateral netting, loss mutualization, legal efficiency, operational efficiency, liquidity, transparency, and default management through an auction process. Weaknesses of a CCP central clearing process are the inability to eliminate counterparty risk, possibility of increased systemic risk, and undesirable consequences of CCP roles, such as moral hazard and adverse selection.

LO 28.3

Bilateral netting and multilateral netting reduce risk exposures compared to a system without netting arrangements. One of the biggest advantages of a CCP is the ability to mitigate systemic risk through multilateral netting.

LO 28.4

Standardization, complexity, liquidity, and wrong-way risk are characteristics of OTC derivative products that make CCP clearing challenging.

LO 28.5

Individual clearing members clear their own trades directly with a CCP. Non-clearing members have no relationship with the CCP and can only trade through a general clearing member, which has the authority to clear trades for third parties.

LO 28.6

The CCP loss waterfall defines the sequence of loss absorption given the default of a member. Losses are first absorbed by the defaulted member's initial margin and reserve contributions. If losses are greater, the CCP equity and survivor members' reserves and equity are used.

LO 28.7

Initial margin is the beginning deposit required from all CCP members to cover future potential default losses in a worst-case scenario. Initial margin is a function of volatility, tail risk, and dependency. An advantage of the value at risk (VaR) approach in calculating initial margin is the ability to model multi-assets that have netting benefits to CCP members. Variation margin is an additional margin for daily changes in asset positions.

LO 28.8

In order to mitigate systemic risk, initial margins need to be set high enough to cover losses resulting from extreme price movements in stressed markets. High initial margins reduce trading volumes. Increasing the initial margin during more volatile markets may actually increase systemic risk. Initial margins are primarily based on market risk, not the credit quality of clearing members.

LO 28.9

In order to prevent CCP failure, operational risk must be controlled to prevent a market breakdown like the one that occurred in October of 1987. Variation margins must be calculated daily and intraday during volatile times. Initial margin and reserve calculation models must use extreme events to calibrate the impact of correlations and other market variables.

Concept Checkers

1. Following the financial crisis of 2007–2009 the roles of central counterparties (CCPs) were increased to reduce systemic risk through a centralized clearing process. Which of the following actions is not a strength of the CCP in the centralized clearing process?
   A. Manage loss mutualization.
   B. Improve operational efficiency.
   C. Increase transparency.
   D. Eliminate counterparty risk.

2. The benefits of multilateral netting versus bilateral netting are dependent on a number of factors. Which of the following factors most strongly suggest the need for fewer central counterparties (CCPs) in a global multilateral netting framework?
   A. Reduction of risk exposures.
   B. Differences in liquidity for asset classes.
   C. Jurisdictional fragmentation.
   D. Reduction in severe systemic risk.

3. There are a number of challenges for clearing over-the-counter (OTC) derivative products through a centralized counterparty (CCP). Which of the following statements best summarizes the key challenges for central clearing of OTC derivative products?
   A. Jurisdictional fragmentation, increased counterparty risk, less transparency, and standardization.
   B. Product complexity, illiquid products, presence of wrong-way risk, and lack of standardization.
   C. Illiquid products, jurisdictional fragmentation, presence of wrong-way risk, and legal concerns.
   D. Lack of standardization, increased counterparty risk, increased dependency risk, and less transparency.

4. In the event of a default, the central counterparty (CCP) manages and controls the defaulted member's positions, and losses are absorbed through a loss waterfall process. Which of the following statements correctly identifies the sequence by which surviving members and the CCP absorb losses after the defaulted member's initial margin and default fund contribution are exhausted?
   A. Portion of CCP's equity, CCP reserve fund, surviving member's capital, CCP's remaining equity.
   B. CCP reserve fund, surviving member's capital, CCP's remaining equity.
   C. Portion of CCP's equity, surviving member's capital, CCP reserve fund, CCP's remaining equity.
   D. Portion of CCP's equity, CCP reserve fund, CCP's remaining equity.

5. Setting margin levels and loss reserves are important aspects of mitigating systemic risk through the use of a central counterparty (CCP). Which of the following statements most accurately reflects the calculation of initial margins?
   A. The value at risk (VaR) approach sets appropriate initial margins at the 99% confidence level.
   B. The Standard Portfolio Analysis of Risk (SPAN) is considered the most advanced methodology today in calculating initial margins.
   C. The calculation of the initial margin should be based on volatility, tail risk, and dependency.
   D. Initial margins depend solely on the credit quality of the clearing member.

Concept Checker Answers

1. **D** CCPs reduce counterparty risk, but they do not eliminate counterparty risk. Improved legal and operational efficiencies, increased transparency, and loss mutualization are major advantages of the CCP central clearing process.

2. **A** One of the biggest benefits of multilateral netting is the reduction of risk exposures. With fewer CCPs a greater degree of risk reduction is realized due to lower dependencies within and across derivative products. This risk reduction helps mitigate systemic risk. Differences in asset classes related to liquidity would suggest more CCPs are needed to concentrate in specific asset classes. Jurisdictional fragmentation in a global market requires local clearing and thus more CCPs. A monopolistic framework with only a few CCPs could lead to severe systemic risk, in the event that margins and collateral are not sufficient to cover losses.

3. **B** Lack of standardized products, complexity, illiquid products, and presence of wrong-way risk are characteristics of OTC derivative products that make CCP clearing challenging. OTC derivative products need to be standardized before they can be cleared through a CCP. More complex and illiquid derivative products are problematic for CCPs because their unique features make them difficult to value. Products with wrong-way risk are also more complex and create additional concerns for the added risk to CCPs in the event of default.

4. **A** Excess losses after the defaulted member has exhausted sources are first covered with CCP equity in the form of current annual profits. Next, reserve funds from surviving member contributions are used. Then, surviving members capital contributions are required. Lastly, the CCP uses any remaining equity to cover losses.

5. **C** The calculation of the initial margin should be based on volatility, tail risk, and dependency. The value at risk (VaR) approach is a more advanced method than the SPAN approach for calculating initial margins. Studies suggest that the VaR approach does a good job of setting initial margins at the 95% confidence level, but at the 99% confidence level initial margins are not sufficient. The initial margin depends primarily on market risk and *not* the credit quality of the clearing member.

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

Credit Exposure

Topic 29

Exam Focus

In this topic, we describe credit exposures for various security positions. For the exam, understand credit exposure metrics and their application. Be prepared to identify potential future exposure (PFE) for the various asset classes discussed. Understand how credit exposure and VaR methods compare, and be able to explain credit exposure factors. Know how payment frequencies and exercise dates impact exposure profiles. Also, be familiar with netting tables and be able to calculate the netting factor. Understand the impact of collateral attributes on credit exposure reduction and know the steps in the remargin period. Finally, be able to explain the difference between risk-neutral and real-world parameters in arbitrage models and risk management applications.

Credit Exposure Metrics

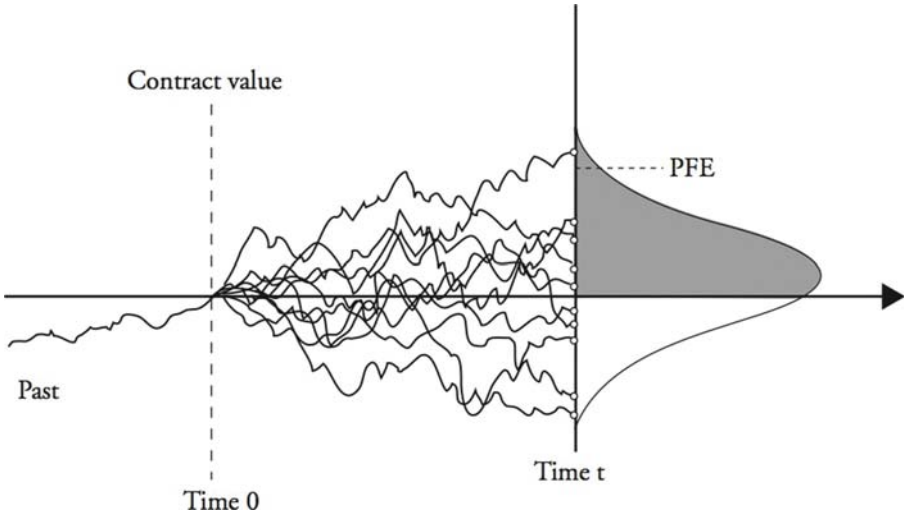
LO 29.1: Describe and calculate the following metrics for credit exposure: expected mark-to-market, expected exposure, potential future exposure, expected positive exposure and negative exposure, effective exposure, and maximum exposure.

Expected mark to market (MtM) is the expected value of a transaction at a given point in the future. Long measurement periods as well as the specifics of cash flows may cause large differences between current MtM and expected MtM.

Expected exposure (EE) is the amount that is expected to be lost if there is positive MtM and the counterparty defaults. Expected exposure is larger than expected MtM because the latter considers both positive and negative MtM values.

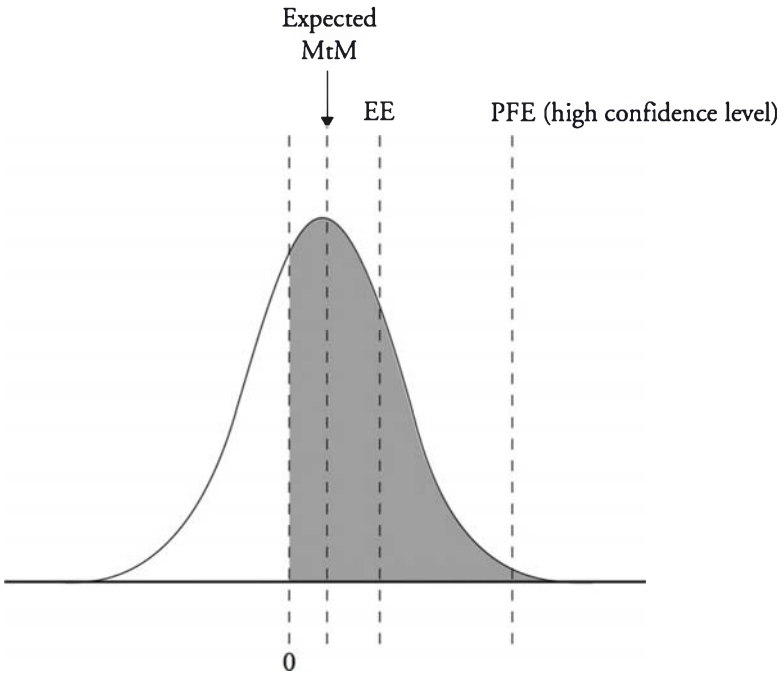
Potential future exposure (PFE) is an estimate of MtM value at a specific point in the future. It is usually based on a high confidence level, taking into account the worst-case scenario. The current MtM may follow a number of different possible paths into the future, so a probability distribution of PFE can be derived, similar to the one shown in Figure 1. Positive MtM (the shaded area in Figure 1) is the part of the exposure that is at risk. Any points in this shaded area can represent PFE.

Figure 1: Potential Future Exposure



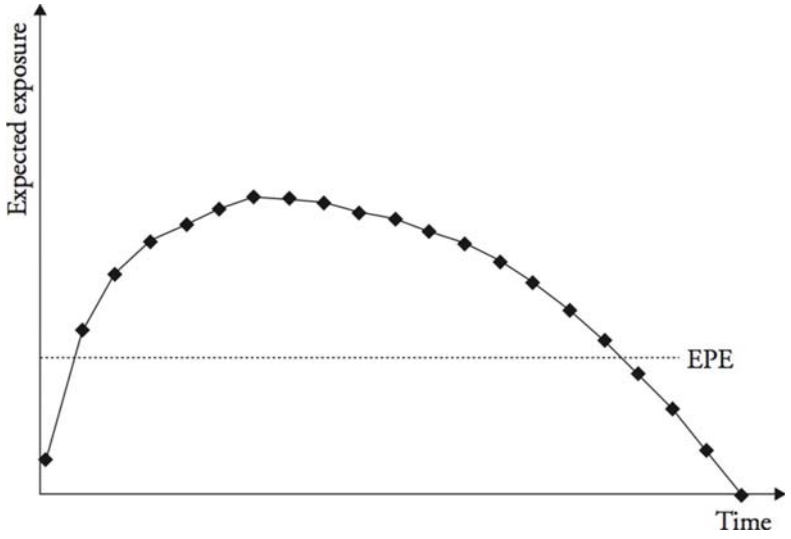
In other words, PFE is the worst exposure that could occur at a given time in the future at a given confidence level. Potential future exposure represents a "gain" amount because it is the amount at risk if the counterparty defaults. **Maximum PFE** is the highest PFE value over a stated time frame.

Figure 2: Credit Exposures



Expected positive exposure (EPE) is the average EE through time. Expected positive exposure is a useful single amount to quantify exposure.

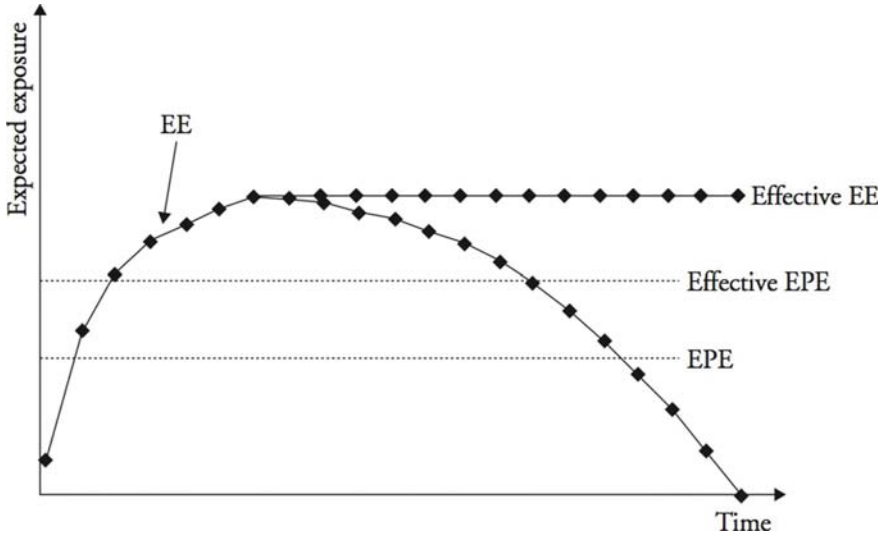
Figure 3: Expected Positive Exposure



Negative exposure, which is the exposure from the counterparty's point of view, is represented by negative future values. The expected negative exposure (ENE) and the negative expected exposure (NEE) are the exact opposite of EPE and EE.

The **effective EE** and **effective EPE** measures are meant to properly capture rollover risk for short-term transactions (under one year). Effective EE is equal to nondecreasing EE. Effective EPE is the average of the effective EE.

Figure 4: Effective EE and Effective EPE



Comparing Credit Exposure to VaR Methods

LO 29.2: Compare the characterization of credit exposure to VaR methods and describe additional considerations used in the determination of credit exposure.

Value at risk (VaR) is a measure used to estimate the risk of loss on a portfolio of financial/investment assets (e.g., stocks, bonds, derivatives, etc.). For example, if an asset portfolio has a one-day 10% VaR of $100,000, there is a 10% probability that the market value of the portfolio will fall by more than $100,000 over a period of one day. The characterization of credit exposure is similar to the characterization of VaR, although additional considerations are relevant to credit exposure, described as follows:

- *Application*: Credit exposure is defined for both pricing and risk management, whereas VaR is just for risk management. As a result, quantifying credit exposure is more difficult and may result in different calculations for both pricing and risk management purposes.
- *Time horizon*: VaR models are based on a relatively short time horizon, whereas credit exposure must be defined over many time horizons. The trend (i.e., drift) of market variables, their underlying volatility, and their levels of co-dependence become relevant for credit exposure, whereas for VaR, these elements are irrelevant due to the short time horizon. Also, while VaR tends to ignore future contractual payments and changes such as exercise decisions, cash flows, and cancellations, credit exposure must take these elements into account because they tend to create path dependency (i.e., credit exposure in the future depends on an event occurring in the past).
- *Risk mitigants*: Netting and collateral are examples of risk mitigants, designed to reduce the level of credit exposure. In order to estimate future levels of credit exposure, these mitigants need to be taken into account. Netting requires that the proper rules be applied, which may add a level of complexity. Future collateral adds a significant element of subjectivity, as the type of collateral and time to receive collateral must all be modeled even though they may be unknown.

Credit Exposure Factors

LO 29.3: Identify factors that affect the calculation of the credit exposure profile and summarize the impact of collateral on exposure.

The credit exposure profile is impacted by several factors, including:

- *Future uncertainty*: In situations where there is a single payout at the end of the life of a contract, uncertainty regarding the value of the final exchange increases over time. Foreign exchange forwards and FRAs often have single payouts at the end of their contract lives.
- *Periodic cash flows*: Unlike the situation where there is a single payout, when cash flows occur regularly, the negative impact of the future uncertainty factor is reduced. However, additional risk exists when periodic cash flows are not equal in each period and are based on variables that may change as is often the case in an interest rate swap with variable interest rates.

- *Combination of profiles*: This exists when the credit exposure of a product results from the combination of multiple underlying risk factors. A cross-currency swap (which combines a foreign exchange forward trade with an interest rate swap) is a good example of this factor.
- *Optionality*: Exercise decisions (e.g., a swap-settled interest rate swaption) will have an impact on credit exposure.

Collateral will also have a significant impact on credit exposure, as it typically reduces the level of credit exposure. However, determining the true level of risk reduction must take into account key parameters (e.g., minimum transfer amounts, thresholds, etc.); the margin period of risk; and other risks associated with collateral such as liquidity, operational risk, and legal risk.

In addition, the reality is that risk is not removed entirely even with collateral due to factors such as delays in receiving collateral, variations in collateral value (i.e., when the collateral is something other than cash), the granularity effect (i.e., key parameters prevent asking for all of the collateral actually required), and the path dependency of collateral (i.e., the amount called for depends on the amount collected in the past).

Security Exposure Profiles

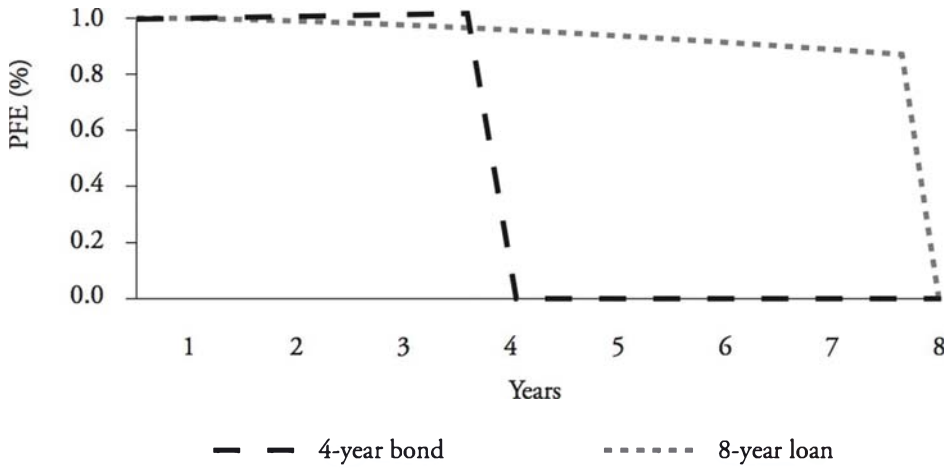
LO 29.4: Identify typical credit exposure profiles for various derivative contracts and combination profiles.

Potential future exposure (PFE) is defined as the maximum expected credit risk exposure for a specified period of time at a prespecified level of confidence. PFE is a measure of counterparty and credit risk exposures. Thus, the maximum credit risk exposure indicated by a PFE analysis is the upper bound on a confidence interval for future credit risk exposure. The ability to quantify counterparty credit exposure is impacted by time to maturity. There is more uncertainty related to market variables further into the future.

Examples of PFE are used to illustrate the credit exposure profile of various security types that result from different sources (e.g., maturity, option exercise, payment frequencies, default risk, and roll-off risk). In this section, a 99% confidence level is used to create the PFEs.

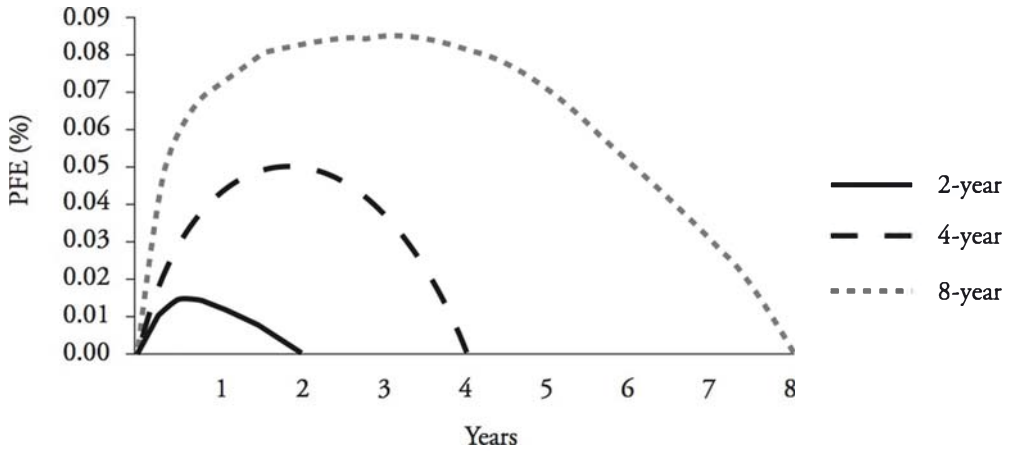
The PFE of bonds, loans, and repos are approximately equal to the notional value. The additional exposure of a four-year bond, as shown in Figure 5, is the result of interest rate risk. Bonds typically pay a fixed interest rate. If interest rates decline, then the exposure may increase. Figure 5 also illustrates the exposure for an eight-year loan. Loans typically have variable interest rates, and the exposure over time may decrease as a result of prepayments.

Figure 5: Loan and Bond PFE



Exposure profiles of swaps are typically characterized by a peak shape, as illustrated in Figure 6. This peaked shape results from the balancing of future uncertainties over payments and the roll-off risk of swap payments over time.

Figure 6: Interest Rate Swap PFE



The high volatility of FX rates, long maturities, and large final payments of notional value result in monotonically increasing exposures for foreign exchange products. Figure 7 illustrates that there is some exposure associated with interest rate risk (IR); however, the majority of the exposure results from the uncertainty regarding the final notional value payment associated with FX rate risk.

Figure 7: Three-Year Cross-Currency Swap PFE (Exposure Impact of Interest and FX Rates)

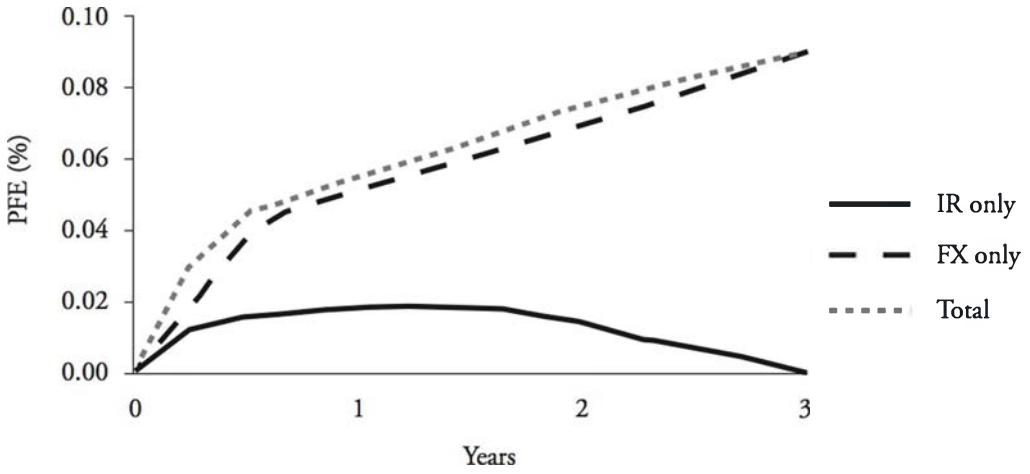
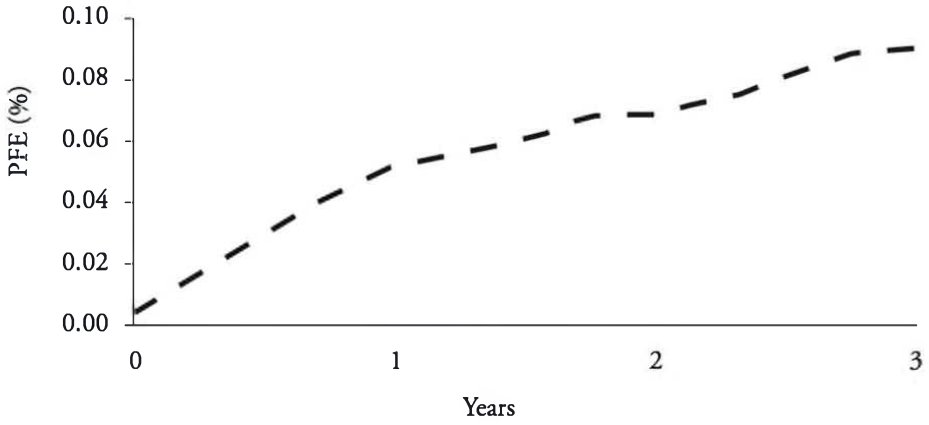


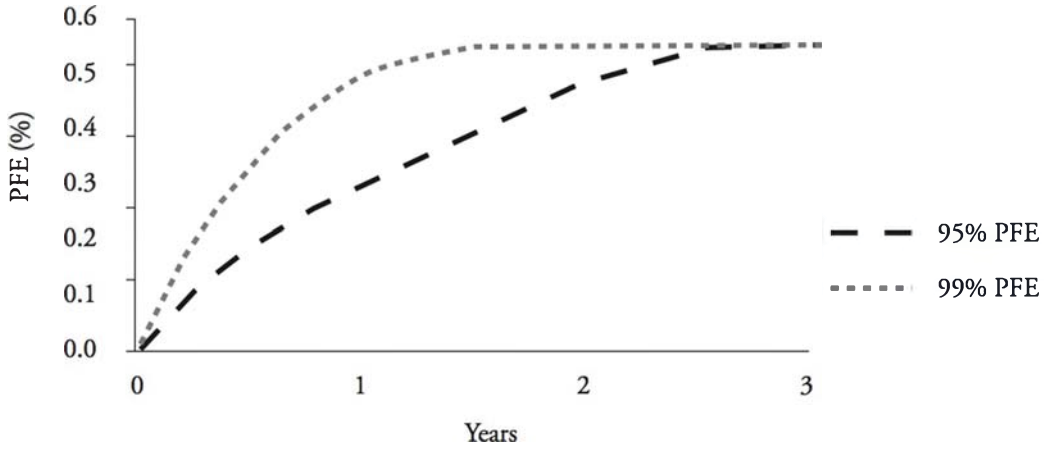
Figure 8 provides an exposure profile for a long option position (with up-front premium) and illustrates the increase over time of the exposure until the option is exercised. The exact shape of the graph can change when the option is near, in, or out of the money. However, the increase over time is similar for all options due to the fact that the option can be deep in the money.

Figure 8: Option PFE



The effect of **wrong-way risk** leads to considerable counterparty risk for credit derivatives. Figure 9 illustrates the exposures for a long-protection credit default swap (CDS) at the 95% and 99% confidence levels. The increase in exposures in early years is the result of the CDS premium (or credit spread) widening. The maximum exposure for the CDS occurs at a credit event where the notional value is paid less the recovery value. The 55% final exposure in this example is the result of a 45% recovery rate.

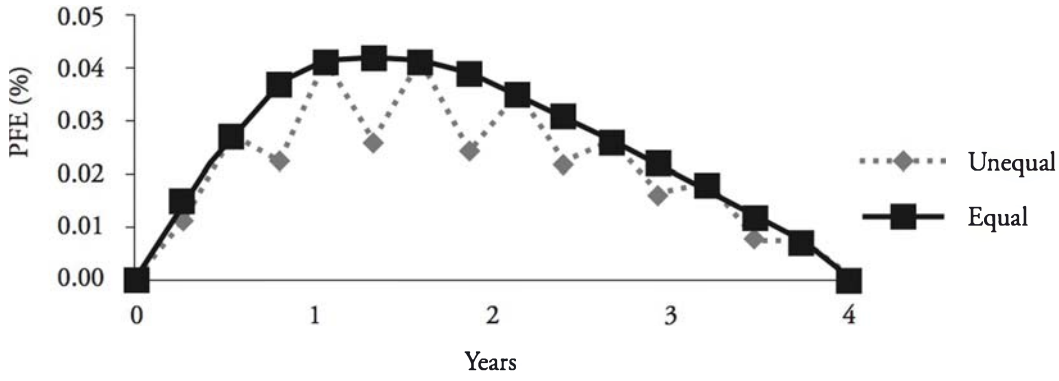
Figure 9: Credit Derivative PFE



LO 29.5: Explain how payment frequencies and exercise dates affect the exposure profile of various securities.

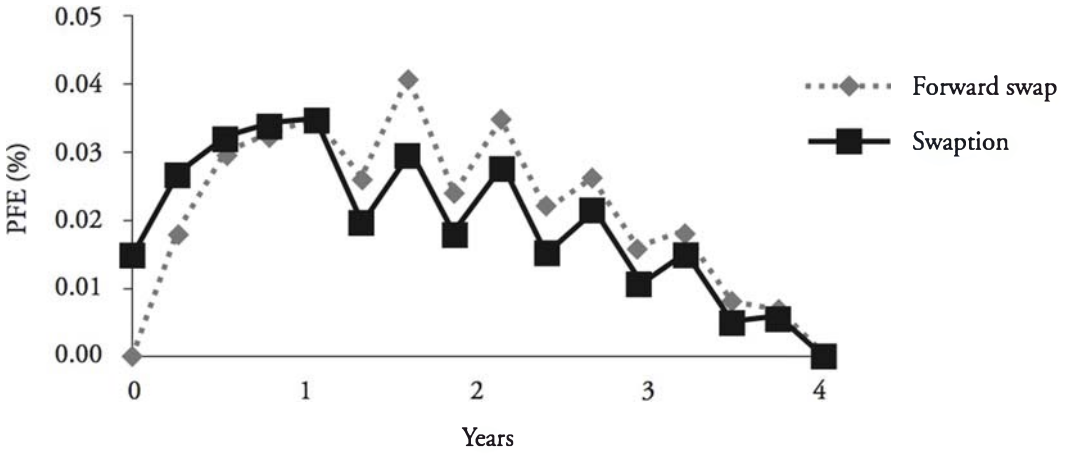
To illustrate the impact of payment frequencies, we can compare interest rate swap PFEs, assuming semiannual fixed payments are made and floating quarterly payments are received. Figure 10 illustrates that with unequal payments there is reduced exposure when payments are received more frequently than payments are made. Conversely, if a PFE were created for an interest rate swap where interest payments made were more frequent than interest payments received, it would have the reverse effect. In that case, the unequal payment PFE would show greater exposure than the equal payment PFE.

Figure 10: PFE for Swap With Equal and Unequal Interest Payments



Exercise dates result in more complex exposure profiles as illustrated in Figure 11, which shows an exposure profile for an interest rate swaption and forward swap with an exercise date of one year. The swaption in this example is swap-settled (as opposed to cash-settled) on the expiration date. The payment frequencies also differ for the swaps in this example. When compared to a forward swap, notice that the exposure is greater for the swaption prior to the one-year exercise date. This relationship reverses after the exercise point and the exposure for the forward swap is greater than the exposure for the swaption. This greater exposure is due to the fact that in some scenarios the forward swap has a positive value and the swaption is not exercised.

Figure 11: PFE for Interest Rate Swaption and Forward Swap



Modeling Netting Agreements

LO 29.6: Explain the impact of netting on exposure, the benefit of correlation, and calculate the netting factor.

Netting agreements allow two parties to net a set of positions should one of the parties default. This type of risk is effectively modeled in Monte Carlo simulations. The benefits of netting are realized when MtM values have opposite signs for two trades. Thus, the netting calculation is done at the individual level prior to calculating the total expected exposure (EE). A single time horizon netting factor is defined by EE, and a weighted average EE over time defines the expected positive exposure (EPE).

It is also important to consider the relationship between netting and correlation. Positive correlations have lower netting benefits than negative correlations, with perfect positive correlation providing the least netting benefit. High positive correlations likely result in trades that are of the same sign, resulting in a small or zero netting benefit.

Figure 12: Netting With Positive Correlations

	MtM		*Total Exposure*		
	Trade 1	*Trade 2*	*No netting*	*Netting*	*Netting benefit*
Scenario 1	15	5	20	20	0
Scenario 2	5	–5	5	0	5
Scenario 3	–5	–15	0	0	0
EE			8.3	6.7	1.7

Professor's Note: EE, or expected exposure, is the average of the netting figures assuming equal weight.

We can, therefore, easily see that negative correlations provide stronger netting benefits, with perfect negative correlation leading to the greatest netting benefit. In this case, trades are perfectly offsetting, and the netting benefit is 100% because there is zero overall risk.

Figure 13: Netting With Negative Correlations

	MtM		*Total Exposure*		
	Trade 1	*Trade 2*	*No netting*	*Netting*	*Netting benefit*
Scenario 1	15	–5	15	10	5
Scenario 2	5	5	10	10	0
Scenario 3	–5	15	15	10	5
EE			13.3	10.0	3.3

Overall, we can derive the following netting formula for the **netting factor** for any set of jointly distributed random variables across different asset classes:

$$\text{netting factor} = \frac{\sqrt{n + n(n-1)\bar{\rho}}}{n}$$

where:
n = number of exposures
$\bar{\rho}$ = average correlation

The netting factor will, therefore, be 100% when there is no netting benefit (correlation is 1) and 0% if the netting benefit is maximized. We also see that the netting benefit improves (i.e., netting factor declines) with a larger number of exposures and a lower correlation. If correlation is zero, the formula simplifies to $1 / \sqrt{n}$, implying that the netting factor for two independent exposures will be reduced to 71%, and for four exposures the netting factor declines to 50%.

Finally, it is important to note that the netting benefit also depends on the initial MtM of transactions. For example, a trade with strong overall negative MtM under all scenarios will have a strong netting benefit by offsetting some or all of the positive MtM of other trades. Similarly, a trade with strong overall positive exposure under all scenarios will reduce the netting benefit by offsetting some or all of the negative MtM of other trades.

Impact of Collateral on Credit Exposure

LO 29.7: Explain the impact of collateralization on exposure, and assess the risk associated with the remargining period, threshold, and minimum transfer amount.

When Party A has a positive exposure (e.g., receives cash flows in a swap transaction from Party B), Party A is said to have credit exposure because Party B could default. When exposure (i.e., mark-to-market value) is negative, Party B must post collateral to Party A to minimize the credit risk exposure.

When calculating an exposure profile, a risk manager should understand the factors that affect the collateral's ability to reduce risk. Specifically, factors that affect the calculation of

exposure include thresholds, minimum transfer amounts, rounding, independent amount, and the remargin period. These factors will be discussed later in this section.

The **remargin period**, also known as the margin call frequency, is the period from which a collateral call takes place to when collateral is actually delivered. It is a period of extreme exposure to the counterparty seeking collateral. A prudent risk analyst will assume default of the counterparty that must post collateral during the remargin period. Steps that enter into the calculation of the number of days in the remargin period are as follows:

Step 1: *Valuation/margin call*: How long it takes to calculate current exposure to the counterparty and the market value of the collateral. These calculations help to determine if a valid call may be made.

Step 2: *Receiving collateral*: The period between when the counterparty receives the request and when it releases the collateral.

Step 3: *Settlement*: The time it takes to sell the collateral for cash. The type of security being settled determines the time necessary. Cash may be posted on an intraday basis, whereas government and corporate bonds may need one- and three-day settlement periods, respectively.

Step 4: *Grace period*: The amount of time afforded to the counterparty obligated to deliver the collateral in the event that the collateral is not received by the requesting counterparty after the call. This may be a short window of time before the delivering counterparty would be considered in default for a failure-to-pay credit event.

Step 5: *Liquidation/close-out and re-hedge*: The time needed to liquidate the collateral, close out, and re-hedge positions.

An example of a remargin period time line is found in Figure 14, along with the minimum period lengths that must be assumed according to Basel II. Over-the-counter (OTC) derivatives and repurchase agreements (repos) are separated as they are governed by different documentation. The length of a remargin period is a function of the collateral agreement, the counterparty in question, legal considerations, and the management structure of the institution in question. Also, the counterparty requesting the collateral could show leniency toward certain counterparties in the interest of maintaining harmonious business relationships.

Figure 14: Remargin Period Time Line

	OTC Derivatives	*Repos*
Valuation/margin call	2 days	–
Receiving collateral	1 day	1 day
Settlement	2 days	1 day
Grace period	3 days	–
Liquidation/close-out and re-hedge	2 days	1 day
Total	10 days	3 days
Basel II minimum period	10 days	5 days

Measuring Exposure During the Remargin Period

Both expected exposure and potential future exposure measure the volatility of exposure over a given period of time. **Expected exposure** (EE) is the expected value of an exposure at a given point in time. During the remargin period, it is calculated as:

$$EE = \frac{1}{\sqrt{2\pi}} \times \sigma_E \times \sqrt{T_M} \approx 0.4 \times \sigma_E \times \sqrt{T_M}$$

where:
σ_E = volatility of collateralized exposure
$\sqrt{T_M}$ = the remargin frequency (in years)

Potential future exposure (PFE) is what the value of the marked-to-market exposure might be at some future point in time. During the remargin period, it is calculated as:

$$PFE = k \times \sigma_E \times \sqrt{T_M}$$

where:
k = a constant that is a function of the confidence level (e.g., k = 2.33 for a 99% confidence level)

Example: Computing PFE

Calculate the worst-case change in the value of an exposure with 7% annual volatility perfectly collateralized by cash over a 10-day remargin period. Assume 250 trading days in the year and a 99% PFE confidence level.

Answer:

$$PFE = -2.33 \times 7\% \times \sqrt{10/250} = -3.3\%$$

Potential disadvantages of PFE calculations include:

- It assumes a strongly collateralized position. PFE fails to work under a large threshold or minimum transfer amount, which produces a partially uncollateralized exposure.
- The analysis fails to account for the uncertainty of collateral volatility.
- Liquidity and liquidation risks are not considered.
- Volatility may differ from expected or implied volatility at the time of the collateral call and may not assume counterparty default.
- Wrong-way risk is not taken into account.

Collateral volatility must be calculated when a decline in the value of noncash collateral has the potential to create undercollateralization. The PFE formula is used for this calculation.

When there is no correlation between the volatility of the underlying exposure and that of the collateral, overall volatility is calculated as follows:

$$\sqrt{\text{variance of noncash collateral} + \text{variance of underlying exposure}}$$

For example, if the volatility of the noncash collateral was 8% and the volatility of the underlying exposure was 5%, the overall volatility would be computed as:

$$\sqrt{8\%^2 + 5\%^2} = 9.4\%$$

This volatility measure would be used in the PFE formula to reflect the additive exposure of the collateral and volatility of the underlying exposure. In this example, collateral lessens exposure but increases the volatility of the position due to the volatility inherent in the collateral itself.

There are also situations where there is a negative or positive correlation, ρ, between the trade and the collateral. For example, assume a 10-year swap is collateralized with a 15-year government bond that is interest rate–sensitive. The volatilities are 4% for the swap and 6% for the bond. The effective volatility of this position is calculated as follows:

$$\text{effective volatility} = \sqrt{4\%^2 + 6\%^2 - 2 \times 4\% \times 6\% \times \rho}$$

The overall risk of the position as a function of correlation is then calculated as:

$$k \times \text{effective volatility} \times \sqrt{T_M}$$

Modeling Collateral

Quantifying how much collateral reduces credit exposure is important. The risks that arise during the process of collateralizing exposure are discussed below.

Collateralization may be deficient due to terms in the collateral agreement, such as threshold, minimum transfer amount, and rounding. These factors may result in less than full collateralization. The following expression represents imperfect collateralization:

$$\text{exposure}_{t-\Delta} > \text{collateral}_{t-\Delta}$$

where:
t = time
Δ = time since collateral was last received (remargin period)

Exposure could increase between margin calls. The increased amount of exposure may not be collateralized. The following expression represents the portion of exposure not collateralized:

$$\text{exposure}_t > \text{exposure}_{t-\Delta}$$

Collateral is path-dependent. This means that the amount of collateral requested depends on how much was requested in the past.

Certain parameters impact the effectiveness of collateral in lessening credit exposure. These parameters are as follows:

1. **Remargin period**: the time between the call for collateral and its receipt.
2. **Threshold**: an exposure level below which collateral is not called. It represents an amount of uncollateralized exposure.
3. **Minimum transfer amount**: the minimum quantity or block in which collateral may be transferred. Quantities below this amount represent uncollateralized exposure as well.
4. **Independent amount**: an amount posted independently of any subsequent collateralization. This is also referred to as the initial margin.
5. **Rounding**: the process by which a collateral call amount will be adjusted (rounded) to a certain increment.

Figuring out how much exposure should be collateralized at a given point in time involves several critical assumptions.

1. *Remargin period*: how long before collateral is received from when it is first requested.
2. *Calculation of collateral called or returned*: this exercise utilizes the aforementioned parameters.
3. *Calculation of collateralized exposure at each point in time*: all amounts called for collateral less the remargin period.

Risk-Neutral vs. Real Probability Measures

LO 29.8: Explain the difference between risk-neutral and real-world parameters, and describe their use in assessing risk.

A risk-neutral parameter is often assumed in arbitrage pricing models where hedging is used. Conversely, when exposures are calculated for risk management purposes, the parameters are not risk-neutral but are based on real historical data and common sense. Parameters used for drifts and volatilities are market-driven (i.e., risk-neutral) and may not always reflect historical data or expected events.

The length of data to use for parameter estimation has important implications. A shorter data sample window results in poor statistics, while a longer data sample window gives more weight to older, less relevant data. For example, when the volatility of a market suddenly and dramatically increases, a model using a longer data sample window for parameter estimation will only gradually reflect this increase as the data sample window moves forward in time.

An implied volatility will reflect the market uncertainty immediately. However, caution should be used when applying implied volatility parameters in exposure models. This is illustrated in the following example scenario as counterparty risk, interest rate drift, and longer time periods will have important impacts.

Consider the PFE for two cross-currency swaps with the same maturity, where one of the swaps pays a higher interest rate and the other swap receives the higher interest rate payment. The swap paying the higher interest rate has a greater exposure than the reverse swap due to the fact that it has a significantly higher gain on the notional value at the maturity of the swaps. In addition, over the long term, the interest rate drift dominates the implied volatility measure. This causes the PFE for the swap receiving the higher interest rate to remain relatively flat.

Key Concepts

LO 29.1

Important metrics for credit exposure include the following: expected MtM, expected exposure (EE), negative expected exposure (NEE), potential future exposure (PFE), expected positive exposure (EPE), expected negative exposure (ENE), effective EE, effective EPE, and maximum PFE.

LO 29.2

Although value at risk (VaR) and credit exposure are similarly used to estimate the risk of loss, additional considerations related to credit exposure that must be accounted for include how it is applied (exposure is defined for pricing and risk management), the time horizon (exposure has a much longer time horizon than VaR), and risk mitigants (netting and collateral).

LO 29.3

The credit exposure profile is impacted by factors such as future uncertainty, periodic cash flows, profile combinations, and optionality. Collateral will also impact exposure, typically in a favorable way. However, risk reduction may be limited by the existence of key parameters (thresholds, minimum transfer amounts), characteristics of collateral (delays, value variations, granularity, path dependency), and other risks (liquidity, operational, legal) associated with collateral.

LO 29.4

The PFE of bonds, loans, and repos are approximately equal to the notional value or 100%. PFEs of swaps have a peaked shape. PFEs of long option positions or FX products monotonically increase. The maximum PFE for credit default swaps occurs at a credit event where the notional value less the recovery value is paid.

LO 29.5

With unequal payments, there is reduced exposure that results when payments are received more frequently than payments are made. Exercise dates result in more complex exposure profiles.

LO 29.6

Positive correlations between contract mark-to-market values have lower netting benefits than negative correlations, with perfect positive correlation providing the least netting benefit and perfect negative correlation the most benefit.

LO 29.7

The remargin period is the period from which a collateral call takes place to when collateral is actually delivered.

Factors that affect the calculation of the exposure profile when taking collateral into account include:

- Remargin period: creates exposure.
- Minimum transfer amount (≠ threshold amount): creates exposure below the minimum transfer amount.
- Threshold (≠ minimum transfer amount): creates exposure below the threshold.
- Independent amount: may reduce exposure, depending on its size.
- Rounding: may create a small amount of exposure, depending on the direction of the rounding.

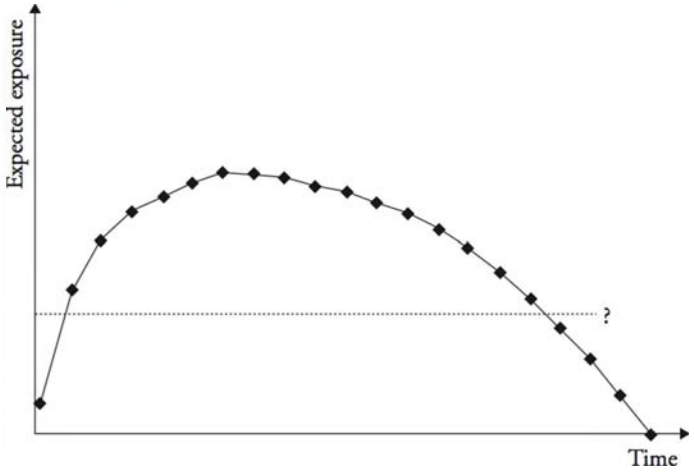
Assumptions and parameters in modeling collateral include (1) terms of the collateral agreement, (2) risk of increased exposure between margin calls, and (3) path dependency of collateral.

LO 29.8

Exposure management should focus on market-implied (risk-neutral) parameters when appropriate.

Concept Checkers

1. Which metric for credit exposure is represented by the "?" in the following graph?



A. Expected positive exposure (EPE).
B. Potential future exposure (PFE).
C. Effective EE.
D. Effective EPE.

2. Miven Corp. has two trades outstanding with one of its counterparties. Which of the following scenarios would result in the greatest netting advantage for Miven?
A. The two trades have strong positive correlation.
B. The two trades have weak positive correlation.
C. The two trades are uncorrelated with each other.
D. The two trades have strong negative correlation.

3. Which of the following security types will most likely result in a peaked shape for the exposure profile represented by potential future exposure (PFE)?
A. Long option position.
B. Foreign exchange product.
C. 10-year loan with a floating rate payment.
D. Swap.

4. Which of the following statements best describes the benefit of netting risk exposures? The benefits of netting are realized when:
A. marked-to-market (MtM) values have high structural correlations for two trades.
B. marked-to-market (MtM) values have opposite signs for two trades.
C. expected exposure (EE) values are minimal.
D. expected future exposure (EFE) values have zero correlation.

5. Time steps that enter into the calculation of the number of days in the remargin period include all of the following except:
   A. valuation/margin call.
   B. posting collateral.
   C. settlement.
   D. close-out and re-hedge.

Concept Checker Answers

1. **A** Expected positive exposure (EPE) is equal to average EE over time. It is a useful single amount to quantify exposure.

2. **D** The greatest netting benefit among the scenarios presented occurs when the two trades have a strong negative correlation. In this case, a large portion of the negative exposures will offset positive exposures.

3. **D** Exposure profiles of swaps are typically characterized by the peaked shape that results from balancing future uncertainties over payments and roll-off risk of swap payments over time.

4. **B** The benefits of netting are realized when MtM values have opposite signs for two trades.

5. **B** The time period from which the request for collateral is received to which it is released refers to the receipt of collateral, but it does not involve its actual posting. All of the remaining items are part of the remargin process.