



SchweserNotes™

Credit Risk Measurement
and Management

PART II BOOK 2

KAPLAN SCHWEISER

Book 2: Credit Risk Measurement and Management

SchweserNotes™ 2024

FRM Part II



SCHWESERNOTESTM 2024 FRM[®] PART II BOOK 2: CREDIT RISK MEASUREMENT AND MANAGEMENT

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READINGS AND LEARNING OBJECTIVES

STUDY SESSION 4

17. Fundamentals of Credit Risk

Sylvain Bouteille and Diane Coogan-Pushner, *The Handbook of Credit Risk Management: Originating, Assessing, and Managing Credit Exposures*, 2nd Edition (Hoboken, NJ: John Wiley & Sons, 2022). Chapter 1.

After completing this reading, you should be able to:

- a. define credit risk and explain how it arises using examples.
- b. explain the distinctions between insolvency, default, and bankruptcy.
- c. identify and describe transactions that generate credit risk.
- d. describe the entities that are exposed to credit risk and explain circumstances under which exposure occurs.
- e. discuss the motivations for managing or taking on credit risk.

18. Governance

Sylvain Bouteille and Diane Coogan-Pushner, *The Handbook of Credit Risk Management: Originating, Assessing, and Managing Credit Exposures*, 2nd Edition (Hoboken, NJ: John Wiley & Sons, 2022). Chapter 2.

After completing this reading, you should be able to:

- a. define risk management responsibilities in an organization and explain the three lines of defense framework for effective risk management and control.
- b. explain the processes that lead to risk taking including credit origination, credit risk assessment, and credit approval processes.
- c. discuss the following key principles underlying best practice for the governance system of credit risk: Guidelines, Skills, Limits, and Oversight.
- d. describe the most common parameters of a credit-sensitive transaction.
- e. describe the roles of the credit committee in an organization.

19. Credit Risk Management

Hennie van Greuning and Sonja Brajovic Bratanovic, *Analyzing Banking Risk*, Fourth Edition (World Bank Group, 2020). Chapter 7.

After completing this reading, you should be able to:

- a. describe key elements of an effective lending or financing policy.
- b. explain the importance and challenges of setting exposure and concentration limits.
- c. describe the scope and allocation processes of a bank's credit facility and explain bank-specific policies and actions to reduce credit risk.
- d. discuss factors that should be considered during the credit asset classification process.
- e. describe and explain loan loss provisions and loan loss reserves.
- f. identify and explain the components of expected loss and distinguish between expected loss and unexpected loss.
- g. explain the requirements for estimating expected loss under IFRS 9.
- h. describe a workout procedure for loss assets and compare the following two approaches used to manage loss assets: retaining loss assets and writing off loss assets.
- i. explain the components of credit risk analysis.
- j. explain the components of credit risk management capacity, and outline key questions that the board of directors of a bank should ask.

20. Capital Structure in Banks

Gerhard Schroeck, *Risk Management and Value Creation in Financial Institutions* (New York, NY: John Wiley & Sons, 2002). Chapter 5, pages 170–186.

After completing this reading, you should be able to:

- a. evaluate a bank's economic capital relative to its level of credit risk.

- b. identify and describe important factors used to calculate economic capital for credit risk: probability of default, exposure, and loss rate.
- c. define and calculate expected loss (EL).
- d. define and calculate unexpected loss (UL).
- e. estimate the variance of default probability assuming a binomial distribution.
- f. calculate UL for a credit asset portfolio and the UL contribution of each asset under various scenarios of portfolio composition, asset characteristics and size.
- g. describe how economic capital is derived.
- h. explain how the credit loss distribution is modeled.
- i. describe challenges to quantifying credit risk.

21. Introduction to Credit Risk Modeling and Assessment

Michalis Doumpos, Christos Lemonakis, Dimitrios Niklis, and Constantin Zopounidis, *Analytical Techniques in the Assessment of Credit Risk: An Overview of Methodologies and Applications* (Springer, 2019). Chapter 1.

After completing this reading, you should be able to:

- a. explain the capital adequacy, asset quality, management, earnings, and liquidity (CAMEL) system used for evaluating the financial condition of a bank.
- b. describe quantitative measurements and factors of credit risk, including probability of default, loss given default, exposure at default, expected loss, and time horizon.
- c. estimate capital adequacy ratio of a financial institution.
- d. describe the judgmental approaches, empirical models, and financial models to predict default.
- e. apply the Merton model to calculate default probability and the distance to default and describe the limitations of using the Merton model.
- f. compare and contrast different approaches to credit risk modeling, such as those related to the Merton model, Credit Risk Plus (CreditRisk+), CreditMetrics, and the Moody's-KMV model.
- g. apply risk-adjusted return on capital (RAROC) to measure the performance of a loan.

22. Credit Scoring and Rating

Michalis Doumpos, Christos Lemonakis, Dimitrios Niklis, and Constantin Zopounidis, *Analytical Techniques in the Assessment of Credit Risk: An Overview of Methodologies and Applications* (Springer, 2019). Chapter 2.

After completing this reading, you should be able to:

- a. compare the credit scoring system to the credit rating system in assessing credit quality and describe the different types of each system.
- b. distinguish between through-the-cycle and point-in-time credit rating systems.
- c. describe the process for developing credit risk scoring and rating models.
- d. describe rating agencies' assignment methodologies for issue and issuer ratings, and identify the main criticisms of the credit rating agencies' ratings.

23. Credit Scoring and Retail Credit Risk Management

Michel Crouhy, Dan Galai, and Robert Mark, *The Essentials of Risk Management*, 2nd Edition (New York, NY: McGraw-Hill, 2014). Chapter 9.

After completing this reading, you should be able to:

- a. analyze the credit risks and other risks generated by retail banking.
- b. explain the differences between retail credit risk and corporate credit risk.
- c. discuss the "dark side" of retail credit risk and the measures that attempt to address the problem.
- d. define and describe credit risk scoring model types, key variables, and applications.
- e. discuss the key variables in a mortgage credit assessment and describe the use of cutoff scores, default rates, and loss rates in a credit scoring model.
- f. discuss the measurement and monitoring of a scorecard performance including the use of cumulative accuracy profile (CAP) and the accuracy ratio (AR) techniques.
- g. describe the customer relationship cycle and discuss the trade-off between creditworthiness and profitability.
- h. discuss the benefits of risk-based pricing of financial services.

24. Country Risk: Determinants, Measures, and Implications

Aswath Damodaran, *Country Risk: Determinants, Measures, and Implications – The 2022*

Edition (2022)

After completing this reading, you should be able to:

- a. identify and explain the different sources of country risk.
- b. evaluate the methods for measuring country risk and discuss the limitations of using those methods.
- c. compare and contrast foreign currency defaults and local currency defaults.
- d. explain the consequences of a country's default.
- e. discuss measures of sovereign default risk and describe components of a sovereign rating.
- f. describe the shortcomings of the sovereign rating systems of rating agencies.
- g. compare the use of credit ratings, market-based credit default spreads, and CDS spreads in predicting default.

STUDY SESSION 5**25. Estimating Default Probabilities**

John C. Hull, *Risk Management and Financial Institutions, Sixth Edition* (John Wiley & Sons, 2023). Chapter 17.

After completing this reading, you should be able to:

- a. compare agencies' ratings to internal credit rating systems.
- b. describe linear discriminant analysis (LDA), define the Altman's Z-score and its usage, and apply LDA to classify a sample of firms by credit quality.
- c. describe the relationship between borrower rating and probability of default.
- d. describe a rating migration matrix and calculate the probability of default, cumulative probability of default, and marginal probability of default.
- e. define the hazard rate and use it to define probability functions for default time as well as to calculate conditional and unconditional default probabilities.
- f. describe recovery rates and their dependencies on default rates.
- g. define a credit default swap (CDS) and explain its mechanics including the obligations of both the default protection buyer and the default protection seller.
- h. describe CDS spreads and explain how CDS spreads can be used to estimate hazard rates.
- i. define and explain CDS-bond basis.
- j. compare default probabilities calculated from historical data with those calculated from credit yield spreads.
- k. describe the difference between real-world and risk-neutral default probabilities and determine which one to use in the analysis of credit risk.
- l. using the Merton model, calculate the value of a firm's debt and equity, the volatility of firm value, and the volatility of firm equity.
- m. using the Merton model, calculate distance to default and default probability.
- n. assess the quality of the default probabilities produced by the Merton model, the Moody's KMV model, and the Kamakura model.

26. Credit Value at Risk

John C. Hull, *Risk Management and Financial Institutions, Sixth Edition* (John Wiley & Sons, 2023). Chapter 19.

After completing this reading, you should be able to:

- a. compare market risk value at risk (VaR) with credit VaR in terms of definition, time horizon, and tools for measuring them.
- b. define and calculate credit VaR.
- c. describe the use of rating transition matrices for calculating credit VaR.
- d. describe the application of the Vasicek model to estimate capital requirements under the Basel II internal-ratings-based (IRB) approach.
- e. interpret the Vasicek's model, Credit Risk Plus (CreditRisk+) model, and the CreditMetrics ways of estimating the probability distribution of losses arising from defaults as well as modeling the default correlation.
- f. define credit spread risk and assess its impact on calculating credit VaR.

27. Portfolio Credit Risk

Allan Malz, *Financial Risk Management: Models, History, and Institutions* (Hoboken, NJ: John

Wiley & Sons, 2011). Chapter 8, Sections 8.1, 8.2, and 8.3.

After completing this reading, you should be able to:

- a. define and calculate default correlation for credit portfolios.
- b. identify drawbacks in using the correlation-based credit portfolio framework.
- c. assess the impact of correlation on a credit portfolio and its Credit VaR.
- d. describe the use of a single factor model to measure portfolio credit risk, including the impact of correlation.
- e. define beta and calculate the asset return correlation of any pair of firms using the single factor model.
- f. using the single factor model, estimate the probability of a joint default of any pair of credits and the default correlation between any pair of credits.
- g. describe how Credit VaR can be calculated using a simulation of joint defaults.
- h. assess the effect of granularity on Credit VaR.

28. Structured Credit Risk**Allan Malz, *Financial Risk Management: Models, History, and Institutions* (Hoboken, NJ: John Wiley & Sons, 2011). Chapter 9.**

After completing this reading, you should be able to:

- a. describe common types of structured products.
- b. describe tranching and the distribution of credit losses in a securitization.
- c. describe a waterfall structure in a securitization.
- d. identify the key participants in the securitization process and describe conflicts of interest that can arise in the process.
- e. compute and evaluate one or two iterations of interim cashflows in a three-tiered securitization structure.
- f. describe the treatment of excess spread in a securitization structure and estimate the value of the overcollateralization account at the end of each year.
- g. Explain the tests on the excess spread that a custodian must go through at the end of each year to determine the cash flow to the overcollateralization account and to the equity noteholders.
- h. describe a simulation approach to calculating credit losses for different tranches in a securitization.
- i. explain how the default probabilities and default correlations affect the credit risk in a securitization.
- j. explain how default sensitivities for tranches are measured.
- k. describe risk factors that impact structured products.
- l. define implied correlation and describe how it can be measured.
- m. identify the motivations for using structured credit products.

29. Credit Risk**John C. Hull, *Options, Futures, and Other Derivatives, 11th Edition* (Pearson, 2022). Chapter 24.**

After completing this reading, you should be able to:

- a. assess the credit risks of derivatives.
- b. define credit valuation adjustment (CVA) and debt valuation adjustment (DVA).
- c. calculate the probability of default using credit spreads.
- d. describe, compare, and contrast various credit risk mitigants and their role in credit analysis.
- e. describe the significance of estimating default correlation for credit portfolios and distinguish between reduced form and structural default correlation models.
- f. describe the Gaussian copula model for time to default and calculate the probability of default using the one-factor Gaussian copula model.
- g. describe how to estimate credit VaR using the Gaussian copula and the CreditMetrics approach.

30. Credit Derivatives**John C. Hull, *Options, Futures, and Other Derivatives, 11th Edition* (Pearson, 2022). Chapter 25.**

After completing this reading, you should be able to:

- a. describe a credit derivative, credit default swap (CDS), total return swap, and collateralized debt obligation (CDO).
- b. explain how to account for credit risk exposure in valuing a CDS.
- c. identify the default probabilities used to value a CDS.
- d. evaluate the use of credit indices and fixed coupons in pricing CDS transactions.

- e. define CDS forwards and CDS options.
- f. describe the process of valuing a synthetic CDO using the spread payments approach and the Gaussian copula model of time to default approach.
- g. define the two measures of implied correlation: compound (tranche) correlation and base correlation.
- h. discuss alternative approaches used to estimate default correlation.

STUDY SESSION 6

31. Derivatives

Jon Gregory, *The xVA Challenge: Counterparty Credit Risk, Funding, Collateral, and Capital, 4th Edition* (West Sussex, UK: John Wiley & Sons, 2020). Chapter 2.

After completing this reading, you should be able to:

- a. define derivatives and explain how derivative transactions create counterparty credit risk.
- b. compare and contrast exchange-traded derivatives and over-the-counter (OTC) derivatives, and discuss the features of their markets.
- c. describe the process of clearing a derivative transaction.
- d. identify the participants and describe the use of collateralization in the derivatives market.
- e. define the International Swaps and Derivatives Association (ISDA) Master Agreement, the risk-mitigating features it provides, and the default events it covers.
- f. describe the features and use of credit derivatives and discuss potential risks they may create.
- g. describe central clearing of OTC derivatives and discuss the roles, mandate, advantages, and disadvantages of the central counterparty (CCP).
- h. explain the margin requirements for both centrally-cleared and non-centrally-cleared derivatives.
- i. define special purpose vehicles (SPVs), derivatives product companies (DPCs), monolines, and credit derivatives product companies (CDPCs) and describe the limitations of using them as risk mitigating methods.
- j. describe the approaches used and the challenges faced in modeling derivatives risk.

32. Counterparty Risk and Beyond

Jon Gregory, *The xVA Challenge: Counterparty Credit Risk, Funding, Collateral, and Capital, 4th Edition* (West Sussex, UK: John Wiley & Sons, 2020). Chapter 3.

After completing this reading, you should be able to:

- a. describe counterparty risk and differentiate it from lending risk.
- b. describe transactions that carry counterparty risk and explain how counterparty risk can arise in each transaction.
- c. identify and describe institutions that take on significant counterparty risk.
- d. describe credit exposure, credit migration, recovery, mark-to-market, replacement cost, default probability, loss given default, and the recovery rate.
- e. describe credit value adjustment (CVA) and compare the use of CVA and credit limits in evaluating and mitigating counterparty risk.
- f. identify and describe the different ways institutions can quantify, manage, and mitigate counterparty risk.
- g. identify and explain the costs of an OTC derivative.
- h. explain the components of the X-Value Adjustment (xVA) term.

33. Netting, Close-Out, and Related Aspects

Jon Gregory, *The xVA Challenge: Counterparty Credit Risk, Funding, Collateral, and Capital, 4th Edition* (West Sussex, UK: John Wiley & Sons, 2020). Chapter 6.

After completing this reading, you should be able to:

- a. explain the purpose of an International Swaps and Derivatives Association (ISDA) master agreement.
- b. summarize netting and close-out procedures (including multilateral netting), explain their advantages and disadvantages, and describe how they fit into the framework of the ISDA master agreement.
- c. describe the effectiveness of netting in reducing credit exposure under various scenarios.
- d. describe the mechanics of termination provisions and trade compressions and explain their advantages and disadvantages.

- e. provide examples of trade compression of derivative positions, calculate net notional exposure amount, and identify the party holding the net contract position in a trade compression.
- f. identify and describe termination events and discuss their potential effects on parties to a transaction.

34. Margin (Collateral) and Settlement

Jon Gregory, *The xVA Challenge: Counterparty Credit Risk, Funding, Collateral, and Capital, 4th Edition* (West Sussex, UK: John Wiley & Sons, 2020). Chapter 7.

After completing this reading, you should be able to:

- a. describe the rationale for collateral management.
- b. describe the terms of a collateral agreement and features of a credit support annex (CSA) within the ISDA Master Agreement including threshold, initial margin, minimum transfer amount and rounding, haircuts, credit quality, and credit support amount.
- c. calculate the credit support amount (margin) under various scenarios.
- d. describe the role of a valuation agent.
- e. describe the mechanics of collateral and the types of collateral that are typically used.
- f. explain the process for the reconciliation of collateral disputes.
- g. explain the features of a collateralization agreement.
- h. differentiate between a two-way and one-way CSA agreement and describe how collateral parameters can be linked to credit quality.
- i. explain aspects of collateral including funding, rehypothecation, and segregation.
- j. explain how market risk, operational risk, and liquidity risk (including funding liquidity risk) can arise through collateralization.
- k. describe the various regulatory capital requirements.

35. Central Clearing

Jon Gregory, *The xVA Challenge: Counterparty Credit Risk, Funding, Collateral, and Capital, 4th Edition* (West Sussex, UK: John Wiley & Sons, 2020). Chapter 8.

After completing this reading, you should be able to:

- a. define a central counterparty (CCP) and describe the mechanics of central clearing.
- b. explain the concept of novation under central clearing.
- c. define netting, multilateral offset, and compression and provide examples of each.
- d. describe the application and estimation of margin and default funds under central clearing.
- e. discuss the risks faced by a CCP and the ways it manages its exposures.
- f. provide examples of a loss waterfall.
- g. explain the different methods of managing the default of one or more members of a CCP.
- h. compare bilateral and central clearing.
- i. compare initial margin and default fund requirements for clearing members in relation to loss coverage, cost of clearing, and moral hazard.
- j. describe the advantages and disadvantages of central clearing.

36. Future Value and Exposure

Jon Gregory, *The xVA Challenge: Counterparty Credit Risk, Funding, Collateral, and Capital, 4th Edition* (West Sussex, UK: John Wiley & Sons, 2020). Chapter 11.

After completing this reading, you should be able to:

- a. 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 expected positive exposure, and maximum exposure.
- b. compare the characterization of credit exposure to VaR methods and describe additional considerations used in the determination of credit exposure.
- c. identify factors that affect the calculation of the credit exposure profile and summarize the impact of collateral on exposure.
- d. identify typical credit exposure profiles for various derivative contracts and combination profiles.
- e. explain how payment frequencies and exercise dates affect the exposure profile of various securities.
- f. explain the general impact of aggregation on exposure, and the impact of aggregation on exposure when there is correlation between transaction values.
- g. describe the differences between funding exposure and credit exposure.
- h. explain the impact of collateralization on exposure and assess the risk associated with the remargining period, threshold, and minimum transfer amount.

- i. assess the impact of collateral on counterparty risk and funding, with and without segregation or rehypothecation.

37. CVA

Jon Gregory, *The xVA Challenge: Counterparty Credit Risk, Funding, Collateral, and Capital, 4th Edition* (West Sussex, UK: John Wiley & Sons, 2020). Chapter 17.

After completing this reading, you should be able to:

- a. explain the motivation for and the challenges of pricing counterparty risk.
- b. describe credit value adjustment (CVA).
- c. calculate CVA and DVA as a spread with no wrong-way risk, netting, or collateralization.
- d. evaluate the impact of changes in the credit spread and recovery rate assumptions on CVA.
- e. describe debt value adjustment (DVA) and bilateral CVA (BCVA).
- f. explain the distinctions between unilateral CVA (UCVA) and BCVA, and between unilateral DVA (UDVA) and BCVA.
- g. calculate DVA, BCVA, and BCVA as a spread.
- h. explain how netting can be incorporated into the CVA calculation.
- i. define and calculate incremental CVA and marginal CVA and explain how to convert CVA into a running spread.
- j. explain the impact of incorporating collateralization into the CVA calculation, including the impact of margin period of risk, thresholds, and initial margins.
- k. describe wrong-way risk and contrast it with right-way risk.
- l. identify examples of wrong-way risk and examples of right-way risk.
- m. discuss the impact of collateral on wrong-way risk.
- n. identify examples of wrong-way collateral.
- o. discuss the impact of wrong-way risk on central counterparties (CCPs).
- p. describe the various wrong-way modeling methods including hazard rate approaches, structural approaches, parametric approaches, and jump approaches.
- q. explain the implications of central clearing on wrong-way risk.

38. The Evolution of Stress Testing Counterparty Exposures

Akhtar Siddique and Iftekhar Hasan (eds.), *Stress Testing: Approaches, Methods, and Applications*, (London, UK: Risk Books, 2013). Chapter 4.

After completing this reading, you should be able to:

- a. differentiate among current exposure, peak exposure, expected exposure, and expected positive exposure.
- b. explain the treatment of counterparty credit risk (CCR) both as a credit risk and as a market risk and describe its implications for trading activities and risk management for a financial institution.
- c. describe a stress test that can be performed on a loan portfolio and on a derivative portfolio.
- d. differentiate between stressed expected loss and stress loss of a credit portfolio, and calculate the stress loss on a loan portfolio and the stress loss on a derivative portfolio.
- e. describe a stress test that can be performed on CVA.
- f. calculate the stressed CVA and the stress loss on CVA.
- g. calculate the DVA and explain how stressing DVA enters into aggregating stress tests of CCR.
- h. describe the common pitfalls in stress testing CCR.

39. An Introduction to Securitization

Moorad Choudhry, *Structured Credit Products: Credit Derivatives & Synthetic Securitization, 2nd Edition* (New York, NY: John Wiley & Sons, 2010). Chapter 12.

After completing this reading, you should be able to:

- a. define securitization, describe the securitization process, and explain the roles of participants in the process.
- b. explain the terms over-collateralization, first-loss piece, equity piece, and cash waterfall within the securitization process.
- c. analyze the differences in the mechanics of issuing securitized products using a trust versus a special purpose vehicle (SPV) and distinguish between the three main SPV structures: amortizing, revolving, and master trust.
- d. explain the reasons for and the benefits of undertaking securitization.
- e. describe and assess the various types of credit enhancements.

- f. explain the various performance analysis tools for securitized structures and identify the asset classes they are most applicable to.
- g. define and calculate the delinquency ratio, default ratio, monthly payment rate (MPR), debt service coverage ratio (DSCR), the weighted average coupon (WAC), the weighted average maturity (WAM), and the weighted average life (WAL) for relevant securitized structures.
- h. explain the prepayment forecasting methodologies and calculate the constant prepayment rate (CPR) and the Public Securities Association (PSA) rate.

The following is a review of the Credit Risk Measurement and Management principles designed to address the learning objectives set forth by GARP®. Cross-reference to GARP assigned reading—Bouteille and Coogan-Pushner, Chapter 1.

READING 17

FUNDAMENTALS OF CREDIT RISK

Study Session 4

EXAM FOCUS

This reading provides the definition of credit risk and the circumstances under which credit exposure occurs as well as the motivations for taking on or mitigating credit exposure. For the exam, be able to differentiate between the events that give rise to credit risk, and be able to distinguish between insolvency, default, and bankruptcy, which are related but distinct concepts. Also, be able to identify and describe the most common transactions that generate credit risk. Finally, be familiar with the types of entities that are exposed to credit risk (i.e., financial institutions, corporations, and individuals) and what creates credit exposure for the subgroups of these entities.

MODULE 17.1: CREDIT RISK DEFINITION AND TRANSACTION TYPES

LO 17.a: Define credit risk and explain how it arises using examples.

Credit risk is the probability that one party (e.g., a creditor) will lose money if a counterparty fails to honor its financial obligation due to either:

- an inability to repay the obligation,
- an unwillingness to repay the obligation (e.g., due to a dispute), or
- nontimeliness of honoring the obligation.



PROFESSOR'S NOTE

Borrower, obligor, counterparty, and bond issuer are typically used synonymously to signify the party receiving funds (credit), which has an obligation to repay it. *Lender, creditor, and obligee* are primarily used to signify the party providing credit.

Losses often arise when a company borrows funds for capital expansion, but is later unable to repay funds owing to creditors when the obligation becomes due. Losses may also happen because a company's product becomes obsolete (e.g., video cassettes, fax

machines) or under any scenario when an entity is unable to cover its financing costs like interest and principal payments. A nonpayment of obligations generates a credit loss for lenders or creditors. Even if obligations are honored but with a delay, the delay can create credit risk for the creditor as it can lead to lost interest income.

Unanticipated and uninsured events like macroeconomic factors could also cause an entity to miss repaying its obligations, which in turn creates credit risk for its creditors. The most recent example is the COVID-19 pandemic—consider a restaurant that saw a significant decline in service and needed to close, causing it to default on a bank loan that it took out previously to fund its operations or expansion.

Nonpayment of an obligation can also happen due to deliberate actions (e.g., an unwillingness by a borrower to honor its obligation, perhaps because of a dispute around the validity of the original contract). Such disputes may be settled between the two parties, or they may end up in court. An infrequent—but not unusual—example is when a sovereign state chooses to default on its international debt obligations, or force a conversion of its foreign currency debt obligations into domestic currency. This typically creates a credit loss for lenders because of the significant devaluation of the domestic currency following these events. A relatively recent example is the 2002 “pesification” in Argentina.

Generally, the longer the term of the contract, the greater the credit risk is to creditors. In assessing this credit risk, creditors generally want to assess (1) the amount of credit risk, (2) the probability of counterparty default, and (3) the recovery amount and timing of payment receipt.

Insolvency vs. Default vs. Bankruptcy

LO 17.b: Explain the distinctions between insolvency, default, and bankruptcy.

A counterparty's inability to pay its financial obligations can be due to insolvency, default, or bankruptcy.

Insolvency refers to a scenario where a counterparty's liabilities exceed its assets (i.e., it has negative equity). While insolvency and bankruptcy are related, insolvent entities are not necessarily bankrupt.

Default describes a scenario where a counterparty fails to meet its contractual obligations. A common reason for default is the inability or unwillingness to pay when an obligation is due.

Bankruptcy is a legal procedure where an entity, typically in default, seeks legal protection through a court. In a bankruptcy process, the court negotiates with the entity's management, creditors, and other stakeholders. The two forms of bankruptcy are dissolution/liquidation (Chapter 7 in the United States) and restructuring/reorganization (Chapter 11 in the United States).

Transactions That Generate Credit Risk

LO 17.c: Identify and describe transactions that generate credit risk.

Credit risk does not arise solely through traditional lending activities that involve the immediate exchange of money. It can arise out of many more complex activities, including trade transactions involving future payments, derivatives transactions, claims on collateral, and contingent liabilities. In the United States, corporate obligations constitute the largest source of credit exposure, concentrated in domestic financial companies. However, globally, the largest source of credit exposure by notional value is from derivatives—estimated at \$600 trillion in June 2020, with most from interest rate derivatives.

The main transaction types that generate credit risk are as follows:

1. *Lending*. When a lender loans funds to a borrower, the lender is exposed to the risk that the borrower will not repay the loan in the future.
2. *Leases*. A lessor (the owner of an asset who often finances the asset with borrowed funds) is exposed to the credit risk that the lessee (the entity using the asset for a period of time) will not make all scheduled lease payments in the future.
3. *Receivables*. If a product or service is sold to a buyer where the buyer has some time (days, weeks, or months) to pay, the seller is exposed to the credit risk of not receiving the payment.
4. *Prepayment*. Prepaying for goods or services exposes the entity making the payment to the risk that the goods or services will not be delivered in the future (e.g., due to the bankruptcy of a company).
5. *Deposits*. Customers are exposed to potential losses (i.e., credit risk) from their banks if they do not have timely access to their bank deposits. Unfortunately, most customers do not evaluate credit risk when choosing a bank. On the other hand, large corporations engage in in-depth due diligence of banks to protect their deposits and minimize credit exposure and risk.
6. *Contingent claims*. Contingent claims are claims that depend on the occurrence of a future event. For example, an insurance policyholder is exposed to the risk that the insurer (insurance company) will not make a payment when a claim is submitted in the future. Similarly, pension plan participants are exposed to the risk that the sponsor's assets are insufficient to meet the fund's liabilities in the future.
7. *Derivatives*. Derivatives create credit risk through indirect exposure to a financial asset, even if no cash flow occurs at the onset. Because each party under a forward or swap agreement could be required to make a payment in the future, each party is exposed to the credit risk of the other party throughout the life of the derivatives transaction. For example, in a currency swap, parties are exposed to the exchange rate fluctuations of two currencies. Other derivatives that give rise to credit risk are repurchase agreements and options.

Figure 17.1 summarizes the credit exposure and loss type relating to the main types of transactions that generate credit risk.

Figure 17.1: Credit Risk Transaction Types

Transaction	Key Credit Exposure	Loss Type
Loans	Slow or no repayment	Interest and face value; time value of money (TVM)
Leases	Nonpayment	Asset recovery; marketing costs
Receivables	Nonpayment	Face value
Prepayments	Slow or no delivery of asset or service	Replacement costs; incremental operating costs; friction costs
Deposits	No repayment	Face value; TVM; friction costs
Contingent claims	Slow or no repayment	Face value; TVM; friction costs
Derivatives	Nonpayment due to default	Replacement costs (i.e., mark-to-market value)

**MODULE QUIZ 17.1**

1. Which of the following set of factors is most critical in helping creditors assess credit risk?
 - A. Amount of credit risk, probability of counterparty default, recovery amount/timing.
 - B. Foreign currency exposure, amount of credit risk, amount of illiquid counterparty assets.
 - C. Probability of counterparty default, counterparty management strength, recovery amount.
 - D. Recovery amount/timing, amount of uninsured assets, probability of counterparty insolvency.

2. Acquaria Corporation's year-end balance sheet shows \$280 million in assets and \$320 million in debt to creditors. Acquaria's management estimates that it will continue to be able to meet its upcoming payment obligations. The company is best characterized as being:
 - A. bankrupt.
 - B. insolvent.
 - C. in default.
 - D. nonperforming.

MODULE 17.2: CREDIT RISK EXPOSURE

LO 17.d: Describe the entities that are exposed to credit risk and explain circumstances under which exposure occurs.

Exposure to credit risk is not inherently bad; it often arises from the daily operating activities of corporations, governments, and other entities, and can even result from the activities of individuals. For example, a tenant prepaying a full year of an apartment lease or a store selling its products on credit exposes them to credit risk. In the United States, the financial sector has the most credit exposure—primarily from the activities of depository institutions and mutual funds, followed by insurance companies, pension plans, and finance companies.

Financial Institutions

Banks

The daily operations of banks expose them to significant credit risk from their individual and corporate borrowers and through their derivatives activities and exposure. Banks tend to be among the most sophisticated institutions in managing credit risk, although the sector's overall risk appetite has declined noticeably in the last few years.

Repurchase agreements and other forms of collateralized lending expose banks to the potential that a counterparty will not repay its obligations or will default. The collateral, which the bank has access to and can sell, mitigates this risk; however, in fast-moving markets, the collateral value may decline and no longer sufficiently cover the amount owed to a bank under the lending contract. Similarly, banks are exposed to counterparty credit risk through their derivatives hedges and portfolio. For example, in 2020, JPMorgan Chase had derivatives receivables credit exposure in excess of \$700 billion.

Asset Managers

Asset managers invest client funds to generate returns while meeting their risk objectives, where the objectives vary from low-return, low-risk investments, to high-return-potential, high-risk investments. As a result, asset managers are exposed to credit risk on behalf of their clients. The risk management team of asset managers provides the risk assessment and oversight of the fund managers' investment decisions. A significant amount of the risk management goals is to mitigate these risks by analyzing the creditworthiness of corporate and government entities that issue bond, equity, and other securities.

Hedge Funds

Hedge funds typically have a higher risk tolerance than other investors and have aggressive mandates to invest in risky financial instruments like private equity and debt and alternative investments. They may also sell protection against a decline in a borrower's creditworthiness, or make long and short investments in distressed securities.

Unlike asset managers, hedge fund managers may look at default as an investment opportunity rather than a risk to avoid or hedge. For example, a manager may short sell the debt or equity securities of companies that the manager believes are in significant distress or may default. Exposure does not have to be direct—for example, derivatives like credit default swaps (CDSs) offer significant indirect return potential. Of course, making significant investments in securities that the hedge fund manager expects will decline in value creates significant risk. For example, in 2021, the hedge fund Melvin Capital entered into short sale transactions on GameStop Corp., anticipating a share price decline. When the GameStop share price increased significantly (from \$10–\$15 to \$350), Melvin had to buy back the shares at significantly higher prices than it sold

initially, suffering extremely large losses that resulted in its bailout by other hedge funds to avoid a default.

Insurance Companies

Insurance companies are unique in that they can have credit exposure from multiple aspects of their operations, including underwriting, investments, and reinsurance:

- *Underwriting.* As part of their underwriting activities, insurers collect premiums from policyholders, invest the premiums in a combination of low-risk and high-risk investments, and later pay out claims when losses occur and claims are made. Insurers must balance the goals of generating significant income and long-term returns from investments for shareholders with the goal to minimize risk for policyholders.
- *Investments.* Insurers (e.g., life insurance companies) may manage significant amounts of investments on behalf of their clients in separate accounts. These assets are segregated from the company and do not belong to shareholders; therefore, losses do not impact shareholder returns. However, significant losses could impact the insurer's reputation and could adversely impact future business opportunities.
- *Reinsurance.* A significant portion of an insurance company's risk of policy claims can be transferred to reinsurance companies like Swiss Re and Munich Re under reinsurance contracts. Insurance companies face credit risk from the time lag between when a policyholder submits a claim to when the reinsurer verifies the claim and makes a payment. The more significant the claim, like earthquake- or hurricane-related losses, the greater the credit risk. Further, for certain types of claims, there could be a very long time (often decades) between collecting the premiums and settlement of any claims. The estimated value of these claims is recorded on the insurance company's balance sheet as a reinsurance recoverable because it represents a contingent claim on the reinsurer—and, therefore, a significant source of credit risk for the insurance company.

Pension Funds

Similar to asset managers who invest funds on behalf of their clients, pension funds invest funds on behalf of pension plan members. Investments in credit-risky securities can generate significant credit risk for members. Increasing pension regulation for both private and public pension funds has mandated significant risk management guardrails for these funds to protect plan members.

Corporations

Corporations typically face credit risk from many sources. Most corporations allow customers to pay later for the products they purchase. Changing customer habits, like the significant decline in demand during the recent pandemic for hospitality services or the increasing popularity of online shopping, can create significant losses for corporations. The five main sources of credit risk for corporations are as follows:

1. *Account receivables.* When a corporation sells goods to customers in advance (the customer receives the product today but pays for it later), it creates credit risk for

the corporation because the customer may be unable or unwilling to pay for the product when payment is due. As a result, corporations attempt to assess the credit quality of customers. For large and established corporate customers, this is done relatively easily; however, for smaller corporate customers and for most individuals, this assessment is more difficult. Corporate risk managers often need to assess customer risk based on incomplete data, although they may be able to rely on customer credit scores. Corporations could mitigate receivables credit risk in the following three ways:

- Buying insurance on their account receivables
- Selling their receivables to another company (i.e., factoring)
- Securing foreign transactions through documentary credit (i.e., a form of guarantee that the seller will receive payment)

2. *Short-term investments and bank deposits.* Corporations face credit risk when they invest in short-term securities because the issuer of the security may fail to make good on its interest or principal obligations. Deposits with banks also create credit risk because banks may be unable to pay out deposits when they face significant liquidity distress, generating losses for corporations. Corporations mitigate this risk by diversifying their deposits across several banks.

3. *Derivatives.* Corporations hedge the price risk of the raw materials they need through commodity derivatives, including commodity forwards and futures. Commodity futures create relatively little credit risk because trades are subject to margin requirements and a clearinghouse guarantees performance. However, forwards and swaps are over-the-counter (OTC), nonstandardized contracts that create credit risk on both sides. A counterparty default on a derivatives trade may force a corporation to buy raw materials at a high price on the open market. Corporations that have significant derivatives exposure often have sophisticated risk management functions that analyze and help mitigate risk exposures.

4. *Vendor financing.* Corporations with financing arms that help customers buy on credit or lease their products, called vendor financing, face credit risk from a customer default or nonpayment.

5. *Supply chain.* Corporations that rely on a single supplier for a component of their product face credit risk from the default of the supplier because a default could generate significant losses for the corporation. Corporations that rely on significant shipments from suppliers could also suffer losses if a supplier's goods do not arrive or are lost. For example, the 2021 grounding of a large container ship in the Suez Canal caused billions of dollars in maritime traffic losses.

Individuals

Individuals can also be exposed to credit risk in several ways. The prepayment of goods or services, like prepayment on contracting services or prepaying rent, creates credit risk and could generate a loss if the goods or services are not delivered at a later date. Individuals are also exposed to the credit risk of a bank failure through their bank deposits, and through their investments with asset managers. The risk of losses from

deposits is mitigated in some countries (including in the United States and Canada) through federal deposit insurance.

Managing Credit Risk

LO 17.e: Discuss the motivations for managing or taking on credit risk.

Credit risk arises out of the consequences of company/management decisions—and because the company is in control of these decisions, it represents controllable risk exposure. Understanding how to manage credit risk is critical. Improper risk management can have costly adverse consequences for the company, its managers, and its shareholders more broadly. Successful companies maintain a sufficient equity buffer to absorb some of the anticipated and unanticipated losses, while considering the company's survival, profitability, and return on equity:

- *Survival.* Managing credit risk ensures that companies avoid large losses, and therefore, do not face bankruptcy.
- *Profitability.* Managing credit exposure and avoiding losses will help increase profitability.
- *Return on equity.* Successful companies find the right balance between debt and equity to maximize their return on equity.



MODULE QUIZ 17.2

1. A bank has entered into a \$25 million, 6-month repurchase agreement with an investment grade corporate client, collateralized by \$26 million notional value, 10-year state bonds. The bank has:
 - A. no credit risk because the repurchase agreement matures before the bonds.
 - B. no credit risk because the client is rated investment grade; therefore, counterparty default is unlikely.
 - C. no credit risk because the notional value of the bonds exceeds the value of the repurchase agreement.
 - D. credit risk because if the client defaults, the bank may not be able to sell the bonds to cover the full amount of the repurchase agreement.
2. Which of the following options would a corporation least likely select to mitigate its receivables credit risk?
 - A. Factoring.
 - B. Insurance.
 - C. Derivatives.
 - D. Documentary credit.

KEY CONCEPTS

LO 17.a

Credit risk is the probability of losses if a borrower fails to honor its financial obligations. This failure can be due to an inability or unwillingness to repay the obligation, or lack of timeliness to repay.

Factors that could create credit losses include the following:

- An inability to repay obligations following borrowing for capital projects, or due to product obsolescence
- A delay in receiving payment, contributing to lost interest or investment income
- Unanticipated and uninsured macroeconomic events
- Deliberate actions, including a sovereign debt default or forced currency conversion

The longer the term of the contract, the greater the credit risk to creditors. Creditors generally want to assess (1) the amount of credit risk, (2) the probability of counterparty default, and (3) the recovery amount and timing of payment receipt.

LO 17.b

Insolvency occurs when a counterparty's liabilities exceed its assets. Default occurs when a counterparty fails to meet its contractual obligations, either due to an inability or unwillingness to pay. Bankruptcy occurs when an entity seeks legal protection through a court, and the court negotiates with the entity's management, creditors, and other stakeholders. Bankruptcy can take the form of dissolution/liquidation or restructuring/reorganization.

LO 17.c

The main transaction types that generate credit risk are as follows:

- *Lending*. The lender is exposed to the risk that the borrower will not repay the loan in the future.
- *Leases*. The lessor is exposed to the risk that the lessee will not make scheduled lease payments.
- *Receivables*. The seller is exposed to the risk of not receiving payment.
- *Prepayment*. Prepaying for goods or services exposes the entity making the payment to the risk that the goods or services will not be delivered in the future.
- *Deposits*. Customers are exposed to potential credit risk if they do not have timely access to their bank deposits.
- *Contingent claims*. Credit risk may arise from the occurrence of a future event.
- *Derivatives*. Credit risk may arise from indirect exposure to a financial asset.

LO 17.d

The following entities and subgroups are exposed to credit risk under various circumstances.

Financial Institutions

- *Banks* face credit risk through their daily operations, given the potential default or nonpayment of their borrowers. Banks are also exposed to credit risk through collateralized transactions like repurchase agreements because the collateral value may decline and no longer sufficiently cover the amount owed to a bank under the lending contract if the counterparty is unable to pay.

- *Asset managers* are mainly exposed to credit risk on behalf of their clients, given the risk of nonpayment or default of the entities they invest in. This risk is managed through sophisticated risk management teams.
- *Hedge funds* face credit risk through their investments, given the risk of nonpayment or default of the entities they invest in. However, hedge funds often look at credit risk as an investment opportunity and take short positions in distressed company securities or via derivatives like CDSs.
- *Insurance companies* are primarily exposed to credit risk through their underwriting activities, including the risk of not receiving premiums and the risk of losses on their investments. They also face credit risk indirectly through reputational damage from losses in separately managed accounts. Finally, credit risk often arises from reinsurance, given the time lag (which can range from very short to very long) of receiving a payment from reinsurance companies to whom they transferred their policy claims.
- *Pension funds* have credit exposure from investments in credit-risky securities that can generate significant credit risk for members.

Corporations

- *Account receivables*. Credit risk arises because the customer may be unable or unwilling to pay for the product when payment is due. This risk can be mitigated through buying insurance, selling receivables, or using documentary credit.
- *Short-term investments and bank deposits*. The issuer of a short-term security may fail to make good on its interest or principal obligations, while banks may be unable to pay out deposits when they face significant liquidity distress.
- *Derivatives*. Corporations face credit risk, mainly through forward contracts and swaps if a counterparty defaults on a derivatives trade.
- *Vendor financing*. Customers leasing or buying products on credit creates credit risk given a potential customer default or nonpayment.
- *Supply chain*. Corporations that rely on a single supplier for a component of their product face credit risk from the default of the supplier.

Individuals

- Individuals can be exposed to credit risk when they prepay for goods or services and face the risk of not receiving those goods or services in the future. A bank failure through their bank deposits and through their investments with asset managers also generates credit risk. In some countries, deposit insurance mitigates deposit risk.

LO 17.e

Credit risk generally arises due to company decisions—and, therefore, represents controllable risk exposure. Successful companies will do the following:

- Maintain an equity buffer to absorb both anticipated and some unanticipated losses
- Strive to avoid large losses to ensure their long-term survival
- Manage credit exposure with the aim to increase profitability

- Maximize their return on equity by finding the right mix of debt and equity

ANSWER KEY FOR MODULE QUIZZES

Module Quiz 17.1

1. A While all factors listed are helpful in assessing credit risk, the three most important factors creditors want to assess are (1) the amount of credit risk, (2) the probability of counterparty default, and (3) the recovery amount and timing of payment receipt. (LO 17.a)
2. B Acquaria is best described as being insolvent, meaning its liabilities exceed the value of its assets. Acquaria continues to perform on its contractual obligations. Default occurs when an entity fails to meet its contractual obligations. Bankruptcy occurs when an entity seeks legal protection through a court. (LO 17.b)

Module Quiz 17.2

1. D The repurchase agreement exposes the bank to the risk that the client will not repay its obligation or will default. Although the collateral mitigates this risk, in a stressed or unfavorable market, the collateral value may decline and no longer sufficiently cover the amount owed to the bank under the repurchase agreement. (LO 17.d)
2. C Corporations typically mitigate receivables credit risk in one of following three ways:
 - Buying insurance on their account receivables
 - Selling their receivables to another company (i.e., factoring)
 - Securing foreign transactions through documentary credit(LO 17.d)

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

READING 18

GOVERNANCE

Study Session 4

EXAM FOCUS

Effective governance provides a framework for achieving an organization's objectives. A key component of effective governance is superior risk management, where risk managers help balance business needs with protecting an organization against undue risks. In this reading, we begin with a general overview of governance and risk management, followed by a detailed examination of the key principles of governance (guidelines, skills, limits, and oversight), transaction parameters, and the role of the credit committee. For the exam, pay particular attention to the management and oversight of guidelines, delegation authority, breaches, and the role of risk management.

MODULE 18.1: GOVERNANCE AND RISK MANAGEMENT

LO 18.a: Define risk management responsibilities in an organization and explain the three lines of defense framework for effective risk management and control.

Effective risk management and control within the governance framework includes the following three lines of defense:

1. **First line of defense.** Business owners who own and manage risks.
2. **Second line of defense.** Enterprise risk management, compliance, and legal functions that monitor and oversee risks and establish policies and procedures. The second line oversees the first line.
3. **Third line of defense.** Internal and external auditors and audit committees who provide independent risk monitoring and assessment.

An organization's chief executive officer (CEO) is responsible for ensuring that adequate governance guidelines have been established. The CEO should have the support of his staff in creating and enforcing robust risk management guidelines.

LO 18.b: Explain the processes that lead to risk taking including credit origination, credit risk assessment, and credit approval processes.

Governance ensures the proper functioning of an organization as well as the detection and mitigation of key risks. Without adequate risk governance, organizations could face losses due to bad judgment by individuals, a breakdown of processes, and/or be exposed to internal or external fraud. The main processes that are involved in risk taking are (1) credit origination, (2) credit risk assessment, and (3) credit approval.

The quality of transactions that are originated will determine an organization's profitability. A portfolio of bad transactions, if not adequately monitored, can create significant losses. Originators are driven by a desire to increase volume and returns/margins, which can lead to higher risk transactions. Adequate risk assessment and credit approval needs to be in place to mitigate these risks.

**MODULE QUIZ 18.1**

1. To ensure an adequate second line of defense, organizations should:
 - A. include the compliance and legal functions in risk oversight.
 - B. look primarily to business owners because they own and manage the risks.
 - C. ensure that the first line of defense has proper oversight of the second line.
 - D. ensure that the audit function provides an independent risk management role.

MODULE 18.2: CREDIT RISK GUIDELINES

LO 18.c: Discuss the following key principles underlying best practice for the governance system of credit risk: Guidelines, Skills, Limits, and Oversight.

Effective governance is based on the following four key principles, which ensure that goals and objectives are achieved, and risks are mitigated:

1. **Guidelines.** Organizations must institute clear guidelines around approvals, including approvals for transactions that give rise to credit risk.
2. **Skills.** Authority must be delegated to those with proper skills.
3. **Limits.** Adequate risk and transaction limits must be set.
4. **Oversight.** Employees and functions should be subject to oversight by qualified and independent people.

Guidelines

Guidelines (i.e., credit policies or risk standards) represent the documents that define the rules for how transactions must be conducted. Guidelines must be understandable, concise, precise, and accessible:

- *Understandable.* Guidelines should be written in a way that is not overly complex and can be easily interpreted. Document language should be clear and straightforward and avoid the complexities and jargon of legal documents.

- *Concise*. Guidelines should be of reasonable length. Users do not appreciate having to read very long documents.
- *Precise*. The goals to be relatively simple and short should not come at the cost of precision. Precision implies that guidelines need to be specific in their language and include real-life scenarios that address how to handle transactions.
- *Accessible*: Guidelines should be easily available on a company's electronic document system. A best practice is to include a 1-to-2-page summary on the company's intranet for easy access.

Creation and Approval

Guidelines help protect organizations against risk. Management is ultimately responsible for the guidelines, and therefore it should ensure that they contain the appropriate authorizations. It is best practice for an organization's chief financial officer (CFO) or chief risk officer (CRO) to sponsor guidelines, which are then ultimately approved by the Board of Directors including one of its risk committees.

Guidelines should be reviewed for content and accuracy periodically, and the content should be up-to-date with current practices and regulations. The Board and its risk committees can request periodic updates on the guidelines to check for quality. Events that cause losses to an organization should trigger a review of the relevant guidelines. Risk managers should consider unlikely but potential hypothetical events and their impact on the organization, such as negative interest rates or negative commodity prices (e.g., the price of oil briefly dipped into negative territory in April 2020 due to a technical issue, causing significant concerns for sellers of oil futures contracts).

Maintenance and Content

The CRO typically owns the guidelines. The CRO's office is responsible for drafting, approving, and maintaining the guidelines. Those drafting guidelines should have sufficient seniority and expertise in the organization and understand the products and markets. Guidelines may pit risk managers against business units and originators, so it is therefore necessary to deal with any conflicts in a professional manner, which can be best handled by those at a more senior level.

As mentioned, guidelines should be reviewed periodically, especially in light of the frequently changing regulatory landscape, with regulations becoming more stringent since 2008. Guidelines may also be modified significantly during notable events in the organization's life, such as mergers and acquisitions.

Guideline topics should include: (1) the purpose of the guidelines, (2) the methodology used, (3) transaction approval flow and delegation of authority, (4) the process on handling new products and markets, (5) the process to review/update the guidelines, and (6) consequences for employees who breach or fail to adequately follow guidelines.

Breach and Noncompliance

Breaches of well-established guidelines should be infrequent. When breaches do occur, they can lead to termination of employment. An organization may tolerate and have

carve-outs for some breaches that occur naturally rather than intentionally, including breaching credit limits due to foreign exchange rate fluctuations.

Organizations typically maintain a central database of transaction exposure and credit parameters, which allows originators to conduct pretrade checks to verify if the contemplated transaction is allowed. This results in an automatic guard against unauthorized trades because the system would either reject the trade or document it as unauthorized.

Skills

Approval

Because it is impractical for the CRO or Board committees to approve all transactions, authorities are delegated down the chain of experienced risk professionals. Risk managers understand that the risk function is often viewed by originators as an impediment to business growth and success. It is therefore important that risk managers and staff understand the business and establish good relations with originators.

Ultimately, risk management does not have approval authority and it is not a profit center. Rather, risk management fulfills an advisory role to the business. Guidelines should clearly describe where input from risk managers is required. While risk managers typically do not have transaction veto rights, there are avenues for expressing dissenting views, often in the form of written memos that are escalated to credit committees.

Delegation of Authority

The delegation of authority includes two steps:

1. Assign risk parameters to each transaction.
2. Delegate authority based on those parameters.

Guidelines should clearly establish the approval and delegation process even where it is not practical or possible to assign parameters to transactions. Transaction parameters should include (1) the amount of exposure, (2) credit quality, and (3) tenor (length) of the exposure (see the next LO for more details).

Approval levels should be based on transaction risk. Simpler, low-risk transactions can be approved at lower approval levels, often by a single individual. The riskier the transaction, the higher the approval level needs to be. Senior management is generally involved in transactions that have particularly high risk exposure, are very long, or are of lower credit quality. The approval process is often depicted based on a risk/approval flow, summarizing the escalation of delegation process. An example of this authority delegation process is provided in Figure 18.1.

Figure 18.1: Escalation of Delegation Example

Internal rating of the counterparty	Exposure in U.S. dollars (millions)			
	R1	150	200	250
	R2	125	150	175
	R3	100	125	150
	R4	75	100	125
	R5	50	75	100
	R6	25	50	75
	Head of trading	Head of trading	Transaction committee	Executive risk committee
	Recommendation of credit risk assessment unit			

Source: Sylvain Bouteille and Diane Coogan-Pushner, *The Handbook of Credit Risk Management: Originating, Assessing, and Managing Credit Exposures* (2nd Edition, Hoboken, NJ: John Wiley & Sons, 2022). Chapter 2.

Based on this escalation of delegation table, a transaction with an exposure of \$110 million with a counterparty rated R4 would require approval by the transaction committee (which has approval for an R4 counterparty up to \$125 million). The transaction also requires the recommendation of the credit risk assessment unit (which reviews transactions exceeding \$75 million).

Limits

Limits, often called credit lines, represent the maximum loss an organization is willing to accept in absolute dollar terms. For example, a firm may be willing to accept an overall absolute risk limit of \$75 million, with smaller limits assigned to individual counterparties, sectors, industries, or even countries. Setting absolute limits works for most types of transactions, although exposure may be difficult to estimate for certain dynamic credit exposures related to long-term trade agreements for physical commodities and derivatives.

Setting risk limits is based on a combination of assessing risk exposures and management's intuition for how much risk is acceptable. This intuition is often based on management experience and feelings. In this case, limits are influenced by what risk regulators, rating agencies, or shareholders find acceptable.

In addition to an aggregate limit at the organization level, limits are also assigned to specific businesses. Originators often prefer to have preapproved limits to facilitate the client marketing process.

Oversight

Effective oversight requires (1) independence, (2) strong qualifications, (3) closeness to the business, and (4) an open mind.

Independence requires that risk management should not be located within or assigned to a profit center, and the compensation of risk managers should be independent of business profitability. To ensure independence, risk management typically reports to the CRO instead of the business unit heads. CROs in most organizations report directly to the CEO, ensuring that the CRO has influence at the top organization level. CROs often have direct access to the Board's risk and audit committees, an increasingly important feature.

While risk managers need to be independent, they should also have a solid understanding of the business units, profit motivations, and transaction structures. In some cases, risk managers may also be asked to attend client meetings in order to adequately articulate an organization's risk position, especially when discussions between the client and originators hit a roadblock due to disagreements on term, price, or limits. When accepting an invitation to a client meeting, a risk manager should have a clear final position based on absolute risk limits, and avoid being influenced by emotions or client pressure. Risk managers should also be mindful of how close they get to business units, because ultimately they need to remain an independent voice regarding risk.

Therefore, a good risk manager needs to balance business needs with protecting the organization's interests. Instead of seeing originators as adversaries, risk managers should help them succeed by facilitating deal closures. Risk managers need to be well qualified for their roles, which allows them to have constructive discussions on transaction risk with originators.

Transaction Parameters

LO 18.d: Describe the most common parameters of a credit-sensitive transaction.

Credit-sensitive transactions can be described by the amount of exposure, credit quality, and length of exposure:

- *Amount of exposure.* Transactions can expose organizations to losses. Measuring the amount of potential losses is critical.
- *Credit quality.* Organizations should assess the risk of losses from transactions with counterparties. Assessing the creditworthiness of counterparties is therefore important.
- *Length of exposure (tenor).* Organizations should have a good understanding of the period during which they are exposed to potential losses, which is the length of time until an obligation is due by a counterparty.

Credit Committee

LO 18.e: Describe the roles of the credit committee in an organization.

The **credit committee** tends to comprise senior executives and is used for making decisions regarding important or high-risk transactions. The credit committee should

have a charter that clearly lays out the approval processes. The committee makes approval decisions on packages prepared by originators well in advance to give the committee sufficient time to review the information. A well-functioning committee has a track record of approving and declining transactions.

Committee members should have sufficient expertise with a deep understanding of risks, and should include key functions of the organization, including business units, risk management, tax and accounting, compliance, and legal. Members should be individuals tasked with making decisions, with only limited ability to delegate authority. The committee should have a chair who solicits opinions and facilitates the discussion objectively. The chair will direct the committee to a vote if there is no consensus. Meeting minutes should be recorded and distributed shortly after the committee concludes.



MODULE QUIZ 18.2

1. A firm's risk management unit is updating their guidelines relating to transaction approval and delegation. Risk managers are worried that even when transactions fall within available credit limits, foreign exchange volatility may cause breaches in these limits. Which of the following guideline parameters would be most appropriate to deal with this type of outcome?
 - A. The guidelines should include a carve-out for breaches that are due to foreign exchange rate volatility.
 - B. Breaches in the credit limit due to foreign exchange rate movements should be immediately escalated to the chief risk officer (CRO).
 - C. The guidelines should treat each breach in the credit limit as an error by the originator, because currency movements should be anticipated.
 - D. Breaches in the credit limit due to foreign exchange rate movements should be immediately escalated to the risk committee of the Board of Directors.
2. Which of the following statements about risk managers' reporting structure is most accurate?
 - A. To be most effective, risk managers should report to the business unit heads.
 - B. To preserve their independence, risk managers should report directly to the CRO.
 - C. Risk managers should have dotted line reporting to both the CRO and business unit heads.
 - D. To ensure effective risk governance, risk managers should report directly to the Board of Directors.
3. A firm recently developed a model to help summarize the creditworthiness of each of its counterparties. Which of the following risk parameters of a credit-sensitive transaction does this most likely represent?
 - A. Tenor.
 - B. Credit quality.
 - C. Maximum loss.
 - D. Amount of exposure.

KEY CONCEPTS

LO 18.a

Effective risk management and control is based on three lines of defense:

1. *First line.* Business owners who own and manage risks.
2. *Second line.* Enterprise risk management, compliance, and legal functions which monitor and oversee risks.
3. *Third line.* Auditors and audit committees who provide independent risk monitoring and assessment.

LO 18.b

Governance helps an organization function properly by detecting and mitigating key risks. The main processes that lead to risk taking include:

- Origination of transactions.
- Credit risk assessment of key risks.
- Credit approval to mitigate transaction risk and potential losses.

LO 18.c

Effective governance includes four key principles: (1) guidelines, (2) skills, (3) limits, and (4) oversight.

1. Guidelines (i.e., credit policies or risk standards) are documents that define how transactions must be conducted, and should be easily understandable, concise, precise, and accessible.
 - Guidelines should be reviewed periodically. Reviews can be based on specific dates, following major events, large transaction losses, or hypothetical scenarios.
 - The CRO's office is responsible for drafting, approving, and maintaining the guidelines. Guidelines should be written by those who have sufficient seniority and expertise.
 - Guideline topics include: (1) purpose of the guidelines, (2) methodology used, (3) transaction approval flow and delegation of authority, (4) process on handling new products and markets, (5) process to review/update the guidelines, and (6) consequences for breaches.
 - Guidelines should be written to ensure breaches are infrequent. Breaches that an organization can tolerate should include carve-outs.
2. Risk managers and risk functions should have adequate skills in understanding risks, should understand the business, and should establish good relations with originators.
 - Risk management functions in an advisory role to the business. Guidelines should describe where input from risk management is required.
 - Delegation of authority is based on (1) assigning risk parameters to transactions, and (2) delegating authority based on those parameters.
 - Transaction parameters should include the amount of exposure, credit quality, and tenor (length) of the exposure.
 - Approval levels should be based on the level of transaction risk. The riskier the transaction, the higher the approval level should be.

3. Limits (i.e., credit lines) represent the maximum loss in dollar terms that is acceptable to an organization. An organization can have an absolute risk limit, and smaller limits assigned to individual counterparties, sectors, industries, or even countries. Setting risk limits is based on the assessment of risk exposures, and management's experience.
4. Adequate oversight requires independence, adequate qualifications, and an understanding of the business.
 - Risk management should not be located within or assigned to a profit center, and the compensation of risk managers should be independent of business profitability. Risk management typically reports to the CRO who has influence at the top organization level.
 - Risk managers should also have familiarity with the business units, profit drivers, and transaction structures. When risk managers attend client meetings, they should have a clear final position based on absolute risk limits, and avoid being influenced by emotions or client pressure.
 - A good risk manager is able to balance the needs of the business with protecting the organization's interests. Risk managers need to be adequately qualified for their roles.

LO 18.d

Credit-sensitive transactions can be described by (1) the amount of exposure (measuring losses), (2) credit quality (assessing the risk of losses due to counterparty exposure), and (3) length of exposure (period during which risk exposure exists).

LO 18.e

The credit committee, which is made up of senior executives, makes decisions regarding high profile/high-risk transactions. The committee should have a charter detailing the approval processes. It should have a chair who solicits opinions and facilitates discussions objectively. It should also balance business needs with risks, resulting in a combination of approving and declining transactions. Committee members should have solid risk experience.

ANSWER KEY FOR MODULE QUIZZES**Module Quiz 18.1**

1. A Effective risk management and control is based on three lines of defense: first line (business owners), second line (enterprise risk management, compliance, and legal functions), and third line (internal and external auditors and audit committees). The second line provides oversight of the first line. (LO 18.a)

Module Quiz 18.2

1. A The firm should include a carve-out in the guidelines to allow for breaches of credit limits due to external factors not within the control of the firm. It is not

prudent to treat these breaches as an originator error, and it is not necessary to escalate them if the guidelines include the carve-outs. (LO 18.c)

2. **B** Risk managers should report to the CRO instead of the business unit heads to ensure they remain independent and free of business influence. CROs have influence at the top organization level including the CEO and risk committees. It would not be feasible for risk managers to report directly to the Board, which deal with broad oversight of risks rather than more granular risk matters. (LO 18.c)
3. **B** Parameters of credit-sensitive transactions include credit quality (assessing the creditworthiness of counterparties and the risk of losses due to counterparty exposure), the amount of exposure (measuring losses), and length of exposure (period during which risk exposure exists). (LO 18.d)

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

READING 19

CREDIT RISK MANAGEMENT

Study Session 4

EXAM FOCUS

This topic focuses on how banks manage credit risk exposures, which is a leading cause of bank failures. For the exam, know the key elements that banks should include in their credit risk management policies. Understand the ways to reduce risk in a bank's formal lending policy, the scope of loan portfolio reviews, and the detail needed for loan loss allowances. Also, be able to categorize a loan into one of the five credit asset classification categories. Be familiar with how to calculate expected loss and be able to compare it with unexpected loss. In addition, know the steps in the loan workout process and the balance sheet impact from the two ways to handle loss assets (i.e., retention and write-off). Finally, be aware of what should be included in a credit risk management capacity review.

MODULE 19.1: CREDIT RISK POLICIES AND CREDIT ASSET CLASSIFICATION

Elements of an Effective Lending Policy

LO 19.a: Describe key elements of an effective lending or financing policy.

Credit risk (i.e., counterparty risk) is the chance that a borrower will either make delayed payments or no payments at all. If this risk is not managed well, it can spill over to affect a bank's liquidity. Credit risk is linked to approximately 70% of a bank's balance sheet, which makes credit risk the primary cause of bank failure.

Supervisors and financial analysts expect banks to have formal policies governing their credit risk management process. A lending (or financing) policy should detail the scope of the bank's credit facilities as well as the ways the risk is managed (i.e., origination, appraisal, internal supervision, and collection procedures). Flexibility to adapt to changing conditions is critical. It is also important for risk managers to have access to the Board of Directors if an issue deserves special consideration.

Almost all regulators impose minimum standards for lending policies. These standards cover the identification of existing (and potential) risks, a detailed description of the bank's risk management philosophy, and the establishment of acceptable credit risk parameters. These policies can loosely fit into one of three high-level categories: (1) policies designed to limit or reduce credit risk, (2) policies that classify assets by credit risk exposure and collectability, and (3) policies to create provisions for potential losses.

Setting Exposure and Concentration Limits

LO 19.b: Explain the importance and challenges of setting exposure and concentration limits.

With the goal of limiting credit risk exposures, regulators focus on three core areas: (1) exposure to a single customer, (2) related-party financing, and (3) overexposure to an economic sector or geographic area.

Concentration limits refer to the maximum exposure to a single client, region, or economic sector. Typically, banks will impose limits based on a percentage of bank reserves or capital. Many countries impose a limit of 10%–25% of capital on individual clients. Things get tricky when less-direct forms of credit are involved (e.g., contingent liabilities, guarantees, acceptances, letters of credit). The valuation of collateral is another matter. In practice, collateral should not be considered when sizing risk exposures. A related discussion is the definition of a “single client,” which traditionally refers to an individual, entity, or connected group (i.e., a client who is mutually controlled by another, which requires aggregation). The concern is that a large exposure to a single client may bias risk managers in appraising the associated risks. In essence, the bank could end up having a vested interest in the success of a large risk exposure client. Regardless, risk managers need to monitor events affecting large clients independent of whether they are currently meeting their obligations.

Related parties may be able to exert control over bank credit decisions. Examples of related parties include parent companies, subsidiaries, major bank shareholders, affiliated companies, directors, and executive officers. The concern is that credit decisions may be made in violation of the bank's policies and that loan terms may be more favorable than market norms. Most regulators impose a limit based on a percentage of Tier 1 capital. If a local regulator does not impose such a limit, then risk managers should create a comparable policy of their own.

Credit Facility Allocation and Credit Risk Reduction

LO 19.c: Describe the scope and allocation processes of a bank's credit facility and explain bank-specific policies and actions to reduce credit risk.

The scope and allocation of a bank's credit facility should cover how loans are originated, appraised, supervised, and collected. This process should include the

flexibility to adapt to changing market conditions. Several relevant factors related to lending policy and risk reduction are as follows:

- *Lending authority.* Lending policy should establish limits for lending officers. There may be higher limits for lending officers with more experience or longer tenure. This process is often centralized with smaller banks and decentralized (based on geographical area, lending products, or types of customers) for larger banks.
- *Types and distribution of loans.* A bank's lending policy should specify which credit instruments the bank will deploy. This decision should be based on the expertise of the lending officers, the bank's deposit structure, and credit demand. Limitations are commonly imposed for lending categories (i.e., commercial, real estate, consumer, etc.). Any deviations from the limits should require approval of the Board.
- *Appraisal process.* A lending policy can reduce risk by formally defining the appraisal process, including limits on appraisals by credit type, the reappraisal process for renewals and extensions, circumstances requiring independent appraisal, and acceptable limits on the ratio of loan to appraised value.
- *Loan pricing.* Rates on loans should be structured by type with consideration for the cost of funds, loan supervision, and administrative overhead. They should also factor in the probability of loss and a reasonable profit margin for the lender. A lending policy should periodically review rates to adjust to market conditions and the competitive landscape.
- *Maturities.* A lending policy should establish clear maximum maturities for various loan types. These should involve a realistic loan repayment schedule with consideration of the source of funds for repayment and the useful life of the collateral.
- *Exposure to geographic or sector-level concentration.* A substantial risk factor is concentration by geographic region or economic sector. Many banks do not have well-developed systems for monitoring these exposures, but this is essential to understand. This is especially the case for regional or specialty banks. The inclusion of international lending also introduces unique risk factors (e.g., political risk and exchange rate risk).
- *Availability of current financial information.* A lending policy should clearly specify the financial information required for commercial and consumer loans. External credit checks should be involved. It should be determined if business financials need to be audited or not, and financial projections should match the maturity of the desired loan.
- *Monitoring of collections.* Risk management for the lending policy should address the process for dealing with any delinquencies. This should include reporting details to the Board and the process for determining potential losses and alternative plans for repayment.
- *Limits on total loans outstanding.* Policy limits on total loans outstanding should be expressed in relation to capital, deposits, or total assets. The volatility of deposits and known credit risks should also be factored in to reduce overall risk.
- *Maximum ratio of loans to market value of pledged securities.* Margin requirements should be clearly established for all security types. A provision for periodic repricing

of collateral should be included to reduce risk.

- *Impairment recognition.* Loan impairments should be periodically and systematically identified to address loans deemed uncollectable.
- *Renegotiated debt treatment.* Renegotiated debt refers to loans restructured to reduce either interest rates or principal amounts. A loan extension is not considered “renegotiated” in this sense. The restructuring process may involve the introduction of a new debtor, transfer of collateral, or a debt-to-equity swap. A large number of restructurings is an indication that the bank (i.e., the lender) has a serious credit risk issue.
- *Written internal guidelines.* It is very important that all lending policies be properly documented. These cannot be informally understood.

Ultimately, the lending policy builds the bank’s loan portfolio. This portfolio should reflect the market demand for loans, the bank’s business and risk strategy, and its ability to extend credit. Periodic reviews of the loan portfolio should include a random sample covering:

- at least 75% of the total loan portfolio by dollar amount,
- at least 30% of the number of loans,
- at least 50% of the number of all foreign loans, and
- all loans with a maturity greater than one year.

Additionally, loan portfolio reviews should include the following:

- All loans to single clients whose aggregate exposure for the bank exceeds 5% of bank capital
- All loans to related parties and shareholders
- All loans whose terms have been altered since loan inception
- All loans that are delinquent beyond 30 days
- All loans classified as substandard, doubtful, or loss (discussed in the next section)

Each individual loan review should include detailed documentation about the customer, the loan terms, the use of funds, the structure of any collateral, any noted delinquencies, descriptions of the borrower’s financial condition, and an itemization of any monitoring efforts conducted. If the amount borrowed exceeds 5% of the bank’s capital, then consideration is given to the associated business plan and debt service capacity. This review should be conducted with input from the assigned credit loan officer.

Risk managers should also periodically review the bank’s policy for loan loss allowances. This review should include the following:

- A survey of the existing policy for allowances
- An overview of the asset classification process
- An assessment of the current risk factors that may lead to losses; the focus should be on the current factors that are different from historical ones
- A trend analysis of historical losses

- A statement of the adequacy of the current policy

Interbank deposits and off-balance-sheet commitments should also be considered with respect to credit risk.

Credit Asset Classification

LO 19.d: Discuss factors that should be considered during the credit asset classification process.

Asset classification is the process of assigning bank assets to credit risk grades based on their likelihood of repayment. This is a key tool in credit risk management. Assets should be classified at loan origination and periodically reviewed and reclassified as needed. Review should consider the client's financial condition, loan service performance, economic trends, and any relevant changes in the markets. Regulators breakdown asset classification into the following five categories:

1. *Standard (i.e., pass)*. This label is applied when delinquency is not in question. Loans that are fully secured with cash or cash equivalents (e.g., certificates of deposit) generally maintain this label regardless of other unfavorable credit factors.
2. *Specially mentioned (i.e., watch)*. This category involves assets with potential weaknesses that could impact the borrower's ability to repay. The reasons for this expected weakness are varied.
3. *Substandard*. Loans with well-defined credit weakness that could jeopardize repayment are categorized here. Often, the primary source of repayment has failed, and the bank is already looking to secondary sources (e.g., collateral). Nonperforming loans that have been delinquent for over 90 days are typically categorized as substandard. Some renegotiated loans end up here if interest payments were delinquent before the renegotiation deal materialized. Renegotiated loans can be promoted out of this ranking once sustained performance has been achieved.
4. *Doubtful*. These assets have the same concerns as substandard assets, but the expectation of loss is more pronounced. Nonperforming loans that are over 180 days delinquent will be categorized here unless they are sufficiently secured. There is still some hope for repayment with these assets.
5. *Loss*. When delinquency is relatively certain, a bank should reclassify the loan as a loss. This categorization does not mean that the probability of collection is zero. However, it does mean that it is not practical to delay the write-off process any further. Nonperforming loans that are over one year delinquent will be categorized here unless they are sufficiently secured.

On a very basic level, "nonperforming loans" do not generate any income for the lender (i.e., bank). This term is typically applied when there are no interest or principal payments after 90 days. However, asset classification is about more than just the receipt of payments. It branches into the consideration of the borrower's cash flows

and the expected ability to repay (even with moderate delay). Analysis of nonperforming loans should include the following considerations:

- *Age.* This is how long delinquency has existed (e.g., 30 days, 90 days, 180 days, one year).
- *Reasons.* As with any trouble spot, it is helpful to understand why the trouble is present (i.e., the root cause). It is possible that the bank could help get the borrower back on track.
- *Case-by-case assessment.* Each individual delinquency case should be reviewed, not just in aggregate. Incremental improvements may be possible.
- *Set provision levels.* The bank needs to set thresholds for each classification with consideration of the bank's overall stability.



MODULE QUIZ 19.1

1. Within their credit risk management plan, banks are either required to include, or at least should strongly consider including, a:
 - A. classification of risks organized by collectability.
 - B. loan loss provisions equal to at least 8% of their loan portfolio.
 - C. duration target for the bank's portfolio that is not higher than 10.
 - D. rigid set of policies designed to address every possible risk source.
2. A risk analyst is reviewing his bank's credit risk management policies. He notes that banks have limits on related-party financing decisions. His colleague agrees and correctly adds that:
 - A. the term *single client* only refers to a legal person.
 - B. all banks have a limit of 10% of capital for a single client.
 - C. loan collateral should be included in exposure sizing using mark-to-market principles.
 - D. acceptances and letters of credit should be factored into the risk exposure of a single client.
3. A regional bank wants to decrease risk in their lending practices. They are considering several lending policy changes. Which of the following items should be included in this new risk-reduction-focused direction?
 - A. All loans should have a maximum maturity schedule of 10 years.
 - B. The Board should approve all individual delinquency workout plans.
 - C. Financial projections from business clients should match the maturity of their loan.
 - D. Credit officers should have the flexibility to extend any type of credit that a customer needs as long as they find it to be a reasonable risk for the bank.
4. Three and a half months ago, XYZ Manufacturing lost their single largest customer, and the company stopped service of all debt payments to ABC Bank. The bank has seized some collateral, but they are working with XYZ as they form plans to find new customers and build a better future. For now, the loans to XYZ Manufacturing should most likely be classified as:
 - A. loss.
 - B. doubtful.
 - C. substandard.

D. specially mentioned.

MODULE 19.2: LOAN LOSS PROVISIONING AND CREDIT RISK ASSESSMENT

Loan Loss Provisions and Reserves

LO 19.e: Describe and explain loan loss provisions and loan loss reserves.

The asset classification process enables banks to form **loan loss provisions**, which are resources set aside to offset potential losses in the future. **Loan loss reserves** are accumulated loan loss provisions, over multiple years, that are recorded on the bank's financial statements. Loan loss provisions and reserves are both normally counted as Tier 2 capital. When determining an appropriate reserve, banks should consider the following items:

- Credit quality policies and procedures
- Previous loss exposures
- Growth in the loan book
- Quality of management in charge of lending
- Loan collection and recovery policies
- Changes in the economic environment and business conditions

Expected Loss vs. Unexpected Loss

LO 19.f: Identify and explain the components of expected loss and distinguish between expected loss and unexpected loss.

In the context of loan loss scenarios, **expected loss (EL)** is the anticipated dollar loss if a borrower defaults. This is essentially quantitatively measuring counterparty risk. To fully understand the drivers of expected loss, it is important to understand the three components of EL:

1. **Probability of default (PD).** PD is the likelihood that a specific borrower will fail to make timely payments (i.e., interest and principal) on their loan. Factors contributing to PD are observations from historically similar customers, observed degradation on credit default swaps, information from credit rating agencies, and personalized credit scores for each customer. This measure considers *who* the bank has lent money to.
2. **Loss given default (LGD).** LGD is expressed as a percentage of the capital at risk in the event of a default. In other words, this is the expected percentage loss of the amount borrowed in the event of a default. This measure considers *what product* was used for the credit risk.
3. **Exposure at default (EAD).** EAD is an estimate of the dollar loss exposure of a bank when a borrower defaults. This measure considers *how long* it has been since the

loan was initiated.

Expected loss is computed as follows:

$$\text{EL}(\$) = \text{PD}(\%) \times \text{LGD}(\%) \times \text{EAD}(\$)$$

Figure 19.1 illustrates the application of EL for three different borrowers.

Figure 19.1: Expected Loss Components

Borrower	Rating	Loan	PD	LGD	EAD	EL
1	AAA	\$1,000,000	0.09%	30.0%	\$550,000	\$148.50
2	B+	\$1,000,000	3.78%	45.0%	\$785,000	\$13,352.85
3	D (defaulted)	\$1,000,000	100.00%	100.0%	\$1,000,000	\$1,000,000

In a very simplistic way, an **unexpected loss** is a loss that was not captured by the expected loss formula. This type of loss is typically thought of as a tail risk event (i.e., 99th percentile event).

Expected Loss Under IFRS 9

LO 19.g: Explain the requirements for estimating expected loss under IFRS 9.

Before 2018, International Accounting Standard (IAS) 39 required an incurred loss model. Beginning January 1, 2018, International Financial Reporting Standards (IFRS) 9 has switched the requirement to a three-stage expected loss model:

- *Stage 1.* All performing assets (i.e., no delinquency) should have provisions for expected loss calculated using a *12-month* expected loss methodology. This analysis should include effective interest based on the *gross* amount.
- *Stage 2.* Assets with any level of delinquency should use a *lifetime* expected loss model including effective interest based on the *gross* amount.
- *Stage 3.* Nonperforming assets should also use a *lifetime* expected loss model including effective interest based on the *net (carrying)* amount.

Managing Loss Assets

LO 19.h: Describe a workout procedure for loss assets and compare the following two approaches used to manage loss assets: retaining loss assets and writing off loss assets.

The **loan workout procedure** is a very important part of reducing risk for a bank. It is helpful to review historical attempts to collect and the success rate. Each borrower should be considered independently. A common workout procedure may include the following four steps that can be applied in any order:

1. Reduce the bank's credit risk exposure by collecting additional capital, collateral, or guarantees.

2. Work with the borrower to identify areas for potential improvement (e.g., providing advice, developing a plan to reduce costs and increase earnings, selling assets, or restructuring the loan). This option borders on consulting.
3. Introduce a third-party as a possible joint-venture partner or a takeover.
4. Liquidation through out-of-court settlement. This could involve foreclosure, liquidating collateral, or calling on guarantees.

From the perspective of a bank's balance sheet, there are two ways to address loss assets. They are (1) retaining loss assets and (2) writing off loss asset. Retention is common among firms that follow the British tradition. The idea is to allow time for collection attempts to be tried. The retention method will cause the loss reserve on the balance sheet to appear larger. Writing off the loss is common among firms that follow the U.S. model. This model will immediately write off any losses, which removes them from the loan loss reserves account on the balance sheet. This method will make reserves appear smaller in relation to the size of the loan portfolio.

Credit Risk Analysis

LO 19.i: Explain the components of credit risk analysis.

Credit risk analysis should evaluate which lending products are being used, who are the customers, and for how long is money being lent. This analysis should consider the following components:

- A summary of major loan types including details like the number of customers, the average maturity, and the average interest rate charged
- The distribution of the loan portfolio including the number of loans, the amount lent, and segmentation information (e.g., currencies involved, short-term vs. long-term maturities, and represented economic sectors); it is also important to identify the category of borrower (e.g., state-owned, private borrowers, corporations, and retail customers)
- A list of all loans with guarantees from governmental bodies or other entities
- A thorough review of loans by risk classification
- An analysis of nonperforming loans with reference to the associated vintage year

Credit Risk Management Capacity

LO 19.j: Explain the components of credit risk management capacity, and outline key questions that the board of directors of a bank should ask.

The Board of Directors is ultimately responsible for the credit risk management capacity at a bank. Their high-level lending objectives are to make sound loans that are collectible, make profitable loans that benefit shareholders and protect depositors, and meet the legitimate lending needs of society.

Credit risk management capacity reviews should include the following:

- *Lending process.* The lending process should be well organized with clear policies. The key objective is to make loans with an acceptable risk level when compared to the expected returns. This review should cover the origination, appraisal, approval, monitoring, and collection procedures deployed. The volume of credit applications appraised versus approved should be considered for the previous 6–12 months. This review should involve an interview with all midlevel managers, and it should include the following:
 - Sample loan applications, internal credit summary forms, loan files, and internal credit manuals
 - The criteria for loan approval
 - Lending limits at the various levels of bank management
 - The collateral review process including revaluations
 - The people responsible for loan administration and monitoring, including compliance and controls
 - The process for handling exceptions
- *Staffing.* The staff involved in credit origination, appraisal, supervision, and credit risk monitoring should be listed. Information needed includes the number of staff, their ages, their experience (i.e., qualifications), and specific responsibilities. An essential component of this portion of the review is to detail all staff training including frequency and adequacy assessments.
- *Information flows.* Lending information is spread all over a bank. Part of the necessary review is to understand how information makes its way to senior managers, to the Board, and specifically to the risk committee. This information should flow in a timely manner. Is the information accessible? Is the information high quality? Is the information cost effective?

With respect to credit risk management, the Board of Directors should be asking the following:

- Are the bank's loans and deposits priced competitively?
- Are the sources of interest income well diversified?
- How secure is the income from the loan portfolio?
- Do investment returns reflect the level of risk taken?
- Can the bank's liquidity position survive stressed scenarios?
- Which internal rating models are used by the bank?
- Are PD, LGD, and EAD estimates historically accurate?
- How does the bank treat delinquent loans?
- How frequently is the loan portfolio stress tested?
- Are all concentration risks adequately disclosed?
- Does the bank have the required information (e.g., exposure trends, concentration trends, loss provisions, limits and breaches, impairment charges, delinquency trends, and stress testing results)?



MODULE QUIZ 19.2

1. Two senior credit managers are reviewing their bank's loan loss reserve procedures. Which of the following elements is most important when determining the appropriate level of reserves?
 - A. Current loan loss reserves.
 - B. The bank's experience with previous losses.
 - C. The current number of nonperforming loans in aggregate.
 - D. A list of all loans that are delinquent for more than 180 days.
2. Which of the following components of expected loss considers the product that was used for the loan?
 - A. Unexpected loss.
 - B. Loss given default.
 - C. Exposure at default.
 - D. Probability of default.
3. A bank's loan asset is considered delinquent, but not yet nonperforming. There is a short-term macroeconomic event that is temporarily preventing repayment. According to IFRS 9, which "stage" is required for this specific loan?
 - A. Stage 1.
 - B. Stage 2.
 - C. Stage 3.
 - D. Stage 4.
4. A financial analyst for ABC Bank notices that loan loss reserves are fairly small relative to the size of the bank's loan portfolio. He tells his coworker that this is a red flag for him. However, his coworker tells him that there could be an easy explanation that could be cleared up by asking management. The coworker is suggesting that ABC Bank could be following the:
 - A. British model and using the retention model for addressing loss assets.
 - B. U.S. model and using the write-down model for addressing loss assets.
 - C. U.S. model and providing internal consulting to help the borrower enhance their ability to pay.
 - D. U.S. model and allowing more time for collection efforts or collateral enhancement to work out.
5. Portfolio-level credit risk analysis should include:
 - A. customer segmentation data.
 - B. current macroeconomic conditions.
 - C. commentary from the credit risk officer.
 - D. details on the bank's interest rate hedging policy.
6. The credit risk management capacity review process should include:
 - A. staff diversity metrics.
 - B. information available to credit loan officers.
 - C. a list of all loans denied in the last three months.
 - D. timeliness of information flows from loan officers to the Board.

KEY CONCEPTS

LO 19.a

Credit risk (i.e., counterparty risk) is critical for banks to consider because it is a leading cause of bank failures. Banks should have formal policies in place to identify credit risks and determine how they will be managed and classified. Flexibility to adapt to changing credit or market conditions is critical. Regulators impose a series of minimum standards that are focused on limiting or reducing credit risk, classifying assets according to collectability, and establishing adequate loan loss provisions.

LO 19.b

When considering credit risk exposure, regulators are concerned with concentration risk and related-party risk. Concentration risk relates to excessive exposure to a single client, while related-party issues are concerned with potentially extending credit to someone who does not comply with the bank's risk management policies and extending terms that are more favorable than market norms. Limits are (or should be) imposed for both concentration risk and related-party financing risk.

LO 19.c

There are many factors to consider for reducing risks in a bank's lending policy. They include lending authority, types and distributions of loans, the appraisal process, loan pricing, maturities, exposure to geographic or economic concentrations, the availability of current financial information, collections monitoring, limits on total loans outstanding, a maximum ratio of loans to market value of pledged securities, impairment recognition methods, and having written internal documentation detailing all policies. The loan portfolio needs to be periodically reviewed, and there should be a formal process for assessing loan loss allowances.

LO 19.d

Asset classification is beneficial for managing a bank's credit risk. Nonperforming loans need to be identified and possible solutions for each scenario need to be considered. The bank should then set thresholds for each category. The categories include standard (or pass), specially mentioned (or watch), substandard, doubtful, and loss. This spectrum moves from healthy borrowers to those in a small to moderate amount of trouble to those estimated to be in default.

LO 19.e

Loan loss provisions account for the estimated losses for a bank. Loan loss reserves are accumulated provisions on the bank's balance sheet. Loan loss provisions and reserves should consider the economic and business conditions, the bank's own credit policies, the experience level of management in charge of the lending process, previous realized losses, loan growth, and the bank's collection and recovery processes.

LO 19.f

Expected loss is a calculated estimate of loss in the event of a default. It is the product of the probability of default, the loss given default, and the exposure at default. Unexpected loss is any realized loss that is not captured by expected loss modeling.

LO 19.g

IFRS 9 established a new standard for reporting loss effective January 1, 2018. There are three stages used for reporting guidance. If the assets are performing, then use a 12-month expected loss model with effective interest calculated based on the gross amount. If the assets have any level of delinquency, then use a lifetime expected loss model with effective interest calculated based on the gross amount. If the assets are nonperforming, then use a lifetime expected loss model with effective interest calculated based on the net amount.

LO 19.h

The loan workout process is important for a bank to formalize. There are four steps that can be applied in any order. They include (1) collecting additional capital, collateral, or guarantees, (2) consulting with the borrower on ways to improve operations to enable repayment, (3) brokering a takeover or joint-venture partner to enable repayment, or (4) liquidation through an out-of-court settlement.

From the perspective of loan loss reserves on the balance sheet, management can choose two primary methods. The first is retaining the loss assets in the reserves to allow time for collection efforts to work out. The second is to immediately write off the loss asset. The first option will make loan loss reserves on the balance sheet appear much larger than writing off the loss (relative to the size of the loan book).

LO 19.i

Credit risk analysis should consider which lending products are being used, who are the customers, and for how long they are borrowing money. Portfolio-level analysis should include a summary of loan types, a distribution of the key segments of customers, a list of all loans with guarantees, a review of loans by risk classification, and an analysis of nonperforming loans by vintage year.

LO 19.j

Credit risk management capacity reviews should consider the lending process, the bank's staffing, and its flow of information. The end goal of information flow analysis is to make sure that senior managers and the Board have the information they need in a timely manner.

ANSWER KEY FOR MODULE QUIZZES**Module Quiz 19.1**

1. A All banks should have a well-developed series of policies to manage credit risk exposures. Policies should include recognizing and managing known risks. They need to be flexible to adapt to changing conditions. While regulators like to see established loan loss provisions and risk parameters, the specific targets are at the discretion of each bank because risk exposures are unique. (LO 19.a)
2. D Credit risk management should consider both related-party financing and concentration limits. The concern with a related-party transaction is either that a

credit decision may be biased, or the loan terms may be more favorable than market norms. Concentration limits should be imposed to protect against overexposure to single client, region, or sector of the economy. Alternative credit (e.g., acceptances, lines of credit, guarantees, etc.) should be factored in as well, but collateral should not be considered when sizing risk exposures. (LO 19.b)

3. **C** Some lending policy practices that reduce risk are matching the length of financial projections to loan maturities, only offering loans that match the bank's targeted products, matching maturity to the type of loan and the source of funds for repayment, and having a formal delinquency workout policy. The Board should be aware of delinquency issues, but they do not need to approve each individual workout plan when a solid policy is in place. (LO 19.c)
4. **C** XYZ Manufacturing is approximately 105 days delinquent on debt service payments. ABC Bank has begun to access secondary sources of capital (i.e., collateral), but XYZ has hope for repayment. There is a path for them to move forward. A renegotiation may be needed down the line, but for now, this loan should be classified as "substandard." They are not as severe as "doubtful" or "loss," and they are a bigger concern than merely being classified as "specially mentioned." (LO 19.d)

Module Quiz 19.2

1. **B** It is important to include the bank's previous experience with loan losses. Loss provisions should not be biased by the number of aggregate losses already on the books (i.e., reserves). Loss provisioning needs to consider the bank's policies at a high level and not focus on classification issues (i.e., the number of days delinquent). If they did factor delinquency, then 180 days is too long. (LO 19.e)
2. **B** The component of expected loss that considers which loan product was used is loss given default (LGD). The probability of default (PD) considers which client is associated with the loan while the exposure at default (EAD) considers how long the loan has been outstanding. (LO 19.f)
3. **B** IFRS 9 requires three stages of reporting. Stage 1 is for performing assets. They can apply a 12-month expected loss methodology using effective interest computed based on the gross amount. Stage 2 is for assets with some level of delinquency. They can apply a lifetime expected loss methodology using effective interest computed based on the gross amount. Stage 3 is for nonperforming assets. They can apply a lifetime expected loss methodology using effective interest computed based on the net amount. (LO 19.g)
4. **B** The U.S. model involves immediate write-down. This method allows for the option of repayment but treats it as unlikely. It will make the loan loss reserves appear smaller on the balance sheet. The British model uses retention of loss assets, which will make the loan loss reserves appear much larger on the balance sheet than the write-off model. While loss assets are retained on the balance sheet, managers give more attention to loss workout options. (LO 19.h)

5. A Portfolio-level credit risk analysis should include a summary of major loan types, customer segmentation data, a list of loans with guarantees, a review of loans by risk classification, and an analysis of nonperforming loans. Because this is a portfolio-level analysis, credit officer commentary is not needed. (LO 19.i)
6. D The credit risk management capacity review process should include the lending process, staffing, and information flow concerns. Census data should be gathered on staff including the number of people in the risk management function, their ages, their experience, and their specific responsibilities. Diversity metrics may be captured by human resources but not in this review. Within the lending process, it is useful to understand credit applications relative to approvals over the last 6–12 months. The key part of information flow analysis is to understand if accurate, timely, and cost-effective data is making its way to the senior managers and the Board. (LO 19.j)

The following is a review of the Credit Risk Measurement and Management principles designed to address the learning objectives set forth by GARP®. Cross-reference to GARP assigned reading—Schroock, Chapter 5.

READING 20

CAPITAL STRUCTURE IN BANKS

Study Session 4

EXAM FOCUS

This reading discusses a bottom-up approach to calculating economic capital for credit risk and issues related to that approach. Since a bank holds many assets, we need to examine the expected and unexpected loss in a portfolio setting. The portfolio expected loss is the sum of the individual expected losses; however, portfolio unexpected loss is significantly less than the sum of individual unexpected losses due to diversification effects. We will derive an expression for unexpected loss equal to a fraction of the exposure amount. As you will see, default and credit migration increase the unexpected loss of a risky asset (i.e., a loan). For the exam, be familiar with the calculations of expected loss, unexpected loss, and the risk contribution of each asset in a portfolio. Also, know that economic capital is used to cover unexpected losses.

MODULE 20.1: EXPECTED AND UNEXPECTED LOSS

Credit Risk Factors

LO 20.b: Identify and describe important factors used to calculate economic capital for credit risk: probability of default, exposure, and loss rate.

The **probability of default (PD)**, also referred to as expected default frequency (EDF), is the likelihood that a borrower will default; however, this measure is not necessarily the creditor's greatest concern. A borrower may briefly default and then quickly correct the situation by making a payment or paying interest charges or penalties for missed payments. Creditors must rely on other measures of risk in addition to PD.

The **exposure amount (EA)**, also referred to as exposure at default (EAD), is the loss exposure stated as a dollar amount (e.g., the loan balance outstanding). EA can also be stated as a percentage of the nominal amount of the loan or the maximum amount available on a credit line.

The **loss rate (LR)**, also referred to as loss given default (LGD), represents the likely percentage loss if the borrower defaults. The severity of a default is equally as

important to the creditor as the likelihood that the default would occur in the first place. If the default is brief and the creditor suffers no loss as a result, it is less of a concern than if the default is permanent and the creditor suffers significant losses. Both PD and LR are expressed as percentages. Note that, by definition, $LR = 1 - \text{recovery rate (RR)}$. Therefore, the factors that affect the loss rate will also impact the recovery rate.

Expected Loss

LO 20.c: Define and calculate expected loss (EL).

Expected loss (EL) is defined as the anticipated deterioration in the value of a risky asset that the bank has taken onto its balance sheet. EL is calculated as the product of EA, PD, and LR:

$$EL = EA \times PD \times LR$$

This expected loss equation describes the average behavior of a risky asset. Over time, the value of the asset will fluctuate above and below its average level. At maturity, in most cases the asset will not have defaulted; however, a fraction of the time default will occur bringing a significant decrease in value. The EL measure does not capture the variation in the risky asset's value. This variation is referred to as *unexpected loss*.

The unanticipated loss on the risky asset can arise from the incidence of default or credit migration. Default is a positive probability event for even the safest of borrowers. Banks can estimate the likelihood of default using historical data, the method employed by rating agencies. On the other hand, default can be estimated using models based on the "option" view of the firm such as the Merton model (discussed in the next two readings). This approach views the firm as holding a call option with a strike price equal to the value of the outstanding debt. If the value of the firm is less than the value of its debt obligations, the firm will default.

Credit migration denotes the possible deterioration in creditworthiness of the borrower. While a shift in migration may not result in immediate default, the probability of such an event increases. It is also possible for the reverse to occur, that is, the credit quality of the obligor improves over time.

Unexpected Loss

LO 20.d: Define and calculate unexpected loss (UL).

LO 20.e: Estimate the variance of default probability assuming a binomial distribution.

As mentioned, **unexpected loss (UL)** represents the variation in expected loss. The observation that the unexpected loss represents the variability of potential losses can be modeled using the typical definition of standard deviation. If UL_H denotes the unexpected loss at the horizon for asset value V_H , then:

$$UL_H \equiv \sqrt{\text{var}(V_H)}$$

In the following equation, the subscript H will be dropped but be aware that we are focused on the horizon date, H. After some algebra, we derive the following expression:

$$UL = EA \times \sqrt{PD \times \sigma_{LR}^2 + LR^2 \times \sigma_{PD}^2}$$

Since we assume a two-state model, the variance of PD is simply the variance of a binomial random variable:

$$\sigma_{PD}^2 = PD \times (1 - PD)$$

Further note, the EA term explicitly recognizes that only the risky portion of the asset is subject to default.



PROFESSOR'S NOTE

Do not lose sight of the big picture here. We are merely applying the basic definition for standard deviation based on the terminal value of the risky asset on the horizon date.

It is also worthwhile to examine the multiplier (square root term) in more detail. Notice that each term is at most equal to one so the UL is a fraction of the exposure amount. In addition, in the extreme case where the default ($\sigma_{PD}^2 = 0$) and recovery ($\sigma_{LR}^2 = 0$) are known with certainty, the unexpected loss equals zero, which confirms that the EL is constant and also known with certainty.

EXAMPLE: Computing expected and unexpected loss

Suppose XYZ Bank has booked a loan with the following characteristics: total commitment of \$2,000,000 of which \$1,800,000 is currently outstanding. The bank has assessed an internal credit rating equivalent to a 1% default probability over the next year. The bank has additionally estimated a 40% loss rate if the borrower defaults. The standard deviation of PD and LR is 10% and 30%, respectively.

Calculate the expected and unexpected loss for XYZ Bank.

Answer:

We can calculate the expected and unexpected loss as follows:

$$EL = EA \times PD \times LR$$

Exposure amount = \$1,800,000

Probability of default = 1%

Loss rate = 40%

$$EL = \$1,800,000 \times 0.01 \times 0.40 = \$7,200$$

$$UL = EA \times \sqrt{PD \times \sigma_{LR}^2 + LR^2 \times \sigma_{PD}^2}$$

$$UL = \$1,800,000 \times \sqrt{0.01 \times 0.3^2 + 0.4^2 \times 0.1^2} = \$90,000$$

The unexpected loss represents 5% of the exposure amount: (\$90,000 / \$1,800,000).

Portfolio Expected and Unexpected Loss

LO 20.f: Calculate UL for a credit asset portfolio and the UL contribution of each asset under various scenarios of portfolio composition, asset characteristics and size.

As mentioned previously, expected loss on the portfolio, EL_p , is the sum of the expected losses of each asset:

$$EL_p = \sum_i EL_i = \sum_i (EA_i \times LR_i \times PD_i)$$

The calculation of portfolio unexpected loss (UL_p) is more complicated from the cross-terms in the variance formula for an N-asset portfolio:

$$UL_p = \sqrt{\sum_i \sum_j \rho_{ij} UL_i UL_j}$$

where each individual unexpected loss follows the unexpected loss equation discussed previously. In the special case where each $\rho_{ij} = 1$ for $i \neq j$, $UL_p = \text{sum of individual unexpected losses}$. In most cases, UL_p will be significantly less than the sum of individual UL_i .

This equation demonstrates that the risk of the portfolio is much less than the sum of the individual risk levels and illustrates that each asset contributes to only a portion of its unexpected loss in the portfolio. This effect is captured by the partial derivative of UL_p with respect to UL_i . Hence, the **risk contribution (RC)**, also known as the **unexpected loss contribution (ULC)**, is defined as:

$$RC_i = UL_i \frac{\partial UL_p}{\partial UL_i}$$

After differentiation, we see that:

$$RC_i = \frac{UL_i \sum_j UL_j \rho_{ij}}{UL_p}$$

Thus, RC_i isolates the incremental risk of adding asset i to the existing portfolio.

For a two-asset portfolio, the risk contributions of each asset are calculated as follows:

$$RC_1 = UL_1 \times \frac{UL_1 + (\rho_{1,2} \times UL_2)}{UL_p}$$

$$RC_2 = UL_2 \times \frac{UL_2 + (\rho_{1,2} \times UL_1)}{UL_p}$$

Together, the two risk contributions will equal the unexpected loss on the portfolio (i.e., $RC_1 + RC_2 = UL_p$).



PROFESSOR'S NOTE

We will demonstrate the calculation of risk contribution shortly.

Diversifiable and Undiversifiable Risk

An asset held in isolation bears both diversifiable (firm-specific) and undiversifiable (market) risk. In a portfolio context, the diversifiable risk is reduced effectively to zero in a large portfolio as the asset-specific risks, both good and bad, cancel each other out. On the other hand, undiversifiable risk is the residual credit risk (i.e., risk contribution) that cannot be diversified away.

The Effect of Correlation

The correlation between bank assets is critical to measuring the potential portfolio loss. Intuitively, as the correlation between assets increases, the bank suffers from **concentration risk**. In this scenario, default on one asset (due to, say, industry effects) spills over to other assets, exacerbating the problem.

It is, therefore, important to have reliable estimates of default correlations. Unfortunately, the practical implementation of this basic concept is challenging for two reasons. First, it is extremely difficult to assess the default correlation between unrelated obligors. Second, even if we were confident in our estimates, the sheer number of necessary calculations is unmanageable. For example, in a portfolio of only 20 assets, 190 correlation pairs are computed; in a portfolio of 100 assets, 4,950 pairs are computed {i.e., $[n \times (n - 1)] / 2$ covariances}.

The following numerical example highlights the impact of the correlation coefficient on expected and unexpected loss. Note the lengthy process based only on a two-asset portfolio.

EXAMPLE: Computing portfolio expected and unexpected loss

Bigger Bank has two assets outstanding. The features of the loans are summarized in Figure 20.1. Assuming a correlation of 0.3 between the assets, compute EL_p and UL_p as well as the risk contribution of each asset.

Figure 20.1: Loan Features

	Asset A	Asset B
EA	\$8,250,000	\$1,800,000
PD	0.50%	1.00%
LR	50.00%	40.00%
σ_{PD}	7.05%	10%
σ_{LR}	25.00%	30.00%

Answer:

Step 1: Compute EL for both assets.

$$\begin{aligned} \text{EL}_A &= EA \times PD \times LR \\ &= \$8,250,000 \times 0.005 \times 0.50 \\ &= \$20,625 \end{aligned}$$

$$\begin{aligned} \text{EL}_B &= EA \times PD \times LR \\ &= \$1,800,000 \times 0.01 \times 0.40 \\ &= \$7,200 \end{aligned}$$

Step 2: Compute UL for both assets.

$$\begin{aligned} \text{UL} &= EA \sqrt{PD \times \sigma_{LR}^2 + LR^2 \times \sigma_{PD}^2} \\ \text{UL}_A &= \$8,250,000 \times \sqrt{0.005 \times 0.25^2 + 0.5^2 \times 0.0705^2} = \$325,333 \\ \text{UL}_B &= \$1,800,000 \times \sqrt{0.01 \times 0.3^2 + 0.4^2 \times 0.1^2} = \$90,000 \end{aligned}$$

Step 3: Compute EL_P .

$$\begin{aligned} \text{EL}_P &= \$20,625 + \$7,200 \\ &= \$27,825 \end{aligned}$$

Step 4: Compute UL_P .

$$\begin{aligned} \text{UL}_P &= \sqrt{(325,333)^2 + (90,000)^2 + (2)(0.3)(325,333)(90,000)} \\ &= \$362,642 \end{aligned}$$

Step 5: Compute RC for both assets.

$$\text{RC}_A = (325,333) \frac{(325,333 + 0.3 \times 90,000)}{362,642} = 316,084$$

$$\text{RC}_B = (90,000) \frac{(90,000 + 0.3 \times 325,333)}{362,642} = 46,558$$

$$\text{RC}_A + \text{RC}_B = \$362,642 = \text{UL}_P$$

EXAMPLE: Computing portfolio expected and unexpected loss

Using the information provided in the previous example and assuming the correlation between the assets has decreased to 0.1, compute EL_P and UL_P .

Answer:

$$\text{EL}_P = \$27,825$$

$$\text{UL}_P = \sqrt{(325,333)^2 + (90,000)^2 + (2)(0.1)(325,333)(90,000)} = \$346,118$$

Because correlation does not impact each asset individually, the expected loss on the portfolio remains the same. However, the unexpected loss (variation) has decreased to \$346,118.

**MODULE QUIZ 20.1**

- XYZ Bank is trying to forecast the expected loss on a loan to a mid-size corporate borrower. It determines that there will be a 75% loss if the borrower does not perform the financial obligation. This risk measure is the:

- A. probability of default.
 B. loss rate.
 C. unexpected loss.
 D. exposure amount.
2. Which of the following statements about expected loss (EL) and unexpected loss (UL) is true?
 A. Expected loss always exceeds unexpected loss.
 B. Unexpected loss always exceeds expected loss.
 C. EL and UL are parameterized by the exact same set of variables.
 D. Expected loss is directly related to exposure.
3. If the recovery rate (RR) increases and the probability of default (PD) decreases, what will be the effect on expected loss (EL), all else equal?
- | | |
|--------------------|--------------------|
| <u>RR increase</u> | <u>PD decrease</u> |
| A. Increase | Increase |
| B. Decrease | Increase |
| C. Increase | Decrease |
| D. Decrease | Decrease |
4. Big Bank has contractually agreed to a \$20,000,000 credit facility with Upstart Corp., of which \$18,000,000 is currently outstanding. Upstart has very little collateral, so Big Bank estimates a one-year probability of default of 2%. The collateral is unique to its industry with limited resale opportunities, so Big Bank assigns an 80% loss rate. The expected loss (EL) for Big Bank is closest to:
 A. \$68,000.
 B. \$72,000.
 C. \$272,000.
 D. \$288,000.
5. Bigger Bank has two assets outstanding. The features of the loans are summarized in the following table. Assuming a correlation of 0.2 between the assets, what is the value of the unexpected loss of the portfolio (UL_p)?

	Asset A	Asset B
Exposure	\$5,100,000	\$3,600,000
PD	2.00%	1.00%
LR	50.00%	40.00%
σ_{PD}	14%	10%
σ_{LR}	25.00%	20.00%

- A. Less than \$300,000.
 B. Between \$300,000 and \$400,000.
 C. Between \$400,000 and \$500,000.
 D. Greater than \$500,000.

MODULE 20.2: ECONOMIC CAPITAL FOR CREDIT

RISK

LO 20.a: Evaluate a bank's economic capital relative to its level of credit risk.

LO 20.g: Describe how economic capital is derived.

The best estimate of the devaluation of a risky asset is expected loss. However, as previous examples illustrate, the unexpected loss can exceed the expected loss by a wide margin. If the bank holds inadequate reserves, there is a possibility the bank will become impaired. Therefore, it is imperative that the bank hold capital reserves to buffer itself from unexpected losses so it can absorb large losses and continue to operate.

Banks set aside credit reserves in preparation for expected losses. However, for unexpected losses, banks need to estimate the excess capital reserves needed to cover any unexpected losses. The excess capital needed to match the bank's estimate of unexpected loss is referred to as **economic capital**.

The amount of economic capital needed to absorb credit losses is the distance between the unexpected (negative) outcome and the expected outcome for a given confidence level. By knowing the shape of the loss distribution, EL_p , and UL_p , the difference between the expected outcome and the confidence level (typically 99.97%) can be estimated. This difference can then be represented as a multiple of portfolio unexpected loss, which is often referred to as the capital multiplier (CM). With this multiplier, economic capital for the portfolio can be derived as:

$$\text{economic capital}_p = UL_p \times CM$$

Modeling Credit Risk

LO 20.h: Explain how the credit loss distribution is modeled.

When estimating economic capital for credit risk, we are largely concerned with the tail of the chosen loss distribution. Credit risks are not normally distributed and tend to be highly skewed, because maximum gains are limited to receiving promised payments while extreme losses are very rare events. Therefore, in practice, a beta distribution is commonly applied in credit risk modeling. The mass of the beta distribution is located between zero and one, so when modeling credit events, losses are defined between 0% and 100%. This distribution is extremely flexible, and can be symmetric or skewed depending on the values of its shape parameters (i.e., β and α). When these shape parameters are equal, the distribution will be symmetric and its mean and variance will be characterized as EL_p and UL_p , respectively. The tail of the credit loss distribution, however, is more difficult to model. In practice, fitting the tail often involves combining the beta distribution with a Monte Carlo simulation.

LO 20.i: Describe challenges to quantifying credit risk.

The bottom-up risk measurement framework that attempts to quantify credit risk has several limitations:

1. Credits are presumed to be illiquid assets. With a bottom-up approach, credit losses are measured by their risk contribution to the credit portfolio and are not influenced by the correlation among risk factors as they are in liquid markets.
2. Credit risk models used in practice only use a one-year estimation horizon. Ideally, credit risk models should incorporate unexpected and expected changes in credit quality of borrowers that occur over several years; however, in practice, this approach is very difficult.
3. Other risk components (such as operational risk and market risk) are separated from credit risk and, thus, managed and measured in different departments within the bank.



MODULE QUIZ 20.2

1. The type of capital used to buffer a bank from unexpected losses is known as:
 - A. economic capital.
 - B. regulatory capital.
 - C. unexpected capital.
 - D. risk-adjusted capital.

KEY CONCEPTS

LO 20.a

A bank must hold capital reserves (i.e., economic capital) to buffer itself from unexpected losses so it can absorb large losses and continue to operate.

LO 20.b

Current measures used to evaluate credit risk are:

- The probability of default (PD), which is the likelihood that a borrower will default.
- The loss rate (LR), which represents the likely percentage loss if the borrower defaults.
- Exposure amount (EA), which can be stated as a dollar amount (e.g., the loan balance outstanding) or as a percentage of the nominal amount of the loan or the maximum amount available on a credit line.

LO 20.c

Expected loss is the product of exposure amount (EA), probability of default (PD), and loss rate (LR):

$$EL = EA \times PD \times LR$$

LO 20.d

Unexpected loss represents the variation in expected loss:

$$UL = EA \times \sqrt{PD \times \sigma_{LR}^2 + LR^2 \times \sigma_{PD}^2}$$

LO 20.e

The variance of the probability of default (PD) assuming a binomial distribution is:

$$\sigma_{PD}^2 = PD \times (1 - PD)$$

LO 20.f

In most cases, UL_p will be significantly less than the sum of individual UL_i .

$$UL_p = \sqrt{\sum_i \sum_j \rho_{ij} UL_i UL_j}$$

For a two-asset portfolio, the risk contributions of each asset are calculated as follows:

$$RC_1 = UL_1 \times \frac{UL_1 + (\rho_{1,2} \times UL_2)}{UL_p}$$

$$RC_2 = UL_2 \times \frac{UL_2 + (\rho_{1,2} \times UL_1)}{UL_p}$$

LO 20.g

The amount of economic capital needed to absorb credit losses is the distance between the unexpected (negative) outcome and the expected outcome for a given confidence level.

LO 20.h

In practice, a beta distribution is commonly used to model credit risk.

LO 20.i

The bottom-up risk measurement framework that attempts to quantify credit risk has several issues given that credits are presumed to be illiquid assets with one-year estimation horizons. In addition, other risk components, such as operational risks and market risks, are managed and measured in different departments within the bank.

ANSWER KEY FOR MODULE QUIZZES
Module Quiz 20.1

- 1. B** Current measures used to evaluate credit risk include the firm's probability of default, which is the likelihood that a borrower will default, the loss rate, which represents the likely percentage loss if the borrower defaults, the exposure amount, and the expected loss, which, for a given time horizon, is calculated as the product of the EA, PD, and LR. The stated 75% loss if the borrower defaults is the loss rate. (LO 20.b)
- 2. D** EL increases with increases in the exposure amount. UL typically exceeds EL, but they are both equal to zero when probability of default is zero. UL has additional variance terms. (LO 20.d)

- 3. D** If recovery rates increase, the loss rate will decrease, which will decrease expected loss. If the probability of default decreases, the expected loss will also decrease. (LO 20.b)

4. D

$$\begin{aligned} EL &= EA \times PD \times LR \\ &= \$18,000,000 \times 0.02 \times 0.8 \\ &= \$288,000 \end{aligned}$$

(LO 20.c)

- 5. C** The following calculations describe the steps to compute the unexpected loss of a portfolio.

Compute UL for both assets.

$$\begin{aligned} UL &= EA \times \sqrt{PD \times \sigma_{LR}^2 + LR^2 \times \sigma_{PD}^2} \\ UL_A &= \$5,100,000 \times \sqrt{0.02 \times 0.25^2 + 0.5^2 \times 0.14^2} = \$399,952 \\ UL_B &= \$3,600,000 \times \sqrt{0.01 \times 0.2^2 + 0.4^2 \times 0.1^2} = \$160,997 \end{aligned}$$

Compute UL_p .

$$\begin{aligned} UL_p &= \sqrt{(399,952)^2 + (160,997)^2 + (2)(0.2)(399,952)(160,997)} \\ &= \$460,041 \end{aligned}$$

(LO 20.f)

Module Quiz 20.2

- 1. A** It is imperative that a bank hold capital reserves (i.e., economic capital) to buffer itself from unexpected losses so that it can absorb large losses and continue to operate. (LO 20.g)

The following is a review of the Credit Risk Measurement and Management principles designed to address the learning objectives set forth by GARP®. Cross-reference to GARP assigned reading—Doumpas et al., Chapter 1.

READING 21

INTRODUCTION TO CREDIT RISK MODELING AND ASSESSMENT

Study Session 4

EXAM FOCUS

This topic focuses on modeling credit risk and credit risk assessment approaches. For the exam, understand how the probability of default, exposure at default, and loss given default are used for estimating expected credit losses. It is also important to understand how the capital adequacy ratio is calculated, including the elements that influence its parameters. In addition, understand the three primary approaches to assessing the probability of default (i.e., judgmental, empirical, and financial models). Pay attention to the type of model inputs, the drawbacks, and the breadth of application for each approach. Within the category of financial models, be familiar with the Merton model, Moody's-KMV model, the CreditMetrics model, and the CreditRisk+ model. Pay attention to how the model variables are defined and the differences between these models. Finally, be able to calculate the risk-adjusted return on capital (RAROC) and use it to determine whether a loan will be profitable for a bank.

MODULE 21.1: CREDIT RISK MODELING AND REGULATORY FRAMEWORK

Evaluating a Bank's Financial Condition

LO 21.a: Explain the capital adequacy, asset quality, management, earnings, and liquidity (CAMEL) system used for evaluating the financial condition of a bank.

Analytical tools for credit risk management are widely used. One of the most common tools is known as CAMEL (capital, assets, management, earnings, and liquidity). Each of these factors is defined as follows:

- *Capital adequacy.* Regulation establishes a minimum capital reserve that all banks must maintain. This analysis should consider historical and current positioning.

- *Asset quality.* Reviewers examine whether the bank's loans are performing or showing some signs of delinquency. This analysis considers interest rate risk and liquidity risk in relation to the bank's assets.
- *Management.* This portion of the analysis focuses on the quality of the bank's risk management structure. Business strategy, financial performance, and internal controls and policies are all considered.
- *Earnings.* Core earnings should be reviewed. Examiners are specifically looking for the stability of earnings, net interest margin, return on assets, and future earnings potential with an eye for the anticipated impact of stressed economic events.
- *Liquidity.* This category considers both the impact of interest rate risk on the bank's investments and the influence of liquidity risk. The goal is to understand if the bank has the potential for short-term liquidity events that could jeopardize the bank's viability.

Credit Risk Factors

LO 21.b: Describe quantitative measurements and factors of credit risk, including probability of default, loss given default, exposure at default, expected loss, and time horizon.

The primary output from a credit risk model is an estimate of expected loss over a set period of time (usually one year). Expected loss is the product of the probability of default, the exposure at default, and the loss given default:

- **Probability of default (PD)** is the likelihood that a borrower will not make scheduled loan payments. In this context, "default" is considered a payment that is delayed by 90 days or more. This factor is expressed as a percentage.
- **Exposure at default (EAD)** is the risk exposure at time of default. It is expressed as a dollar amount and influenced by the characteristics of the loan. Some loans have a stable principal level, while others (e.g., credit card loans) may have principal levels that fluctuate.
- **Loss given default (LGD)** is the percentage of the loan that is expected to be lost in the event of total default. Recovery rates are a complementary concept where the recovery rate (RR) is equal to 100% minus the LGD%. Borrower characteristics can help inform this estimate. For example, corporate loans may be influenced by the size of the borrower, its business sector, and its overall financial health.

Capital Adequacy Ratio

LO 21.c: Estimate capital adequacy ratio of a financial institution.

Banks should always have enough capital to match the risk of their assets. This amount of capital can be measured using the **capital adequacy ratio (CAR)**:

$$\text{CAR} = \frac{\text{capital}}{\text{risk-weighted assets}} \geq \alpha$$

In this formula, capital refers to both Tier 1 and Tier 2 capital. The **risk-weighted assets (RWA)** measure is the weighted average of the bank's assets with the weight adjusted by risk level. The regulatory minimum level for CAR is denoted by α (e.g., 8% under Basel II and 10.5% under Basel III).

There are two methods for deriving a bank's RWA: (1) the standardized approach and (2) the internal ratings-based (IRB) approach.

1. **Standardized approach.** A supervisory authority can prescribe predetermined weights for various asset categories. This method is easy to deploy, but it is based on data that is external to a given bank. This likely will be costlier for the bank because the weights are set high to adjust for the ambiguity of the approach.
2. **Internal ratings-based (IRB) approach.** The IRB approach is customized to each bank and requires sophisticated modeling using historical data. Internal credit scores can be combined with historical data to estimate the PD and LGD. The RWA is then calculated using an *asymptotic risk factor (ASFR) model*, which assumes the credit portfolio is diversified such that no idiosyncratic risk is left (i.e., only systematic risk remains).

Under the IRB approach, the ASFR model allows capital charges to be calculated on a loan-by-loan basis and then aggregated up to the portfolio level. The RWA for an individual corporate borrower is found by applying the following formula:

$$\text{RWA} = K \times 12.5 \times \text{EAD}$$

In this formula, K is the capital required, which is a function of PD, LGD, loan maturity (M), an asset correlation parameter (R), and a maturity adjustment (β):

$$K = \left[\text{LGD} \times N\left(\frac{N^{-1}(\text{PD})}{\sqrt{1-R}} + N^{-1}(0.999)\sqrt{\frac{R}{1-R}}\right) - \text{PD} \times \text{LGD} \right] \frac{1 + (M - 2.5)\beta}{1 - 1.5\beta}$$

Where N is the cumulative standard normal distribution function and N^{-1} is its inverse. The maturity adjustment (β) is computed as:

$$\beta = [0.11852 - 0.05478 \log(\text{PD})]^2$$

The asset correlation parameter, R , considers the borrower's dependence on the general state of the economy, and it is set by the Basel Committee. This parameter reflects that:

1. asset correlations decrease as PD increases. This infers that higher PD also means higher idiosyncratic risk potential.
2. asset correlations increase with firm size. In other words, larger firms are more influenced by the broad economy while smaller firms are more likely to default due to idiosyncratic reasons.

The maturity parameter, β , is influenced by both loan maturity and PD. This measure suggests that long-term borrowers are riskier than short-term borrowers (i.e., downgrades are more likely for long-term borrowers). This means that capital requirements should increase with maturity. It also reflects that low PD borrowers have higher downgrade potential than high PD borrowers. In other words, maturity adjustments should be higher for low PD borrowers.

The Basel III Accord enhanced risk measurement through several updates. It increased the CAR from the 8% threshold required by Basel II to 10.5%. It added liquidity and leverage requirements. It emphasized counterparty risk specifically for derivatives and securitized products. Additionally, it introduced a new framework for risk management including stress tests for extreme market volatility, model validation, and a testing program to enhance realistic expectations during volatile conditions.



MODULE QUIZ 21.1

1. Which subcomponent of the CAMEL analysis tool is focused on delinquent loans?
 - A. Liquidity.
 - B. Earnings.
 - C. Asset quality.
 - D. Capital adequacy.
2. A credit risk analyst is trying to determine the percentage of a loan that is expected to be lost if a specific borrower were to default. Which of the following metrics should he apply?
 - A. Loss given default.
 - B. Exposure at default.
 - C. Probability of default.
 - D. Recovery default rate.
3. The internal ratings-based (IRB) approach for calculating a bank's capital adequacy ratio (CAR) has several underlying elements. Which of the following statements relates to the IRB approach?
 - A. Idiosyncratic risk is explicitly factored into the model.
 - B. Estimates of probability of default are made by regulators.
 - C. Maturity adjustments should be higher for borrowers with high probabilities of default.
 - D. The maturity parameter reflects that capital requirements should increase with maturity.

MODULE 21.2: CREDIT RISK ASSESSMENT APPROACHES

Predicting Default in Credit Risk Models

LO 21.d: Describe the judgmental approaches, empirical models, and financial models to predict default.

There are three primary approaches for assessing the likelihood of default in credit risk models. They are the judgmental approach, data-driven empirical models, and theory-based financial models. The differences between these methods involve the input data required, their scope, and the range of application.

The **judgmental approach** is also sometimes called the “qualitative approach” or the “expert system.” The reason for these alternate names is that this approach primarily relies on qualitative data sourced from experts (e.g., credit risk officers). One common

judgmental approach is known as “5C Analysis” because it covers five core dimensions of a borrower’s creditworthiness:

1. *Character* is the personality of the borrower.
2. *Capacity* is the ability of the borrower to repay in a timely manner.
3. *Capital* considers the amount of the borrower’s own capital that is at risk in the transaction.
4. *Collateral* factors any secondary sources that are guaranteeing the loan.
5. *Conditions* reviews the business environment and any loan-specific characteristics.

Data inputs could be publicly available financial statements or a business plan. They could also relate to the business sector or region in which the borrower operates, the broad market, or the general economy. This breadth of inputs means that a judgmental approach can be used for both consumer and corporate loans.

Judgmental approaches can be very beneficial when adequate historical data is not available for a loan. One example is project finance. Many projects are unique, which makes finding relevant historical comparisons problematic. In this scenario, the experience of a credit analyst can add value to the risk analysis.

However, there are some drawbacks to this approach. While this method typically involves a well-structured and systematic process, it relies on expert judgments rather than empirical theories. With this in mind, it can be difficult to validate the quality of the output, update quickly for changing conditions, or assess how a single borrower may impact the entire credit portfolio. This method is neither transparent nor consistent, but it can be a good option for loan types that are highly unique.

Empirical models use historical data (e.g., loans accepted, rejected, in good standing, and in default) to search for nontrivial patterns in the relationship between the likelihood of default and input variables (i.e., risk factors). Data inputs can be gathered from internal databases or from credit rating agencies (CRAs) and other external data providers. Relevant data points are characteristics of the borrower, loan status (i.e., in good standing or in default), and other external risk factors.

This data-driven approach can harness the power of machine learning (ML) to search for highly complex, nonlinear relationships. Using ML can help identify new risk factors. One such newer risk factor that has recently been identified is corporate governance practices. Inputs from social networks and real-time market information can also be incorporated in this manner.

The empirical approach has the following advantages:

1. Relative to the judgmental approach, it adds transparency and consistency to the process.
2. Both the underlying structure of the model and its predictive power can be empirically validated.
3. A hypothesized relationship can be analytically explored.
4. Market data can be updated in real-time to better adjust to changing conditions.

5. Adjustments can be made for specific sectors of the market.
6. The breadth of data inputs enables this approach to be used for both consumer and corporate loans.

While these advantages are important, there are also some important weaknesses of the empirical method. The reliance on historical data may not properly predict a future outcome. This is especially true during periods of high uncertainty and volatility. Additionally, even though market data can be updated in real-time, not all inputs can be. Financial statement data may only be available on a quarterly basis. This frequency of model review may not provide risk information as quickly as a judgmental approach.

In contrast to empirical models, **financial models** are based on normative economic and financial theory. They are sometimes known as “market models” because of their reliance on financial market data. This reliance means that they can only be used for corporate borrowers, which contrasts with both judgmental and empirical approaches that can be used for either corporate or consumer loans. There are two primary types of financial models:

1. **Structural models.** This method assumes that default is an endogenous process, which is influenced by the firm's internal structural characteristics (e.g., the Merton model).
2. **Reduced-form models.** This method assumes that default is driven by a random exogenous event (e.g., a Poisson jump process). The primary input sources for the credit risk structure are market data on credit derivatives and bonds.

Default Probability Using the Merton Model

LO 21.e: Apply the Merton model to calculate default probability and the distance to default and describe the limitations of using the Merton model.

The **Merton model** is an option pricing model where the capital structure of a borrower is viewed as a call option on the assets of the firm. The shareholders of the borrower are like the buyers of the call and the creditors are the writers. The creditors temporarily “own” a portion of the company, but the shareholders have the right to buy back the loan by paying it off or refinancing.

Consider a simplistic example in which a firm has only one loan outstanding with a face value of L that is maturing at time T . It makes economic sense for the shareholders to pay off the debt only if the market value of the firm (A_T) is greater than its debt. If this were not the case, then the firm's net value would be negative. The net worth of the firm could then be summarized as follows:

$$\max(A_T - L, 0)$$

This formula should look familiar because it is also the terminal payoff formula for a call option with a strike price of L and a terminal price at expiration of A_T . Following this logic, the market value of equity (E) can be derived using the Black-Scholes-Merton option pricing formula as follows: