

2016 SchweserNotes™

Part II

FRM®

Exam Prep

**Risk Management and
Investment Management;
Current Issues in Financial
Markets**

eBook 4



**KAPLAN
UNIVERSITY**

SCHOOL OF PROFESSIONAL
AND CONTINUING EDUCATION

SCHWESER

Getting Started

Part II FRM® Exam

Welcome

As the VP of Advanced Designations at Kaplan Schweser, I am pleased to have the opportunity to help you prepare for the 2016 FRM® Exam. Getting an early start on your study program is important for you to sufficiently **Prepare ▶ Practice ▶ Perform™** on exam day. Proper planning will allow you to set aside enough time to master the learning objectives in the Part II curriculum.

Now that you've received your SchweserNotes™, here's how to get started:

Step 1: Access Your Online Tools

Visit www.schweser.com/frm and log in to your online account using the button located in the top navigation bar. After logging in, select the appropriate part and proceed to the dashboard where you can access your online products.

Step 2: Create a Study Plan

Create a study plan with the [Schweser Study Calendar](#) (located on the Schweser dashboard). Then view the [Candidate Resource Library](#) on-demand videos for an introduction to core concepts.

Step 3: Prepare and Practice

Read your SchweserNotes™

Our clear, concise study notes will help you **prepare** for the exam. At the end of each reading, you can answer the Concept Checker questions for better understanding of the curriculum.

Attend a Weekly Class

Attend our [Live Online Weekly Class](#) or review the on-demand archives as often as you like. Our expert faculty will guide you through the FRM curriculum with a structured approach to help you **prepare** for the exam. (See our instruction packages to the right. Visit www.schweser.com/frm to order.)

Practice with SchweserPro™ QBank

Maximize your retention of important concepts and **practice** answering exam-style questions in the [SchweserPro™ QBank](#) and taking several [Practice Exams](#). Use [Schweser's QuickSheet](#) for continuous review on the go. (Visit www.schweser.com/frm to order.)

Step 4: Final Review

A few weeks before the exam, make use of our [Online Review Workshop Package](#). Review key curriculum concepts in every topic, **perform** by working through demonstration problems, and **practice** your exam techniques with our 8-hour live [Online Review Workshop](#). Use [Schweser's Secret Sauce®](#) for convenient study on the go.

Step 5: Perform

As part of our [Online Review Workshop Package](#), take a [Schweser Mock Exam](#) to ensure you are ready to **perform** on the actual FRM Exam. Put your skills and knowledge to the test and gain confidence before the exam.

Again, thank you for trusting Kaplan Schweser with your FRM Exam preparation!

Sincerely,

Timothy Smaby

Timothy Smaby, PhD, CFA, FRM

Vice President, Advanced Designations, Kaplan Schweser

The Kaplan Way for Learning



PREPARE

Acquire new knowledge through demonstration and examples.



PRACTICE

Apply new knowledge through simulation and practice.



PERFORM

Evaluate mastery of new knowledge and identify achieved outcomes.

FRM® Instruction Packages:

➤ PremiumPlus™ Package

➤ Premium Instruction Package

Live Instruction*:

Remember to join our Live Online Weekly Class. Register online today at www.schweser.com/frm.



May Exam Instructor
Dr. John Broussard
CFA, FRM



November Exam Instructor
Dr. Greg Filbeck
CFA, FRM, CAIA

*Dates, times, and instructors subject to change

Contact us for questions about your study package, upgrading your package, purchasing additional study materials, or for additional information:

www.schweser.com/frm | Toll-Free: 888.325.5072 | International: +1 608.779.8397

FRM PART II BOOK 4: RISK MANAGEMENT AND INVESTMENT MANAGEMENT; CURRENT ISSUES IN FINANCIAL MARKETS

READING ASSIGNMENTS AND LEARNING OBJECTIVES	v
RISK MANAGEMENT AND INVESTMENT MANAGEMENT	
63: Portfolio Construction	1
64: Portfolio Risk: Analytical Methods	13
65: VaR and Risk Budgeting in Investment Management	30
66: Risk Monitoring and Performance Measurement	46
67: Portfolio Performance Evaluation	57
68: Illiquid Assets	79
69: Hedge Funds	93
70: Performing Due Diligence on Specific Managers and Funds	105
CURRENT ISSUES IN FINANCIAL MARKETS	
71: Forging Best Practices in Risk Management	119
72: Case Studies on Disruptions During the Crisis	128
73: Why Do We Need Both Liquidity Regulations and a Lender of Last Resort? A Perspective From Federal Reserve Lending During the 2007–09 U.S. Financial Crisis	139
74: Global Financial Markets Liquidity Study	153
75: Reforming LIBOR and Other Financial Market Benchmarks	175
76: Central Counterparties: Addressing Their Too Important to Fail Nature	188
77: Stress Testing Convergence	201
78: Cybersecurity 101: A Resource Guide for Bank Executives	208
SELF-TEST: RISK MANAGEMENT AND INVESTMENT MANAGEMENT; CURRENT ISSUES IN FINANCIAL MARKETS	222
FORMULAS	228
APPENDIX	231
INDEX	235

FRM 2016 PART II BOOK 4: RISK MANAGEMENT AND INVESTMENT MANAGEMENT;
CURRENT ISSUES IN FINANCIAL MARKETS

©2016 Kaplan, Inc., d.b.a. Kaplan Schweser. All rights reserved.

Printed in the United States of America.

ISBN: 978-1-4754-3810-9

PPN: 3200-7218

Required Disclaimer: GARP® does not endorse, promote, review, or warrant the accuracy of the products or services offered by Kaplan Schweser of FRM® related information, nor does it endorse any pass rates claimed by the provider. Further, GARP® is not responsible for any fees or costs paid by the user to Kaplan Schweser, nor is GARP® responsible for any fees or costs of any person or entity providing any services to Kaplan Schweser. FRM®, GARP®, and Global Association of Risk Professionals™ are trademarks owned by the Global Association of Risk Professionals, Inc.

These materials may not be copied without written permission from the author. The unauthorized duplication of these notes is a violation of global copyright laws. Your assistance in pursuing potential violators of this law is greatly appreciated.

Disclaimer: The SchweserNotes should be used in conjunction with the original readings as set forth by GARP®. The information contained in these books is based on the original readings and is believed to be accurate. However, their accuracy cannot be guaranteed nor is any warranty conveyed as to your ultimate exam success.

READING ASSIGNMENTS AND LEARNING OBJECTIVES

The following material is a review of the Risk Management and Investment Management, and Current Issues in Financial Markets principles designed to address the learning objectives set forth by the Global Association of Risk Professionals.

READING ASSIGNMENTS

Risk Management and Investment Management

Richard Grinold and Ronald Kahn, *Active Portfolio Management: A Quantitative Approach for Producing Superior Returns and Controlling Risk, 2nd Edition* (New York: McGraw-Hill, 2000).

63. "Portfolio Construction," Chapter 14 (page 1)

Philippe Jorion, *Value-at-Risk: The New Benchmark for Managing Financial Risk, 3rd Edition*. (New York: McGraw Hill, 2007).

64. "Portfolio Risk: Analytical Methods," Chapter 7 (page 13)

65. "VaR and Risk Budgeting in Investment Management," Chapter 17 (page 30)

Robert Litterman and the Quantitative Resources Group, *Modern Investment Management: An Equilibrium Approach* (Hoboken, NJ: John Wiley & Sons, 2003).

66. "Risk Monitoring and Performance Measurement," Chapter 17 (page 46)

Zvi Bodie, Alex Kane, and Alan J. Marcus, *Investments, 10th Edition* (New York: McGraw-Hill, 2013).

67. "Portfolio Performance Evaluation," Chapter 24 (page 57)

Andrew Ang, *Asset Management: A Systematic Approach to Factor Investing* (New York: Oxford University Press, 2014).

68. "Illiquid Assets," Chapter 13 (page 79)

G. Constantinides, M. Harris and R. Stulz, eds., *Handbook of the Economics of Finance, Volume 2B* (Oxford: Elsevier, 2013).

69. "Hedge Funds," Chapter 17 (page 93)

Kevin R. Mirabile, *Hedge Fund Investing: A Practical Approach to Understanding Investor Motivation, Manager Profits, and Fund Performance* (Hoboken, NJ: Wiley Finance, 2013).

70. “Performing Due Diligence on Specific Managers and Funds,” Chapter 11
(page 105)

Current Issues in Financial Markets

71. Paul Glasserman, “Firm-Level Issues in Risk Measurement,” *Forging Best Practices in Risk Management* (Working Paper #0002, Office of Financial Research, U.S. Department of Treasury, 2012).
(page 119)

72. Tanju Yorulmazer, “Case Studies on Disruptions During the Crisis,” FRBNY Economic Policy Review, 2014.
(page 128)

73. “Why Do We Need Both Liquidity Regulations and a Lender of Last Resort? A Perspective from Federal Reserve Lending During the 2007-09 U.S. Financial Crisis,” Federal Reserve Board, February 2015.
(page 139)

74. *Global Financial Markets Liquidity Study*, PwC, August 2015.
(page 153)

75. Darrell Duffie and Jeremy C. Stein, “Reforming LIBOR and Other Financial Market Benchmarks,” *Journal of Economic Perspectives* 29, no. 2 (Spring 2015): 191–212.
(page 175)

76. Froukelien Wendt, “Central Counterparties: Addressing their Too Important to Fail Nature” (Working paper, International Monetary Fund, 2015).
(page 188)

77. German Gutierrez Gallardo, Til Schuermann, and Michael Duane, “Stress Testing Convergence,” 2015.
(page 201)

78. “Cybersecurity 101: A Resource Guide for Bank Executives,” Conference of State Banking Supervisors, December 2014.
(page 208)

LEARNING OBJECTIVES

63. Portfolio Construction

After completing this reading, you should be able to:

1. Distinguish among the inputs to the portfolio construction process. (page 1)
2. Evaluate the methods and motivation for refining alphas in the implementation process. (page 1)
3. Describe neutralization and methods for refining alphas to be neutral. (page 2)
4. Describe the implications of transaction costs on portfolio construction. (page 3)
5. Assess the impact of practical issues in portfolio construction such as determination of risk aversion, incorporation of specific risk aversion, and proper alpha coverage. (page 4)
6. Describe portfolio revisions and rebalancing and evaluate the tradeoffs between alpha, risk, transaction costs and time horizon. (page 5)
7. Determine the optimal no-trade region for rebalancing with transaction costs. (page 5)
8. Evaluate the strengths and weaknesses of the following portfolio construction techniques: screens, stratification, linear programming, and quadratic programming. (page 6)
9. Describe dispersion, explain its causes and describe methods for controlling forms of dispersion. (page 7)

64. Portfolio Risk: Analytical Methods

After completing this reading, you should be able to:

1. Define, calculate, and distinguish between the following portfolio VaR measures: individual VaR, incremental VaR, marginal VaR, component VaR, undiversified portfolio VaR, and diversified portfolio VaR. (page 13)
2. Explain the role of correlation on portfolio risk. (page 14)
3. Describe the challenges associated with VaR measurement as portfolio size increases. (page 18)
4. Apply the concept of marginal VaR to guide decisions about portfolio VaR. (page 22)
5. Explain the risk-minimizing position and the risk and return-optimizing position of a portfolio. (page 22)
6. Explain the difference between risk management and portfolio management, and describe how to use marginal VaR in portfolio management. (page 23)

65. VaR and Risk Budgeting in Investment Management

After completing this reading, you should be able to:

1. Define risk budgeting. (page 30)
2. Describe the impact of horizon, turnover and leverage on the risk management process in the investment management industry. (page 30)
3. Describe the investment process of large investors such as pension funds. (page 31)
4. Describe the risk management challenges associated with investments in hedge funds. (page 32)
5. Distinguish among the following types of risk: absolute risk, relative risk, policy-mix risk, active management risk, funding risk and sponsor risk. (page 32)
6. Apply VaR to check compliance, monitor risk budgets and reverse engineer sources of risk. (page 35)

7. Explain how VaR can be used in the investment process and the development of investment guidelines. (page 37)
8. Describe the risk budgeting process and calculate risk budgets across asset classes and active managers. (page 38)

66. Risk Monitoring and Performance Measurement

After completing this reading, you should be able to:

1. Define, compare, and contrast VaR and tracking error as risk measures. (page 46)
2. Describe risk planning, including its objectives, effects and the participants in its development. (page 47)
3. Describe risk budgeting and the role of quantitative methods in risk budgeting. (page 48)
4. Describe risk monitoring and its role in an internal control environment. (page 48)
5. Identify sources of risk consciousness within an organization. (page 48)
6. Describe the objectives and actions of a risk management unit in an investment management firm. (page 49)
7. Describe how risk monitoring can confirm that investment activities are consistent with expectations. (page 50)
8. Explain the importance of liquidity considerations for a portfolio. (page 50)
9. Describe the use of alpha, benchmark, and peer group as inputs in performance measurement tools. (page 52)
10. Describe the objectives of performance measurement. (page 51)

67. Portfolio Performance Evaluation

After completing this reading, you should be able to:

1. Differentiate between time-weighted and dollar-weighted returns of a portfolio and describe their appropriate uses. (page 57)
2. Describe and distinguish between risk-adjusted performance measures, such as Sharpe's measure, Treynor's measure, Jensen's measure (Jensen's alpha), and information ratio. (page 60)
3. Describe the uses for the Modigliani-squared and Treynor's measure in comparing two portfolios, and the graphical representation of these measures. (page 60)
4. Determine the statistical significance of a performance measure using standard error and the t-statistic. (page 67)
5. Explain the difficulties in measuring the performance of hedge funds. (page 68)
6. Explain how changes in portfolio risk levels can affect the use of the Sharpe ratio to measure performance. (page 68)
7. Describe techniques to measure the market timing ability of fund managers with a regression and with a call option model, and compute return due to market timing. (page 69)
8. Describe style analysis. (page 71)
9. Describe and apply performance attribution procedures, including the asset allocation decision, sector and security selection decision and the aggregate contribution. (page 71)

68. Illiquid Assets

After completing this reading, you should be able to:

1. Evaluate the characteristics of illiquid markets. (page 79)
2. Examine the relationship between market imperfections and illiquidity. (page 80)
3. Assess the impact of biases on reported returns for illiquid assets. (page 81)

4. Compare illiquidity risk premiums across and within asset categories. (page 83)
5. Evaluate portfolio choice decisions on the inclusion of illiquid assets. (page 87)

69. Hedge Funds

After completing this reading, you should be able to:

1. Describe the characteristics of hedge funds and the hedge fund industry, and compare hedge funds with mutual funds. (page 93)
2. Explain biases which are commonly found in databases of hedge funds. (page 93)
3. Explain the evolution of the hedge fund industry and describe landmark events which precipitated major changes in the development of the industry. (page 93)
4. Evaluate the role of investors in shaping the hedge fund industry. (page 93)
5. Explain the relationship between risk and alpha in hedge funds. (page 94)
6. Compare and contrast the different hedge fund strategies, describe their return characteristics, and describe the inherent risks of each strategy. (page 95)
7. Describe the historical portfolio construction and performance trend of hedge funds compared to equity indices. (page 98)
8. Describe market events which resulted in a convergence of risk factors for different hedge fund strategies, and explain the impact of such a convergence on portfolio diversification strategies. (page 99)
9. Describe the problem of risk sharing asymmetry between principals and agents in the hedge fund industry. (page 99)
10. Explain the impact of institutional investors on the hedge fund industry and assess reasons for the growing concentration of assets under management (AUM) in the industry. (page 100)

70. Performing Due Diligence on Specific Managers and Funds

After completing this reading, you should be able to:

1. Identify reasons for the failures of funds in the past. (page 105)
2. Explain elements of the due diligence process used to assess investment managers. (page 106)
3. Identify themes and questions investors can consider when evaluating a manager. (page 107)
4. Describe criteria that can be evaluated in assessing a fund's risk management process. (page 109)
5. Explain how due diligence can be performed on a fund's operational environment. (page 110)
6. Explain how a fund's business model risk and its fraud risk can be assessed. (page 112)
7. Describe elements that can be included as part of a due diligence questionnaire. (page 113)

71. Forging Best Practices in Risk Management

After completing this reading, you should be able to:

1. Identify the areas of risk management that have been most affected by the recent financial crisis and describe the major trends and developments brought on by the crisis. (page 119)
2. Evaluate the presence of volatility regimes in market data. (page 121)
3. Analyze the implications of multiple firms attempting to take the same risk-mitigating steps. (page 122)

4. Describe the implications of risk-mitigation strategies employed by firms and how they can amplify risk. (page 122)
5. Explain practices to address and alleviate amplified risk. (page 123)

72. Case Studies on Disruptions During the Crisis

After completing this reading, you should be able to:

1. Understand the use and purpose of funding mechanisms and describe the distress in the markets during the recent credit crisis. (page 128)
2. Distinguish between Commercial Paper and Asset-Backed Commercial Paper and describe the policy responses to recent market collapses. (page 129)
3. Compare and contrast sources of disruption in the money market mutual funds, repo markets, and credit commitments. (page 131)
4. Evaluate the implications of the dollar funding model of non-U.S. banks during the recent crisis. (page 133)

73. Why Do We Need Both Liquidity Regulations and a Lender of Last Result? A Perspective from Federal Reserve Lending During the 2007–09 U.S. Financial Crisis

After completing this reading, you should be able to:

1. Compare the advantages and disadvantages of liquidity regulations and a lender of last resort in managing liquidity and systemic risk during a financial crisis, and identify situations where each is more effective. (page 140)
2. Explain how the existence of a lender of last resort can create moral hazard. (page 143)
3. Describe situations where a central bank should begin lending to banks before liquidity buffers are exhausted. (page 143)
4. Describe challenges and constraints to a central bank acting as a lender of last resort. (page 144)
5. Analyze the Federal Reserve's lending policies and lending decisions during the 2007–2009 financial crisis, and describe the effectiveness of each. (page 144)
6. Explain how a combination of liquidity regulations and lender of last resort can lead to an optimal policy mix to manage systemic risk during financial downturns. (page 147)

74. Global Financial Markets Liquidity Study

After completing this reading, you should be able to:

1. Define liquidity and describe the dimensions by which liquidity can be measured. (page 153)
2. Explain how liquidity is provided in different financial markets, including the role of market makers and the economics of market making. (page 155)
3. Describe current global trends and factors which have impacted liquidity in financial markets and explain their liquidity impact. (page 156)
4. Summarize trends over the past 10 years in the volume and liquidity of the following financial markets: interest rates and interest rate derivatives, sovereign bonds, repos, corporate bonds, CDS, securitized products, foreign exchange, equities, and emerging market financial products. (page 158)

75. Reforming LIBOR and Other Financial Market Benchmarks

After completing this reading, you should be able to:

1. Discuss the recommended principles to make benchmark rates such as LIBOR and other interbank offered rates less susceptible to manipulation. (page 175)

2. Evaluate the implications, advantages, and disadvantages of using benchmarks. (page 176)
3. Assess the types of agglomeration effects after a benchmark has been established. (page 177)
4. Explain the motives for manipulating benchmarks and describe the processes to alleviate manipulation. (page 178)
5. Describe how the US dollar LIBOR is used and identify the costs associated with the increase in trading of LIBOR-linked contracts. (page 179)
6. Explain and assess some proposed methodologies to reform LIBOR. (page 180)

76. Central Counterparties: Addressing Their Too Important to Fail Nature

After completing this reading, you should be able to:

1. Describe the benefits of central counterparties (CCPs) and the potential risks which can arise when clearing through a CCP. (page 188)
2. Explain the interconnections between central counterparties and other financial institutions, including banks, clearing members, financial markets, and other CCPs. (page 190)
3. Explain how the failure of a CCP can spread systemic risk to other financial markets or institutions. (page 192)
4. Identify policy measures designed to reduce the probability or impact of potential CCP failures, and describe limitations to these measures. (page 194)
5. Explain measures which can be adopted to mitigate systemic risks related to interconnections and interdependence of CCPs. (page 195)

77. Stress Testing Convergence

After completing this reading, you should be able to:

1. Explain how trends in stress testing and capital management have evolved from 2009 SCAP to the 2015 CCAR. (page 201)
2. Compare trends in capital management approaches by different classes of CCAR institutions from 2012 to 2015, and explain the motivations for each class of institutions to adopt their approach. (page 202)
3. Identify and describe factors that have encouraged banks to manage capital more closely to regulatory minimum levels. (page 203)
4. Describe potential consequences as stress test results from different banks have appeared to converge and more institutions begin to manage capital to Fed-projected results. (page 204)

78. Cybersecurity 101: A Resource Guide for Bank Executives

After completing this reading, you should be able to:

1. Identify the five core functions of the NIST's Cybersecurity Framework. (page 208)
2. Explain the risk assessment process to identify threats to information or information systems. (page 208)
3. Describe various measures to protect banks' systems, assets, and data. (page 211)
4. Describe the approaches to detect system intrusions, data breaches, and unauthorized access. (page 214)
5. Explain the incident response plan and the recovery plan. (page 215)

PORTFOLIO CONSTRUCTION

Topic 63

EXAM FOCUS

This topic addresses techniques for optimal portfolio construction. We will discuss important inputs into the portfolio construction process as well as ways to modify allocations by refining the position alphas within a portfolio. This topic also goes into detail regarding transactions costs and how they influence allocation decisions with regard to portfolio monitoring and rebalancing. For the exam, pay attention to the discussions of refining alpha and the implications of transactions costs. Also, be familiar with the different techniques used to construct optimal portfolios.

THE PORTFOLIO CONSTRUCTION PROCESS

LO 63.1: Distinguish among the inputs to the portfolio construction process.

The process of constructing an investment portfolio has several inputs which include:

- *Current portfolio*: The assets and weights in the current portfolio. Relative to the other inputs, the current portfolio input can be measured with the most certainty.
- *Alphas*: The excess return of each asset. This input is subject to error and bias and as a result is sometimes unreasonable.
- *Covariances*: Covariance measures how the returns of the assets in the portfolio are related. Estimates of covariance often display elements of uncertainty.
- *Transactions costs*: Like covariance, transaction costs are an important input for portfolio construction, however, these costs also contain a degree of uncertainty. Transaction costs must be amortized over the investment horizon in order to determine the optimal portfolio adjustments.
- *Active risk aversion*: This input must be consistent with the specified target active risk level. Active risk is another name for tracking error, which is the standard deviation of active return (i.e., excess return).

REFINING ALPHAS

LO 63.2: Evaluate the methods and motivation for refining alphas in the implementation process.

The motivation for refining alpha is to address the various constraints that each investor or manager might have. For the investor, constraints might include not having any short positions and/or a restriction on the amount of cash held within the portfolio. For the manager, the constraints might include restrictions on allocations to certain stocks and/or making the portfolio neutral across sectors. The resulting portfolio will be different

from a corresponding unconstrained portfolio and as a result will likely be less efficient. Constrained optimization methods for portfolio construction are often cumbersome to implement.

A method that involves refining the alphas can derive the optimal portfolio, given the consideration of portfolio constraints, in a less complicated manner. This method refines the optimal position alphas and then adjusts each position's allocation. In other words, if no short sales are allowed, then the modified alphas would be drawn closer to zero, and the optimization that would follow would call for a zero percent allocation to those short positions. If, in addition to short sales, all long position allocations were required to more closely resemble the benchmark weights, then all modified alphas would be pulled closer to zero relative to the original alphas, indicating that the constrained portfolio would more closely resemble the benchmark portfolio (i.e., since alpha is closer to zero, the returns between the benchmark and portfolio are now closer). The main idea to this approach is that refining alphas and then optimizing position allocations can replace even the most sophisticated portfolio construction process.

A manager can refine the alphas by procedures known as scaling and trimming. By considering the structure of alpha, we can understand how to use the technique of scaling.

$$\text{alpha} = (\text{volatility}) \times (\text{information coefficient}) \times (\text{score})$$

In this equation, score has a mean of zero and standard deviation of one. This means that alphas will have a mean zero and a range that is determined by the volatility (i.e., residual risk) and the information coefficient (i.e., correlation between actual and forecasted outcomes). The manager can rescale the alphas to make them have the proper scale for the portfolio construction process. For example, if the original alphas had a standard deviation of 2%, the rescaled alphas could have a lower standard deviation of 0.5%.

Trimming extreme values is another method of refining alpha. The manager should scrutinize alphas that are large in absolute value terms. “Large” might be defined as three times the scale of the alphas. It may be the case that such alphas are the result of questionable data, and the weights for those position allocations should be set to zero. Those extreme alphas that appear genuine may be kept but lowered to be within some limit, say, three times the scale.

LO 63.3: Describe neutralization and methods for refining alphas to be neutral.

Neutralization is the process of removing biases and undesirable bets from alpha. There are several types of neutralization: benchmark, cash, and risk-factor. In all cases, the type of neutralization and the strategy for the process should be specified before the process begins.

Benchmark neutralization involves adjusting the benchmark alpha to zero. This means the optimal position that uses the benchmark will have a beta of one. This ensures that the alphas are benchmark-neutral and avoids any issues with benchmark timing. For example, suppose that a modified alpha has a beta of 1.2. By making this alpha benchmark-neutral, a new modified alpha will be computed where the beta is reduced to one. Making the alphas

cash-neutral involves adjusting the alphas so that the cash position will not be active. It is possible to simultaneously make alphas both cash and benchmark-neutral.

The risk-factor approach separates returns along several dimensions (e.g., industry). The manager can identify each dimension as a source of either risk or value added. The manager should neutralize the dimensions or factors that are a source of risk (for which the manager does not have adequate knowledge).

TRANSACTIONS COSTS

LO 63.4: Describe the implications of transaction costs on portfolio construction.

Transactions costs are the costs of moving from one portfolio allocation to another. They need to be considered in addition to the alpha and active risk inputs in the optimization process. When considering only alpha and active risk, any problem in setting the scale of the alphas can be offset by adjusting active risk aversion. The introduction of transactions costs increases the importance of the precision of the choice of scale. Some researchers propose that the accuracy of estimates of transactions costs is as important as the accuracy of alpha estimates. Furthermore, the existence of transactions costs increases the importance of having more accurate estimates of alpha.

When considering transactions costs, it is important to realize that these costs generally occur at a point in time while the benefits (i.e., the additional return) are realized over a time period. This means that the manager needs to have a rule concerning how to amortize the transactions costs over a given period. Beyond the implications of transactions costs, a full analysis would also consider the causes of transactions costs, how to measure them, and how to avoid them.

To illustrate the role of transactions costs and how to amortize them, we will assume forecasts can be made with certainty and the risk-free rate is zero. The cost of buying and selling stock is \$0.05. The current prices of stock A and B are both \$10. The forecasts are for the price of stock A to be \$11 in one year and the price of stock B to be \$12 in two years; therefore, the annualized alphas are the same at 10%. Also, neither stock will change in value after reaching the forecasted value. Now, assume in each successive year that the manager discovers a stock with the same properties as stock A and every two years a stock exactly like stock B. The manager would trade the stock-A type stocks each year and incur \$0.10 in transactions costs at the end of each year. The alpha is 10%, and the transactions costs are 1% for type-A stocks for a net return of 9%. For the type-B stocks, the annual return is also 10%, but the transactions costs per year are only 0.5% because they are incurred every other year. Thus, on an annualized basis, the after-cost-return of type-B stocks is greater than that of type-A stocks.

PORTFOLIO CONSTRUCTION ISSUES

LO 63.5: Assess the impact of practical issues in portfolio construction such as determination of risk aversion, incorporation of specific risk aversion, and proper alpha coverage.

Practical issues in portfolio construction include the level of risk aversion, the optimal risk, and the alpha coverage.

Measuring the level of **risk aversion** is dependent on accurate measures of the inputs in the following expression:

$$\text{risk aversion} = \frac{\text{information ratio}}{2 \times \text{active risk}}$$

For example, assuming that the information ratio is 0.8 and the desired level of active risk is 10%, then the implied level of risk aversion is 0.04. Being able to quantify risk aversion allows the manager to understand a client's utility in a mean-variance framework. Utility can be measured as: excess return – (risk aversion × variance).



Professor's Note: Remember here that active risk is just another name for tracking error. Also note that in this risk aversion equation, the desired level of active risk is inputted as a percent instead of a decimal (i.e., 10 instead of 0.10).

Aversion to specific factor risk is important for two reasons. It can help the manager address the risks associated with having a position with the potential for huge losses, and the potential dispersion across portfolios when the manager manages more than one portfolio. This approach can help a manager decide the appropriate aversion to common and specific risk factors.

Proper **alpha coverage** refers to addressing the case where the manager has forecasts of stocks that are not in the benchmark and the manager doesn't have forecasts for assets in the benchmark. When the manager has information on stocks not in the benchmark, a benchmark weight of zero should be assigned with respect to benchmarking, but active weights can be assigned to generate active alpha.

When there is not a forecast for assets in the benchmark, alphas can be inferred from the alphas of assets for which there are forecasts. One approach is to first compute the following two measures:

value-weighted fraction of stocks with forecasts = sum of active holdings with forecasts

$$\text{average alpha for the stocks with forecasts} = \frac{(\text{weighted average of the alphas with forecasts})}{(\text{value-weighted fraction of stocks with forecasts})}$$

The second step is to subtract this measure from each alpha for which there is a forecast and set alpha to zero for assets that do not have forecasts. This provides a set of benchmark-neutral forecasts where assets without forecasts have an alpha of zero.

PORTFOLIO REVISIONS AND REBALANCING

LO 63.6: Describe portfolio revisions and rebalancing and evaluate the tradeoffs between alpha, risk, transaction costs and time horizon.

LO 63.7: Determine the optimal no-trade region for rebalancing with transaction costs.

If transactions costs are zero, a manager should revise a portfolio every time new information arrives. However, in a practical setting, the manager should make trading decisions based on expected active return, active risk, and transactions costs. The manager may wish to be conservative due to the uncertainties of these measures and the manager's ability to interpret them. Underestimating transactions costs, for example, will lead to trading too frequently. In addition, the frequent trading and short time-horizons would cause alpha estimates to exhibit a great deal of uncertainty. Therefore, the manager must choose an optimal time horizon where the certainty of the alpha is sufficient to justify a trade given the transactions costs.

The rebalancing decision depends on the tradeoff between transactions costs and the value added from changing the position. Portfolio managers must be aware of the existence of the no-trade region where the benefits are less than the costs. The benefit of adjusting the number of shares in a portfolio of a given asset is given by the following expression:

$$\text{marginal contribution to value added} = (\text{alpha of asset}) - [2 \times (\text{risk aversion}) \times (\text{active risk}) \times (\text{marginal contribution to active risk of asset})]$$

As long as this value is between the negative cost of selling and the cost of purchase, the manager would not trade that particular asset. In other words, the no-trade range is as follows:

$$-(\text{cost of selling}) < (\text{marginal contribution to value added}) < (\text{cost of purchase})$$

Rearranging this relationship with respect to alpha gives a no-trade range for alpha:

$$[2 \times (\text{risk aversion}) \times (\text{active risk}) \times (\text{marginal contribution to active risk})] - (\text{cost of selling}) < \text{alpha of asset} < [2 \times (\text{risk aversion}) \times (\text{active risk}) \times (\text{marginal contribution to active risk})] + (\text{cost of purchase})$$

The size of the no-trade region is determined by transactions costs, risk aversion, alpha and the riskiness of the assets.

PORTFOLIO CONSTRUCTION TECHNIQUES

LO 63.8: Evaluate the strengths and weaknesses of the following portfolio construction techniques: screens, stratification, linear programming, and quadratic programming.

The following four generic classes of procedures cover most of the applications of institutional portfolio construction techniques: screens, stratification, linear programming, and quadratic programming. In each case the goal is the same: high alpha, low active risk, and low transactions costs. The success of a manager is determined by the value they can add minus any transaction costs:

$$(\text{portfolio alpha}) - (\text{risk aversion}) \times (\text{active risk})^2 - (\text{transactions costs})$$

Screens

Screens are accomplished by ranking the assets by alpha, choosing the top performing assets, and composing either an equally weighted or capitalization-based weighted portfolio. Screens can also rebalance portfolios; for example, the manager can sort the universe of portfolios by alpha; then, (1) divide the universe of assets into buy, hold, and sell decisions based on the rankings, (2) purchase any assets on the buy list not currently in the existing portfolio, and (3) sell any stocks in the portfolio that are on the sell list.

Screens are easy to implement and understand. There is a clear link between the cause (being in the buy/hold/sell class) and the effect (being a part of the portfolio). This technique is also robust in that extreme estimates of alpha will not bias the outcome. It enhances return by selecting high-alpha assets and controls risk by having a sufficient number of assets for diversification. Shortcomings of screening include ignoring information within the rankings, the fact there will be errors in the rankings, and excluding those categories of assets that tend to have low alphas (e.g., utility stocks). Also, other than having a large number of assets for diversification, this technique does not properly address risk management motives.

Stratification

Stratification builds on screens by ensuring that each category or stratum of assets is represented in the portfolio. The manager can choose to categorize the assets by economic sectors and/or by capitalization. If there are five categories and three capitalization levels (i.e., small, medium and large), then there will be 15 mutually exclusive categories. The manager would employ a screen on each category to choose assets. The manager could then weight the assets from each category based on their corresponding weights in the benchmark.

Stratification has the same benefits as screening and one fewer shortcoming in that it has solved the problem of the possible exclusion of some categories of assets. However, this technique still suffers from possible errors in measuring alphas.

Linear Programming

Linear programming uses a type of stratification based on characteristics such as industry, size, volatility, beta, etc. without making the categories mutually exclusive. The linear programming methodology will choose the assets that produce a portfolio which closely resembles the benchmark portfolio. This technique can also include transactions costs, reduce turnover, and set position limits.

Linear programming's strength is that the objective is to create a portfolio that closely resembles the benchmark. However, the result can be very different from the benchmark with respect to the number of assets and some risk characteristics.

Quadratic Programming

Quadratic programming explicitly considers alpha, risk, and transactions costs. Like linear programming techniques, it can also incorporate constraints. Therefore, it is considered the ultimate approach in portfolio construction. This approach is only as good as its data, however, as there are many opportunities to make mistakes. Although a small mistake could lead to a large deviation from the optimal portfolio, this is not necessarily the case since small mistakes tend to cancel out in the overall portfolio.

The following loss function provides a measure that illustrates how a certain level of mistakes may only lead to a small loss, but the losses increase dramatically when the mistakes exceed a certain level:

$$\frac{\text{loss}}{\text{value added}} = \left[1 - \left[\frac{\text{actual market volatility}}{\text{estimated market volatility}} \right]^2 \right]^2$$

If actual market volatility is 20%, an underestimate of 1% will only produce a loss-to-value ratio of 0.0117. Underestimations of 2% and 3% will produce loss-to-value ratios equal to 0.055 and 0.1475, respectively. Thus, the increase in loss increases rapidly in response to given increases in error.

PORTFOLIO RETURN DISPERSION

LO 63.9: Describe dispersion, explain its causes and describe methods for controlling forms of dispersion.

Dispersion is a measure of how much each individual client's portfolio might be different from the composite returns reported by the manager. One measure is the difference between the maximum return and minimum return for separate account portfolios. The basic causes of dispersion are the different histories and cash flows of each of the clients.

Managers can control some forms of dispersion but unfortunately not all forms. One source of dispersion beyond the manager's control is the differing constraints that each client has (e.g., not being able to invest in derivatives or other classes of assets). Managers do, however, have the ability to control the dispersion caused by different betas since this dispersion

often results from the lack of proper supervision. If the assets differ between portfolios, the manager can control this source of dispersion by trying to increase the proportion of assets that are common to all the portfolios.

The existence of transactions costs implies that there is some optimal level of dispersion. To illustrate the role of transactions costs in causing dispersion, we will assume a manager has only one portfolio that is invested 60% stocks and 40% bonds. The manager knows the optimal portfolio is 62% stocks and 38% bonds, but transactions costs would reduce returns more than the gains from rebalancing the portfolio. If the manager acquires a second client, he can then choose a portfolio with weights 62% and 38% for that second client. Since one client has a 60/40 portfolio and the other has a 62/38 portfolio, there will be dispersion. Clearly, higher transactions costs can lead to a higher probability of dispersion.

A higher level of risk aversion and lower transactions costs leads to lower tracking error. Without transactions costs, there will be no tracking error or dispersion because all portfolios will be optimal. The following expression shows how dispersion is proportional to active risk:

$$E(\text{max portfolio return} - \text{min portfolio return}) = 2 \times N^{-1}(0.5^{1/J}) \times (\text{active risk})$$

where:

N^{-1} = inverse of the cumulative normal distribution function N

J = number of portfolios

Adding more portfolios will tend to increase the dispersion because there is a higher chance of an extreme value with more observations. Over time, as the portfolios are managed to pursue the same moving target, convergence will occur. However, there is no certainty as to the rate this might occur.

KEY CONCEPTS

LO 63.1

The inputs into the portfolio construction process are the current portfolio, the alphas, covariance estimates, transactions costs, and active risk aversion. With the exception of the current portfolio, all of these are subject to error and possible bias.

LO 63.2

Refining alpha is one method for including both investor constraints (e.g., no short selling) and manager constraints (e.g., proper diversification). Using refined alphas and then performing optimization can achieve the same goal as a complicated constrained optimization approach.

LO 63.3

Neutralization is the process of removing biases and undesirable bets from alphas.

Benchmark neutralization involves adjusting the benchmark alpha to zero. Cash neutralization eliminates the need for active cash management. Risk-factor neutralization neutralizes return dimensions that are only associated with risk and do not add value.

LO 63.4

Transactions costs have several implications. First, they may make it optimal not to adjust even in the face of new information. Second, transactions costs increase the importance of making alpha estimates more robust.

Including transactions costs can be complicated because they occur at one point in time, but the benefits of the portfolio adjustments are measured over the investment horizon.

LO 63.5

Practical issues in portfolio construction are the level of risk aversion, the optimal risk, and the alpha coverage. The inputs in computing the level of risk aversion need to be accurate. The aversion to a specific risk factor can help a manager address the risks of a position with a large potential loss and the dispersion across portfolios. Proper alpha coverage refers to addressing the case where the manager makes forecasts of stocks that are not in the benchmark and the manager not having forecasts for assets in the benchmark.

LO 63.6

In the process of portfolio revisions and rebalancing, there are tradeoffs between alpha, risk, transaction costs, and time horizon. The manager may wish to be conservative based on the uncertainties of the inputs. Also, the shorter the horizon, the more uncertain the alpha, which means the manager should choose an optimal time horizon where the certainty of the alpha is sufficient to justify a trade given the transactions costs.

LO 63.7

Because of transactions costs, there will be an optimal no-trade region when new information arrives concerning the alpha of an asset. That region would be determined by the level of risk aversion, active risk, the marginal contribution to active risk, and the transactions costs.

LO 63.8

Portfolio construction techniques include screens, stratification, linear programming, and quadratic programming. Stratification builds on screens, and quadratic programming builds on linear programming.

Screens simply choose assets based on raw alpha. Stratification first screens and then chooses stocks based on the screen and also attempts to include assets from all asset classes.

Linear programming attempts to construct a portfolio that closely resembles the benchmark by using such characteristics as industry, size, volatility, and beta. Quadratic programming builds on the linear programming methodology by explicitly considering alpha, risk, and transactions costs.

LO 63.9

For a manager with several portfolios, dispersion is the result of portfolio returns not being identical. The basic causes of dispersion are the different histories and cash flows of each of the clients. A manager can control this source of dispersion by trying to increase the proportion of assets that are common to all portfolios.

CONCEPT CHECKERS

1. The most measurable of the inputs into the portfolio construction process is(are) the:
 - A. position alphas.
 - B. transactions costs.
 - C. current portfolio.
 - D. active risk aversion.

2. Which of the following is correct with respect to adjusting the optimal portfolio for portfolio constraints?
 - A. No reliable method exists.
 - B. By refining the alphas and then optimizing, it is possible to include constraints of both the investor and the manager.
 - C. By refining the alphas and then optimizing, it is possible to include constraints of the investor, but not the manager.
 - D. By optimizing and then refining the alphas, it is possible to include constraints of both the investor and the manager.

3. An increase in which of the following factors will increase the no-trade region for the alpha of an asset?
 - I. Risk aversion.
 - II. Marginal contribution to active risk.
 - A. I only.
 - B. II only.
 - C. Both I and II.
 - D. Neither I nor II.

4. Which of the following statements most correctly describes a consideration that complicates the incorporation of transactions costs into the portfolio construction process?
 - A. The transactions costs and the benefits always occur in two distinct time periods.
 - B. The transactions costs are uncertain while the benefits are relatively certain.
 - C. There are no complicating factors from the introduction of transactions costs.
 - D. The transactions costs must be amortized over the horizon of the benefit from the trade.

5. A manager has forecasts of stocks A, B, and C, but not of stocks D and E. Stocks A, B, and D are in the benchmark portfolio. Stocks C and E are not in the benchmark portfolio. Which of the following are correct concerning specific weights the manager should assign in tracking the benchmark portfolio?
 - A. $w_C = 0$.
 - B. $w_D = 0$.
 - C. $w_C = (w_A + w_B)/2$.
 - D. $w_C = w_D = w_E$.

CONCEPT CHECKER ANSWERS

1. C The current portfolio is the only input that is directly observable.
2. B The approach of first refining alphas and then optimizing can replace even the most sophisticated portfolio construction process. With this technique both the investor and manager constraints are considered.
3. C This is evident from the definition of the no-trade region for the alpha of the asset.

$$[2 \times (\text{risk aversion}) \times (\text{active risk}) \times (\text{marginal contribution to active risk})] - (\text{cost of selling}) < \text{alpha of asset} < [2 \times (\text{risk aversion}) \times (\text{active risk}) \times (\text{marginal contribution to active risk})] + (\text{cost of purchase})$$
4. D A challenge is to correctly assign the transactions costs to projected future benefits. The transactions costs must be amortized over the horizon of the benefit from the trade. The benefits (e.g., the increase in alpha) occurs over time while the transactions costs generally occur at a specific time when the portfolio is adjusted.
5. A The manager should assign a tracking portfolio weight equal to zero for stocks for which there is a forecast but that are not in the benchmark. A weight should be assigned to Stock D, and it should be a function of the alphas of the other assets.

PORTFOLIO RISK: ANALYTICAL METHODS

Topic 64

EXAM FOCUS

Due to diversification, the value at risk (VaR) of a portfolio will be less than or equal to the sum of the VaRs of the positions in the portfolio. If all positions are perfectly correlated, then the portfolio VaR equals the sum of the individual VaRs. A manager can make optimal adjustments to the risk of a portfolio with such measures as marginal VaR, incremental VaR, and component VaR. This topic is highly quantitative. Be able to find the optimal portfolio using the excess-return-to-marginal VaR ratios. For the exam, understand how correlations impact the measure of portfolio VaR. Also, it is important that you know how to compute incremental VaR and component VaR using the marginal VaR measure. We have included several examples to help with application of these concepts.

Portfolio theory depends a lot on statistical assumptions. In finance, researchers and analysts often assume returns are normally distributed. Such an assumption allows us to express relationships in concise expressions such as beta. Actually, beta and other convenient concepts can apply if returns follow an elliptical distribution, which is a broader class of distributions that includes the normal distribution. In what follows, we will assume returns follow an elliptical distribution unless otherwise stated.

LO 64.1: Define, calculate, and distinguish between the following portfolio VaR measures: individual VaR, incremental VaR, marginal VaR, component VaR, undiversified portfolio VaR, and diversified portfolio VaR.



Professor's Note: LO 64.1 is addressed throughout this topic.

DIVERSIFIED PORTFOLIO VAR

Diversified VaR is simply the VaR of the portfolio where the calculation takes into account the diversification effects. The basic formula is:

$$\text{VaR}_p = Z_c \times \sigma_p \times P$$

where:

Z_c = the z-score associated with the level of confidence c

σ_p = the standard deviation of the portfolio return

P = the nominal value invested in the portfolio

Examining the formula for the variance of the portfolio returns is important because it reveals how the correlations of the returns of the assets in the portfolio affect volatility. The variance formula is:

$$\sigma_P^2 = \sum_{i=1}^N w_i^2 \sigma_i^2 + 2 \sum_{i=1}^N \sum_{j<i}^N w_i w_j \rho_{i,j} \sigma_i \sigma_j$$

where:

σ_P^2 = the variance of the portfolio returns

w_i = the portfolio weight invested in position i

σ_i = the standard deviation of the return in position i

$\rho_{i,j}$ = the correlation between the returns of asset i and asset j

The standard deviation, denoted σ_P , is:

$$\sigma_P = \sqrt{\sigma_P^2} = \sqrt{\sum_{i=1}^N w_i^2 \sigma_i^2 + 2 \sum_{i=1}^N \sum_{j<i}^N w_i w_j \rho_{i,j} \sigma_i \sigma_j}$$

Clearly, the variance and standard deviation are lower when the correlations are lower.

In order to calculate delta-normal VaR with more than one risk factor, we need a covariance matrix that incorporates correlations between each risk factor in the portfolio and volatilities of each risk factor. If we know the volatilities and correlations, we can derive the standard deviation of the portfolio and the corresponding VaR measure. We will discuss how to calculate VaR using matrix multiplication later in this topic.

Individual VaR is the VaR of an individual position in isolation. If the proportion or weight in the position is w_i , then we can define the individual VaR as:

$$\text{VaR}_i = Z_c \times \sigma_i \times |P_i| = Z_c \times \sigma_i \times |w_i| \times P$$

where:

P = the portfolio value

P_i = the nominal amount invested in position i

We use the absolute value of the weight because both long and short positions pose risk.

LO 64.2: Explain the role of correlation on portfolio risk.

In a two-asset portfolio, the equation for the standard deviation is:

$$\sigma_P = \sqrt{w_1^2 \sigma_1^2 + w_2^2 \sigma_2^2 + 2 w_1 w_2 \rho_{1,2} \sigma_1 \sigma_2}$$

and the VaR is:

$$\text{VaR}_P = Z_c P \sqrt{w_1^2 \sigma_1^2 + w_2^2 \sigma_2^2 + 2 w_1 w_2 \rho_{1,2} \sigma_1 \sigma_2}$$

We can square Z_c and P and put them under the square-root sign. This allows us to express VaR_p as a function of the VaRs of the individual positions, which we express as VaR_i for each position i . For a two-asset portfolio we will have VaR_1 and VaR_2 . If the correlation is zero, $\rho_{1,2} = 0$, then the third term under the radical is zero and:

$$\text{VaR for uncorrelated positions: } \text{VaR}_p = \sqrt{\text{VaR}_1^2 + \text{VaR}_2^2}$$

The other extreme is when the correlation is one, $\rho_{1,2} = 1$. If the correlation equals one, then there is no benefit from diversification. For the two-asset portfolio, we find:

$$\text{Undiversified VaR} = \text{VaR}_p = \sqrt{\text{VaR}_1^2 + \text{VaR}_2^2 + 2\text{VaR}_1\text{VaR}_2} = \text{VaR}_1 + \text{VaR}_2$$

In general, undiversified VaR is the sum of all the VaRs of the individual positions in the portfolio when none of those positions are short positions.

Notice how evaluating VaR using both a correlation of zero and a correlation of one will place a lower and upper bound on the total (or portfolio) VaR. Total VaR will be less if the positions are uncorrelated and greater if the positions are correlated. The following examples illustrate this point.

Example: Computing portfolio VaR (part 1)

An analyst computes the VaR for the two positions in her portfolio. The VaRs: $\text{VaR}_1 = \$2.4$ million and $\text{VaR}_2 = \$1.6$ million. **Compute** VaR_p if the returns of the two assets are uncorrelated.

Answer:

For uncorrelated assets:

$$\text{VaR}_p = \sqrt{\text{VaR}_1^2 + \text{VaR}_2^2} = \sqrt{(2.4^2 + 1.6^2)(\$ \text{millions})^2} = \sqrt{8.32(\$ \text{millions})^2}$$

$$\text{VaR}_p = \$2.8844 \text{ million}$$

Example: Computing portfolio VaR (part 2)

An analyst computes the VaR for the two positions in her portfolio. The VaRs: $\text{VaR}_1 = \$2.4$ million and $\text{VaR}_2 = \$1.6$ million. **Compute** VaR_p if the returns of the two assets are perfectly correlated.

Answer:

For perfectly correlated assets:

$$\text{VaR}_p = \text{VaR}_1 + \text{VaR}_2 = \$2.4 \text{ million} + \$1.6 \text{ million} = \$4 \text{ million}$$

Under certain assumptions, the portfolio standard deviation of returns for a portfolio with more than two assets has a very concise formula. The assumptions are:

- The portfolio is equally weighted.
- All the individual positions have the same standard deviation of returns.
- The correlations between each pair of returns are the same.

The formula is then:

$$\sigma_p = \sigma \sqrt{\frac{1}{N} + \left(1 - \frac{1}{N}\right)\rho}$$

where:

N = the number of positions

σ = the standard deviation that is equal for all N positions

ρ = the correlation between the returns of each pair of positions



Professor's Note: This formula greatly simplifies the process of having to calculate portfolio standard deviation with a covariance matrix.

To demonstrate the benefits of diversification, we can simply set up a 2×2 table where there is a small and large correlation (ρ) column and a small and large sample size (N) row. Assuming that the standard deviation of returns is 20% for both assets, we see how the portfolio variance is affected by the different inputs.

Figure 1: Portfolio Standard Deviation

<i>Sample size/correlation</i>	$\rho = 0.1$	$\rho = 0.5$
$N = 4$	$\sigma_p = 11.40\%$	$\sigma_p = 15.81\%$
$N = 10$	$\sigma_p = 8.72\%$	$\sigma_p = 14.83\%$

Example: Computing portfolio VaR (part 3)

A portfolio has five positions of \$2 million each. The standard deviation of the returns is 30% for each position. The correlations between each pair of returns is 0.2. Calculate the VaR using a Z-value of 2.33.

Answer:

The standard deviation of the portfolio returns is:

$$\sigma_P = 30\% \sqrt{\frac{1}{5} + \left(1 - \frac{1}{5}\right) 0.2}$$

$$\sigma_P = 30\% \sqrt{0.36}$$

$$\sigma_P = 18\%$$

The VaR in nominal terms is:

$$\text{VaR}_P = Z_c \times \sigma_P \times V = (2.33)(18\%)(\$10 \text{ million})$$

$$\text{VaR}_P = \$4,194,000$$

MARGINAL VaR

Marginal VaR applies to a particular position in a portfolio, and it is the *per unit change in a portfolio VaR that occurs from an additional investment in that position*. Mathematically speaking, it is the partial derivative of the portfolio VaR with respect to the position:

$$\text{Marginal VaR} = \text{MVaR}_i = \frac{\partial \text{VaR}_P}{\partial (\text{monetary investment in } i)} = Z_c \frac{\partial \sigma_P}{\partial w_i} = Z_c \frac{\text{cov}(R_i, R_P)}{\sigma_P}$$

Using CAPM methodology, we know a regression of the returns of a single asset i in a portfolio on the returns of the entire portfolio gives a beta, denoted β_i , which is a concise measure that includes the covariance of the position's returns with the total portfolio:

$$\beta_i = \frac{\text{cov}(R_i, R_P)}{\sigma_P^2}$$

Using the concept of beta gives another expression for marginal VaR:

$$\text{Marginal VaR} = \text{MVaR}_i = \frac{\text{VaR}_P}{\text{portfolio value}} \times \beta_i$$

Example: Computing marginal VaR

Assume Portfolio X has a VaR of €400,000. The portfolio is made up of four assets: Asset A, Asset B, Asset C, and Asset D. These assets are equally weighted within the portfolio and are each valued at €1,000,000. Asset A has a beta of 1.2. Calculate the marginal VaR of Asset A.

Answer

$$\text{Marginal VaR}_A = (\text{VaR}_P / \text{portfolio value}) \times \beta_A$$

$$\text{Marginal VaR}_A = (400,000 / 4,000,000) \times 1.2 = 0.12$$

Thus, portfolio VaR will change by 0.12 for each euro change in Asset A.

INCREMENTAL VaR

LO 64.3: Describe the challenges associated with VaR measurement as portfolio size increases.

Incremental VaR is the change in VaR from the addition of a new position in a portfolio. Since it applies to an entire position, it is generally larger than marginal VaR and may include nonlinear relationships, which marginal VaR generally assumes away. The problem with measuring incremental VaR is that, in order to be accurate, a full revaluation of the portfolio after the addition of the new position would be necessary. The incremental VaR is the difference between the new VaR from the revaluation minus the VaR before the addition. The revaluation requires not only measuring the risk of the position itself, but it also requires measuring the change in the risk of the other positions that are already in the portfolio. For a portfolio with hundreds or thousands of positions, this would be time consuming. Clearly, VaR measurement becomes more difficult as portfolio size increases given the expansion of the covariance matrix. Using a shortcut approach for computing incremental VaR would be beneficial.

For small additions to a portfolio, we can approximate the incremental VaR with the following steps:

- Step 1:* Estimate the risk factors of the new position and include them in a vector $[\eta]$.
- Step 2:* For the portfolio, estimate the vector of marginal VaRs for the risk factors $[\text{MVar}_j]$.
- Step 3:* Take the cross product.

This probably requires less work and is faster to implement because it is likely the managers already have estimates of the vector of MVar_j values in Step 2.

Before we take a look at how to calculate incremental VaR, let's review the calculation of delta-normal VaR using matrix notation (i.e., using a covariance matrix).

Example: Computing VaR using matrix notation

A portfolio consists of assets A and B. These assets are the risk factors in the portfolio. The volatilities are 6% and 14%, respectively. There are \$4 million and \$2 million invested in them, respectively. If we assume they are uncorrelated with each other, compute the VaR of the portfolio using a confidence parameter, Z, of 1.65.

Answer:

We can use matrix notation to derive the dollar variance of the portfolio:

$$\sigma_P^2 V^2 = \begin{bmatrix} \$4 & \$2 \end{bmatrix} \begin{bmatrix} 0.06^2 & 0 \\ 0 & 0.14^2 \end{bmatrix} \begin{bmatrix} \$4 \\ \$2 \end{bmatrix} = 0.0576 + 0.0784 = 0.136$$

This value is in (\$ millions)². VaR is then the square root of the portfolio variance times 1.65:

$$\text{VaR} = (1.65)(\$368,782) = \$608,490$$



Professor's Note: Matrix multiplication consists of multiplying each row by each column. For example: $(4 \times 0.06^2) + (2 \times 0) = 0.0144$; $0.0144 \times 4 = 0.0576$. Had the positions been positively correlated, some positive value would replace the zeros in the covariance matrix.

Example: Computing incremental VaR

A portfolio consists of assets A and B. The volatilities are 6% and 14%, respectively. There are \$4 million and \$2 million invested in them respectively. If we assume they are uncorrelated with each other, compute the incremental VaR for an increase of \$10,000 in Asset A. Assume a Z-score of 1.65.

Answer:

To find incremental VaR, we compute the per dollar covariances of each risk factor:

$$\begin{bmatrix} \text{cov}(R_A, R_P) \\ \text{cov}(R_B, R_P) \end{bmatrix} = \begin{bmatrix} 0.06^2 & 0 \\ 0 & 0.14^2 \end{bmatrix} \begin{bmatrix} \$4 \\ \$2 \end{bmatrix} = \begin{bmatrix} 0.0144 \\ 0.0392 \end{bmatrix}$$

These per dollar covariances represent the covariance of a given risk factor with the portfolio. Thus, we can substitute these values into the marginal VaR equations for the risk factors as follows.

The marginal VaRs of the two risk factors are:

$$MVaR_A = Z_c \times \frac{\text{cov}(R_A, R_P)}{\sigma_P} = 1.65 \times \frac{0.0144}{\sqrt{0.136}} = 0.064428$$

$$MVaR_B = Z_c \times \frac{\text{cov}(R_B, R_P)}{\sigma_P} = 1.65 \times \frac{0.0392}{\sqrt{0.136}} = 0.175388$$

Since the two assets are uncorrelated, the incremental VaR of an additional \$10,000 investment in Position A would simply be \$10,000 times 0.064428, or \$644.28.

COMPONENT VaR

Component VaR for position i , denoted $CVaR_i$, is the amount of risk a particular fund contributes to a portfolio of funds. It will generally be less than the VaR of the fund by itself (i.e., stand alone VaR) because of diversification benefits at the portfolio level. In a large portfolio with many positions, the approximation is simply the marginal VaR multiplied by the dollar weight in position i :

$$CVaR_i = (MVaR_i) \times (w_i \times P) = VaR \times \beta_i \times w_i$$

Using $CVaR_i$, we can express the total VaR of the portfolio as:

$$VaR = \sum_{i=1}^N CVaR_i = VaR \left(\sum_{i=1}^N w_i \times \beta_i \right)$$

Given the way the betas were computed we know:

$$\left(\sum_{i=1}^N w_i \times \beta_i \right) = 1$$

Example: Computing component VaR (Example 1)

Assume Portfolio X has a VaR of €400,000. The portfolio is made up of four assets: Asset A, Asset B, Asset C, and Asset D. These assets are equally weighted within the portfolio and are each valued at €1,000,000. Asset A has a beta of 1.2. Calculate the component VaR of Asset A.

Answer:

$$\text{Component VaR}_A = VaR_P \times \beta_A \times \text{asset weight}$$

$$\text{Component VaR}_A = 400,000 \times 1.2 \times (1,000,000 / 4,000,000) = €120,000$$

Thus, portfolio VaR will decrease by €120,000 if Asset A is removed.

Example: Computing component VaR (Example 2, Part 1)

Recall our previous incremental VaR example of a portfolio invested \$4 million in A and \$2 million in B. Using their respective marginal VaRs, 0.064428 and 0.175388, **compute** the component VaRs.

Answer:

$$CVaR_A = (MVaR_A) \times (w_A \times P) = (0.064428) \times (\$4 \text{ million}) = \$257,713$$

$$CVaR_B = (MVaR_B) \times (w_B \times P) = (0.175388) \times (\$2 \text{ million}) = \$350,777$$



Professor's Note: The values have been adjusted for rounding.

Example: Computing component VaR (Example 2, Part 2)

Using the results from the previous example, **compute** the percent of contribution to VaR of each component.

Answer:

The answer is the sum of the component VaRs divided into each individual component VaR:

$$\% \text{ contribution to VaR from A} = \frac{\$257,713}{(\$257,713 + \$350,777)} = 42.35\%$$

$$\% \text{ contribution to VaR from B} = \frac{\$350,777}{(\$257,713 + \$350,777)} = 57.65\%$$

Normal distributions are a subset of the class of distributions called elliptical distributions. As a class, elliptical distributions have fewer assumptions than normal distributions. Risk management often assumes elliptical distributions, and the procedures to estimate component VaRs up to this point have applied to elliptical distributions.

If the returns do not follow an elliptical distribution, we can employ other procedures to compute component VaR. If the distribution is homogeneous of degree one, for example, then we can use Euler's theorem to estimate the component VaRs. The return of a portfolio of assets is homogeneous of degree one because, for some constant, k , we can write:

$$k \times R_P = \sum_{i=1}^N k \times w_i \times R_i$$

The following steps can help us find component VaRs for a non-elliptical distribution using historical returns:

Step 1: Sort the historical returns of the portfolio.

Step 2: Find the return of the portfolio, which we will designate $R_{P(VaR)}$, that corresponds to a return that would be associated with the chosen VaR.

Step 3: Find the returns of the individual positions that occurred when $R_{P(VaR)}$ occurred.

Step 4: Use each of the position returns associated with $R_{P(VaR)}$ for component VaR for that position.

To improve the estimates of the component VaRs, an analyst should probably obtain returns for each individual position for returns of the portfolio slightly above and below $R_{P(VaR)}$. For each set of returns for each position, the analyst would compute an average to better approximate the component VaR of the position.

MANAGING PORTFOLIOS USING VAR

LO 64.4: Apply the concept of marginal VaR to guide decisions about portfolio VaR.

LO 64.5: Explain the risk-minimizing position and the risk and return-optimizing position of a portfolio.

A manager can *lower a portfolio VaR by lowering allocations to the positions with the highest marginal VaR*. If the manager keeps the total invested capital constant, this would mean increasing allocations to positions with lower marginal VaR. Portfolio risk will be at a global minimum where all the marginal VaRs are equal for all i and j :

$$MVaR_i = MVaR_j$$

We can use our earlier example to see how we can use marginal VaRs to make decisions to lower the risk of the entire portfolio. In the earlier example, Position A has the smaller MVaR; therefore, we will compute the marginal VaRs and total VaR for a portfolio which has \$5 million invested in A and \$1 million in B. The portfolio variance is:

$$\sigma_P^2 V^2 = \begin{bmatrix} \$5 & \$1 \end{bmatrix} \begin{bmatrix} 0.06^2 & 0 \\ 0 & 0.14^2 \end{bmatrix} \begin{bmatrix} \$5 \\ \$1 \end{bmatrix} = 0.0900 + 0.0196 = 0.1096$$

This value is in (\$ millions)². VaR is then the square root of the portfolio variance times 1.65 (95% confidence level):

$$VaR = (1.65)(\$331,059) = \$546,247$$

The VaR of \$546,247 is less than the VaR of \$608,490, which was produced when Portfolio A had a lower weight. We can see that the marginal VaRs are now much closer in value:

$$\begin{bmatrix} \text{cov}(R_A, R_P) \\ \text{cov}(R_B, R_P) \end{bmatrix} = \begin{bmatrix} 0.06^2 & 0 \\ 0 & 0.14^2 \end{bmatrix} \begin{bmatrix} \$5 \\ \$1 \end{bmatrix} = \begin{bmatrix} 0.0180 \\ 0.0196 \end{bmatrix}$$

The marginal VaRs of the two positions are:

$$MVaR_A = Z_c \times \frac{\text{cov}(R_A, R_P)}{\sigma_P} = 1.65 \times \frac{0.0180}{\sqrt{0.1096}} = 0.08971$$

$$MVaR_B = Z_c \times \frac{\text{cov}(R_B, R_P)}{\sigma_P} = 1.65 \times \frac{0.0196}{\sqrt{0.1096}} = 0.09769$$

LO 64.6: Explain the difference between risk management and portfolio management, and describe how to use marginal VaR in portfolio management.

As the name implies, risk management focuses on risk and ways to reduce risk; however, minimizing risk may not produce the optimal portfolio. Portfolio management requires assessing both risk measures and return measures to choose the optimal portfolio.

Traditional efficient frontier analysis tells us that the minimum variance portfolio is not optimal. We should note that the **efficient frontier** is the plot of portfolios that have the lowest standard deviation for each expected return (or highest return for each standard deviation) when plotted on a plane with the vertical axis measuring return and the horizontal axis measuring the standard deviation. The optimal portfolio is represented by the point where a ray from the risk-free rate is just tangent to the efficient frontier. That optimal portfolio has the highest Sharpe ratio:

$$\text{Sharpe ratio} = \frac{(\text{portfolio return} - \text{risk-free rate})}{(\text{standard deviation of portfolio return})}$$

We can modify this formula by replacing the standard deviation with VaR so that the focus then becomes the excess return of the portfolio over VaR:

$$\frac{(\text{portfolio return} - \text{risk-free rate})}{(\text{VaR of portfolio})}$$

This ratio is maximized when the excess return in each position divided by its respective marginal VaR equals a constant. In other words, at the optimum:

$$\frac{(\text{Position } i \text{ return} - \text{risk-free rate})}{(MVaR_i)} = \frac{(\text{Position } j \text{ return} - \text{risk-free rate})}{(MVaR_j)}$$

for all positions i and j



Professor's Note: Equating the excess return/MVaR ratios will obtain the optimal portfolio. This differs from equating just the MVaRs, which obtains the portfolio with the lowest portfolio VaR.

Assuming that the returns follow elliptical distributions, we can represent the condition in a more concise fashion by employing betas, β_i , which are obtained from regressing each position's return on the portfolio return:

$$\frac{(\text{Position } i \text{ return} - \text{risk-free rate})}{\beta_i} = \frac{(\text{Position } j \text{ return} - \text{risk-free rate})}{\beta_j}$$

for all positions i and j

The portfolio weights that make these ratios equal will be the optimal portfolio. We now turn our attention to determining the optimal portfolio for our example portfolio of A and B. We will assume the expected excess return of A is 6% and that of B is 11%. Even without this information, we should know that the optimal portfolio will have an allocation in A less than \$5 million and in B greater than \$1 million. This is because the marginal VaRs were almost equal with those allocations. *Thus, the resulting portfolio would be close to the minimum variance*, which will not be optimal. We might want to find out how to adjust the allocation with respect to the original values of \$4 million in A and \$2 million in B. By comparing the ratios of the two assets we find:

$$\frac{\text{Excess return of A}}{\text{MVar}_A} = \frac{0.06}{0.064428} = 0.9313$$

$$\frac{\text{Excess return of B}}{\text{MVar}_B} = \frac{0.11}{0.175388} = 0.6272$$

We see that there is too much allocated in B. Before we adjust the portfolio, we compute the excess-return-to-VaR ratio for the entire portfolio. The return is:

$$\% \text{ excess return on portfolio} = 7.67\% = \frac{\$4 \text{ million}}{\$6 \text{ million}}(6\%) + \frac{\$2 \text{ million}}{\$6 \text{ million}}(11\%)$$

The return to VaR (scaled by the size of the portfolio) is:

$$0.7559 = \frac{0.0767}{\$608,490} \times \$6 \text{ million}$$

Now, because the return to MVar ratio was greater for A, we will increase the allocation in A to \$4.5 million and decrease that in B to \$1.5 million. With those changes, the portfolio variance is:

$$\sigma_P^2 V^2 = \begin{bmatrix} \$4.5 & \$1.5 \end{bmatrix} \begin{bmatrix} 0.06^2 & 0 \\ 0 & 0.14^2 \end{bmatrix} \begin{bmatrix} \$4.5 \\ \$1.5 \end{bmatrix} = 0.0729 + 0.0441 = 0.1170$$

This value is in (\$ millions)². VaR is then the square root of the portfolio variance times 1.65 (95% confidence level):

$$\text{VaR} = (1.65)(\$342,053) = \$564,387$$

In this case, the marginal VaRs are found by:

$$\begin{bmatrix} \text{cov}(R_A, R_P) \\ \text{cov}(R_B, R_P) \end{bmatrix} = \begin{bmatrix} 0.06^2 & 0 \\ 0 & 0.14^2 \end{bmatrix} \begin{bmatrix} \$4.5 \\ \$1.5 \end{bmatrix} = \begin{bmatrix} 0.0162 \\ 0.0294 \end{bmatrix}$$

The marginal VaRs of the two positions are then:

$$\text{MVaR}_A = Z_c \times \frac{\text{cov}(R_A, R_P)}{\sigma_P} = 1.65 \times \frac{0.0162}{\sqrt{0.1170}} = 0.0781$$

$$\text{MVaR}_B = Z_c \times \frac{\text{cov}(R_B, R_P)}{\sigma_P} = 1.65 \times \frac{0.0294}{\sqrt{0.1170}} = 0.1418$$

We see the expected excess-return-to-marginal VaR ratios are much closer:

$$\frac{0.06}{0.0781} = 0.7678$$

$$\frac{0.11}{0.1418} = 0.7756$$

The portfolio return is now:

$$\% \text{ excess return on portfolio} = 7.25\% = \frac{\$4.5 \text{ million}}{\$6 \text{ million}}(6\%) + \frac{\$1.5 \text{ million}}{\$6 \text{ million}}(11\%)$$

The portfolio return divided by the portfolio VaR has risen. The return to VaR (scaled by the size of the portfolio) is:

$$0.7707 = \frac{0.0725}{\$564,387} \times \$6 \text{ million}$$

This is greater than the 0.7559 value associated with the original \$4 million and \$2 million allocations. The result is a more optimal portfolio allocation.

KEY CONCEPTS

LO 64.1

Diversified VaR is simply the VaR of the portfolio where the calculation takes into account the diversification effects.

Individual VaR is the VaR of an individual position in isolation.

Diversified VaR is simply the VaR of the portfolio where the calculation takes into account the diversification effects. The basic formula is:

$$\text{VaR}_P = Z_c \times \sigma_P \times P$$

where:

Z_c = the z-score associated with the level of confidence c

σ_P = the standard deviation of the portfolio return

P = the nominal value invested in the portfolio

Individual VaR is the VaR of an individual position in isolation. If the proportion or weight in the position is w_i , then we can define the individual VaR as:

$$\text{VaR}_i = Z_c \times \sigma_i \times |P_i| = Z_c \times \sigma_i \times |w_i| \times P$$

where:

P = the portfolio value

P_i = the nominal amount invested in position i

Marginal VaR is the change in a portfolio VaR that occurs from an additional one unit investment in a given position. Useful representations are:

$$\text{Marginal VaR} = \text{MVar}_i = Z_c \frac{\text{cov}(R_i, R_P)}{\sigma_P}$$

$$\text{Marginal VaR} = \text{MVar}_i = \frac{\text{VaR}}{P} \times \beta_i$$

Incremental VaR is the change in VaR from the addition of a new position in a portfolio. It can be calculated precisely from a total revaluation of the portfolio, but this can be costly. A less costly approximation is found by (1) breaking down the new position into risk factors, (2) multiplying each new risk factor times the corresponding partial derivative of the portfolio with respect to the risk factor, and then (3) adding up all the values.

Component VaR for position i , denoted CVaR_i , is the amount a portfolio VaR would change from deleting that position in a portfolio. In a large portfolio with many positions, the approximation is simply the marginal VaR multiplied by the dollar weight in position i :

$$\text{CVaR}_i = (\text{MVar}_i) \times (w_i \times P) = \text{VaR} \times \beta_i \times w_i$$

There is a method for computing component VaRs for distributions that are not elliptical. The procedure is to sort the historical returns of the portfolio and designate a portfolio return that corresponds to the loss associated with the VaR and then find the returns of each of the components associated with that portfolio loss. Those position returns can be used to compute component VaRs.

LO 64.2

For a two-asset portfolio, two special cases are:

1. VaR for uncorrelated positions:

$$\text{VaR}_P = \sqrt{\text{VaR}_1^2 + \text{VaR}_2^2}$$

2. VaR for perfectly correlated positions:

$$\text{Undiversified VaR} = \text{VaR}_P = \sqrt{\text{VaR}_1^2 + \text{VaR}_2^2 + 2\text{VaR}_1\text{VaR}_2} = \text{VaR}_1 + \text{VaR}_2$$

LO 64.3

The incremental VaR is the difference between the new VaR from the revaluation minus the VaR before the addition. The revaluation requires not only measuring the risk of the position itself, but it also requires measuring the change in the risk of the other positions that are already in the portfolio. For a portfolio with hundreds or thousands of positions, this would be time consuming.

LO 64.4

Portfolio risk will be at a global minimum where all the marginal VaRs are equal for all i and j :

$$\text{MVar}_i = \text{MVar}_j$$

LO 64.5

Equating the MVarS will obtain the portfolio with the lowest portfolio VaR. Equating the excess return/MVaR ratios will obtain the optimal portfolio.

LO 64.6

The optimal portfolio is the one for which all excess-return-to-marginal VaR ratios are equal:

$$\frac{(\text{Position } i \text{ return} - \text{risk-free rate})}{(\text{MVar}_i)} = \frac{(\text{Position } j \text{ return} - \text{risk-free rate})}{(\text{MVar}_j)}$$

CONCEPT CHECKERS

1. Which of the following is the best synonym for diversified VaR?
 - A. Vector VaR.
 - B. Position VaR.
 - C. Portfolio VaR.
 - D. Incidental VaR.

2. When computing individual VaR, it is proper to:
 - A. use the absolute value of the portfolio weight.
 - B. use only positive weights.
 - C. use only negative weights.
 - D. compute VaR for each asset within the portfolio.

3. A portfolio consists of two positions. The VaR of the two positions are \$10 million and \$20 million. If the returns of the two positions are not correlated, the VaR of the portfolio would be closest to:
 - A. \$5.48 million.
 - B. \$15.00 million
 - C. \$22.36 million.
 - D. \$25.00 million.

4. Which of the following is true with respect to computing incremental VaR? Compared to using marginal VaRs, computing with full revaluation is:
 - A. more costly, but less accurate.
 - B. less costly, but more accurate.
 - C. less costly, but also less accurate.
 - D. more costly, but also more accurate.

5. A portfolio has an equal amount invested in two positions, X and Y. The expected excess return of X is 9% and that of Y is 12%. Their marginal VaRs are 0.06 and 0.075, respectively. To move toward the optimal portfolio, the manager will probably:
 - A. increase the allocation in Y and/or lower that in X.
 - B. increase the allocation in X and/or lower that in Y.
 - C. do nothing because the information is insufficient.
 - D. not change the portfolio because it is already optimal.

CONCEPT CHECKER ANSWERS

1. C Portfolio VaR should include the effects of diversification. None of the other answers are types of VaRs.
2. A The expression for individual VaR is $VaR_i = Z_c \times \sigma \times |P_i| = Z \times \sigma_i \times |w_i| \times P$. The absolute value signs indicate that we need to measure the risk of both positive and negative positions, and risk cannot be negative.
3. C For uncorrelated positions, the answer is the square root of the sum of the squared VaRs:

$$VaR_p = \sqrt{10^2 + 20^2} \times (\$ \text{ million}) = \$22.36 \text{ million.}$$
4. D Full revaluation means recalculating the VaR of the entire portfolio. The marginal VaRs are probably already known, so using them is probably less costly, but will not be as accurate.
5. A The expected excess-return-to-MVaR ratios for X and Y are 1.5 and 1.6, respectively. Therefore, the portfolio weight in Y should increase to move the portfolio toward the optimal portfolio.

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

VaR AND RISK BUDGETING IN INVESTMENT MANAGEMENT

Topic 65

EXAM FOCUS

Banks on the “sell side” of the investment industry have long used risk budgeting and value at risk (VaR). There is a trend for the “buy side” investment firms to increasingly use VaR. One reason for increased demand for risk budgeting is the increased complexity, dynamics, and globalization of the investment industry. Use of VaR can help set better guidelines than more traditional limits. By measuring marginal and incremental VaRs, a manager can make better decisions concerning portfolio weights. For the exam, be comfortable with the concept of surplus at risk (SaR). Also, understand how to budget risk across asset classes and active managers.

RISK BUDGETING

LO 65.1: Define risk budgeting.

Risk budgeting is a top-down process that involves choosing and managing exposures to risk. The main idea is that the risk manager establishes a risk budget for the entire portfolio and then allocates risk to individual positions based on a predetermined fund risk level. The risk budgeting process differs from market value allocation since it involves the allocation of risk.

MANAGING RISK WITH VaR

LO 65.2: Describe the impact of horizon, turnover and leverage on the risk management process in the investment management industry.

The “sell side” of the investment industry largely consists of banks that have developed VaR techniques and have used them for many years. Investors make up the “buy side” of the investment industry. Investors are now using VaR techniques, but they have to adapt them to the different nature of that side of the business. To understand why the needs are different, we should compare the characteristics of the two “sides.” Figure 1 makes direct comparisons.

Figure 1: Sell Side and Buy Side Characteristics

<i>Characteristic</i>	<i>Sell Side</i>	<i>Buy Side</i>
Horizon	Short-term (days)	Long-term (month or more)
Turnover	Fast	Slow
Leverage	High	Low
Risk measures	VaR Stress tests	Asset allocation Tracking error
Risk controls	Position limits VaR limits Stop-loss rules	Diversification Benchmarking Investment guidelines

Banks trade rapidly, which is why they cannot rely on traditional measures of risk that are based on historical data. For banks, yesterday's risk may not have anything to do with today's positions. Investors usually try to hold positions for longer periods of time (e.g., years).

Having a more dynamic method for measuring risk such as VaR is also important for banks because of their high leverage. Institutional investors often have much stronger constraints with respect to leverage; therefore, they have a much lower need to control downside risk.

THE INVESTMENT PROCESS

LO 65.3: Describe the investment process of large investors such as pension funds.

The *first step* in the investment process is to determine the long-term, strategic asset allocations. Usually, the goal of the first step is to balance returns and risks using methods like mean-variance portfolio optimization. This step determines the allocations to asset classes such as domestic and foreign stocks, domestic and foreign bonds, and alternative investments such as real estate, venture capital, and hedge funds. Making this allocation relies on passive indices and other benchmarks to help measure the properties of the investment, and the availability of passive indices helps make the allocations feasible.

The *second step* in the investment process is to choose the managers who may either passively manage the fund (i.e., simply track the benchmarks) or actively manage the fund in an effort to outperform the benchmarks. The investors should review the managers' activities and performance periodically. Their activities should conform to a list of guidelines, which includes the types of investments and risk exposure restrictions such as beta and duration. Managers' performance can be evaluated by analyzing their tracking error.

VaR risk management systems are beginning to become more important because of the globalization of available investments and the increased complexity of investments. Also, investment companies are becoming more dynamic, which makes it more difficult to assess risk. With many managers, for example, each of the managers may make changes within his constraints, but the collective changes could be difficult to gauge with historical measures. In sum, because of increased globalization, complexity, and the dynamic nature of the investment industry, simply measuring risk using historical measures is no longer adequate, which has increased the need for VaR.

HEDGE FUND ISSUES

LO 65.4: Describe the risk management challenges associated with investments in hedge funds.

Hedge funds are a very heterogeneous class of assets that include a variety of trading strategies. Since they often use leverage and trade a great deal, their risk characteristics may be more similar to the “sell side” of the industry. Hedge funds have some other risks like liquidity and low transparency. Liquidity risk has many facets. First, there is the obvious potential loss from having to liquidate too quickly. Second, there is the difficulty of measuring the exact value of the fund to be able to ascertain its risk. Furthermore, the low liquidity tends to lower the volatility of historical prices as well as the correlations of the positions. These properties will lead to an underestimation of traditional measures of risk. In addition to these risks, there is the low level of transparency. This makes the risk measurement difficult with respect to both the size and type. Not knowing the type of risk increases the difficulty of risk management for the entire portfolio in which an investor might include hedge funds.

ABSOLUTE VS. RELATIVE RISK AND POLICY MIX VS. ACTIVE RISK

LO 65.5: Distinguish among the following types of risk: absolute risk, relative risk, policy-mix risk, active management risk, funding risk and sponsor risk.

Absolute or asset risk refers to the total possible losses over a horizon. It is simply measured by the return over the horizon. **Relative risk** is measured by excess return, which is the dollar loss relative to a benchmark. The shortfall is measured as the difference between the fund return and that of a benchmark in dollar terms. VaR techniques can apply to tracking error (i.e., standard deviation of excess return) if the excess return is normally distributed.



Professor's Note: The author's definition of tracking error differs from the definition of tracking error in other assigned readings. Jorion defines tracking error as active return minus the benchmark return. In other readings, this value is simply the excess return and tracking error is the volatility (i.e., standard deviation) of the excess return. Throughout this topic, we have expressed excess return as portfolio return minus benchmark return and tracking error as the volatility of the excess return. This methodology follows the definition of tracking error on previous FRM exams.

Distinguishing policy mix from active risk is important when an investment firm allocates funds to different managers in various asset classes. This breaks down the risk of the total portfolio into that associated with the target policy (i.e., the weights assigned to the various funds in the policy) and the risk from the fact that managers may make decisions which lead to deviations from the designated weights. VaR analysis is especially useful here because it can show the risk exposure associated with the two types of risk and how they affect the overall risk of the entire portfolio. Often, active management risk is not much of a problem for several reasons:

- For well-managed funds, it is usually fairly small for each of the individual funds.

- There will be diversification effects across the deviations.
- There can be diversification effects with the policy mix VaR to actually lower the total portfolio VaR.

FUNDING RISK

Funding risk refers to being able to meet the obligations of an investment company (e.g., a pension's payout to retirees). Put another way, funding risk is the risk that the value of assets will not be sufficient to cover the liabilities of the fund. The level of funding risk varies dramatically across different types of investment companies. Some have zero, while defined benefit pension plans have the highest.

The focus of this analysis is the surplus, which is the difference between the value of the assets and the liabilities, and the change in the surplus, which is the difference between the change in the assets and liabilities:

$$\text{Surplus} = \text{Assets} - \text{Liabilities}$$

$$\Delta \text{Surplus} = \Delta \text{Assets} - \Delta \text{Liabilities}$$

Typically, in managing funding risk, an analyst will transform the nominal return on the surplus into a return on the assets, and break down the return as indicated:

$$R_{\text{surplus}} = \frac{\Delta \text{Surplus}}{\text{Assets}} = \frac{\Delta \text{Assets}}{\text{Assets}} - \left(\frac{\Delta \text{Liabilities}}{\text{Liabilities}} \right) \left(\frac{\text{Liabilities}}{\text{Assets}} \right) = R_{\text{asset}} - R_{\text{liabilities}} \left(\frac{\text{Liabilities}}{\text{Assets}} \right)$$

Evaluating this expression requires assumptions about the liabilities, which are in the future and uncertain. For pension funds, liabilities represent “accumulated benefit obligations,” which are the present value of pension benefits owed to the employees and other beneficiaries. Determining the present value requires a discount rate, which is usually tied to some current level of interest rates in the market. An ironic aspect of funding risk is that assets for meeting the obligations like equities and bonds usually increase in value when interest rates decline, but the present value of future obligations may increase even more. When assets and liabilities change by different amounts, this affects the surplus, and the resulting volatility of the surplus is a source of risk. If the surplus turns negative, additional contributions will be required. This is called **surplus at risk (SaR)**.

One answer to this problem is to immunize the portfolio by making the duration of the assets equal that of the liabilities. This may not be possible since the necessary investments may not be available, and it may not be desirable because it may mean choosing assets with a lower return.

Example: Determining a fund's risk profile

The XYZ Retirement Fund has \$200 million in assets and \$180 million in liabilities. Assume that the expected return on the surplus, scaled by assets, is 4%. This means the surplus is expected to grow by \$8 million over the first year. The volatility of the surplus is 10%. Using a Z-score of 1.65, compute VaR and the associated deficit that would occur with the loss associated with the VaR.

Answer:

First, we calculate the expected value of the surplus. The current surplus is \$20 million (= \$200 million – \$180 million). It is expected to grow another \$8 million to a value of \$28 million. As for the VaR:

$$\text{VaR} = (1.65)(10\%)(\$200 \text{ million}) = \$33 \text{ million}$$

If this decline in value occurs, the deficit would be the difference between the VaR and the expected surplus value: \$33 million – \$28 million = \$5 million.



Professor's Note: According to the assigned reading, the surplus at risk (SaR) is the VaR amount calculated above. Note that SaR on previous exams has been approached differently, as illustrated in the following example. Be prepared for either approach on the actual exam. In the example to follow, we will illustrate how to calculate the volatility of surplus growth. On previous FRM exams, this value has not been provided.

Example: Surplus at risk (via computing volatility of surplus)

The XYZ Retirement Fund has \$200 million in assets and \$180 million in liabilities. Assume that the expected annual return on the assets is 4% and the expected annual growth of the liabilities is 3%. Also assume that the volatility of the asset return is 10% and the volatility of the liability growth is 7%. Compute 95% surplus at risk assuming the correlation between asset return and liability growth is 0.4.

Answer:

First, compute the expected surplus growth:

$$200 \times (0.04) - 180 \times (0.03) = \$2.6 \text{ million}$$

Next, compute the volatility of the surplus growth. To compute the volatility you need to recall one of the properties of covariance discussed in the FRM Part I curriculum. The variance of assets minus liabilities [i.e., $\text{Var}(A-L)$] = $\text{Var}(A) + \text{Var}(L) - 2 \times \text{Cov}(A,L)$. Where covariance is equal to the standard deviation of assets times the standard deviation of liabilities times the correlation between the two. The asset and liability amounts will also need to be applied to this formula.

$$\begin{aligned}\text{Variance}(A-L) &= 200^2 \times 0.10^2 + 180^2 \times 0.07^2 - 2 \times 200 \times 180 \times 0.10 \times 0.07 \times 0.4 \\ &= 400 + 158.76 - 201.6 = \$357.16 \text{ million}\end{aligned}$$

$$\text{Standard deviation} = \sqrt{357.16} = \$18.89$$

Thus, SaR can be calculated by incorporating the expected surplus growth and standard deviation of the growth.

$$95\% \text{ SaR} = 2.6 - 1.65 \times 18.89 = \$28.57 \text{ million}$$



Professor's Note: Like VaR, SaR is a negative value since it is the surplus amount that is at risk. As a result, the negative sign is usually not presented since a negative amount is implied.

PLAN SPONSOR RISK

The plan sponsor risk is an extension of surplus risk and how it relates to those who ultimately bear responsibility for the pension fund. We can distinguish between the following risk measures:

- **Economic risk** is the variation in the total economic earnings of the plan sponsor. This takes into account how the risks of the various components relate to each other (e.g., the correlation between the surplus and operating profits).
- **Cash-flow risk** is the variation of contributions to the fund. Being able to absorb fluctuations in cash flow allows for a more volatile risk profile.

Ultimately, from the viewpoint of the sponsor, the focus should be on the variation of the economic value of the firm. The management should integrate the various risks associated with the movement of the assets and surplus with the overall financial goals of the sponsor. This is aligned with the current emphasis on enterprise-wide risk management.

MONITORING RISK WITH VAR

LO 65.6: Apply VaR to check compliance, monitor risk budgets and reverse engineer sources of risk.

There are many types of risks that can increase dramatically in a large firm. For example, the “rogue trader” phenomenon is more likely in a large firm. This occurs when a manager of one of the accounts or funds within the larger portfolio deviates from her guidelines

in terms of portfolio weights or even trades in unauthorized investments. Such deviations from compliance can be very short-term, and regular reporting measures may not catch the violations.

Risk management is necessary for all types of portfolios—even passively managed portfolios. Some analysts erroneously believe that passive investing, or benchmarking, does not require risk monitoring. This is not true because the risk profiles of the benchmarks change over time. In the late 1990s, a portfolio benchmarked to the S&P 500 would clearly have seen a change in risk exposures (e.g., an increase in the exposure to risks associated with the high-tech industry). A forward-looking risk measurement system would pick up on such trends.

Monitoring the risk of actively managed portfolios should help identify the reasons for changes in risk. Three explanations for dramatic changes in risk are (1) a manager taking on more risk, (2) different managers taking similar bets, and (3) more volatile markets. Thus, when there is an increase in the overall risk of a portfolio, top management would want to investigate the increase by asking the following questions.

Has the manager exceeded her risk budget? VaR procedures and risk management can allocate a risk budget to each manager. The procedures should give an indication if and why the manager exceeds the risk budget. Is it a temporary change from changes in the market? Has the manager unintentionally let the weights of the portfolio drift so as to increase risk? Or, more seriously, has the manager engaged in unauthorized trades?

Are managers taking too many of the same style bets? If the managers are acting independently, it is possible that they all start pursuing strategies with the same risk exposures. This could happen, for example, if all managers forecast lower interest rates. Bond managers would probably begin moving into long-term bonds, and equity managers would probably begin moving into stocks that pay a high and stable dividend like utility companies and REITs. This would drastically increase the interest rate risk of the overall portfolio.

Have markets become more volatile? If the risk characteristics of the entire market have changed, top management will have to decide if it is worth accepting the volatility or make decisions to reduce it by changing the target portfolio weights.

VaR can also be reverse engineered by utilizing the VaR tools outlined in the previous topic, such as component VaR and marginal VaR. These tools provide insight on how the overall portfolio will be affected by individual position changes. This method can be used provided that all relevant risks have been identified within the risk management system.

In the risk management process, there is a problem with measuring the risk of some unique asset classes like real estate, hedge funds, and venture capital. Also, there may be limited information on investments in a certain class (e.g., emerging markets and initial public offerings).

There is a trend in the investment industry toward management choosing a global custodian for the firm. Such a choice means an investor aggregates the portfolios with a single custodian, which more easily allows a consolidated picture of the total exposures of the fund. The custodian can combine reports on changes in positions with market data to produce forward-looking risk measures. Thus, the global custodian is an easy choice in pursuing centralized risk management. Along with the trend toward global custodians,

there has been a trend in the “custodian industry” toward fewer custodians that can provide more services. Large custodian banks such as Citibank, Deutsche Bank, and State Street are providing risk management products.

Those that choose not to use a global custodian have done so because they feel that they have a tighter control over risk measures and can better incorporate VaR systems into operations. There are often economies of scale for larger firms in that they can spread the cost of risk management systems over a large asset base. Also, they can require tighter control when their assets are partly managed internally.

Increasingly, clients are asking money managers about their risk management systems. The clients are no longer satisfied with quarterly performance reports. Many investment managers have already incorporated VaR systems into their investment management process. Widely used risk standards for institutional investors recommend measuring the risk of the overall portfolio and measuring the risk of each instrument. It may be the case that those who do not have comprehensive risk management systems will soon be at a significant disadvantage to those who do have such systems. There also seems to be some attempt by managers to differentiate themselves with respect to risk management.

VAR APPLICATIONS

LO 65.7: Explain how VaR can be used in the investment process and the development of investment guidelines.

Investment Guidelines

VaR can help move away from the ad hoc nature and overemphasis on notionals and sensitivities that characterize the guidelines many managers now use. Clearly, ad hoc procedures will generally be inferior to formal guidelines using established principles. Also, limits on notionals and sensitivities have proven insufficient when leverage and positions in derivatives exist. The limits do not account for variations in risk nor correlations. VaR limits include all of these factors.

The problem with controlling positions and not risk is that there are many rules and restrictions, which in the end may not achieve the main goal. There is no measure of the possible losses that can occur in a given time period—a good quantity to identify in order to know how much capital to have on hand to meet liquidity needs. Furthermore, simple restrictions on certain positions can be easily evaded with the many instruments that are now available. As a wider range of products develop, obviously, the traditional and cumbersome position-by-position guidelines will become even less effective.

Investment Process

VaR can help in the first step of the investment process, which is the strategic asset-allocation decision. Since this step usually uses mean-variance analysis, as does the most basic VaR measures, VaR can help in the portfolio allocation process. Furthermore, VaR can

measure specific changes in risk that can result as managers subjectively adjust the weights from those recommended by pure quantitative analysis.

VaR is also useful at the trading level. A trader usually focuses on the return and stand-alone risk of a proposed position. The trader may have some idea of how the risk of the position will affect the overall portfolio, but an adequate risk management system that uses VaR can give a specific estimate of the change in risk. In fact, the risk management system should stand ready to automatically calculate the marginal VaR of each existing position and proposed position. When the trader has the choice between adding one of two positions with similar return characteristics, the trader would choose the one with the lower marginal VaR. VaR methodology can help make choices between different assets too. The optimal portfolio will be the one that has the excess-return-to-marginal VaR ratios equal for all asset types, as seen in the previous topic. Thus, when a trader is searching for the next best investment, the trader will look at securities in the asset classes that currently have the higher returns-to-marginal-VaR ratios.

BUDGETING RISK

LO 65.8: Describe the risk budgeting process and calculate risk budgets across asset classes and active managers.

Risk budgeting should be a top down process. The first step is to determine the total amount of risk, as measured by VaR, that the firm is willing to accept. The next step is to choose the optimal allocation of assets for that risk exposure. As an example, a firm's management might set a return volatility target equal to 20%. If the firm has \$100 million in assets under management and assuming the returns are normally distributed, at a 95% confidence level, this translates to:

$$\text{VaR} = (1.65) \times (20\%) \times (\$100 \text{ million}) = \$33 \text{ million}$$

The goal will be to choose assets for the fund that keep VaR less than this value. Unless the asset classes are perfectly correlated, the sum of the VaRs of the individual assets will be greater than the actual VaR of the portfolio. Thus, the budgeting of risk across asset classes should take into account the diversification effects. Such effects can be carried down to the next level when selecting the individual assets for the different classes.

Example: Budgeting risk across asset classes (part 1)

A manager has a portfolio with only one position: a \$500 million investment in W. The manager is considering adding a \$500 million position X or Y to the portfolio. The current volatility of W is 10%. The manager wants to limit portfolio VaR to \$200 million at the 99% confidence level. Position X has a return volatility of 9% and a correlation with W equal to 0.7. Position Y has a return volatility of 12% and a correlation with W equal to zero. Determine which of the two proposed additions, X or Y, will keep the manager within his risk budget.

Answer:

Currently, the VaR of the portfolio with only W is:

$$\text{VaR}_W = (2.33)(10\%)(\$500 \text{ million}) = \$116.5 \text{ million}$$

When adding X, the return volatility of the portfolio will be:

$$8.76\% = \sqrt{(0.5^2)(10\%)^2 + (0.5^2)(9\%)^2 + (2)(0.5)(0.5)(0.7)(10\%)(9\%)}$$

$$\text{VaR}_{W+X} = 2.33(8.76\%)(\$1,000 \text{ million}) = \$204 \text{ million}$$

When adding Y, the return volatility of the portfolio will be:

$$7.81\% = \sqrt{(0.5^2)(10\%)^2 + (0.5^2)(12\%)^2}$$

$$\text{VaR}_{W+Y} = (2.33)(7.81\%)(\$1,000 \text{ million}) = \$182 \text{ million}$$

Thus, Y keeps the total portfolio within the risk budget.

Example: Budgeting risk across asset classes (part 2)

In the previous example, **demonstrate** why focusing on the stand-alone VaR of X and Y would have led to the wrong choice.

Answer:

Obviously, the VaR of X is less than that of Y.

$$\text{VaR}_X = (2.33)(9\%)(\$500 \text{ million}) = \$104.9 \text{ million}$$

$$\text{VaR}_Y = (2.33)(12\%)(\$500 \text{ million}) = \$139.8 \text{ million}$$

The individual VaRs would have led the manager to select X over Y; however, the high correlation of X with W gives X a higher incremental VaR, which puts the portfolio of W and X over the limit. The zero correlation of W and Y makes the incremental VaR of Y much lower, and the portfolio of W with Y keeps the risk within the limit.

The traditional method for evaluating active managers is by measuring their excess return and tracking error and using it to derive a measure known as the information ratio. Excess return is the active return minus the benchmark return. The **information ratio** of manager i is:

$$IR_i = \frac{(\text{expected excess return of the manager})}{(\text{the manager's tracking error})}$$

For a portfolio of funds, each managed by a separate manager, the top management of the entire portfolio would be interested in the portfolio information ratio:

$$IR_P = \frac{(\text{expected excess return of the portfolio})}{(\text{the portfolio's tracking error})}$$

If the excess returns of the managers are independent of each other, it can be shown that the optimal allocation across managers is found by allocating weights to managers according to the following formula:

$$\text{weight of portfolio managed by manager } i = \frac{IR_i \times (\text{portfolio's tracking error})}{IR_P \times (\text{manager's tracking error})}$$

One way to use this measure is to “budget” portfolio tracking error. Given the IR_P , the IR_i , and the manager's tracking error, top management can calculate the respective weights to assign to each manager. The weights of the allocations to the managers do not necessarily have to sum to one. Any difference can be allocated to the benchmark itself because, by definition, $IR_{\text{benchmark}} = 0$.

Determining the precise weights will be an iterative process in that each selection of weights will give a different portfolio expected excess return and tracking error. Figure 2 illustrates a set of weights derived from the given inputs that satisfy the condition.

Figure 2: Budgeting Risk Across Active Managers

	<i>Tracking Error</i>	<i>Information Ratio</i>	<i>Weights</i>
Manager A	5.0%	0.70	51%
Manager B	5.0%	0.50	37%
Benchmark	0.0%	0.00	12%
Portfolio	3.0%	0.82	100%

Although we have skipped the derivation, we can see that the conditions for optimal allocation hold true:

$$\text{For A: } 51\% = \frac{(3\%)(0.70)}{(5\%)(0.82)}$$

$$\text{For B: } 37\% = \frac{(3\%)(0.50)}{(5\%)(0.82)}$$

The difference between 100% and the sum of the weights 51% and 37% is the 12% invested in the benchmark.

KEY CONCEPTS

LO 65.1

Risk budgeting is a top-down process that involves choosing and managing exposures to risk.

LO 65.2

Compared to banks on the “sell side,” investors on the “buy side” have a longer horizon, slower turnover, and lower leverage. They have tended to use historical risk measures and focus on tracking error, benchmarking, and investment guidelines. Banks use forward-looking VaR risk measures and VaR limits. Investors seem to be using VaR more and more, but they have to adapt it to their needs.

LO 65.3

Investors are relying more on VaR because of increased globalization, complexity, and dynamics of the investment industry. They have found simply measuring risk from historical measures is no longer adequate.

LO 65.4

Hedge funds have risk characteristics that make them more similar to the “sell side” of the industry like the use of leverage and high turnover. In addition to that, they have other risks such as low liquidity and low transparency. Low liquidity leads to problems in measuring risk because it tends to put a downward bias on volatility and correlation measures.

LO 65.5

Absolute or asset risk refers to the total possible losses over a horizon. Relative risk is measured by excess return, which is the dollar loss relative to a benchmark. VaR measures can apply to both.

The risk from the policy mix is from the chosen portfolio weights, and active risk is from individual managers deviating from the chosen portfolio weights.

Funding risk is the risk that the value of assets will not be sufficient to cover the liabilities of the fund. It is important for pension funds. In applying VaR, a manager will add the expected increase in the surplus to the surplus and subtract the VaR of the assets from it. The difference between the expected surplus and the portfolio VaR is the shortfall associated with the VaR.

Two components of sponsor risk are cash-flow risk, which addresses variations of contributions to the fund, and economic risk, which is the variation of the earnings.

LO 65.6

Risk monitoring is important in large firms to catch “rogue traders” whose activities may go undetected with simple periodic statements. It is also needed for passive portfolios because the risk characteristics of the benchmarks can change. Risk monitoring can also determine why changes in risk have occurred (e.g., individual managers exceeding their budget, different managers taking on the same exposures, or the risk characteristics of the whole market changing).

There is a trend toward using a global custodian in the risk management of investment firms. It is an easy means to the goal of centralized risk management. The custodians can combine reports on changes in positions with market data to produce forward-looking risk measures. Those that choose not to use a global custodian have done so because they feel they have tighter control over risk measures and can better incorporate VaR systems into operations.

LO 65.7

There is a trend of investment managers incorporating VaR systems into their investment management process. There is evidence that money managers are differentiating themselves with respect to their risk management systems, and those that do not use such systems are at a competitive disadvantage.

VaR techniques can help move away from the ad hoc nature and overemphasis on notionals and sensitivities that characterize the guidelines many managers now use. Such guidelines are cumbersome and ineffective in that they focus on individual positions and can be easily circumvented.

VaR is useful for the investment process. When a trader has a choice between two new positions for a portfolio, the trader can compare the marginal VaRs to make the selection. When deciding whether to increase one existing position over another, the trader can compare the excess-return-to-MVaR ratios and increase the position in the one with the higher ratio.

LO 65.8

Budgeting risk across asset classes means selecting assets whose combined VaRs are less than the total allowed. The budgeting process would examine the contribution each position makes to the portfolio VaR.

For allocating across active managers, it can be shown that the optimal allocation is achieved with the following formula:

$$\text{weight of portfolio managed by manager } i = \frac{IR_i \times (\text{portfolio's tracking error})}{IR_P \times (\text{manager's tracking error})}$$

For a given group of active managers, the weights may not sum to one. The remainder of the weight can be allocated to the benchmark, which has no tracking error.

CONCEPT CHECKERS

1. With respect to the buy side and sell side of the investment industry:
 - I. the buy side uses more leverage.
 - II. the sell side has relied more on VaR measures.
 - A. I only.
 - B. II only.
 - C. Both I and II.
 - D. Neither I nor II.
2. Compared to policy risk, which of the following is not a reason that management risk is not much of a problem?
 - A. There will be diversification effects across the deviations.
 - B. Managers tend to make the same style shifts at the same time.
 - C. For well-managed funds, it is usually fairly small for each of the individual funds.
 - D. There can be diversification with the policy mix VaR to actually lower the total portfolio VaR.
3. Using VaR to monitor risk is important for a large firm with many types of managers because:
 - A. it can help catch rogue traders and it can detect changes in risk from changes in benchmark characteristics.
 - B. although it cannot help catch rogue traders, it can detect changes in risk from changes in benchmark characteristics.
 - C. although it cannot detect changes in risk from changes in benchmark characteristics, it can help detect rogue traders.
 - D. of no reason. VaR is not useful for monitoring risk in large firms.
4. VaR can be used to compose better guidelines for investment companies by:
 - I. relying less on notionals.
 - II. focusing more on overall risk.
 - A. I only.
 - B. II only.
 - C. Both I and II.
 - D. Neither I nor II.

5. In making allocations across active managers, which of the following represents the formula that gives the optimal weight to allocate to a manager denoted i , where IR_i and IR_P are the information ratios of the manager and the total portfolio respectively?
- A. $\frac{IR_P \times (\text{portfolio's tracking error})}{IR_i \times (\text{manager's tracking error})}$.
- B. $\frac{IR_i \times (\text{manager's tracking error})}{IR_P \times (\text{portfolio's tracking error})}$.
- C. $\frac{IR_i \times (\text{portfolio's tracking error})}{IR_P \times (\text{manager's tracking error})}$.
- D. $\frac{IR_P \times (\text{manager's tracking error})}{IR_i \times (\text{portfolio's tracking error})}$.

CONCEPT CHECKER ANSWERS

1. **B** Compared to banks on the “sell side,” investors on the “buy side” have a longer horizon, slower turnover, and lower leverage. Banks use forward-looking VaR risk measures and VaR limits.
2. **B** If managers make the same style shifts, then that would actually increase management risk. All the other reasons are valid.
3. **A** Both of these are reasons large firms find VaR and risk monitoring useful.
4. **C** Investment companies have been focusing on limits on notionals, which is cumbersome and has proved to be ineffective.
5. **C** weight of portfolio managed by manager $i = \frac{IR_i \times (\text{portfolio's tracking error})}{IR_p \times (\text{manager's tracking error})}$

RISK MONITORING AND PERFORMANCE MEASUREMENT

Topic 66

EXAM FOCUS

Most of this topic is qualitative in nature, however, it does contain several testable concepts. Many of the concepts covered here are also covered in other assigned readings, so this topic should serve as reinforcement of those concepts. For the exam, focus on the three pillars of effective risk management: planning, budgeting, and monitoring. Understand the concept of a risk management unit (RMU) and be able to discuss its appropriate role within a company. Always keep in mind while reviewing this topic that it is the amount of risk taken that ultimately drives the level of returns—risk is the “cost” of returns.

RISK MEASURES

LO 66.1: Define, compare, and contrast VaR and tracking error as risk measures.

Value at risk (VaR) is defined to be the *largest* loss possible for a *certain* level of confidence over a *specific* period of time. For example, a firm could express its VaR as being 95% certain that they will lose a maximum of \$5 million in the next ten days. Delta-normal VaR assumes a normal distribution, and its calculation reflects losses in the lower tail of the returns distribution.

Tracking error is defined as the standard deviation of excess returns. Excess return is defined as the portfolio return less the benchmark return (i.e., alpha). Assuming a normal distribution of excess returns, 95% of the outcomes will fall within the mean benchmark return plus or minus roughly two standard deviations.

VaR and tracking error are both measures of risk. An organization’s objective is to maximize profits for a given level of risk taken. Too much risk taken (in comparison with budget) suggests a VaR level that is too high and a willingness to accept large losses to produce unnecessarily high returns. Too little risk taken suggests that there is not enough active management, and actual returns will fall short of budgeted returns.

VaR may be used to suggest the maximum dollar value of losses for a specific level of confidence over a specific time. From a portfolio management perspective, VaR could be determined for each asset class, and capital allocation decisions could be made amongst the asset classes depending on risk and return preferences. This will help to achieve targeted levels of dollar VaR. In contrast, tracking error may be used to determine the relative amount of discretion that can be taken by the portfolio manager (away from benchmark returns) in his or her attempts at active management.

RISK PLANNING

LO 66.2: Describe risk planning, including its objectives, effects and the participants in its development.

There are five risk planning objectives for any entity to consider.

1. Setting expected return and expected volatility goals.

Examples of an entity's goals could include specifying the acceptable amounts of VaR and tracking error for a given period of time. Scenario analysis could be employed to determine potential sources of failure in the plan as well as ways to respond should those sources occur.

2. Defining quantitative measures of success or failure.

Specific guidelines should be stated. For example, one could state an acceptable level of return on equity (ROE) or return on risk capital (RORC). This would help regulatory agencies assess the entity's success or failure from a risk management perspective.

3. Generalizing how risk capital will be utilized to meet the entity's objectives.

Objectives relating to return per unit of risk capital need to be defined. For example, the minimum acceptable RORC should be defined for each activity where risk is allocated from the budget. The correlations between the RORCs should also be considered within an entity-wide risk diversification context.

4. Defining the difference between events that cause ordinary damage versus serious damage.

Specific steps need to be formulated to counter any event that threatens the overall long-term existence of the entity, even if the likelihood of occurrence is remote. The choice between seeking external insurance (i.e., put options) versus self-insurance for downside portfolio risk has to be considered from a cost-benefit perspective, taking into account the potential severity of the losses.

5. Identifying mission critical resources inside and outside the entity and discussing what should be done in case those resources are jeopardized.

Examples of such resources would include key employees and financing sources. Scenario analysis should be employed to assess the impact on those resources in both good and bad times. Specifically, adverse events often occur together with other adverse (and material) events.

In general, the risk planning process frequently requires the input and approval of the entity's owners and its management team. An effective plan requires very active input from the entity's highest level of management so as to ensure risk and return issues are addressed, understood, and communicated within the entity, to key stakeholders, and to regulatory agencies.

RISK BUDGETING

LO 66.3: Describe risk budgeting and the role of quantitative methods in risk budgeting.

The risk budget quantifies the risk plan. There needs to be a structured budgeting process to allocate risk capital to meet the entity's objectives and minimize deviations from the plan. Each specific allocation from the risk budget comes with a reasonable return expectation. The return expectation comes with an estimate of variability around that expectation.

With risk budgets, an amount of VaR could be calculated for each item on the income statement. This allows RORC to be calculated individually and in aggregate.

Quantitative methods (i.e., mathematical modeling) may be used in risk budgeting as follows:

1. Set the minimum acceptable levels of RORC and ROE over various time periods. This is to determine if there is sufficient compensation for the risks taken (i.e., risk-adjusted profitability).
2. Apply mean-variance optimization (or other quantitative methods) to determine the weights for each asset class.
3. Simulate the portfolio performance based on the weights above and for several time periods. Apply sensitivity analysis to the performance by considering changes in estimates of returns and covariances.

RISK MONITORING

LO 66.4: Describe risk monitoring and its role in an internal control environment.

Within an entity's internal control environment, risk monitoring attempts to seek and investigate any significant variances from budget. This is to ensure, for example, that there are no threats to meeting its ROE and RORC targets. Risk monitoring is useful in that it should detect and address any significant variances in a timely manner.

LO 66.5: Identify sources of risk consciousness within an organization.

The increasing sense of risk consciousness within and among organizations is mainly derived from the following three sources:

1. *Banks* who lend funds to investors are concerned with where those funds are invested.
2. *Boards of investment clients, senior management, and plan sponsors* have generally become more versed in risk management issues and more aware of the need for effective oversight over asset management activities.

3. *Investors* have become more knowledgeable about their investment choices. For example, beneficiaries of a defined contribution plan are responsible for selecting their individual pension investments.

LO 66.6: Describe the objectives and actions of a risk management unit in an investment management firm.

A risk management unit (RMU) monitors an investment management entity's portfolio risk exposure and ascertains that the exposures are authorized and consistent with the risk budgets previously set. To ensure proper segregation of duties, it is crucial that the risk management function has an independent reporting line to senior management.

The objectives of a RMU include:

- Gathering, monitoring, analyzing, and distributing risk data to managers, clients, and senior management. Accurate and relevant information must be provided to the appropriate person(s) at the appropriate time(s).
- Assisting the entity in formulating a systematic and rigorous method as to how risks are identified and dealt with. Promotion of the entity's risk culture and best risk practices is crucial here.
- Going beyond merely providing information by taking the initiative to research relevant risk topics that will affect the firm.
- Monitoring trends in risk on a continual basis and promptly reporting unusual events to management before they become significant problems.
- Promoting discussion throughout the entity and developing a process as to how risk data and issues are discussed and implemented within the entity.
- Promoting a greater sense of risk awareness (culture) within the entity.
- Ensuring that transactions that are authorized are consistent with guidance provided to management and with client expectations.
- Identifying and developing risk measurement and performance attribution analytical tools.
- Gathering risk data to be analyzed in making portfolio manager assessments and market environment assessments.
- Providing the management team with information to better comprehend risk in individual portfolios as well as the source of performance.
- Measuring risk within an entity. In other words, measuring how consistent portfolio managers are with respect to product objectives, management expectations, and client objectives. Significant deviations are brought to the attention of appropriate management to provide a basis for correction.



Professor's Note: You may see references elsewhere to an Independent Risk Oversight Unit. This is the same concept as RMU. Both measure and manage risk exposure and operate as an independent business unit.

LO 66.7: Describe how risk monitoring can confirm that investment activities are consistent with expectations.

Is the manager generating a forecasted level of tracking error that is consistent with the target?

The forecasted tracking error is an approximation of the potential risk of a portfolio using statistical methods. For each portfolio, the forecast should be compared to budget using predetermined guidelines as to how much variance is acceptable, how much variance requires further investigation, and how much variance requires immediate action. Presumably, the budget was formulated taking into account client expectations.

Tracking error forecast reports should be produced for all accounts that are managed similarly in order to gauge the consistency in risk levels taken by the portfolio manager.

Is risk capital allocated to the expected areas?

Overall tracking risk is not sufficient as a measure on its own; it is important to break down the tracking risk into “subsections.” If the analysis of the risk taken per subsection does not suggest that risk is being incurred in accordance with expectations, then there may be style drift. Style drift may manifest itself in a value portfolio manager who attains the overall tracking error target but allocates most of the risk (and invests) in growth investments.

Therefore, by engaging in risk decomposition, the RMU may ensure that a portfolio manager’s investment activities are consistent with the predetermined expectations (i.e., stated policies and manager philosophy). Also, by running the report at various levels, unreasonably large concentrations of risk (that may jeopardize the portfolio) may be detected.

LIQUIDITY CONSIDERATIONS

LO 66.8: Explain the importance of liquidity considerations for a portfolio.

Liquidity considerations are important because a portfolio’s liquidity profile could change significantly in the midst of a volatile market environment or an economic downturn, for instance. Therefore, measuring portfolio liquidity is a priority in stress testing.

One potential measure is **liquidity duration**. It is an approximation of the number of days necessary to dispose of a portfolio’s holdings without a significant market impact. For a given security, the liquidity duration could be calculated as follows:

$$LD = \frac{Q}{(0.10 \times V)}$$

where:

LD = liquidity duration for the security on the assumption that the desired maximum daily volume of any security is 10%

Q = number of shares of the security

V = daily volume of the security

PERFORMANCE MEASUREMENT

LO 66.10: Describe the objectives of performance measurement.

Performance measurement looks at a portfolio manager's actual results and compares them to relevant comparables such as benchmarks and peer groups. Therefore, performance measurement seeks to determine whether a manager can consistently outperform (through excess returns) the benchmark on a risk-adjusted basis. Similarly, it seeks to determine whether a manager consistently outperforms its peer group on a risk-adjusted basis.

Furthermore, performance measurement may help to determine whether the returns achieved are commensurate with the risk taken. Finally, performance measurement provides a basis for identifying managers who are able to generate consistent excess risk-adjusted returns. Such superior processes and performance could be replicated on an on-going basis, thereby maximizing the entity's long-run returns and profitability.

Comparison of Performance with Expectations

From a risk perspective (e.g., tracking error), portfolio managers should be assessed on the basis of being able to produce a portfolio with risk characteristics that are expected to approximate the target. In addition, they should also be assessed on their ability to actually achieve risk levels that are close to target.

From a returns perspective (e.g., performance), portfolio managers could be assessed on their ability to earn excess returns.

Goldman Sachs Asset Management utilizes a so-called “green zone” to identify instances of actual tracking error or performance that are outside of normal expectations. An acceptable amount of deviation (from a statistical perspective) is determined, and any deviations up to that amount are considered a green zone event. Unusual events that are expected to occur with some regularity are considered “yellow zone” events. Truly unusual events that require immediate investigation are considered “red zone” events. In using this simple color-coded system, the various zones are predefined and provide clear expectations for the portfolio managers. The movements of portfolios into yellow or red zones are triggering events that require further investigation and discussion.

Return Attribution

The source of returns can be attributed to specific factors or securities. For example, it is important to ensure that returns result from decisions where the manager intended to take risk and not simply from sheer luck.

Variance analysis is used to illustrate the contribution to overall portfolio performance by each security. The securities can be regrouped in various ways to conduct analysis by industry, sector, and country, for example.

In performing return attribution, factor risk analysis and factor attribution could be used. Alternatively, risk forecasting and attribution at the security level could also be used.

Sharpe and Information Ratio

The **Sharpe ratio** is calculated by taking the portfolio's actual return and subtracting the risk-free rate in the numerator. The denominator is the portfolio's standard deviation. The **information ratio** is calculated by taking the portfolio's excess returns and subtracting the benchmark's excess returns (if applicable) in the numerator. The denominator is the portfolio's tracking error. These two measures are both considered risk-adjusted return measures.

Strengths of these metrics include the following: (1) easy to use as a measure of relative performance compared to a benchmark or peer group; (2) easy to determine if the manager has generated sufficient excess returns in relation to the amount of risk taken; and (3) easy to apply to industrial sectors and countries.

Weaknesses of these metrics include the following: (1) insufficient data available to perform calculations; and (2) the use of realized risk (instead of potential risk) may result in overstated performance calculations.

Comparisons with Benchmark Portfolios and Peer Groups

LO 66.9: Describe the use of alpha, benchmark, and peer group as inputs in performance measurement tools.

One could use linear regression analysis to regress the excess returns of the investment against the excess returns of the **benchmark**. One of the outputs from this regression is **alpha**, and it could be tested for statistical significance to determine whether the excess returns are attributable to manager skill or just pure luck. The other output is beta, and it relates to the amount of leverage used or underweighting/overweighting in the market compared to the benchmark.

The regression also allows a comparison of the absolute amount of excess returns compared to the benchmark. Furthermore, there is the ability to separate excess returns due to leverage and excess returns due to skill. One limitation to consider is that there may not be enough data available to make a reasonable conclusion as to the manager's skill.

One could also regress the excess returns of the manager against the excess returns of the manager's **peer group**. The features of this regression are generally similar to that for the benchmark above, except that the returns of the peer group suffer from **survivorship bias**, and there is usually a wide range of funds under management amongst the peers (that reduces the comparability).

KEY CONCEPTS

LO 66.1

VaR and tracking error are both measures of risk. VaR is defined to be the largest loss possible for a certain level of confidence over a specific period of time. Tracking error is defined as the standard deviation of excess returns.

LO 66.2

There are five risk planning objectives to consider.

- Setting expected return and expected volatility goals.
- Defining quantitative measures of success or failure.
- Generalizing how risk capital will be utilized to meet the entity's objectives.
- Defining the difference between events that cause ordinary damage versus serious damage.
- Identifying mission critical resources inside and outside the entity and discussing what should be done in case those resources are jeopardized.

The risk planning process frequently requires the input and approval of the entity's owners and its management team.

LO 66.3

The risk budget quantifies the risk plan. There needs to be a structured budgeting process to allocate risk capital to meet the corporate objectives and minimize deviations from plan.

Quantitative methods may be used in risk budgeting. Activities include: setting the minimum acceptable levels of RORC and ROE, applying mean-variance optimization, simulating portfolio performance, and applying sensitivity analysis.

LO 66.4

Within an entity's internal control environment, risk monitoring attempts to seek and investigate any significant variances from budget.

LO 66.5

Sources of risk consciousness include: (1) banks, (2) boards of investment clients, senior management, and plan sponsors, and (3) investors.

LO 66.6

A risk management unit (RMU) monitors an investment management entity's portfolio risk exposure and ascertains that the exposures are authorized and consistent with the risk budgets previously set. To ensure proper segregation of duties, it is crucial that the risk management function be independent and not report to senior management.

LO 66.7

The risk monitoring process attempts to confirm that investment activities are consistent with expectations. Specifically, is the manager generating a forecasted level of tracking error that is consistent with the target? And is risk capital allocated to the expected areas?

LO 66.8

Liquidity considerations are important because a portfolio's liquidity profile could change significantly in the midst of a volatile market environment or an economic downturn, for instance.

LO 66.9

The excess returns of an investment can be regressed against the excess returns of its benchmark (e.g., S&P 500 Index). An output from this regression is alpha, which determines whether the investment's excess returns are due to skill or luck.

The excess returns of a manager can be regressed against the excess returns of the manager's peer group. This is similar to the linear regression with a benchmark portfolio, but differs since it suffers from survivorship bias.

LO 66.10

Performance measurement looks at a portfolio manager's actual results and compares them to relevant comparables such as benchmarks and peer groups.

A performance measurement framework includes: (1) comparison of performance with expectations, (2) return attribution, (3) calculation of metrics such as the Sharpe ratio and the information ratio, and (4) comparisons with benchmark portfolios and peer groups.

CONCEPT CHECKERS

1. Which of the following statements about tracking error and value at risk (VaR) is least accurate?
 - A. Tracking error and VaR are complementary measures of risk.
 - B. Both tracking error and VaR may assume a normal distribution of returns.
 - C. Tracking error is the standard deviation of the excess of portfolio returns over the return of the peer group.
 - D. VaR can be defined as the maximum loss over a given time period.
2. Which of the following statements about the use of quantitative methods in risk budgeting is least accurate? They may be used:
 - A. to simulate the performance of portfolios.
 - B. to set levels of return on equity (ROE) and return on risk capital (RORC).
 - C. in a scenario analysis context to determine the weights for each asset class.
 - D. in a sensitivity analysis context to consider changes in estimates of returns and covariances.
3. A risk management unit (RMU) is most likely to be active in which of the following contexts?
 - A. Risk monitoring.
 - B. Risk measurement.
 - C. Risk budgeting.
 - D. Risk planning.
4. Which of the following statements does not help explain the purpose of risk decomposition?
 - A. To ensure that there is no style drift.
 - B. To detect large concentrations of risk.
 - C. To detect excessive amounts of tracking risk.
 - D. To ensure that investment activities are consistent with expectations.
5. Which of the following statements regarding alphas and betas is incorrect?
 - A. Alpha is the excess return attributable to pure luck.
 - B. Alpha is the excess return attributable to managerial skill.
 - C. Beta suggests the relative amount of leverage used.
 - D. Beta suggests whether some of the returns are attributable to over or under weighting the market.

CONCEPT CHECKER ANSWERS

1. C All of the statements are accurate with the exception of the one relating to the peer group. Tracking error is the standard deviation of the excess of portfolio returns over the return of an appropriate benchmark, not peer group.
2. C All of the statements are accurate with the exception of the one relating to scenario analysis. One should apply mean-variance optimization (and not scenario analysis) to determine the weights for each asset class.
3. A A RMU monitors an investment management firm's portfolio risk exposure and ascertains that the exposures are authorized and consistent with the risk budgets previously set.
4. C Risk decomposition is not designed to detect excessive amounts of tracking risk. In fact, it is the forecasted tracking error amount that should be compared to budget to ensure that there is not excessive tracking risk. All the other reasons are consistent with the purpose of risk decomposition.
5. A Alpha is a measure of the excess return of a manager over the peer group/benchmark that relates to skill as opposed to pure luck. Beta is a measure of the amount of leverage used compared to the peer group or a measure of the underweighting or overweighting of the market compared to the benchmark.

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

PORTFOLIO PERFORMANCE EVALUATION

Topic 67

EXAM FOCUS

Professional money managers are routinely evaluated using a wide array of metrics. In this topic, alternative methods of computing portfolio returns will be presented, and contrasts will be made between time-weighted and dollar-weighted returns for portfolios experiencing cash redemptions and contributions. For the exam, be sure to understand differences in the risk-adjusted performance measures, including the Sharpe ratio, Treynor ratio, Jensen's alpha, information ratio, and M^2 , and how the trading practices of hedge funds complicates the evaluation process. Be able to apply Sharpe's regression-based style analysis to conduct performance attributions.

TIME-WEIGHTED AND DOLLAR-WEIGHTED RETURNS

LO 67.1: Differentiate between time-weighted and dollar-weighted returns of a portfolio and describe their appropriate uses.

The **dollar-weighted rate of return** is defined as the internal rate of return (IRR) on a portfolio, taking into account all cash inflows and outflows. The beginning value of the account is an inflow as are all deposits into the account. All withdrawals from the account are outflows, as is the ending value.

Example: Dollar-weighted rate of return

Assume an investor buys a share of stock for \$100 at $t = 0$, and at the end of the next year ($t = 1$), she buys an additional share for \$120. At the end of year 2, the investor sells both shares for \$130 each. At the end of each year in the holding period, the stock paid a \$2.00 per share dividend. What is the investor's dollar-weighted rate of return?

Answer:

Step 1: Determine the timing of each cash flow and whether the cash flow is an inflow (+) or an outflow (–).

t = 0:	purchase of first share	=	–\$100
t = 1:	dividend from first share	=	+\$2
	purchase of second share	=	<u>–\$120</u>
	subtotal, t = 1		–\$118
t = 2:	dividend from two shares	=	+\$4
	proceeds from selling shares	=	<u>+\$260</u>
	subtotal, t = 2		+\$264

Step 2: Net the cash flows for each time period, and set the PV of cash inflows equal to the present value of cash outflows.

$$PV_{\text{inflows}} = PV_{\text{outflows}}$$

$$\$100 + \frac{\$120}{(1 + r)} = \frac{\$2}{(1 + r)} + \frac{\$264}{(1 + r)^2}$$

Step 3: Solve for *r* to find the dollar-weighted rate of return. This can be done using trial and error or by using the IRR function on a financial calculator or spreadsheet.

The intuition here is that we deposited \$100 into the account at t = 0, then added \$118 to the account at t = 1 (which, with the \$2 dividend, funded the purchase of one more share at \$120), and ended with a total value of \$264.

To compute this value with a financial calculator, use these net cash flows and follow the procedure described in Figure 1 to calculate the IRR.

Net cash flows: CF₀ = –100; CF₁ = –120 + 2 = –118; CF₂ = 260 + 4 = 264

Figure 1: Calculating Dollar-Weighted Return with the TI Business Analyst II Plus® Calculator

Key Strokes	Explanation	Display
[CF] [2nd] [CLR WORK]	Clear cash flow registers	CF0 = 0.00000
100 [+/-] [ENTER]	Initial cash outlay	CF0 = –100.00000
[↓] 118 [+/-] [ENTER]	Period 1 cash flow	C01 = –118.00000
[↓] [↓] 264 [ENTER]	Period 2 cash flow	C02 = 264.00000
[IRR] [CPT]	Calculate IRR	IRR= 13.86122

The dollar-weighted rate of return for this problem is 13.86%.

Time-weighted rate of return measures compound growth. It is the rate at which \$1.00 compounds over a specified time horizon. Time-weighting is the process of averaging a set of values over time. The *annual* time-weighted return for an investment may be computed by performing the following steps:

- Step 1:* Value the portfolio immediately preceding significant addition or withdrawals. Form subperiods over the evaluation period that correspond to the dates of deposits and withdrawals.
- Step 2:* Compute the holding period return (HPR) of the portfolio for each subperiod.
- Step 3:* Compute the product of $(1 + \text{HPR}_t)$ for each subperiod t to obtain a total return for the entire measurement period [i.e., $(1 + \text{HPR}_1) \times (1 + \text{HPR}_2) \dots (1 + \text{HPR}_n)$]. If the total investment period is greater than one year, you must take the geometric mean of the measurement period return to find the annual time-weighted rate of return.

Example: Time-weighted rate of return

A share of stock is purchased at $t = 0$ for \$100. At the end of the next year, $t = 1$, another share is purchased for \$120. At the end of year 2, both shares are sold for \$130 each. At the end of years 1 and 2, the stock paid a \$2.00 per share dividend. What is the time-weighted rate of return for this investment? (This is the same data as presented in the dollar-weighted rate-of-return example.)

Answer:

Step 1: Break the evaluation period into two subperiods based on timing of cash flows.

Holding period 1:	beginning price = \$100.00
	dividends paid = \$2.00
	ending price = \$120.00
Holding period 2:	beginning price = \$240.00 (2 shares)
	dividends paid = \$4.00 (\$2 per share)
	ending price = \$260.00 (2 shares)

Step 2: Calculate the HPR for each holding period.

$$\text{HPR}_1 = [(\$120 + 2) / \$100] - 1 = 22\%$$

$$\text{HPR}_2 = [(\$260 + 4) / \$240] - 1 = 10\%$$

Step 3: Take the geometric mean of the annual returns to find the annualized time-weighted rate of return over the measurement period.

$$(1 + \text{time-weighted rate of return})^2 = (1.22)(1.10)$$

$$\text{time-weighted rate of return} = \left[\sqrt{(1.22)(1.10)} \right] - 1 = 15.84\%$$

In the investment management industry, the time-weighted rate of return is the preferred method of performance measurement for a portfolio manager because it is not affected by the timing of cash inflows and outflows, which may be beyond the manager's control.

In the preceding examples, the time-weighted rate of return for the portfolio was 15.84%, while the dollar-weighted rate of return for the same portfolio was 13.86%. The difference in the results is attributable to the fact that the procedure for determining the dollar-weighted rate of return gave a larger weight to the year 2 HPR, which was 10% versus the 22% HPR for year 1.

If funds are contributed to an investment portfolio just before a period of relatively poor portfolio performance, the dollar-weighted rate of return will tend to be depressed. Conversely, if funds are contributed to a portfolio at a favorable time, the dollar-weighted rate of return will increase. The use of the time-weighted return removes these distortions, providing a better measure of a manager's ability to select investments over the period. If a private investor has complete control over money flows into and out of an account, the dollar-weighted rate of return may be the more appropriate performance measure.

Therefore, the dollar-weighted return will exceed the time-weighted return for a manager who has superior market timing ability.

RISK-ADJUSTED PERFORMANCE MEASURES

LO 67.2: Describe and distinguish between risk-adjusted performance measures, such as Sharpe's measure, Treynor's measure, Jensen's measure (Jensen's alpha), and information ratio.

LO 67.3: Describe the uses for the Modigliani-squared and Treynor's measure in comparing two portfolios, and the graphical representation of these measures.

Universe Comparisons

Portfolio rankings based merely on returns ignore differences in risk across portfolios. A popular alternative is to use a comparison universe. This approach classifies portfolios according to investment style (e.g., small cap growth, small cap value, large cap growth, large cap value) and, then, ranks portfolios based on rate of return within the appropriate style universe. The rankings are now more meaningful because they have been standardized on the investment style of the funds. This method will fail, however, if risk differences remain across the funds within a given style.

The Sharpe Ratio

The **Sharpe ratio** uses standard deviation (total risk) as the relevant measure of risk. It shows the amount of excess return (over the risk-free rate) earned per unit of total risk. Hence, the Sharpe ratio evaluates the performance of the portfolio in terms of both overall return and diversification.

The Sharpe ratio is defined as:

$$S_A = \frac{\bar{R}_A - \bar{R}_F}{\sigma_A}$$

where:

$\bar{R}_A$ = average account return

$\bar{R}_F$ = average risk-free return

σ_A = standard deviation of account returns



Professor's Note: Again, the risk measure, standard deviation, should ideally be the actual standard deviation during the measurement period.

The Treynor Measure

The Treynor measure is very similar to the Sharpe ratio except that it uses beta (systematic risk) as the measure of risk. It shows the excess return (over the risk-free rate) earned per unit of systematic risk.

The Treynor measure is defined as:

$$T_A = \frac{\bar{R}_A - \bar{R}_F}{\beta_A}$$

where:

$\bar{R}_A$ = average account return

$\bar{R}_F$ = average risk-free return

β_A = average beta



Professor's Note: Ideally, the Treynor measure should be calculated using the actual beta for the portfolio over the measurement period. Since beta is subject to change due to varying covariance with the market, using the premeasurement period beta may not yield reliable results. The beta for the measurement period is estimated by regressing the portfolio's returns against the market returns.

For a well-diversified portfolio, the difference in risk measurement between the Sharpe ratio and the Treynor measure becomes irrelevant as the total risk and systematic risk will be very close. For a less than well-diversified portfolio, however, the difference in rankings based on the two measures is likely due to the amount of diversification in the portfolio. Used along with the Treynor measure, the Sharpe ratio provides additional information about the degree of diversification in a portfolio.

Sharpe vs. Treynor. If a portfolio was not well-diversified over the measurement period, it may be ranked relatively higher using Treynor than using Sharpe because Treynor considers only the beta (i.e., systematic risk) of the portfolio over the period. When the Sharpe ratio is calculated for the portfolio, the excess total risk (standard deviation) due to diversifiable risk will cause rankings to be lower. Although we do not get an absolute measure of the lack of

diversification, the change in the rankings shows the presence of unsystematic risk, and the greater the difference in rankings, the less diversified the portfolio.

Jensen's Alpha

Jensen's alpha, also known as Jensen's measure, is the difference between the actual return and the return required to compensate for systematic risk. To calculate the measure, we subtract the return calculated by the capital asset pricing model (CAPM) from the account return. Jensen's alpha is a direct measure of performance (i.e., it yields the performance measure without being compared to other portfolios).

$$\alpha_A = R_A - E(R_A)$$

where:

α_A = alpha

R_A = the return on the account

$E(R_A) = R_F + \beta_A[E(R_M) - R_F]$

A superior manager would have a statistically significant and positive alpha. Jensen's alpha uses the portfolio return, market return, and risk-free rate for each time period separately. The Sharpe and Treynor measures use only the average of portfolio return and risk-free rate. Furthermore, like the Treynor measure, Jensen's alpha only takes into account the systematic risk of the portfolio and, hence, gives no indication of the diversification in the portfolio.

Information Ratio

The Sharpe ratio can be changed to incorporate an appropriate benchmark instead of the risk-free rate. This form is known as the **information ratio** or **appraisal ratio**:

$$IR_A = \frac{\bar{R}_A - \bar{R}_B}{\sigma_{A-B}}$$

where:

$\bar{R}_A$ = average account return

$\bar{R}_B$ = average benchmark return

σ_{A-B} = standard deviation of excess returns measured as the difference between account and benchmark returns

The information ratio is the ratio of the surplus return (in a particular period) to its standard deviation. It indicates the amount of risk undertaken (denominator) to achieve a certain level of return above the benchmark (numerator). An active manager makes specific cognitive bets to achieve a positive surplus return. The variability in the surplus return is a measure of the risk taken to achieve the surplus. The ratio computes the surplus return relative to the risk taken. A higher information ratio indicates better performance.



Professor's Note: The version of the information ratio presented here is the most common. However, you should be aware that an alternative calculation of this ratio exists that uses alpha over the expected level of unsystematic risk over the time period, $\frac{\alpha_A}{\sigma(\epsilon_A)}$.

M-Squared (M^2) Measure

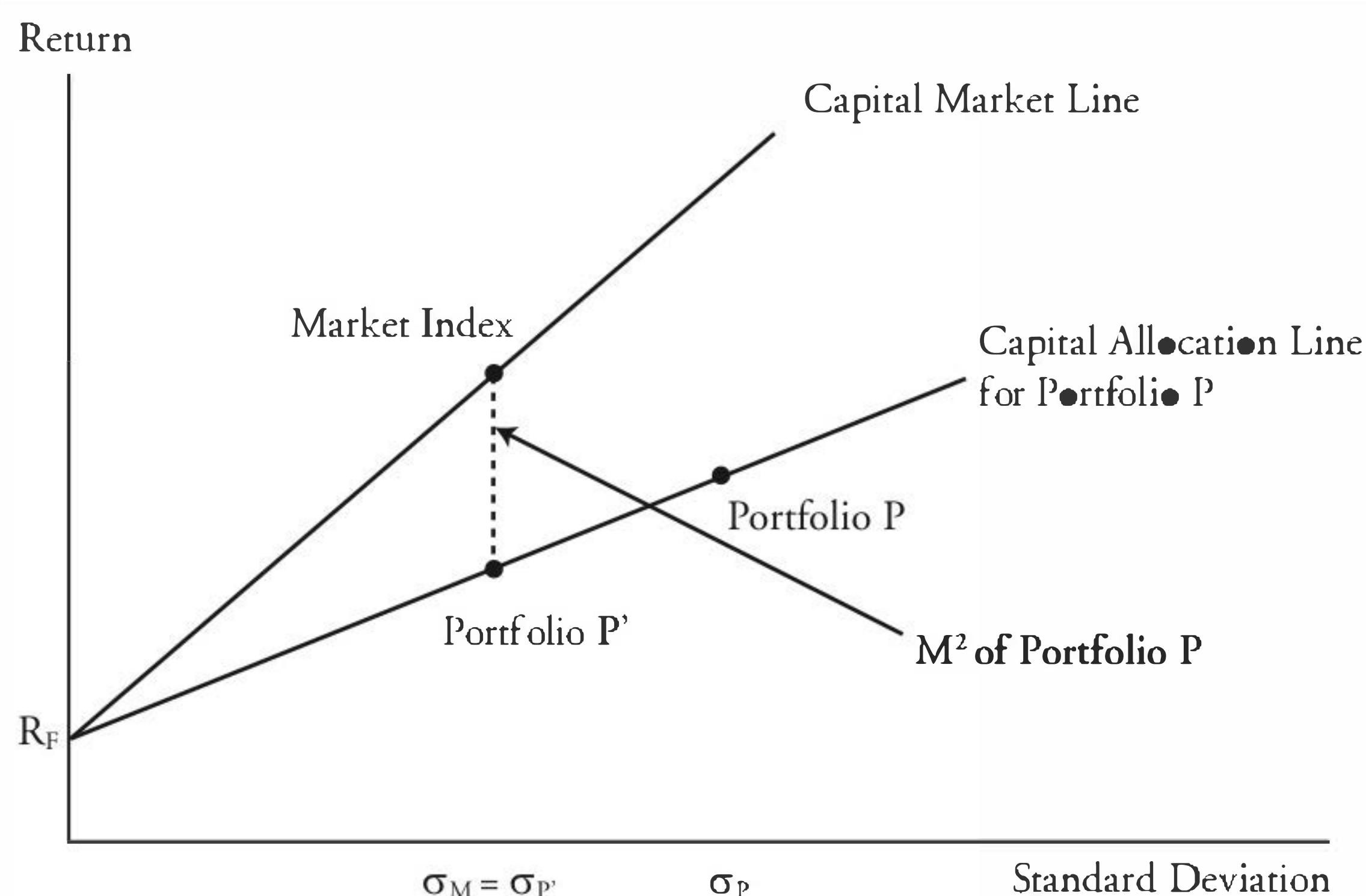
A relatively new measure of portfolio performance developed by Leah Modigliani and her grandfather, 1985 Nobel Prize recipient Franco Modigliani, has become quite popular. The M^2 measure compares the return earned on the managed portfolio against the market return, after adjusting for differences in standard deviations between the two portfolios.



Professor's Note: There are no squared terms in the M-squared calculation. The term “M-squared” merely refers to the last names of its originators (Leah and Franco Modigliani).

The M^2 measure can be illustrated with a graph comparing the capital market line for the market index and the capital allocation line for managed Portfolio P. In Figure 2, notice that Portfolio P has a higher standard deviation than the market index. But, we can easily create a Portfolio P' that has standard deviation equal to the market standard deviation by investing appropriate percentages in both the risk-free asset and Portfolio P. The difference in return between Portfolio P' and the market portfolio, equals the M^2 measure for Portfolio P.

Figure 2: The M^2 Measure of Portfolio Performance



Example: Calculating the M^2 performance measure

Calculate the M^2 measure for Portfolio P:

- Portfolio P mean return 10%
- Portfolio P standard deviation 40%
- Market portfolio mean return 12%
- Market portfolio standard deviation 20%
- Risk-free rate 4%

Answer:

To answer the question, first note that a portfolio, P', can be created that allocates 50/50 to the risk-free asset and to Portfolio P such that the standard deviation of Portfolio P' equals the standard deviation of the market portfolio:

$$\sigma_{P'} = w_P \sigma_P = 0.50(0.40) = 0.20$$

Therefore, a 50/50 allocation between Portfolio P and the risk-free asset provides risk identical to the market portfolio. What is the difference in return between Portfolio P' and the market portfolio? To answer this question, first we must derive the mean return on Portfolio P':

$$R_{P'} = w_F R_F + w_P R_P = 0.50(0.04) + 0.50(0.10) = 0.07$$

Alternatively, the mean return for Portfolio P' can be derived by using the equation of the capital allocation line for Portfolio P:

$$\begin{aligned} R_{P'} &= R_F + \left(\frac{R_P - R_F}{\sigma_P} \right) \sigma_{P'} = R_F + \left(\frac{R_P - R_F}{\sigma_P} \right) \sigma_M \\ &= 0.04 + \left(\frac{0.10 - 0.04}{0.40} \right) 0.20 = 0.04 + (0.15)0.20 = 0.07 \end{aligned}$$

Therefore, we now have created a portfolio, P', that matches the risk of the market portfolio (standard deviation equals 20%). All that remains is to calculate the difference in returns between Portfolio P' and the market portfolio:

$$M^2 = R_{P'} - R_M = 0.07 - 0.12 = -0.05$$

Clearly, Portfolio P is a poorly performing portfolio. After controlling for risk, Portfolio P provides a return that is 5 percentage points below the market portfolio.



Professor's Note: Unfortunately, a consistent definition of M^2 does not exist. Sometimes M^2 is defined as equal to the return on the risk-adjusted Portfolio P' rather than equal to the difference in returns between P' and M . However, portfolio rankings based on the return on P' or on the difference in returns between P' and M will be identical. Therefore, both definitions provide identical portfolio performance rankings.

M^2 will produce the same conclusions as the Sharpe ratio. As stated earlier, Jensen's alpha will produce the same conclusions as the Treynor measure. However, M^2 and Sharpe may not give the same conclusion as Jensen's alpha and Treynor. A discrepancy could occur if the manager takes on a large proportion of unsystematic risk relative to systematic risk. This would lower the Sharpe ratio but leave the Treynor measure unaffected.

Example: Risk-adjusted performance appraisal measures

The data in Figure 3 has been collected to appraise the performance of four asset management firms:

Figure 3: Performance Appraisal Data

	<i>Fund 1</i>	<i>Fund 2</i>	<i>Fund 3</i>	<i>Fund 4</i>	<i>Market Index</i>
Return	6.45%	8.96%	9.44%	5.82%	6%
Beta	0.88	1.02	1.36	0.80	1.00
Standard deviation	2.74%	4.54%	3.72%	2.64%	2.80%
Standard deviation of excess returns	5.6%	6.1%	12.5%	5.3%	N/A

The market index return and risk-free rate of return for the relevant period were 6% and 3%, respectively. Calculate and rank the funds using Jensen's alpha, the Treynor measure, the Sharpe ratio, the information ratio, and M^2 .

Answer:

<i>Evaluation Tool</i>	<i>Fund 1</i>	<i>Fund 2</i>	<i>Fund 3</i>	<i>Fund 4</i>
Jensen's Alpha	$6.45 - 5.64 = 0.81\%$	$8.96 - 6.06 = 2.90\%$	$9.44 - 7.08 = 2.36\%$	$5.82 - 5.40 = 0.42\%$
Rank	3	1	2	4
Treynor	$\frac{6.45 - 3}{0.88} = 3.92$	$\frac{8.96 - 3}{1.02} = 5.84$	$\frac{9.44 - 3}{1.36} = 4.74$	$\frac{5.82 - 3}{0.80} = 3.53$
Rank	3	1	2	4
Sharpe	$\frac{6.45 - 3}{2.74} = 1.26$	$\frac{8.96 - 3}{4.54} = 1.31$	$\frac{9.44 - 3}{3.72} = 1.73$	$\frac{5.82 - 3}{2.64} = 1.07$
Rank	3	2	1	4
Information Ratio	$\frac{6.45 - 6}{5.6} = 0.08$	$\frac{8.96 - 6}{6.1} = 0.49$	$\frac{9.44 - 6}{12.5} = 0.28$	$\frac{5.82 - 6}{5.3} = -0.03$
Rank	3	1	2	4
M ²	$3 + (1.26) \times (2.8) = 6.53\% - 6\% = 0.53\%$	$3 + (1.31) \times (2.8) = 6.67\% - 6\% = 0.67\%$	$3 + (1.73) \times (2.8) = 7.84\% - 6\% = 1.84\%$	$3 + (1.07) \times (2.8) = 6\% - 6\% = 0$
Rank	3	2	1	4

Note that Jensen's alpha and the Treynor measures give the same rankings, and the Sharpe and M² measures give the same rankings. However, when comparing the alpha/Treynor rankings to the Sharpe/M² measures, Funds 2 and 3 trade places.

Fund 2 has a much higher total risk (standard deviation) than Fund 3 but has a much lower beta. Relatively speaking, a smaller proportion of Fund 2's total risk relates to systematic risk, which is reflected in the low beta. Compared to Fund 3, it must have a bigger proportion of risk relating to non-systematic risk factors.

Hence, Fund 2 does better in the alpha/Treynor measures, as those measures only look at systematic risk (beta). It fares less well when it comes to the Sharpe/M² measures that look at total risk.

STATISTICAL SIGNIFICANCE OF ALPHA RETURNS

LO 67.4: Determine the statistical significance of a performance measure using standard error and the t -statistic.

Alpha (α) plays a critical role in determining portfolio performance. A positive alpha produces an indication of superior performance; a negative alpha produces an indication of inferior performance; and zero alpha produces an indication of normal performance matching the benchmark. The performance indicated by alpha, however, could be a result of luck and not skill. In order to assess a manager's ability to generate alpha, we conduct a t -test under the following hypotheses:

Null (H_0): True alpha is zero.

Alternative (H_A): True alpha is not zero.

$$t = \frac{\alpha - 0}{\sigma / \sqrt{N}}$$

where:

α = alpha estimate

σ = alpha estimate volatility

N = sample number of observations

standard error of alpha estimate = $\sigma / \sqrt{N}$

In order to compute the t -statistic, we will need to know the alpha estimate, the sample number of observations, and the alpha estimate of volatility. From the volatility and sample size estimates, we can compute the standard error of the alpha estimate, which is shown in the denominator of the t -statistic calculation.

At a 95% confidence level (5% significance level) we reject the null hypothesis if we estimate a t -value of 2 or larger. That is, the probability of observing such a large estimated alpha by chance is only 5%, assuming returns are normally distributed.



Professor's Note: Using a t -value of 2 is a general test of statistical significance. From the FRM Part I curriculum, we know that the actual t -value with a 95% confidence level given a large sample size is 1.96.

If we assume an excess (alpha) return of 0.09% and a standard error of the alpha of 0.093%, the t -statistic would be equal to 0.97 ($t = 0.09\% / 0.093\%$); therefore, we fail to reject H_0 and conclude that there is no evidence of superior (or inferior) performance.



Professor's Note: Using statistical inference when evaluating performance is extremely challenging in practice. By the time you are reasonably confident that a manager's returns are in fact due to skill, the manager may have moved elsewhere.

MEASURING HEDGE FUND PERFORMANCE

LO 67.5: Explain the difficulties in measuring the performance of hedge funds.

Long-short hedge funds are often used to complement an investor's well-diversified portfolio. For example, the investor might allocate funds to a passively managed index fund and an actively managed long-short hedge fund. The hedge fund is designed to provide positive alpha with zero beta to the investor's overall composite portfolio. The hedge fund creates **portable alpha** in the sense that the alpha does not depend on the performance of the broad market and can be ported to any existing portfolio. Because the long-short fund is market-neutral, the alpha may be generated outside the investor's desired asset class mix.

Unfortunately, hedge fund performance evaluation is complicated because:

- Hedge fund risk is not constant over time (nonlinear risk).
- Hedge fund holdings are often illiquid (data smoothing).
- Hedge fund sensitivity with traditional markets increases in times of a market crisis and decreases in times of market strength.

The latter problem necessitates the use of estimated prices for hedge fund holdings. The values of the hedge funds, therefore, are not transactions-based. The estimation process unduly smoothes the hedge fund "values," inducing serial correlation into any statistical examination of the data.

PERFORMANCE EVALUATION WITH DYNAMIC RISK LEVELS

LO 67.6: Explain how changes in portfolio risk levels can affect the use of the Sharpe ratio to measure performance.

The Sharpe ratio is useful when evaluating the portfolio performance of a passive investment strategy, where risk and return characteristics are relatively constant over time. However, the application of the Sharpe ratio is challenged when assessing the performance of active investment strategies, where risk and return characteristics are more dynamic. Changes in volatility will likely bias the Sharpe ratio, and produce incorrect conclusions when comparing portfolio performance to a benchmark or index.

Take for example a low-risk portfolio with an alpha return of 1% and a standard deviation of 3%. The manager implements this strategy for one-year, producing quarterly returns of -2%, 4%, -2%, and 4%. The Sharpe ratio for this portfolio is calculated as: $1\% / 3\% = 0.3333$. If the market index has a Sharpe ratio of 0.3, we would conclude that this portfolio has superior risk-adjusted performance. In the following year, the portfolio manager decides to switch to a high-risk strategy. The alpha return and risk correspondingly increase to 5% and 15%, respectively. For the second year, quarterly returns were -10%, 20%, -10%, and 20%. The Sharpe ratio in this case is still 0.3333 ($= 5\% / 15\%$), which still indicates superior performance compared to the market index. However, if the Sharpe ratio is evaluated over the two-year time frame, considering both the low-risk and high-risk strategies, the measure will drop to 0.2727 since average excess return over both years was 3% with volatility of 11%. The lower Sharpe ratio now suggests underperformance relative to the market index.

In this example, the Sharpe ratio was biased downward due to the perceived increase in risk in portfolio returns. In isolation, both the low-risk and high-risk strategies produced higher Sharpe ratios than the market index. However, when analyzed together, the Sharpe ratio suggests that the portfolio excess returns are inferior to the market. Therefore, it is important to consider changes in portfolio composition when using performance measures, as dynamic risk levels can lead to incorrect ranking conclusions.

MEASURING MARKET TIMING ABILITY

LO 67.7: Describe techniques to measure the market timing ability of fund managers with a regression and with a call option model, and compute return due to market timing.

Measuring Market Timing with Regression

Extending basic return regression models offers a tool to assess superior market timing skills of a portfolio manager. A market timer will include high (low) beta stocks in her portfolio if she expects an up (down) market. If her forecasts are accurate, her portfolio will outperform the benchmark portfolio. Using a market timing regression model, we can empirically test whether there is evidence of superior market timing skills exhibited by the portfolio manager. The regression equation used for this test is as follows:

$$R_P - R_F = \alpha + \beta_P(R_M - R_F) + M_P(R_M - R_F)D + \varepsilon_P$$

In this equation, D is a dummy variable that is assigned a value of 0 for down markets (i.e., when $R_M < R_F$) and 1 for up markets (i.e., when $R_M > R_F$). M_P is the difference between the up market and down market betas and will be positive for a successful market timer. In a bear market, beta is simply equal to β_P . In a bull market, beta is equal to $\beta_P + M_P$. Empirical evidence of mutual fund return data suggests that M_P is actual negative for most funds. Thus, researchers have concluded that fund managers exhibit little, if any, ability to correctly time the market.

Measuring Market Timing with a Call Option Model

Consider an investor who has 100% perfect market forecasting ability and holds a portfolio allocated either 100% to Treasury bills or 100% to the S&P 500 equity market index, depending on the forecast performance of the S&P 500 versus the Treasury bill return. The investor's portfolio will be:

100% invested in the S&P 500 if $E(R_M) > R_F$
 100% invested in Treasury bills if $E(R_M) < R_F$

If the investor has perfect forecasting ability, then his return performance will be as follows:

$$\begin{array}{l} R_M \text{ if } R_M > R_F \\ R_F \text{ if } R_M < R_F \end{array}$$

Now consider an investor who invests S_0 (the current value of the S&P 500) in Treasury bills and also owns a call option on the S&P 500 with exercise price equal to the current value of the index times $(1 + R_F)$, or $S_0(1+R_F)$. Note that the exercise price equals the value of the S&P 500 if it grows at a rate equal to the risk-free rate.

What are the return possibilities for this investor? To answer this question, note that if the S&P 500 holding period return exceeds the risk-free rate, then the ending value of the call option will be:

$$S_T - X = S_0(1+R_M) - S_0(1+R_F)$$

The investor also owns Treasury bills with face value equal to $S_0(1+R_F)$. Therefore, the face value (FV) of the Treasury bills will perfectly offset the exercise price of the call option. In the up-market scenario, the ending value of the calls plus bills portfolio equals:

$$S_T - X + FV = S_0(1+R_M) - S_0(1+R_F) + S_0(1+R_F) = S_0(1+R_M)$$

Therefore, the return performance on the calls plus bills portfolio will equal:

$$R_M \text{ if } R_M > R_F$$

If the market rises by less than the risk-free rate, the call option has no value, but the risk-free asset will still return R_F . Therefore, the down-market scenario return for the calls plus bills portfolio is:

$$R_F \text{ if } R_M < R_F$$

In summary, the returns to the calls plus bills portfolio are identical to the 100% perfect foresight returns. Therefore, the value or appropriate fee for perfect foresight should equal the price of the call option on the market index.

STYLE ANALYSIS

LO 67.8: Describe style analysis.

LO 67.9: Describe and apply performance attribution procedures, including the asset allocation decision, sector and security selection decision and the aggregate contribution.

William Sharpe introduced the concept of style analysis. From January 1985 to December 1989 he analyzed the returns on Fidelity's Magellan Fund for style and selection bets. His study concluded that 97.3% of the fund's returns were explained by style bets (asset allocation), and 2.7% were due to selection bets (individual security selection and market timing). The importance of long-run asset allocation has been well established empirically. These results suggest that the returns to market timing and security selection are minimal at best and at worst insufficient to cover the associated operating expenses and trading costs.

The steps for Sharpe's style analysis are as follows:

1. Run a regression of portfolio returns against an exhaustive and mutually exclusive set of asset class indices:

$$R_P = b_{P1}R_{B1} + b_{P2}R_{B2} + \dots + b_{Pn}R_{Bn} + e_P$$

where:

R_P = return on the managed portfolio

R_{Bj} = return on passive benchmark asset class n

b_{Pj} = sensitivity or exposure of Portfolio P return to passive asset class n return

e_P = random error term

In Sharpe's style analysis, the slopes are constrained to be non-negative and to sum to 100%. In that manner, the slopes can be interpreted to be "effective" allocations of the portfolio across the asset classes.

2. Conduct a performance attribution (return attributable to asset allocation and to selection):
 - The percent of the performance attributable to asset allocation = R^2 (the coefficient of determination).
 - The percent of the performance attributable to selection = $1 - R^2$.

The **asset allocation attribution** equals the difference in returns attributable to active asset allocation decisions of the portfolio manager:

$$[b_1R_{B1} + b_2R_{B2} + \dots + b_nR_{Bn}] - R_B$$

Notice if the slopes (estimated allocations) for the managed portfolio equal those within the benchmark (passive asset allocation), then the asset allocation attribution will be zero.

The **selection attribution** equals the difference in returns attributable to superior individual security selection (correct selection of mispriced securities) and sector allocation (correct over and underweighting of sectors within asset classes):

$$R_P - [b_1 R_{B1} + b_2 R_{B2} + \dots + b_n R_{Bn}]$$

Notice if the manager has no superior selection ability, then portfolio returns earned within each asset class will equal the benchmark asset class returns: $R_{Pj} = R_{Bj}$, and the selection attribution will equal zero. Also, notice that the sum of the two attribution components (asset allocation plus selection) equals the total excess return performance: $R_P - R_B$.

3. Uncover the investment style of the portfolio manager: the regression slopes are used to infer the investment style of the manager. For example, assume the following results are derived:

$$R_P = 0.75R_{LCG} + 0.15R_{LCV} + 0.05R_{SCG} + 0.05R_{SCV}$$

where:

R_{LCG} = return on the large cap growth index

R_{LCV} = return on the large cap value index

R_{SCG} = return on the small cap growth index

R_{SCV} = return on the small cap value index

The regression results indicate that the manager is pursuing primarily a large cap growth investment style.

KEY CONCEPTS

LO 67.1

The dollar-weighted rate of return is defined as the internal rate of return (IRR) on a portfolio, taking into account all cash inflows and outflows. The beginning value of the account is an inflow as are all deposits into the account. All withdrawals from the account are outflows, as is the ending value.

Time-weighted rate of return measures compound growth. It is the rate at which \$1 compounds over a specified time horizon. Time-weighting is the process of averaging a set of values over time.

LO 67.2

The Sharpe ratio uses standard deviation (total risk) as the relevant measure of risk. It shows the amount of excess return (over the risk-free rate) earned per unit of total risk.

The Treynor measure is very similar to the Sharpe ratio except that it uses beta (systematic risk) as the measure of risk. It shows the excess return (over the risk-free rate) earned per unit of systematic risk.

Jensen's alpha is the difference between the actual return and the return required to compensate for systematic risk. To calculate the measure, we subtract the return calculated by the capital asset pricing model (CAPM) from the account return.

The information ratio is the ratio of the surplus return (in a particular period) to its standard deviation. It indicates the amount of risk undertaken to achieve a certain level of return above the benchmark.

LO 67.3

The M^2 measure compares the return earned on the managed portfolio against the market return, after adjusting for differences in standard deviations between the two portfolios.

LO 67.4

A positive alpha produces an indication of superior performance; a negative alpha produces an indication of inferior performance; and zero alpha produces an indication of normal performance matching the benchmark.

LO 67.5

Hedge fund performance evaluation is complicated because:

- Hedge fund risk is not constant over time (nonlinear risk).
- Hedge fund holdings are often illiquid (data smoothing).
- Hedge fund sensitivity with traditional markets increases in times of a market crisis and decreases in times of market strength.

LO 67.6

Changes in volatility will likely bias the Sharpe ratio, and produce incorrect conclusions when comparing portfolio performance to a benchmark or index.

LO 67.7

Extending basic return regression models offers a tool to assess superior market timing skills of a portfolio manager. A market timer will include high (low) beta stocks in her portfolio if she expects an up (down) market. If her forecasts are accurate, her portfolio will outperform the benchmark portfolio.

LO 67.8

William Sharpe introduced the concept of style analysis. From January 1985 to December 1989 he analyzed the returns on Fidelity's Magellan Fund for style and selection bets. His study concluded that 97.3% of the fund's returns were explained by style bets (asset allocation), and 2.7% were due to selection bets (individual security selection and market timing).

LO 67.9

The importance of long-run asset allocation has been well established empirically. Historical results suggest that the returns to market timing and security selection are minimal at best and at worst insufficient to cover the associated operating expenses and trading costs.

CONCEPT CHECKERS

Use the following data to answer Questions 1 and 2.

Assume you purchase a share of stock for \$50 at time $t = 0$ and another share at \$65 at time $t = 1$, and at the end of year 1 and year 2, the stock paid a \$2.00 dividend. Also at the end of year 2, you sold both shares for \$70 each.

1. The dollar-weighted rate of return on the investment is:
 - A. 10.77%.
 - B. 15.45%.
 - C. 15.79%.
 - D. 18.02%.
2. The time-weighted rate of return on the investment is:
 - A. 18.04%.
 - B. 18.27%.
 - C. 20.13%.
 - D. 21.83%.
3. The following information is available for funds ABC, RST, JKL, and XYZ:

<i>Fund</i>	<i>Annual Rate of Return</i>	<i>Beta</i>	<i>Volatility</i>
ABC	15%	1.25	20%
RST	18%	1.00	25%
JKL	25%	1.20	15%
XYZ	11%	1.36	9%

The average risk-free rate was 5%. Rank the funds from best to worst according to their Treynor measure.

- A. JKL, RST, ABC, XYZ.
- B. JKL, RST, XYZ, ABC.
- C. RST, JKL, ABC, XYZ.
- D. XYZ, ABC, RST, JKL.

Use the following information to answer Question 4.

The following data has been collected to appraise funds A, B, C, and D:

	<i>Fund A</i>	<i>Fund B</i>	<i>Fund C</i>	<i>Fund D</i>	<i>Market Index</i>
Return	8.25%	7.21%	9.44%	10.12%	8.60%
Beta	0.91	0.84	1.02	1.34	1.00
Standard deviation	3.24%	3.88%	3.66%	3.28%	3.55%

The risk-free rate of return for the relevant period was 4%.

4. Calculate and rank the funds from best to worst using Jensen's alpha.
 - A. B, D, A, C.
 - B. A, C, D, B.
 - C. C, A, D, B.
 - D. C, D, A, B.
5. Sharpe's style analysis, used to evaluate an active portfolio manager's performance, measures performance relative to:
 - A. a passive benchmark of the same style.
 - B. broad-based market indices.
 - C. the performance of an equity index fund.
 - D. an average of similar actively managed investment funds.

CONCEPT CHECKER ANSWERS

1. D One way to do this problem is to set up the cash flows so that the PV of inflows = PV of outflows and then to plug in each of the multiple choices.

$$50 + 65 / (1 + \text{IRR}) = 2 / (1 + \text{IRR}) + 144 / (1 + \text{IRR})^2 \rightarrow \text{IRR} = 18.02\%$$

Alternatively, on your financial calculator, solve for IRR: $-50 - \frac{65 - 2}{1 + \text{IRR}} + \frac{2(70 + 2)}{(1 + \text{IRR})^2} = 0$

<i>Calculating Dollar-Weighted Return With the TI Business Analyst II Plus®</i>		
Key Strokes	Explanation	Display
[CF] [2nd] [CLR WORK]	Clear CF Memory Registers	CF0 = 0.00000
50 [+/-] [ENTER]	Initial cash inflow	CF0 = -50.00000
[↓] 63 [+/-] [ENTER]	Period 1 cash inflow	C01 = -63.00000
[↓] [↓] 144 [ENTER]	Period 2 cash outflow	C02 = 144.00000
[IRR] [CPT]	Calculate IRR	IRR = 18.02210

2. D $\text{HPR}_1 = (65 + 2) / 50 - 1 = 34\%$, $\text{HPR}_2 = (140 + 4) / 130 - 1 = 10.77\%$

$$\text{time-weighted return} = [(1.34)(1.1077)]^{0.5} - 1 = 21.83\%.$$

3. A Treynor measures:

$$T_{\text{ABC}} = \frac{0.15 - 0.05}{1.25} = 0.08 = 8$$

$$T_{\text{RST}} = \frac{0.18 - 0.05}{1.00} = 0.13 = 13$$

$$T_{\text{JKL}} = \frac{0.25 - 0.05}{1.20} = 0.1667 = 16.7$$

$$T_{\text{XYZ}} = \frac{0.11 - 0.05}{1.36} = 0.0441 = 4.4$$

The following table summarizes the results:

<i>Fund</i>	<i>Treynor Measure</i>	<i>Rank</i>
ABC	8.00%	3
RST	13.00%	2
JKL	16.67%	1
XYZ	4.41%	4

4. C CAPM Returns:

$$\begin{aligned}
 R_A &= 4 + 0.91(8.6 - 4) = 8.19\% \\
 R_B &= 4 + 0.84(8.6 - 4) = 7.86\% \\
 R_C &= 4 + 1.02(8.6 - 4) = 8.69\% \\
 R_D &= 4 + 1.34(8.6 - 4) = 10.16\%
 \end{aligned}$$

	<i>Fund A</i>	<i>Fund B</i>	<i>Fund C</i>	<i>Fund D</i>
Alpha	8.25% – 8.19% = +0.06	7.21% – 7.86% = –0.65%	9.44% – 8.69% = +0.75%	10.12% – 10.16% = –0.04%
Ranking	2	4	1	3

5. A Sharpe’s style analysis measures performance relative to a passive benchmark of the same style.

ILLIQUID ASSETS

Topic 68

EXAM FOCUS

This topic examines illiquid asset market characteristics and the relationship between illiquidity and market imperfections. Reported return biases are discussed as well as the illiquidity risk premium within and across asset classes. For the exam, understand that all markets, even highly liquid markets such as commercial paper, can be illiquid at some points in time. Also, know the three biases that impact reported returns of illiquid asset classes (survivorship bias, sample selection bias, and infrequent sampling). Finally, understand the factors that influence the decision to include illiquid asset classes in a portfolio.

ILLIQUID ASSET MARKETS

LO 68.1: Evaluate the characteristics of illiquid markets.

There are several characteristics that describe illiquid asset markets, including:

1. Most asset classes are illiquid, at least to some degree.
2. Markets for illiquid assets are large.
3. Illiquid assets comprise the bulk of most investors' portfolios.
4. Liquidity dries up even in liquid asset markets.

MOST ASSET CLASSES ARE ILLIQUID

All markets, even large-cap equity markets, are somewhat illiquid. It is clear, however, that some assets (e.g., real estate) are less liquid than others (e.g., public equities). Illiquid assets trade infrequently, in small amounts, and generally exhibit low turnover. For example, there are mere seconds between transactions in public equity markets with an annualized turnover rate greater than 100%. In contrast, over-the-counter (OTC) equities typically trade within a day, but sometimes a week or more may pass between trades, with annualized turnover of 25% to 35%. Corporate bonds trade daily, and municipal bonds typically trade semiannually. At the far end of the liquidity spectrum is institutional infrastructure with an average investment commitment of 50 to 60 years (up to 99 years), and art, with 40 to 70 years between transactions. There is negligible turnover in infrastructure. Turnover in residential real estate is about 5% per year, while turnover in institutional real estate is approximately 7%. Time between real estate transactions can range from months to decades.

MARKETS FOR ILLIQUID ASSETS ARE LARGE

The size of the U.S. residential mortgage market was \$16 trillion in 2012. The institutional real estate market was measured at \$9 trillion. In contrast, the market capitalization of the NYSE and Nasdaq combined was approximately \$17 trillion. The total wealth held in illiquid assets exceeds the total wealth in traditional, liquid stock, and bond markets.

INVESTOR HOLDINGS OF ILLIQUID ASSETS

The home is often an individual's most valuable asset. As a result, illiquid assets represent approximately 90% of total wealth, not counting human capital, the largest and least liquid asset for many individual investors. High net worth individuals in the United States even typically allocate 10% of portfolios to fine art and jewelry, known as treasure assets. High net worth individuals in foreign countries hold an average of 20% in treasure assets. Institutional investors have also increased allocations to illiquid assets over the last 20 years. University endowments have increased allocations of illiquid assets to approximately 25%, up from 5% in the early 1990s. Pension funds have increased allocations to approximately 20%, up from 5% in 1995. In general, investors hold sizeable amounts of illiquid assets.

LIQUIDITY CAN DRY UP

In stressed economic periods, such as during the 2007–2009 financial crisis, liquidity can dry up. For example, money markets froze (i.e., repurchase agreement and commercial paper markets) during the crisis as investors were unwilling to trade at any price. Residential and commercial mortgage-backed securities markets, structured credit markets, and the auction rate securities market, a market for floating rate municipal bonds, also became illiquid during the crisis. The auction rate securities market is still frozen, more than six years later. Major liquidity crises have occurred at least once every 10 years across the globe, in conjunction with downturns and financial distress.

MARKET IMPERFECTIONS

LO 68.2: Examine the relationship between market imperfections and illiquidity.

Many economic theories assume that markets are perfect. This means that market participants are rational and pursue utility maximization, that there are no transactions costs, regulation or taxes, that assets are perfectly divisible, that there is perfect competition in markets, and that all market participants receive information simultaneously. The reality, though, is that markets are imperfect.

Imperfections that encourage illiquidity include:

- **Market participation costs.** There are costs associated with entering markets, including the time, money, and energy required to understand a new market. In many illiquid markets, only certain types of investors have the expertise, capital, and experience to participate. This is called a **clienteles effect**. There will be less liquidity in markets that are suited to a limited number of investors and/or where there are barriers to entry in terms of required experience, capital, or expertise.

- **Transaction costs.** Transaction costs include taxes and commissions. For many illiquid assets, like private equity, there are additional costs, including costs associated with performing due diligence. Investors must pay attorneys, accountants, and investment bankers. These costs can impede investment.

When acknowledging the existence of transaction costs (i.e., acknowledging that markets are imperfect), some academic studies assume that as long as an investor can pay the transaction costs (and sometimes these costs are large), then any investor can transact (i.e., any asset can be liquid if one can pay the transaction cost). However, this is not always true. For example, there are:

- **Difficulties finding a counterparty (i.e., search frictions).** For example, it may be difficult to find someone to understand/purchase a complicated structured credit product. It may also be difficult to find buyers with sufficient capital to purchase an office tower or a skyscraper in a city like New York. No matter how high the transaction cost, it may take weeks, months, or years to transact in some situations.
- **Asymmetric information.** Some investors have more information than others. If an investor fears that the counterparty knows more than he does, he will be less willing to trade, which increasing illiquidity. When asymmetric information is extreme, people assume all products are lemons. Because no one wants to buy a lemon, markets break down. Often liquidity freezes are the result of asymmetric information. Because investors are looking for non-predatory counterparties who are not seeking to take advantage of asymmetric information, information itself can be a form of search friction.
- **Price impacts.** Large trades can move markets, which, in turn, can result in liquidity issues for the asset or asset class.
- **Funding constraints.** Many illiquid assets are financed largely with debt. For example, even at the individual level, housing purchases are highly leveraged. As a result, if access to credit is compromised, investors cannot transact.

ILLIQUID ASSET RETURN BIASES

LO 68.3: Assess the impact of biases on reported returns for illiquid assets.

In general, investors should be skeptical of reported returns in illiquid asset markets. The reason is that reported returns are generally overstated. There are reporting biases that result in inflated returns. Three main biases that impact returns of illiquid assets are:

- Survivorship bias.
- Selection bias.
- Infrequent trading.

Survivorship Bias

There are no requirements for certain types of funds (e.g., private equity, hedge funds, buyout funds, and so on) to report returns to database providers. As such, poorly performing funds have a tendency to stop reporting. Additionally, funds may never begin reporting because returns are not high enough to appeal to investors. This results in **reporting biases**. In addition, many poorly performing funds ultimately fail. Performance studies generally include only those funds that were successful enough to survive over the entire period of analysis, leaving out the returns of funds that no longer exist. Both of these factors result in reported returns that are too high. This is called **survivorship bias**. Non-surviving funds

have below average returns and surviving funds have above average returns, but it is the surviving fund returns that are reported. Studies show mutual fund returns are 1% to 2% lower than reported and returns may be as much as 4% lower for illiquid asset markets. While the solution to survivorship bias seems obvious (to observe the entire universe of funds), it is impossible to do in illiquid asset markets.

Sample Selection Bias

Asset values and returns tend to be reported when they are high. For example, houses and office buildings typically are sold when values are high. Often, a seller will wait until property values recover before selling. These higher selling prices are then used to calculate returns. This results in **sample selection bias**.

The problem with selection bias is especially prevalent in private equity markets. Buyout funds take companies public when stock prices are high. Venture capitalists sell companies when values are high. Distressed companies are often not liquidated and left as shell companies (these are sometimes called zombie companies). It is difficult to tell, based on old data without any recent transactions, if a company is alive or whether it is a zombie.

Impacts of sample selection bias include:

- Higher reported alphas relative to true alphas because only high prices are recorded. For example, one study estimates an alpha of more than 90% for venture capital log returns. However, alpha falls to -7% after correcting for sample selection bias. Another study estimates returns are decreased 2% to 5% per month if you correct for the bias.
- Lower reported betas than true betas because there are fewer (only high) prices recorded, flattening the security market line (SML). The effect is smaller for real estate returns because volatility is lower than in private equity and studies often include downturns such as what happened in real estate in the early 1990s and the early 2000s.
- Lower reported variance of returns than the true variance of returns because only high returns are counted (i.e., underestimated risk).

In sum, sample selection bias results in overestimated expected returns and underestimated risk as measured by beta and the standard deviation of returns (i.e., volatility).

Infrequent Trading

Illiquid assets, by definition, trade infrequently. **Infrequent trading** results in underestimated risk. Betas, return volatilities, and correlations are too low when they are computed using the reported returns of infrequently traded assets. Returns for these infrequently traded assets are smoothed. For example, if one compares quarterly returns to the daily returns of the same asset, quarterly returns will appear (and actually be) less volatile. Prices will often be higher or lower in a given investment horizon, than it appears when examining quarterly returns. The computed standard deviation of returns often will be lower when examining quarterly returns compared to daily returns. Also, correlations with other asset classes (e.g., liquid assets such as large-cap stocks) will be artificially low because return volatility is muted by infrequent trades.

It is possible to unsmooth or de-smooth returns using **filtering algorithms**. Filtering algorithms generally remove noise from signals. However, unsmoothing adds noise back to

reported returns to uncover the true, noisier returns. Unsmoothing returns affects risk and return estimates, and could have a dramatic effect on returns. For example, reported real estate returns during the 1990s downturn were -5.3% . The corresponding unsmoothed returns were -22.6% . The National Council of Real Estate Investment Fiduciaries (NCREIF) returns reached -8.3% in December 2008. Unsmoothed returns during the same quarter were -36.3% . The standard deviation of the raw returns was 2.25% during the same quarter compared to 6.26% for unsmoothed returns. For comparison, stock return volatility was approximately 7.5% per quarter. Correlations between the S&P 500 Index and NCREIF returns increased from 9.2% to 15.8% when returns were unsmoothed.

ILLIQUIDITY RISK PREMIUMS

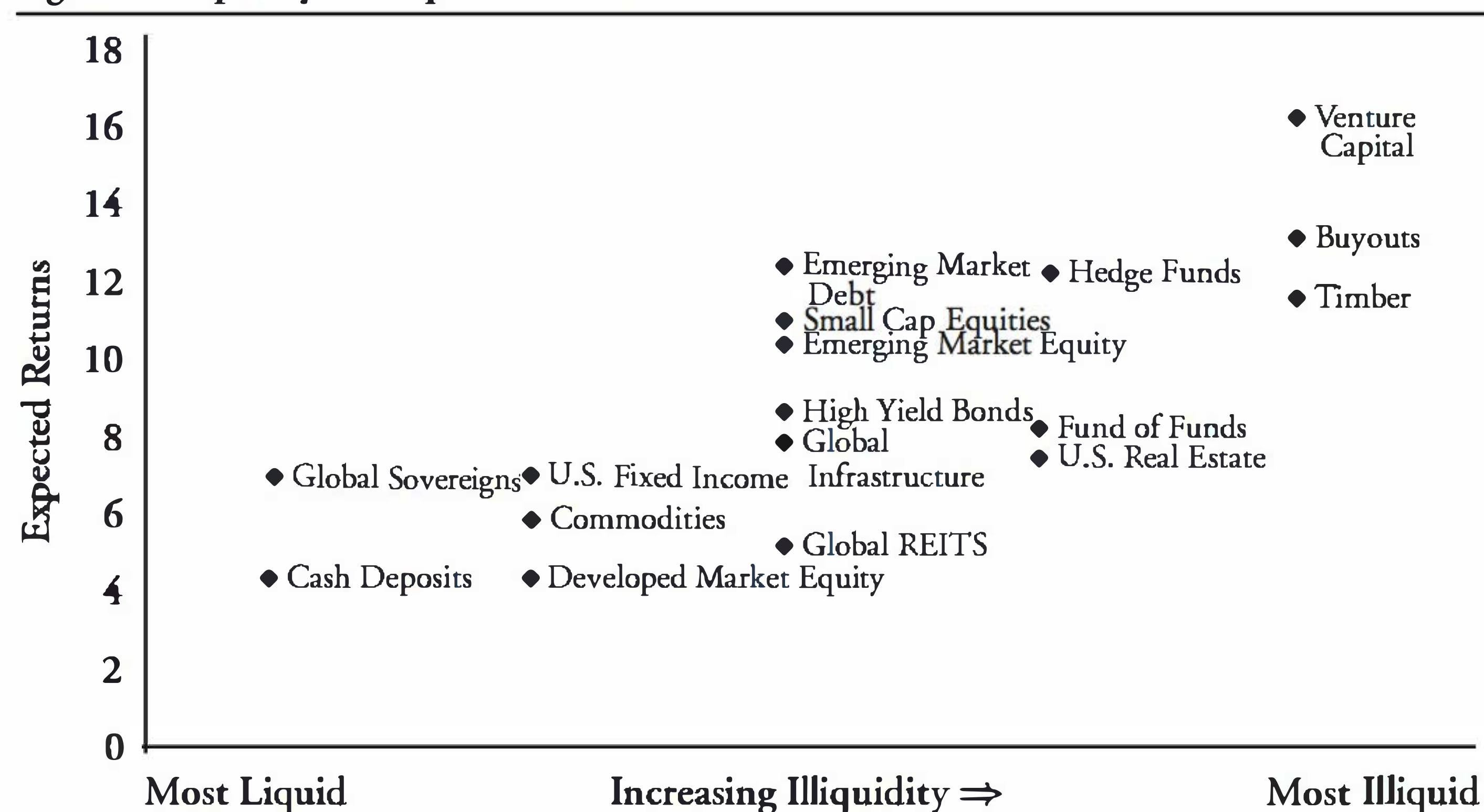
LO 68.4: Compare illiquidity risk premiums across and within asset categories.

Illiquidity Risk Premiums Across Asset Classes

As part of the analysis in Antti Ilmanen's 2011 book *Expected Returns*¹, we can relate liquidity to expected returns as shown in Figure 1. Note, however, that we cannot completely pigeonhole asset classes based on illiquidity (e.g., some private equity funds are more liquid than some hedge funds or infrastructure investments). Also note that, in this analysis, returns are computed over the period 1990 to 2009 and the illiquidity estimates are just estimates (i.e., they represent Ilmanen's opinions). Ilmanen's work does imply a positive relationship between the illiquidity of an asset class and its expected return. Venture capital is considered the least liquid and has the highest expected return, between 16% and 17% . Buyout funds and timber are also illiquid but command lower expected returns, approximately 13% and close to 12% , respectively. Hedge funds are more liquid and are expected to earn a little more than 12% . Real estate is on par with hedge funds in terms of liquidity but commands a lower return of nearly 8% . Equities are much more liquid and earned a bit more than 4% over the period. Cash is the most liquid and it too earned a little over 4% during the period.

¹ Ilmanen, A. (2011). *Expected Returns: An Investor's Guide to Harvesting Market Rewards*. Chichester, West Sussex, U.K.: Wiley.

Figure 1: Liquidity vs. Expected Returns



It is the conventional view that there is a premium for illiquidity. However, this may not be true. First, there are illiquidity biases. As discussed in the previous LO, reported returns of illiquid assets are too high (i.e., overstated if using raw, unsmoothed data) and risk and correlation estimates are too low.

Second, illiquid asset classes such as private equity, buyout funds, and physical assets like timber contain significant risks beyond liquidity risk. After adjusting for these risks, illiquid asset classes are much less attractive. According to one study, after adjusting for risk, most investors are better off investing in the S&P 500 than in a portfolio of private equity.

Third, there is no “market index” for illiquid assets. Private equity, hedge fund, and real estate indices are not investable, so no investor is actually earning the index return. For example, the NCREIF includes thousands of properties. Because individuals do not typically own thousands of properties, they are much more subject to idiosyncratic risks and are less diversified within the asset class.

Fourth, you must rely on manager skill in illiquid asset classes. There is no way, as there is with tradeable, cheap bond and equity index funds, to separate factor risk (i.e., systematic risk) from the talents of fund managers. As noted, there is no way to earn index returns. If an investor cannot earn index returns in illiquid asset class markets, he has no way of separating passive returns from alpha generated by active managers.

These factors imply that it may not be possible to generate substantial illiquidity risk premiums across illiquid asset classes. However, there is evidence of large illiquidity risk premiums within asset classes.

Illiquidity Risk Premiums Within Asset Classes

Less liquid assets generally have higher returns than more liquid assets, within asset classes. Currently, there is no formal theory about why illiquidity risk premiums exist within asset

classes but not between. It might be that investors simply overpay for illiquid asset classes, chasing the illusion of higher returns. It may also be that firms do not manage portfolios as a cohesive whole, but instead put asset classes in different silos. Mispricing (i.e., the lack of a premium across classes) may be due to slow-moving capital across classes, limits to arbitrage, and institutional constraints (e.g., the fixed-income desk doesn't talk to the equity traders, and so on).

Illiquidity Effects in U.S. Treasury Markets

On-the-run (i.e., newly issued) Treasury bills (T-bills) are more liquid and have lower yields than off-the-run (seasoned) T-bills. The difference is called the on-the-run/off-the-run bond spread. During the 2007–2009 financial crisis, same maturity T-bonds and T-notes traded with different yields. While prices should have been the same, T-bond prices were more than 5% lower than T-note prices. Given that the U.S. Treasury market is one of the largest and most liquid in the world, it is surprising to observe large illiquidity effects.

Illiquidity Effects in Corporate Bond Markets

Larger bid-ask spreads and infrequent trading led to higher yields in corporate bond markets. Studies indicate that illiquidity risk explains 7% of the variation in investment grade bond yields and 22% of the variation in junk bond yields. Also, as bid-ask spreads increase, yield spreads increase by more than double the amount (e.g., a one-basis point increase in the bid-ask spread results in a more than two-basis point increase in the yield spread).

Illiquidity Effects in Equity Markets

There are several variables related to illiquidity that are shown to impact equity returns. Studies indicate that less liquid stocks earn higher returns than more liquid stocks. Illiquidity factors that impact equity returns are:

- Bid-ask spreads.
- Volume.
- Turnover.
- Volume measured by whether the trade was initiated by buyers or sellers.
- Ratio of absolute returns to dollar volume, called the “Amihud measure.”
- Price impact of large trades.
- Informed trading measures (i.e., adverse selection).
- Quote size.
- Quote depth.
- Frequency of trades.
- Number of “zero” returns (in liquid markets returns are usually not zero).
- Return autocorrelations (which are a measure of stale prices).

All of these factors are characteristics of illiquidity that are unique to each stock. There are also illiquidity risk betas that are covariances of stock returns with illiquidity factors. Researchers estimate illiquidity risk premiums at 1% to 8% depending on the illiquidity measure used. Research also indicates that risk premiums have declined, although studies find a 1% risk premium for listed equities compared to a 20% risk premium for OTC stocks.

Secondary Markets for Private Equity and Hedge Funds

Private equity funds trade companies with each other, providing needed liquidity. In 2005, these secondary buyouts represented about 15% of all private-equity buyout deals. This does allow funds to get out of specific deals, may give limited partners (LPs) some cash in the process, and may allow LPs to better understand the values of portfolio companies. However, secondary buyouts do not allow limited partners to get out of the private equity fund itself.

LPs can exit private equity funds in secondary markets. However, these markets are immature, small, and more opaque. Firms participating in these markets on the buy side were called vultures in the 1990s. Buyers took advantage of distressed sellers, getting discounts of 30% to 50%. Discounts fell below 20% in the early 2000s, but shot up again during the 2007–2009 financial crisis.

Harvard University saw its endowment fall by more than \$8 billion, or 22%, between July 1, 2008, and October 31, 2008. Harvard relies on the endowment for some of its operating funds. Endowment fund managers attempted to sell stakes in private equity to free up cash for operations and faced discounts of 50%.

Because hedge fund investors can typically redeem their investments at predetermined dates, discounts on secondary market transactions are much smaller than in private equity investments. During the recent financial crisis, hedge fund discounts were 6% to 8% on average. Some funds traded at a premium, even during the crisis, due to strong demand (i.e., the funds were closed to new investors). Large asset owners like sovereign funds and pension funds can supply liquidity in hedge fund and private equity markets, buying stakes at reduced prices and harvesting illiquidity risk premiums.

In sum, there are four ways that investors can harvest illiquidity premiums:

1. Allocating a portion of the portfolio to illiquid asset classes like real estate. This is **passive allocation to illiquid asset classes**.
2. Choosing more illiquid assets within an asset class. This means engaging in **liquidity security selection**.
3. Acting as a **market maker** for individual securities. For example, Dimensional Funds Advisors (DFA) is a liquidity provider that buys stock at a discount from those wanting to sell quickly and sells small-cap stocks at a premium to investors demanding shares. The firm avoids adverse selection problems by choosing counterparties who fully disclose information about stocks. The firm is trustworthy in its dealings and does not manipulate prices or engage in front running. Sovereign wealth funds, large pension funds, and other large asset owners can also act as market makers, providing liquidity while buying at discounts and selling at premiums.

4. Engaging in **dynamic factor strategies** at the aggregate portfolio level. This means taking long positions in illiquid assets and short positions in liquid assets to harvest the illiquidity risk premium. Investors rebalance to take advantage of the liquidity differences as less liquid assets become more liquid. Rebalancing the portfolio is the simplest way to provide liquidity. As long as buyers buy when others want to sell and sell when others want to buy, rebalancing is countercyclical. Of the four ways investors can harvest the illiquidity premium, this is the easiest to implement and can have the greatest effect on portfolio returns.

PORTFOLIO ALLOCATION TO ILLIQUID ASSETS

LO 68.5: Evaluate portfolio choice decisions on the inclusion of illiquid assets.

In determining the portfolio allocation to illiquid asset classes, or any asset class for that matter, investors must consider their personal circumstances. The illiquid asset allocation decision is influenced by different investment horizons, the lack of tradeable indices, the need to hire talented active portfolio managers, and the need to monitor those managers. Portfolio choice models that include illiquid assets must consider two important aspects of illiquidity that impact investors:

1. Long time horizons between trades (i.e., infrequent trading).
2. Large transaction costs.

Asset Allocation to Illiquid Asset Classes with Transaction Costs

The primary issue with asset allocation models that include transaction costs is that they assume an asset will always trade if the counterparty pays the transaction cost. However, this is not true in private equity, infrastructure, real estate, and timber markets. It is not (or may not) be possible to find a buyer in a short period of time. Counterparties, if identified, must perform due diligence, which takes time. In some cases, the counterparty, upon completion of due diligence, chooses not to buy the asset. In periods of stress, even liquid asset classes face liquidity freezes and it becomes impossible to find buyers at any price.

Asset Allocation to Illiquid Asset Classes with Infrequent Trading

As anyone trying to sell in a period of illiquidity knows, one cannot “eat” illiquid assets. Consider the example of Harvard University, briefly described earlier. The only way the university could generate cash for operations in a period of significant losses and illiquidity across what some would consider some of the most liquid assets (i.e., commercial paper and repurchase agreements), Harvard would have had to sell at huge discounts. Only liquid assets can be consumed. As a result, illiquidity has a major effect on investors’ portfolio choices. Illiquidity causes the following with respect to portfolio choice:

- **Reduces optimal holdings.** The less frequently a liquidity event is expected to occur, the lower the allocation to the illiquid asset class.
- Rebalancing illiquid assets (i.e., when there is infrequent trading in the asset class) causes allocations to **vary significantly**. The investor must wait until the liquidity event arrives. As such, the allocation prior to a liquidity event (or during nonrebalancing periods) can vary from too high to too low relative to the optimal allocation.

- Investors cannot hedge against declining values when an asset cannot be traded. As a result, **illiquid asset investors must consume less** than liquid asset investors to offset the risk.
- **There are no illiquidity “arbitrages.”** To construct an arbitrage, an asset must be continuously traded. Illiquid assets are not continuously traded.
- Due to infrequent trading, illiquid asset investors must **demand an illiquidity risk premium**. The more frequently the asset is traded, the lower the premium. For example, one study indicates that private equity investments generate returns 6% higher than public markets to compensate investors for illiquidity.

The inclusion of illiquid assets in a portfolio is not as simple or desirable as it might seem. The following points should be considered:

1. Studies show that illiquid assets do not deliver higher risk-adjusted returns.
2. Investors are subject to agency problems because one must rely on the talents and skills of the manager. It is difficult to monitor external managers (e.g., private equity managers).
3. In many firms, illiquid assets are managed separately from the rest of the portfolio.
4. Illiquid asset investors face high idiosyncratic risks. There is no “market” portfolio of illiquid assets. Recall the example of the NCREIF versus the individual investor. It is not possible for most investors to hold thousands of properties, and small numbers of properties can lead to undiversified, property specific risks (but also returns, making illiquid assets compelling to investors). Illiquid assets are compelling because:
 - Illiquid asset markets are less efficient than stock and bond markets.
 - There are large information asymmetries in illiquid asset markets.
 - High transaction costs keep many investors out of the market.
 - Management skill is crucial and alpha opportunities are widely dispersed.

All of these factors suggest there are great opportunities for the skilled investor to profit from investments in illiquid assets. Investors must have the skills and resources to find, evaluate, and monitor illiquid asset opportunities. Endowments like Harvard, Yale, and Stanford have the skills and resources. Unskilled investors, even those endowments at less sophisticated, skilled, and connected schools, can lose big in illiquid asset markets.

KEY CONCEPTS

LO 68.1

There are four main characteristics that describe illiquid asset markets, including:

1. Most asset classes are illiquid, at least to some degree.
2. Markets for illiquid assets are large.
3. Illiquid assets comprise the bulk of most investors' portfolios.
4. Liquidity dries up even in liquid asset markets.

LO 68.2

Market imperfections encourage illiquidity in asset markets. Specifically, market participation costs (i.e., clientele effects) and transaction costs give rise to illiquidity. Some academic models assume that all assets can be traded if one will pay the required (sometimes very high) transaction cost. However, this is not necessarily true in illiquid asset markets. There are search frictions (i.e., difficulties finding a counterparty and information asymmetries), price impacts, and funding constraints that may prevent trades from occurring, no matter how high the transaction cost.

LO 68.3

In general, investors should be skeptical of reported returns in illiquid asset markets as they are generally overstated. There are reporting biases that result in artificially inflated returns. The three main biases that impact reported illiquid asset returns are:

1. Survivorship bias: Poor performing funds often quit reporting results. Also, many poor performing funds ultimately fail. Finally, some poor performing funds never begin reporting returns because performance is weak. All of these factors lead to survivorship bias. Survivorship bias leads to an overstatement of stated returns relative to true returns.
2. Selection bias: Asset values and returns tend to be reported when they are high. For example, houses and office buildings typically are sold when values are high. These higher selling prices are used to calculate returns. This results in sample selection bias, which again leads to overstated returns.
3. Infrequent trading: Illiquid assets, by definition, trade infrequently. Infrequent trading results in underestimated risk. Betas, return volatilities, and correlations are too low when they are computed using the reported returns of infrequently traded assets.

LO 68.4

There is little evidence that there are large illiquidity risk premiums across asset classes. However, there are large illiquidity risk premiums within asset classes.

There are four primary ways that investors can harvest illiquidity premiums:

1. Allocating a portion of the portfolio to illiquid asset classes like real estate. This is passive allocation to illiquid asset classes.
2. Choosing more illiquid assets within an asset class. This means engaging in liquidity security selection.
3. Acting as a market maker for individual securities.
4. Engaging in dynamic factor strategies at the aggregate portfolio level. This means taking long positions in illiquid assets and short positions in liquid assets to harvest the illiquidity risk premium. Of the four ways investors can harvest illiquidity premiums, this is the easiest to implement and can have the greatest effect on portfolio returns.

LO 68.5

There are several points to consider when deciding to allocate portfolio resources to illiquid assets:

1. Studies show that illiquid assets do not deliver higher risk-adjusted returns.
2. Investors are subject to agency problems because one must rely on the talents and skills of portfolio managers. It is difficult to monitor external managers.
3. In many firms, illiquid assets are managed separately from the rest of the portfolio.
4. Illiquid asset investors face high idiosyncratic risks. There is no “market” portfolio of illiquid assets. Illiquid assets are compelling because illiquid asset markets are less efficient than stock and bond markets, there are large information asymmetries in illiquid asset markets, high transaction costs keep many investors out of the market, management skill is crucial, and alpha opportunities are widely dispersed.

CONCEPT CHECKERS

1. Global liquidity crises generally occur because:
 - A. governments choose not to engage in monetary policy actions to stimulate economies.
 - B. financial distress causes markets to freeze.
 - C. markets for illiquid assets shrink, causing liquidity issues to infect traditional asset classes.
 - D. transaction costs increase as developing economies get stronger.
2. When an investor has difficulty finding a counterparty for a complicated credit product like a structured debt instrument, this is known as:
 - A. market participation costs.
 - B. agency costs.
 - C. search frictions.
 - D. selection bias.
3. Blue Sky Funds, a private equity fund, has suffered low returns for the last five years. As a result, the fund has decided to quit reporting returns. The fund did report returns each year for the last 10 years when performance was strong. This problem of reporting leads to:
 - A. survivorship bias.
 - B. sample selection bias.
 - C. infrequent trading bias.
 - D. attrition bias.
4. Which of the following variables is not an illiquidity factor that affects equity returns?
 - A. Measures of adverse selection.
 - B. The number of recorded positive returns.
 - C. Turnover.
 - D. Volume.
5. Rick Faircloth, a general partner and portfolio manager with Faircloth Funds, is considering ways in which his company can profit from illiquidity risk premiums. He has studied several alternative methods for harvesting illiquidity risk premiums. Which of the following strategies might Faircloth implement that will likely have the greatest effect on portfolio returns?
 - A. Acting as a market maker for individual securities.
 - B. Choosing the most illiquid assets within an asset class, even if the asset class is generally considered to be liquid.
 - C. Allocating a portion of a portfolio to illiquid asset classes.
 - D. Using dynamic factor strategies at the aggregate portfolio level.

CONCEPT CHECKER ANSWERS

1. B In stressed economic periods, such as during the 2007–2009 financial crisis, liquidity can dry up. Major liquidity crises have occurred at least once every ten years across the globe, in conjunction with downturns and financial distress.
2. C Difficulties finding a counterparty are called search frictions. For example, it may be difficult to find someone to understand/purchase a complicated structured credit product. It may also be difficult to find buyers with sufficient capital to purchase multimillion dollar office towers in major metropolitan areas. No matter how high the transaction costs, it may take weeks, months, or years to transact in some situations. Asymmetric information can also be a type of search friction as investors search for non-predatory counterparties with which to transact.
3. A There are no requirements for certain types of funds, like private equity funds, to report returns. As such, poorly performing funds have a tendency to stop reporting. Additionally, many poorly performing funds ultimately fail. Performance studies generally include only those funds that were successful enough to survive over the entire period of analysis, leaving out the returns of funds that no longer exist. Both of these factors result in reported returns that are too high. This is called survivorship bias.
4. B There are several variables related to illiquidity that are shown to impact equity returns. They are bid-ask spreads, volume, turnover, volume measured by whether the trade was initiated by buyers or sellers, the ratio of absolute returns to dollar volume, the price impact of large trades, informed trading measures (i.e., adverse selection), quote size and depth, the frequency of trades, the number of zero returns, and return autocorrelations. It is not the number of recorded positive returns, but the number of recorded zero returns, that are relevant.
5. D There are four primary ways that investors can harvest illiquidity premiums:
 1. Allocating a portion of the portfolio to illiquid asset classes like real estate (i.e., passive allocation to illiquid asset classes).
 2. Choosing more illiquid assets within an asset class (i.e., liquidity security selection).
 3. Acting as a market maker for individual securities.
 4. Engaging in dynamic factor strategies at the aggregate portfolio level. This means taking long positions in illiquid assets and short positions in liquid assets to harvest the illiquidity risk premium. Of the four ways investors can harvest illiquidity risk premiums, this is the easiest to implement and can have the greatest effect on portfolio returns.

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

HEDGE FUNDS

Topic 69

EXAM FOCUS

The topic examines two decades of hedge fund performance. Significant events that shaped the hedge fund industry are discussed, including the growth of institutional investments. Different hedge fund strategies are explained, along with the continuing growth of assets under management. Performance is analyzed to see if the rewards justify the risks, and performance is compared with the broad equity markets. The performance of top fund managers is also compared to the performance across the hedge fund industry.

CHARACTERISTICS OF HEDGE FUNDS

LO 69.1: Describe the characteristics of hedge funds and the hedge fund industry, and compare hedge funds with mutual funds.

There are important distinctions between hedge funds and mutual funds. Hedge funds are private, much less regulated investment vehicles, not available to the general public. On the other hand, mutual funds are more structured and regulated. Hedge funds are highly leveraged, and managers obtain profits from both long and short positions. Hedge fund managers tend to take large bets based on perceived relative price discrepancies of assets.

Privacy is a hallmark of hedge funds. There is little transparency in the hedge fund industry because managers do not want their methods copied. A hedge fund charges a fixed management fee plus a healthy share of new profits from the fund, generally around 10–20%.

EVOLUTION OF THE HEDGE FUND INDUSTRY

LO 69.2: Explain biases which are commonly found in databases of hedge funds.

LO 69.3: Explain the evolution of the hedge fund industry and describe landmark events which precipitated major changes in the development of the industry.

LO 69.4: Evaluate the role of investors in shaping the hedge fund industry.

Historical data on hedge fund performance was difficult to obtain prior to the early 1990s. In early 1994, dramatic losses triggered by a Federal Reserve change in interest rate policy had a large impact on hedge fund performance reporting. This prompted the development of hedge fund databases so that participants could better obtain and analyze hedge fund performance.

Assets under management have increased 10 times from 1997 to 2010 as the number of funds has quadrupled. There are some hedge funds that do not participate in commercial databases, which impacts aggregate hedge fund performance. Thus, there is **selection bias**, also known as **self-reporting bias**, contained in hedge fund databases.

There is evidence that suggests that selection bias in large hedge fund databases is actually small. The average return of funds-of-hedge funds (FOHF), comprised of managers who theoretically invest across all hedge funds, not just funds reported to commercial databases, is highly correlated to the average return of hedge funds in commercial databases.

However, there are still concerns about possible measurement errors and various biases in reported hedge fund returns. The consensus is that hedge fund index returns became increasingly reliable beginning in 1996. Prior to 1996, looking at the period from 1987 to 1996, 27 large hedge funds substantially outperformed the S&P 500 index. The outperformance is high, which is more than enough to account for any measurement biases.

The collapse of Long-Term Capital Management (LTCM) in 1998 was a watershed event in the hedge fund industry. It was a reminder that higher returns are accompanied by higher risk. The LTCM collapse had a much greater effect on hedge fund performance compared to equity performance.

The time period of 2000 to 2001 brought the dot-com bubble collapse. During this period, the hedge fund industry experienced a 20% net asset inflow and there was a major shift in the hedge fund industry structure. Hedge funds outperformed the S&P 500 with half of the S&P 500 standard deviation. As a result, institutional investors poured money into hedge funds.

From 1999 to 2007, hedge funds' assets under management went from \$197 billion to \$1.39 trillion. Investors in hedge funds thus shifted from exclusively private wealth to institutions, including foundations, endowments, pension funds, and insurance companies. Evidence suggests that these institutional investors were rewarded from 2002 to 2010 with high returns, due in large part to bearing credit and emerging market risks.

ALPHA-BETA SEPARATION

LO 69.5: Explain the relationship between risk and alpha in hedge funds.

Alpha is a risk-adjusted measure of return often used to assess the performance of active managers. It is the return in excess of the compensation for risk. It is important to identify how much of a strategy's return results from risk (i.e., beta) and how much results from active management (i.e., alpha). This is known as **distinguishing alpha and beta**. A manager who uses statistical techniques, quantitative tools, and benchmarking to discern whether high returns are the result of the superior performance of an active manager or a function of bearing high levels of systematic risk is attempting to distinguish alpha from beta.

A hedge fund may attempt to independently manage alpha and beta. The firm may manage beta exposure while separately managing the portfolio's alpha. This is known as **separating alpha and beta**. Managers can use investment tools to pursue alpha while sustaining a target

beta for the portfolio. Managers typically seek to limit beta while trying to optimize alpha. Derivatives are often used to minimize or eliminate undesired systematic risk.

For example, assume a manager's benchmark is the S&P 500. He would like to pursue opportunities that increase alpha, but the result is beta exposure different from the benchmark. He can use futures contracts to hedge all systematic risks other than exposure to the S&P 500 such that the portfolio's beta relative to the S&P 500 is 1.0. He does this while simultaneously pursuing an alpha optimizing strategy. In this way, he is independently managing, or separating, alpha from beta.

HEDGE FUND STRATEGIES

LO 69.6: Compare and contrast the different hedge fund strategies, describe their return characteristics, and describe the inherent risks of each strategy.

Managed Futures and Global Macro

Managed futures funds focus on investments in bond, equity, commodity futures, and currency markets around the world. Systematic trading programs are used which rely on historical pricing data and market trends. A high degree of leverage is employed because futures contracts are used. With managed futures, there is no net long or net short bias.

Many managed futures funds are market timing funds, which switch between stocks and Treasuries. When both short and long positions are considered, the payoff function of this strategy is similar to a lookback straddle, which is a combination of a lookback call option and a lookback put option. The lookback call option gives the owner the right to purchase the underlying instrument at the lower price during the call option's life, while the lookback put option gives the owner the right to sell the underlying instrument at the highest price during the put option's life.

Global macro fund managers make large bets on directional movements in interest rates, exchange rates, commodities, and stock indices. They are dynamic asset allocators, betting on various risk factors over time.

Both managed futures and global macro funds have *trend following* behavior (i.e., directional styles). Global macro funds do better during extreme moves in the currency markets. Both of these strategies are essentially *asset allocation* strategies, since the managers take opportunistic bets in different markets. They also both have a low return correlation to equities.

Merger/Risk Arbitrage and Distressed Securities

Merger (or risk) arbitrage strategies try to capture spreads in merger/acquisition transactions involving public companies, following public announcement of a transaction. The primary risk is **deal risk**, or the risk that the deal will fail to close.

Examining merger arbitrage returns, the largest negative monthly returns in this strategy are after the S&P 500 index has had a large negative return. This equates to being long deal risk. The logic is that when the market has a large decline, mergers have a greater tendency to be called off.

Distressed hedge funds is another event-driven hedge fund style. This strategy invests across the capital structure of firms that are under financial or operational distress, or are in the middle of bankruptcy. The strategy tends to have a long bias. With this strategy, hedge fund managers try to profit from an issuer's ability to improve its operation, or come out of a bankruptcy successfully.

A key feature of the strategy is long exposure to credit risk of corporations with low credit ratings. A good proxy for these types of returns is publicly traded high-yield bonds since the correlation between the DJCS Distress index and high-yield bonds is 0.55.

In sum, both of these event-driven strategies exhibit nonlinear return characteristics, since tail risk appears under extreme market conditions. With merger arbitrage, the tail risk is a large drop in equity investments. With distressed hedge funds, the tail risk is a big move in short-term rates. Unlike trend following strategies, event-driven funds are hurt by extreme market movements.

Fixed Income Arbitrage

Fixed income arbitrage funds attempt to obtain profits by exploiting inefficiencies and price anomalies between related fixed income securities. The fund managers try to limit volatility by hedging exposure to interest rate risk. An example of this strategy is leveraging long/short positions in fixed income securities that are related—mathematically or economically.

The sectors traded under fixed income arbitrage include:

- Credit yield curve relative value trading of swaps, government securities, and futures.
- Volatility trading using options.
- Mortgage-backed securities arbitrage.

A swap spread trade is a bet that the fixed side of the spread will stay higher than the floating side of the spread, and stay in a reasonable range according to historical trends. With yield-curve spread trades, the hope is that bond prices will deviate from the overall yield curve only in the short term, and will revert to normal spreads over time. Mortgage spread trades are bets on prepayment rates, while fixed income volatility trades are bets that the implied volatility of interest rate caps have a tendency to be higher than the realized volatility of, for example, a Eurodollar futures contract. Capital structure or credit arbitrage trades try to capitalize on mispricing among different types of securities (e.g., equity and debt).

Convertible Arbitrage

Convertible arbitrage funds attempt to profit from the purchase of convertible securities and the shorting of corresponding stock, taking advantage of a perceived pricing error made in the security's conversion factor. The number of shares shorted is based on a delta neutral or

market neutral ratio. The plan is for the combined position to be insensitive to underlying stock price fluctuations under normal market conditions.

The return to convertible arbitrage hedge funds comes from the liquidity premium paid by issuers of convertible bonds to hedge fund managers, for holding convertible bonds and managing the inherent risk by hedging the equity part of the bonds.

Long/Short Equity

Long/short equity funds take both long and short positions in the equity markets, diversifying or hedging across sectors, regions, or market capitalizations. Examples are shifts from value to growth, small- to mid-cap stocks, and net long to net short. Trades in equity futures and options can also take place.

Thirty to forty percent of hedge funds are long/short. Long/short managers are stock pickers with varying opinions and abilities, so performance tends to be very idiosyncratic. Underpriced or under-researched stocks are favored, as are small stocks, on the long side. On the short side, low liquidity makes small stocks and foreign stocks less attractive. Long/short equity funds have directional exposure to the overall market and also have exposure to long small-cap/short large-cap positions.

Dedicated Short Bias

Funds with a dedicated short bias tend to take net short positions in equities. Sometimes the short position strategy is implemented by selling forward. To manage risk, managers take offsetting long positions and stop-loss positions. The returns are negatively correlated with equities.

Emerging Markets

Emerging market funds invest in currencies, debt, equities, and other instruments in countries with emerging or developing markets. These markets are usually identified in terms of gross national product (GNP) per capita. China, India, Latin America, Southeast Asia, parts of Eastern Europe, and parts of Africa are examples of emerging markets. These funds have a long bias because it is more difficult to short securities in emerging markets.

Equity Market Neutral

When reviewing equity market neutral hedge fund strategies, research shows that there is not one common component (or risk factor) in their returns. Different funds utilize different trading strategies, but they all have a similar goal of trying to achieve zero beta(s) against a broad set of equity indices.

HEDGE FUND PERFORMANCE

LO 69.7: Describe the historical portfolio construction and performance trend of hedge funds compared to equity indices.

Twenty-seven large hedge funds were identified in 2000, and research has been done to determine if these hedge funds are truly a separate asset class, not correlated to equity or bond indices. Hedge fund returns were regressed against an 8-factor model used to analyze hedge fund performance. Findings were that hedge fund portfolios had no significant exposure to stocks and bonds. As an equally weighted portfolio, this portfolio of 27 top performing hedge funds had a large alpha of 1.48% per month. There was a persistent exposure to emerging markets, but other factor betas showed a lot of variability. Also, alpha declined over time, and there was not a persistent directional exposure to the U.S. equity market. Measurement bias may have affected these results somewhat.

Alternatively, a strategy of investing in a portfolio of the top 50 large hedge funds was tested using data from 2002 to 2010. Two test portfolios were constructed:

- The first test portfolio attempted to mimic performance of a strategy of investing in the top funds in equal dollar amounts, and rebalancing at the end of each calendar year. The funds were selected based on the assets under management at year-end 2001.
- A similar portfolio was constructed using top funds based on year-end 2010, rather than 2001.

For the first portfolio, the intent was to give a lower and upper bound of performance which investors could achieve, by just following a strategy of investing equally in the top 50 large hedge funds, and rebalancing yearly. The second portfolio was “foresight assisted.”

In evaluating performance characteristics, the first portfolio did not have a significant alpha, while the foresight-assisted portfolio had a monthly alpha of 0.53%, and was statistically significant at the 1% level. Compared to hedge fund returns prior to 2002, the decline in alpha is consistent with the thinking that there is more competition in the hedge fund industry. It should, however, be noted that there is no significant negative alpha.

Looking at the top 50 hedge funds versus all hedge funds, the top 50 portfolios (both versions) demonstrated statistically significant alpha relative to the DJCSI and HFRI hedge fund indices. The strategy of buying large hedge funds appears to deliver superior performance compared to just investing in hedge fund indices.

During the 2002 to 2010 time period, the top 50 hedge fund portfolios (with the exception of the foresight-assisted portfolio), and the two broad hedge fund indices, DJCSI and HFRI, all outperformed the equity market, as measured by the S&P 500 index. In sum, analysis of large hedge funds shows that managers are still delivering alpha return relative to peers, and also have low exposure to the U.S. equity market. These factors continue to attract institutional investors.

CONVERGENCE OF RISK FACTORS

LO 69.8: Describe market events which resulted in a convergence of risk factors for different hedge fund strategies, and explain the impact of such a convergence on portfolio diversification strategies.

Theoretically, diversification among hedge fund strategies should protect investors, but there are certain events that affect all, or mostly all, strategies, as they all undergo stress at the same time. Portfolio diversification implodes, and seemingly diverse hedge fund portfolios *converge* in terms of risk factors during times of stress.

The first recorded major market event for hedge funds was in March and April of 1994 when unexpected changes in interest rate policy were set by the Federal Reserve. This caused two months of losses by seven of the ten style-specific sub-indices in the DJCS family. Exceptions were short sellers and managed futures funds. Merger arbitrage funds earned a positive return in March, while equity market neutral funds had a positive return in April.

Another major event was in August 1998 right before the collapse of LTCM. Eight of the ten niche DJCS style sub-indices had large losses. Short sellers and managed futures funds avoided losses. The losses occurred primarily due to market-wide liquidation of risky assets and the high amount of leverage on LTCM's balance sheet.

With hedge fund investing, leverage has a magnifying effect on gains and losses, and risk is on both sides of the balance sheet. There were events prior to the 2007–2008 financial crisis that illustrated how much a market-wide funding crisis can significantly impair leveraged positions. In August 2007, for the first time, all nine specialist style sub-indices lost money. The only positive return was from short sellers. During the peak of the financial crisis from July to October 2008, July to September brought losses for all hedge fund styles (excluding short sellers). When leveraged positions are forced to liquidate, losses can be high.

The point is that when there is a market-wide funding crisis, it is difficult to mitigate risk by simply spreading capital among different hedge fund strategies. There is significant credit-driven tail risk in a hedge fund portfolio. The use of managed futures may be a partial solution—it has been a strategy with a convex performance profile relative to other hedge fund strategies. Hedge fund investors need to consider portfolio risks associated with dramatic market events.

RISK SHARING ASYMMETRY

LO 69.9: Describe the problem of risk sharing asymmetry between principals and agents in the hedge fund industry.

In the hedge fund industry, risk sharing asymmetry between the principal (investor) and the agent (fund manager) is a concern due to variable compensation schemes.

The problem occurs when the incentive fee that a hedge fund manager is entitled to, typically 15–20% of new profits [profits above a high water mark (HWM)], encourages a fund manager to take outsized risks. This tends to increase the future loss-carried-forward if

and when these bets fail. If the fund fails, the same fund manager can start up a new hedge fund.

However, there is an opportunity cost involved in cases where a hedge fund manager closes a fund. It is costly in terms of harming the track record of the manager and affects reputation risk of both the manager and the fund company. All things considered, this cost does not totally mitigate the basic principal/agent conflict.

Investors may be best served to invest in funds for which the fund managers invest a good portion of their own wealth. As much as this issue has been discussed, the basic structure of how fund managers are compensated has not changed.

IMPACT OF INSTITUTIONAL INVESTORS

LO 69.10: Explain the impact of institutional investors on the hedge fund industry and assess reasons for the growing concentration of assets under management (AUM) in the industry.

As mentioned earlier, beginning in 2000, institutional investor funds flowed into hedge funds, and assets under management in the hedge fund industry grew from \$197 billion at 1999 year-end to \$1.39 trillion by 2007 year-end. Institutional investors were rewarded for allocating capital to a much higher fee environment. Three hedge fund performance databases, DJCSI, HFRI, and HFRFOFI, respectively, reported cumulative performance of 72.64%, 69.82%, and 38.18% from the 2002 to 2010 time period, compared to the S&P 500 index return of 13.5%. The S&P 500 index had a 16% standard deviation during that period, versus annualized standard deviations of return of 5.84%, 6.47%, and 5.51%, for the respective hedge fund indices.

With the increase of institutional investment came greater demands on hedge fund management for operational integrity and governance. Some institutional investors were seeking absolute performance, while others were seeking alternative sources of return beyond equities. There is some concern that there is no identifiable alpha associated with hedge fund investing, so it is increasingly important that hedge fund managers differentiate themselves from their peers.

KEY CONCEPTS

LO 69.1

Hedge funds are private investments and have very little financial regulation. They tend to be highly leveraged, and managers make large bets. On the other hand, mutual funds are regulated and more structured.

LO 69.2

There are some hedge funds that do not participate in commercial databases, which impacts aggregate hedge fund performance. Thus, there is selection bias contained in hedge fund databases.

LO 69.3

There have been major events affecting the hedge fund industry, including large losses following a change in Fed policy in 1994, the LTCM collapse in 1998, and the dot-com collapse in 2001.

LO 69.4

From 1999 to 2007, investors in hedge funds shifted from exclusively private wealth to institutions, including foundations, endowments, pension funds, and insurance companies.

LO 69.5

Alpha is the return in excess of the compensation for risk. Beta is a measure of the systematic risk of the security or portfolio relative to the market as a whole. Firms may independently manage alpha and beta. This is known as separating alpha and beta. Managers can use investment tools to pursue alpha while sustaining a target beta for the portfolio.

LO 69.6

Managed futures funds focus on investments in bond, equity, commodity futures, and currency markets around the world. The payoff function of this strategy is similar to a lookback straddle.

Global macro managers make large bets on directional movements in interest rates, exchange rates, commodities, and stock indices, and do better during extreme moves in the currency markets.

Merger arbitrage funds bet on spreads related to proposed merger and acquisition transactions, and perform poorly during major market declines.

Distressed hedge funds invest across the capital structure of firms that are under financial or operational distress, or are in the middle of bankruptcy. The strategy tends to have a

long-bias. These hedge fund managers try to profit from an issuer's ability to improve its operation, or come out of a bankruptcy successfully.

Fixed income arbitrage funds try to obtain profits by exploiting inefficiencies and price anomalies between related fixed income securities. Their performance is correlated to changes in the convertible bond default spread.

Convertible arbitrage funds attempt to profit from the purchase of convertible securities and the shorting of corresponding stock.

Long/short equity funds take both long and short positions in the equity markets, diversifying or hedging across sectors, regions, or market capitalizations, and have directional exposure to the overall market and also have exposure to long small-cap/short large-cap positions.

Dedicated short bias funds tend to take net short positions in equities, and their returns are negatively correlated with equities.

Emerging market funds invest in currencies, debt, equities, and other instruments in countries with emerging or developing markets.

Equity market neutral funds attempt to achieve zero beta(s) against a broad set of equity indices.

LO 69.7

The top 50 hedge funds demonstrated statistically significant alpha relative to the DJCSI and HFRI hedge fund indices. The strategy of buying large hedge funds appears to deliver superior performance compared to just investing in hedge fund indices. Hedge fund managers are still delivering alpha relative to peers, and also have low exposure to the U.S. equity market.

LO 69.8

Diversification among hedge fund strategies may not always be effective due to the convergence of risk during times of extreme market stress. There is significant credit-driven tail risk in a hedge fund portfolio. The use of managed futures may be a partial solution—it has been a strategy with a convex performance profile relative to other hedge fund strategies. Hedge fund investors need to consider portfolio risks associated with dramatic market events.

LO 69.9

In the hedge fund industry, risk sharing asymmetry between the principal (investor) and the agent (fund manager) is a concern due to variable compensation schemes.

LO 69.10

Institutional investors flocked to hedge funds beginning in 2000. With the increase of institutional investment came greater demands on hedge fund management for operational integrity and governance.

CONCEPT CHECKERS

1. What critical shift occurred in the hedge fund industry following the collapse of Long-Term Capital Management (LTCM) in 1998 and the dot-com bubble burst in 2001?
 - A. There was a significant drop in assets under management in the hedge fund industry.
 - B. There was a large influx of institutional investors investing in hedge funds.
 - C. Reporting within the hedge fund industry became more regulated than mutual funds.
 - D. There was a significant increase in hedge fund failures.
2. Which of the following hedge fund strategies would be characterized as an “asset allocation” strategy that performs best during extreme moves in the currency markets?
 - A. Global macro.
 - B. Risk arbitrage.
 - C. Dedicated short bias.
 - D. Long/short equity.
3. Comparing hedge fund performance during the time period 2002–2010 to earlier time periods, how would monthly alpha compare, if looking at large hedge funds?
 - A. Alpha was higher in the 2002–2010 time period.
 - B. Alpha remained constant over both time periods.
 - C. A “foresight-assisted” portfolio did not have a statistically significant alpha during the 2002–2010 time period.
 - D. There was a decline in alpha in the 2002–2010 time period.
4. Jamie Chen, FRM, is considering investing a client into distressed hedge funds. Which of the following investments would serve as the best proxy for the types of returns to expect?
 - A. Convertible bonds.
 - B. Small-cap equities.
 - C. Managed futures.
 - D. High-yield bonds.
5. What would be an ideal approach for a hedge fund investor who is concerned about the problem of risk sharing asymmetry between principals and agents within the hedge fund industry?
 - A. Focus on investing in funds for which the fund managers have a good portion of their own wealth invested.
 - B. Focus on diversifying among the various niche hedge fund strategies.
 - C. Focus on funds with improved operational efficiency and transparent corporate governance.
 - D. Focus on large funds from the “foresight-assisted” group.

CONCEPT CHECKER ANSWERS

1. **B** During the time period following the dot-com collapse, hedge funds outperformed the S&P 500 with a lower standard deviation, which attracted institutional investment.
2. **A** A global macro fund does better if there are extreme moves in the currency markets. Along with managed futures, global macro is an asset allocation strategy. Managers take opportunistic bets in different markets. The strategy has a low correlation to equities.
3. **D** Comparing the two different time periods, there was a decline in alpha due to more competition in the hedge fund industry.
4. **D** Distressed hedge funds have long exposure to credit risk of corporations with low credit ratings. Publicly traded high-yield bonds are a good proxy for the returns to expect.
5. **A** The incentive fee structure within the hedge fund industry has not really changed over the years, and there is incentive for managers to take undue risks in order to earn fees. Thus, there should be a focus on investing in funds for which the fund managers have a good portion of their own wealth invested.

PERFORMING DUE DILIGENCE ON SPECIFIC MANAGERS AND FUNDS

Topic 70

EXAM FOCUS

This topic emphasizes the reasons investors should perform due diligence on potential investments. It provides a thorough list of items to consider in the due diligence process. For the exam, understand in detail the steps involved in evaluating a manager, a fund's risk management process, and a fund's operational environment.

PAST FUND FAILURES

LO 70.1: Identify reasons for the failures of funds in the past.

Investors should be familiar with the reasons past funds have failed to ensure they can avoid investing in a failing fund. Following is a concise list of reasons past funds have failed.

1. **Poor investment decisions.** Could be a series of decisions (“domino effect”) or a very calculated risk on a specific investment that backfired.
2. **Fraud.** Fraud could occur in several forms including accounting (e.g., misstating asset book values or misstating income), valuation (e.g., misstating asset market values), and theft of funds.
3. **Extreme events.** Events occurring that would otherwise occur with very low probability or were unexpected (e.g., market crashes).
4. **Excess leverage.** Related to making poor investment decisions. Leverage goes both ways. That is, it magnifies gains but also magnifies losses.
5. **Lack of liquidity.** Too many capital withdrawals and redemptions to honor at once, thereby creating a squeeze on cash flow and an inability to meet all capital withdrawals and redemptions.
6. **Poor controls.** Closely related to fraud. Lack of supervision could result in excessive risks being taken that lead to losses large enough to bankrupt the fund.

7. **Insufficient questioning.** Often in a committee-style decision-making process, there may be a dominant member who sways the decision and/or members who are afraid to voice any valid concerns over information they have discovered that would question the merits of the investment manager and/or investment. Ideally, all due diligence team members should be encouraged to play the role of “devil’s advocate” when appropriate and raise reasonable concerns as early as possible, especially before they reach the committee stage.
8. **Insufficient attention to returns.** Investment funds attempting to reduce operational risk sometimes overcompensate by implementing excessive controls and may end up bearing too many expenses and not generating enough returns. Ideally, there is a healthy balance between generating strong returns while taking on a reasonable level of risk.

DUE DILIGENCE ELEMENTS

LO 70.2: Explain elements of the due diligence process used to assess investment managers.

Prior to investing, an investor performs due diligence on a potential investment manager, which involves assessing the manager, the fund, and the investment strategy. Information such as the investment background, manager’s reputation (e.g., education, employers), and past performance have always been key considerations but are insufficient on their own.

An additional element of due diligence involves assessing the investment process and risk controls. The starting point is a review of the fund’s prospectus or offering memorandum. Additionally, an attribution analysis could be performed to determine how the returns were generated. Were they generated through the skill and control of the manager, luck, and/or factors beyond the manager’s control? In addition, was the amount of return in line with the amount of risk taken?

Another related element is assessing the fund’s operations and business model. In general, are there internal controls and policies in place to preserve the investors’ funds? Specifically, are the controls in place sufficiently robust to detect and prevent fraudulent activities or are limits imposed on managers to seek higher level approval for transactions exceeding a certain dollar amount or frequency? Is there appropriate segregation of duties between the front office and the back office? What is the process and frequency of asset valuations? What is the fee structure and are there any additional fees after a specific threshold? Are there any limitations or blackout periods on redemptions?

In the end, investors should assess potential managers and their investment strategies with an objective and unbiased mind. They should not get caught up with a manager’s past successes.

MANAGER EVALUATION

LO 70.3: Identify themes and questions investors can consider when evaluating a manager.

Manager evaluation is not a task that should be taken lightly by potential investors. This process can be broken down into four areas including strategy, ownership, track record, and investment management.

Strategy

General questions regarding a manager's strategy may include:

- Does the manager follow a particular investment style (e.g., growth, value)?
- Are there any current “trends” in the fund or specializations in specific securities, industries, or sectors?
- How has the fund changed its investment style or rebalanced its holdings over the past year? What changes are contemplated in light of anticipated market conditions?
- What is the extent of turnover and liquidity in the fund? What market signals are used to determine whether to exit or enter a position?
- What mechanisms are in place to limit any potential losses in the fund?
- To what extent is quantitative analysis and modeling utilized in the investment process? Have any models been developed or tested to date?
- Are short sales used to generate excess profits or to hedge? How successful or detrimental have they been so far?
- Are derivatives used in the portfolio? If so, are they used for hedging or speculative purposes?
- How does the trade execution process work? Does a central trading desk exist for maximum efficiency?
- What is the extent of any investment in private company securities and their role in the overall investment strategy?
- What is the tradeoff between maximizing current returns versus long-term fund growth?
- Has the fund ever been closed or provided investors with a return of capital?

Ownership

Ownership interests often help align the interests of the investment team and the investors. They can be useful in attracting and maintaining quality staff, thereby enhancing and/or continuing to generate strong investment returns for investors.

Therefore, potential investors should inquire as to whether any members of the investment team (e.g., traders, portfolio managers, research analysts) have ownership interests in the firm.

Track Record

Specific questions about the manager's and fund's track records may include:

- How does the past performance of the manager and/or fund compare to its peers and/or funds that follow the same or similar investment philosophy?
- Has past performance been audited or verified by a third party?
- Is there sufficient performance history to perform trend and/or attribution analysis? How did the manager or fund perform during market downturns?
- What were the investment returns relative to the size of the investment assets?
- Are most or all of the staff on the investment team that generated those past results still employed by the firm?

Investment Management

Inquiries during manager interviews may include:

- What is/was the manager's investment strategy for generating excess returns?
- How did the manager cope with tough market periods?

Reference checks on managers could include the following individuals:

- Former employers: Was the manager a leader or follower? Proactive or reactive? A team player or individualist?
- Current and former colleagues, clients, and other independent parties: Ensure consistency but if there are mixed reviews, follow up for explanations and/or obtain clarification from the manager.
- Current and former investors: What good and bad investment experiences did they have with the manager?

Background checks on managers may include the following questions/activities:

- Obtaining comprehensive background check reports on the manager.
- Review the Form ADV filed by the manager with the SEC and state securities authorities. It contains general information about the business as well as more detailed information such as fees, services provided, conflicts of interest, and background of key personnel.
- Has the manager consistently demonstrated herself to be a person of integrity? This could be verified by examining public databases and the SEC website to look for any past or current instances of litigation or criminal behavior.
- Has the manager demonstrated strong personal financial responsibility? This could be verified by examining personal credit reports and bankruptcy reports.
- Are the manager's stated representations accurate? This could be verified by inquiring with auditors and brokers who are currently working with the manager or have worked with the manager in the past.
- What is the extent of the manager's involvement in any related party transactions?

RISK MANAGEMENT EVALUATION

LO 70.4: Describe criteria that can be evaluated in assessing a fund's risk management process.

A proper risk management process should contain an assessment of the following areas: risk, security valuation, portfolio leverage and liquidity, tail risk exposure, risk reports, and consistency of the fund terms with the investment strategy.

Risk

- Assess the applicable systematic risk factors (i.e., regular market risks common to most or all funds) and unsystematic risk factors (i.e., risks specific to the manager, fund, or strategy).
- Determine whether written policies and procedures exist regarding measuring and monitoring risk.
- Determine whether a risk committee exists that would receive such measurements. If so, how often are they reported?
- Evaluate the extent of the risk management culture among the various types of employees. For example, how actively involved are employees with managing and mitigating the firm's risks on a day-to-day basis?
- Assess the information technology resources used to quantify the risks. For example, are they reliable and do they measure items consistently between traders and portfolio managers?
- Identify the existence and structure of any risk models. What are their inputs and assumptions? Have the models been tested and are they robust?

Security Valuation

- Identify the proportion of fund assets that are objectively valued through reliable market prices versus those that are more subjectively valued by the broker or through simulation.
- Examine the independence of valuations. Is valuation performed by the fund administrator (generally more independent) or by the fund manager (generally less independent)?
- Determine if prices may be overridden for valuation purposes. If so, by whom? Is there documentation or an approval process?

Portfolio Leverage and Liquidity

- Assess the sources of leverage as well as the current and historical levels of leverage.
- Calculate the current level of liquidity and observe how it has changed over time. The current level is especially relevant because of the impact on portfolio investment capacity and whether it can take on more investment capital.
- Within a stated investment strategy, excessive leverage and/or illiquidity could generate actual returns that are significantly different than expected (i.e., no longer comparing apples to apples), thereby requiring an adjustment in expected returns.

Exposure to Tail Risk

- Analyze information about the fund to conclude whether the fund's return distribution possesses skewness or kurtosis.
- Discuss the possibility of tail risk with the manager and determine whether the manager has sufficiently mitigated the risk or whether further action is required by the investor.

Risk Reports

- Review risk reports prior to investing in the fund. Investors should receive these risk reports on a regular basis (e.g., monthly, quarterly, annually) whether they are prepared in-house or by a third party.
- Analyze key risk metrics and compare them to other similar funds for benchmarking purposes and for determining if any unusual risks exist in the fund.

Consistency of the Fund Terms with the Investment Strategy

- Examine the general fee structure of the fund and determine whether it is consistent with similar funds.
- Identify the existence of any additional fees after a specific threshold (e.g., high-water mark, hurdle rate).
- Evaluate whether high fees are being paid to managers in search of market alpha (fair) as opposed to beta (unfair).
- Identify the existence of any limitations or blackout periods on redemptions.

OPERATIONAL DUE DILIGENCE

LO 70.5: Explain how due diligence can be performed on a fund's operational environment.

Investors should focus on several key areas when performing operational due diligence on a fund. The focus areas are internal control assessment, documents and disclosure, and service provider evaluation.

Internal Control Assessment

A starting point in due diligence is examining the qualifications and attitudes of the personnel. For instance, does the CEO believe in controls and compliance with the rules? An analyst must also assess whether the internal control staff have sufficient technical and work experience to perform their compliance duties properly. Have they been properly trained and do they continue to expand their skills in compliance? Some assurance may be required regarding whether the back and middle office managers are sufficiently experienced in performing supervisory duties. Finally, background checks on critical internal control staff members might be required.

Examining the fund's policies and procedures may also be useful. Related documents may cover areas such as trading, derivatives usage, and transaction processing. One drawback is that these documents tend to be general and only demonstrate the intention to have a strong control environment. In other words, merely reading the documents provides little assurance that the policies and procedures are actually being followed or are effective. It is

usually a good sign if a fund has been proactive and obtained an audit report and opinion on the effectiveness of its controls. If this report is available, it should be reviewed.

The due diligence process should include an examination of the in-house or outsourced compliance system that is in place. Examples of specific items to consider include the code of ethics (if one exists) and any restrictions on employee trading and related-party transactions.

There should be an investigation into how the funds deal with counterparty risk arising from OTC derivatives and other counterparties. Is such risk mitigated by dealing with more than one counterparty? Are the counterparties monitored for risk on a daily basis?

Finally, there should be an assessment as to the effectiveness of corporate governance. Is it pervasive throughout the organization? Are examples of internal control “breaches” followed up with appropriate actions to remedy and prevent future recurrence?

Documents and Disclosure

As part of the due diligence process, investors must confirm with the fund’s legal counsel its involvement in preparing the original version of the fund documents as well as any subsequent revisions. The investor should also confirm if the law firm remains as the fund’s legal counsel. A physical check of the documents should be made to look for any changes made after the date indicated on the documents.

The investor should corroborate the terms of the offering memorandum by examining other documents such as the Form ADV, subscription agreement, and investment management agreement. Consistency is important here. Terms relating to fees, redemption rights, liquidity, and lockups should be examined closely and clarified with the manager if required.

Conflicts of interest that are disclosed in the offering memorandum should be scrutinized carefully. Lack of clarity in the disclosure may be a red flag and warrant further discussion with the manager and/or require independent information.

Similarly, lack of clarity or sufficiency in the disclosure of risks may warrant further investigation. The discussion of very general or irrelevant risk factors may be cause for concern.

The focus of any due diligence should be on the manager. As a starting point, the potential investor should determine the extent of the manager’s authority. Are the provisions very broad (potentially more risky) or quite specific? Is the manager subject to limitations on the amount of leverage employed or on the percentage of the fund invested in specific securities, sectors, or industries? Can the manager be indemnified for his actions outside of fraud, gross negligence, or malicious intent? Additionally, there should be a consideration of the manager’s reporting duties to investors (e.g., audited financial statements, disclosure of the tax treatment of the fund’s income and transactions).

In analyzing the financial statements, the investor should begin by ensuring the audit opinion is unqualified (i.e., the auditor believes the financial statements contain no material misstatements). The balance sheet and income statement should be examined for

consistency with the fund's investment strategy (e.g., a high leverage fund should have high interest expense on the income statement and high liabilities on the balance sheet). Any inconsistencies should be discussed with the manager on a timely basis. In addition, the footnotes (which are also audited) should be examined carefully since they provide more detailed information on key items (e.g., contingent liabilities, related-party transactions) than the corresponding financial statements.

Fees paid to the manager by the fund should be scrutinized and recalculated. They should be corroborated with the offering memorandum. Specifically, there should be a check of any incentive fees paid in loss years.

Finally, there should be a check for the level of net contributions to the fund by the general partner. Any fund withdrawals should be questioned.

Service Provider Evaluation

Third-party service providers may be hired by a fund for trade execution, information technology, valuation, verification, and asset safeguarding purposes.

A starting point for assessing the actual service providers is to examine the internal control letters issued by its auditors and its audited financial statements. Further due diligence could be performed through in-person discussions regarding the service provider's role.

BUSINESS MODEL AND FRAUD RISK

LO 70.6: Explain how a fund's business model risk and its fraud risk can be assessed.

In addition to the previous due diligence, potential investors need to closely examine the fund to ensure that the risks associated with its business model and potential fraud are not excessive.

Business Model Risk

Evaluating business model risk requires assessing whether managers know how to operate the business as well as generate high returns. Typical risks, potentially leading to failure and closure of the fund, include a lack of cash and working capital, a lack of a succession plan, and excessive redemptions in a short period of time.

A fund's business model risk can be assessed by performing the following tasks:

- Examining the nature of the revenues and expenses. For example, are revenue items stable, recurring, or one-time? Can costs be reduced or are they increasing uncontrollably?
- Calculating the percentage of revenues derived from variable incentive or performance fees (that may not materialize in market downturns).
- Assessing the significance of the gap between management fees (revenue) and operating expenses.

- Considering the sufficiency of the amount of working capital (especially cash) in place to cover revenue shortfalls and/or expense overages for a reasonable period of time.
- Determining how frequently budgets are created and for what period of time.
- Determining the fund's breakeven points in terms of assets under management and required performance level. Comparing those amounts to current (actual) and future (projected) amounts.
- Ascertaining if there is sufficient personnel or capacity to increase the fund's investment asset base.
- Ascertaining the existence of key person insurance on relevant individuals and the existence of a succession plan.

Fraud Risk

Fraud risk can always exist even though extensive due diligence has been performed on the manager and fund prior to investing. A fund's fraud risk can be assessed by determining the existence of the following factors:

- Frequent related-party transactions, including trading through a broker or using a valuator who is a related party.
- Frequent instances of illiquidity, including significant concentrations of illiquid investments (especially those that are valued by the manager only).
- Frequent litigation as a defendant, especially regarding claims of fraud.
- Unreasonably high (stated) investment returns.
- Frequent personal trading by the manager of the same or similar securities as those held by the fund.
- Frequent shorting transactions.

Fraud risk may be mitigated by performing the following actions:

- Check the SEC website for any prior regulatory infractions.
- Check court records for any prior litigation and bankruptcy records for examples of financial irresponsibility.
- Inquire with service providers for assurance over their competence and independence from the manager.
- Perform extensive background checks on the manager.

DUE DILIGENCE QUESTIONNAIRE

LO 70.7: Describe elements that can be included as part of a due diligence questionnaire.

Properly designed due diligence questionnaires that are thoroughly and honestly answered by respondents can yield valuable information to a potential investor and may provide a list of concerns that need further assessment. The questionnaire should make the following inquiries:

1. Inquiry into general information on the manager provides a starting point in the due diligence process. Examples of such information include:
 - Confirmation of proper registration with regulatory authorities.
 - Determination of ownership form (e.g., corporation) and structure.
 - Identification of key shareholders.

- Reference checks.
 - Information on past performance.
 - Business contact information.
2. Inquiry into general information on the fund also is critical. Examples of general information that should be collected include:
 - Fees.
 - Lockup periods.
 - Redemption policies.
 - Primary broker.
 - Fund director.
 - Administrator.
 - Compliance: auditor and legal advisor.
 - Financial: assets under administration, investment capacity, and historical performance (also see financial statements).
 - Historical drawdown levels.
 3. Inquiry into execution and trading as well as service providers may provide some insight on the speed and accuracy of transaction processing and the existence of related-party service providers, the latter of which may raise red flags with potential investors as discussed earlier.
 4. Inquiry regarding the firm's third-party research policy may be useful to determine a fund's sources of research information, thereby allowing the assessment of the extent and quality of the due diligence performed by the fund in its investment process.
 5. Inquiry regarding compliance processes, the existence and degree of involvement of in-house legal counsel, and the existence of anti-money laundering policy and procedures may help provide comfort that the fund and its managers have a desire to operate in an ethical manner and/or within the boundaries of the law.
 6. Inquiry into the existence of information regarding disaster recovery and business continuity plans as well as insurance coverage and key person provisions may provide some assurance regarding the stability of the firm and, therefore, the safety of any invested funds.
 7. Inquiry into the investment process and portfolio construction provides the potential investor with information required to make an informed decision whether the overall risk and return profile of the fund is consistent with the investor's investment objectives.
 8. Inquiry into risk controls such as leverage, liquidity, asset concentrations, portfolio diversification, and market risk factors give the investor a more complete picture of the investment risks and how the managers attempt to manage and mitigate them.

The existence of financial statements, especially if audited with an unqualified opinion, provide objective and historical financial information on the fund that can be used to assess performance. Information on the composition of the invested assets may also be helpful to the potential investor. Finally, interim statements (not necessarily audited) may provide more timely information to make a more current assessment of the fund by the potential investor.

KEY CONCEPTS

LO 70.1

Past fund failures can be attributed to poor investment decisions, fraud, extreme events, excess leverage, lack of liquidity, poor controls, insufficient questioning, and insufficient attention to returns.

LO 70.2

The due diligence process for assessing investment managers should include information on the investment background and reputation of the managers and past performance. In addition, there should be an assessment of the fund's investment process, risk controls, operations, and business model.

LO 70.3

In evaluating a manager, investors should consider four broad themes including strategy (e.g., evolution, risk management, quantification, types of investments), ownership, track record (e.g., comparison with peers, independent verification of results), and investment management (e.g., manager interviews, reference checks, background checks).

LO 70.4

Criteria that could be used in assessing a fund's risk management process includes risk (e.g., types, culture, quantification/models), security valuation, portfolio leverage and liquidity, tail risk exposure, risk reports, and consistency of the fund terms with the investment strategy.

LO 70.5

Performing due diligence on a fund's operating environment focuses on:

- Internal control assessment (i.e., qualifications and attitude of personnel, written policies and procedures, compliance system, counterparty risk, effectiveness of governance).
- Documents and disclosure (i.e., confirmations with the fund's legal counsel regarding fund documents, corroborating terms of the offering memorandum, conflicts of interest, disclosure of risks, manager's authority, manager's reporting duties to investors, financial statements, and fees paid to the manager, net contributions/withdrawals by the general partner).
- Service provider evaluation.

LO 70.6

Business model risk can be assessed by considering revenues and expenses (detailed examination), sufficiency of working capital, existence of budgets, computation of breakeven points, ability to increase investment asset base, existence of key person insurance, and existence of a succession plan.

Fraud risk can be assessed by considering the existence of related-party transactions, illiquidity, litigation, unreasonably high (stated) investment returns, personal trading by the manager of the same or similar securities as those held by the fund, and shorting transactions.

LO 70.7

Items to include as part of the due diligence questionnaire include general information on the manager and the fund, execution and trading, service providers, third-party research policy, compliance processes, existence and degree of involvement of in-house legal counsel, existence of anti-money laundering policy and procedures, existence of information regarding disaster recovery and business continuity plans, insurance coverage, key person provisions, details of the investment process and portfolio construction, risk controls, and information contained in the fund's financial statements.

CONCEPT CHECKERS

1. Based on historical evidence, which of the following factors is least likely to result in the eventual failure of a hedge fund?
 - A. Excessive controls in place.
 - B. Taking on more systematic risk.
 - C. Making decisions in a committee setting.
 - D. Materially misstated financial statements.
2. In performing due diligence on a potential investment manager, which of the following factors is the least important for the investor to consider?
 - A. Risk controls.
 - B. Business model.
 - C. Past performance.
 - D. Investment process.
3. Which of the following items is least likely to be included as requested information on a due diligence questionnaire?
 - A. Insurance coverage.
 - B. Returns attribution analysis.
 - C. Disaster recovery procedures.
 - D. Anti-money laundering policy.
4. Which of the following statements regarding the assessment of a fund's risk management process is correct?
 - A. The periodic valuation of a fund's securities is best performed by the fund manager.
 - B. The existence of written policies and procedures for internal controls is useful in measuring and monitoring risk.
 - C. The risk reports received by investors are preferably prepared by a third-party risk provider instead of by the fund itself.
 - D. The key requirement for information technology resources used to quantify the risks is that they measure items consistently.
5. Lisa Tahara, FRM, is considering an institutional investment in a hedge fund that has experienced volatile and generally positive returns in the past. Which of the following considerations about the fund's track record is least relevant for consideration in her investment decision?
 - A. Size of investment assets.
 - B. Absolute level of past returns.
 - C. Verification of returns by a third party.
 - D. Employment continuity of the investment team.

CONCEPT CHECKER ANSWERS

1. B If a fund takes on more systematic risk (i.e., regular market risk), it is less likely to result in a failure unless there is a significant market downturn. Taking on more unsystematic risk, however, is more likely to result in a failure. Excessive controls to reduce operational risk may be a good idea but may also result in excessive expenses and insufficient returns, thereby leading to a possible failure of the fund.

In a committee-style decision-making process, there may be a dominant member who sways the decision and/or members who are afraid to voice any valid concerns. Materially misstated financial statements are a form of accounting fraud, which significantly increases the risk of the eventual failure of a fund.

2. C Investors should assess potential managers and their investment strategies with an objective and unbiased mind. They should not be unduly concerned with a manager's past successes given that past performance is not always indicative of future performance. Risk controls, the business model, and the investment process are all fundamental parts of the due diligence process.
3. B A returns attribution analysis could be performed to determine how a fund's returns were generated. Return attributions are not generally part of a due diligence questionnaire but such an analysis could subsequently be performed based on some of the information received from the questionnaire. The other items (insurance coverage, disaster recovery procedures, and anti-money laundering policy) are all standard items that would be found in most, if not all, due diligence questionnaires.
4. D It is very important for the information technology resources used to quantify risks to measure items consistently. Securities valuation is an important and potentially subjective task, therefore, independence and objectivity is critical. Policies and procedures tend to be general and only demonstrate the intention to have a strong control environment. Their existence alone provides little assurance that they are properly measuring and monitoring risk. In general, the reporting of risk measures is a more objective task and as a result, there is little or no preference for the reporting to be done internally or externally.
5. B The absolute level of past returns is least relevant here given the volatile returns in the past. Also, past returns are not an assurance of similar returns in the future. The relative level of returns is more important than the absolute level. Verification of returns by a third party provides assurance that the return calculations were computed fairly and accurately by the fund. It is relevant to ascertain whether most or all of the staff on the investment team that generated the past results are still currently employed by the fund. It provides some (but not absolute) assurance that similar returns may be generated in the future.

The following is a review of the Current Issues in Financial Markets principles designed to address the learning objectives set forth by GARP®. This topic is also covered in:

FORGING BEST PRACTICES IN RISK MANAGEMENT

Topic 71

EXAM FOCUS

This qualitative topic examines the key trends and changes in risk measurement resulting from the 2007–2009 financial crisis. The main theme here is that firms should aim to develop accurate risk measures but not engage in risk management techniques that exacerbate risk. The existence of volatility regimes makes that task much more problematic. Overall, the objective for firms should be to have procyclical measures but to manage risk from a countercyclical perspective.

IMPACT OF RECENT FINANCIAL CRISIS ON RISK MANAGEMENT

LO 71.1: Identify the areas of risk management that have been most affected by the recent financial crisis and describe the major trends and developments brought on by the crisis.

Eight specific areas of risk management that have been most affected by the 2007–2009 financial crisis and the corresponding trends and developments since the crisis are summarized below.

Time Period

A longer-term view on risk, with regard to both the past and the future, is becoming evident. A good example would be the impact of the Great Depression from a stress testing perspective. A longer-term view also helps detect any volatility regimes that would significantly affect risk measurement.

Counterparty Risk

There is now more attention focused on greater controls over counterparty risk in over-the-counter (OTC) derivatives and prime brokerage businesses.

Key trends include:

- More due diligence and stricter monitoring of counterparties are now occurring as counterparty assessment is no longer bypassed simply because of strong credit ratings.
- A notable increase in the three-month LIBOR-overnight indexed swap (OIS) spread and the swap rate for a one-year swap of three-month versus a six-month LIBOR (first in August 2007 and then in September 2008). The LIBOR-OIS spread is viewed as a measure of interbank counterparty risk.

- A gradual increase in collateralized derivatives transactions from approximately half of all OTC transactions to 80% of all transactions over a 10-year period ending in 2010.
- Greater use of netting of OTC derivatives transactions, resulting in significant compression in the notional outstanding amounts of interest rate swaps and credit default swaps.
- The Dodd-Frank Act has required the transition of derivatives transactions from OTC markets to central clearing to help monitor counterparty exposures and minimize the amount of counterparty risk.

Funding Liquidity

The lack of short-term funding played a major role in the financial crisis. As a result, rules that are more stringent have been introduced pertaining to repos and money market funds (e.g., reduction in ability of money market funds to serve as short-term funding). Basel III also imposes liquidity buffers on banks. Within OTC derivatives, it is now the norm to have differing quoted prices based on differing funding rates; pricing is a function of the funding and collateral arrangements.

Market and Credit Risk

There is increased use of the **credit value adjustment (CVA)** in derivatives markets. For example, in computing the CVA for a portfolio of swaps, the firm must account for wrong-way risk, the risk that the counterparty will more likely default when the amount of transactions with the counterparty increases. Furthermore, the firm must model both the counterparty's default risk and market risk factors that will affect the swaps' market values. Although one key limitation in determining credit risk is the limited amount of data available with credit default swaps, the main limitation is proper modeling of the risks.

Credit Ratings

The failings of credit ratings are commonly thought to have had a significant role in the financial crisis. As a result, there is less reliance on credit ratings (e.g., credit ratings are not part of regulatory requirements per Dodd-Frank Act), resulting in firms needing to undertake much more thorough credit analyses of their own.

Sovereign Risk

Sovereign risk used to be associated only with emerging markets but recent downgrades in the United States and a European financial crisis have increased the overall levels of sovereign risk. Credit default swaps are used to monitor and deal with sovereign risk but have become far less effective due to new rules to reduce defaults.

Focus on Stress Scenarios

There has been an increased desire to model stress scenarios that account for rare events. Such scenarios are highly subjective, require significant judgment, and may not necessarily be quantifiable using traditional means such as value at risk (VaR).

Regulatory Changes

The financial crisis has brought on increased regulatory activity, as demonstrated by the Dodd-Frank Act and Basel III (new capital and liquidity requirements). The short-term impact in the markets is an increased level of regulatory uncertainty.

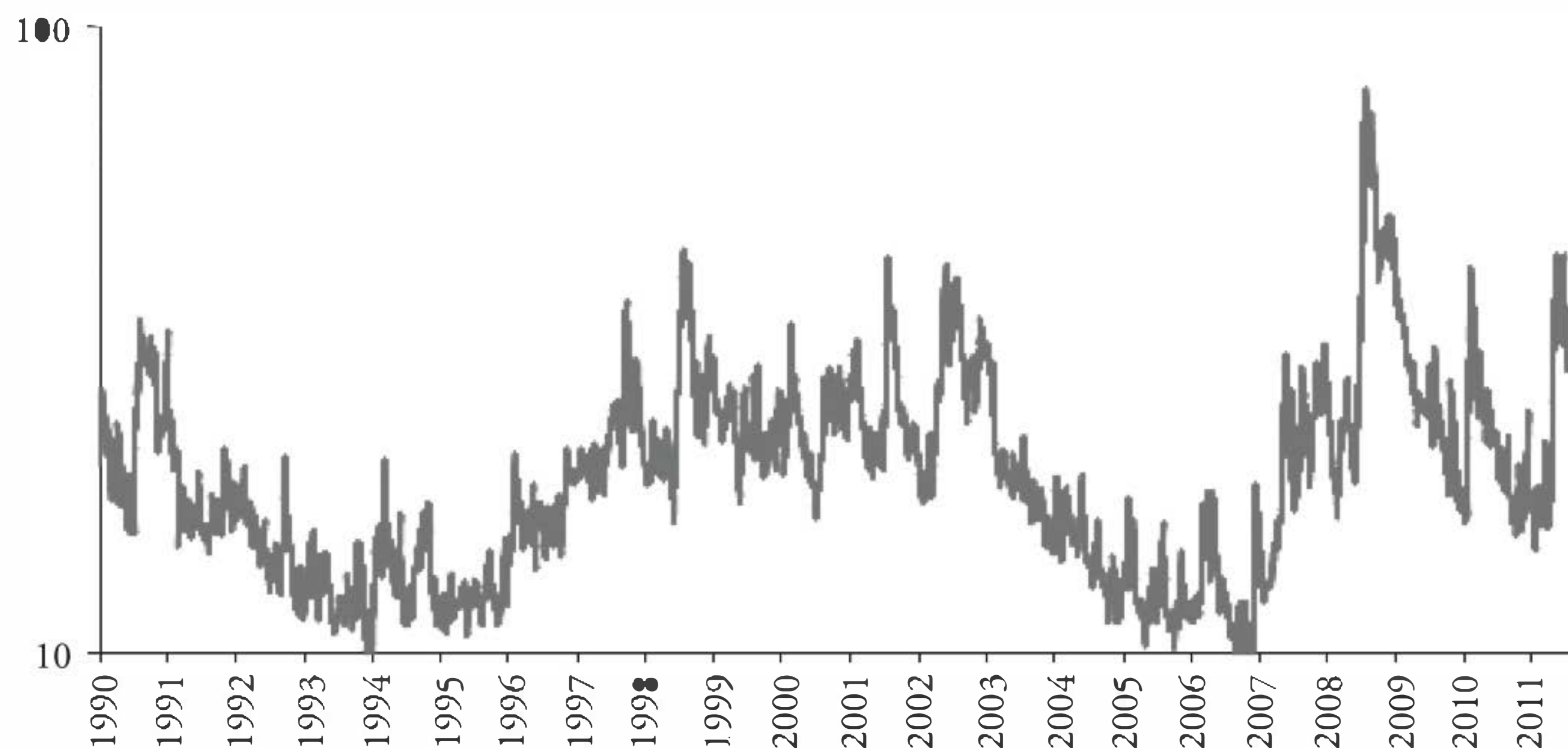
VOLATILITY REGIMES

LO 71.2: Evaluate the presence of volatility regimes in market data.

There is significant evidence of the presence of volatility regimes in market data in the form of intermittent patterns of increases and decreases in volatility over time.

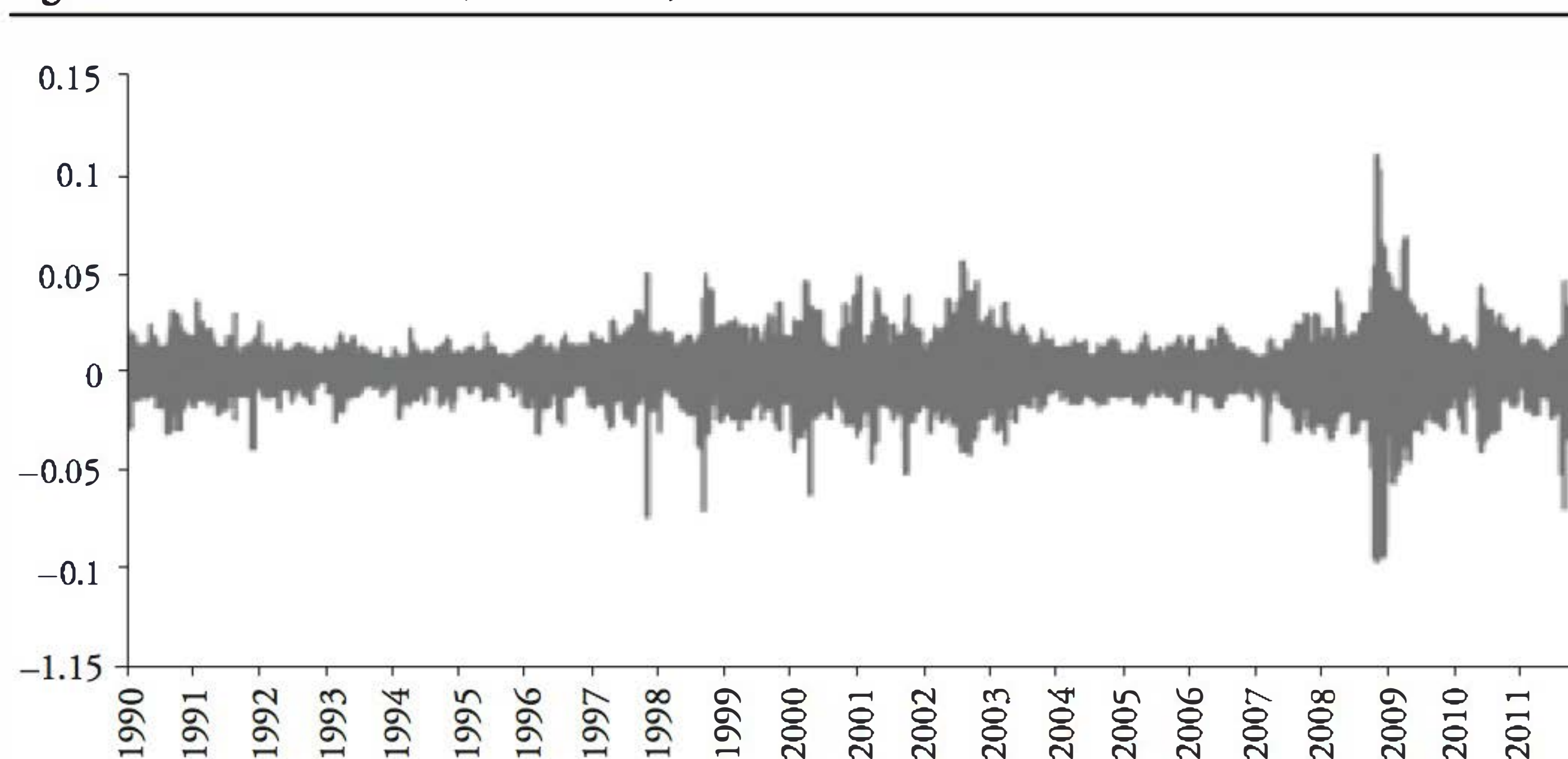
Consider Figure 1, which illustrates the **VIX volatility index** between 1990 and 2011, scaled logarithmically. Assume that the VIX approximates market volatility levels. An analysis of Figure 1 suggests the existence of volatility regimes. There are two distinct periods of low volatility (about 1991–1997 and 2004–2007) and two distinct periods of high volatility (about 1998–2003 and 2008–2011). A clear period of transition between a low volatility regime to a high volatility regime occurs in the latter half of 2007.

Figure 1: VIX Volatility Index (1990–2011)



Now consider Figure 2, which illustrates the daily returns (realized volatility) of the S&P 500 between 1990 and 2011. Similar to Figure 1, there are contrasting periods of low volatility versus high volatility. Because of the contrasts, the overall data distribution shows extreme kurtosis (11.7 versus 3 for a normal distribution), which is indicative of fat tails (i.e., a greater likelihood of extremely large deviations from the mean).

Figure 2: S&P 500 Index (1990–2011)



The same volatility regime patterns are also observed for interest rates, exchange rates, and the Baa 5-year Treasury spreads for approximately the same 1990 to 2011 period.

The main point here is that volatility regimes are often difficult to detect if market participants are only looking back the usual two to four years when making risk estimates. Instead, a longer period of time, say 20 years or more, may be required. In order to quantify volatility regimes, one might use a regime-switching model that identifies individual regimes. The model parameters are constant within a given regime but they may be vastly different between different regimes. For every regime change, the model identifies the critical event that causes the change. A regime-switching model requires many years of data in order to have accurate calculations (e.g., more than five regime changes). Alternatively, a GARCH model could be used to examine the persistence of volatility.

RISK-MITIGATING STEPS

LO 71.3: Analyze the implications of multiple firms attempting to take the same risk-mitigating steps.

LO 71.4: Describe the implications of risk-mitigation strategies employed by firms and how they can amplify risk.

The risk arising from volatility regime changes is exacerbated when multiple firms react with the same risk-mitigating steps. A general example could include any procyclical changes, which are changes that are positively correlated to the state of the economy.

Examples of procyclical activities include:

- *Credit granting*: reduced during an economic downturn (which leads to a larger downturn) and increased during an economic boom.
- *Loan loss reserve accounting*: increased loss reserves in weak economic periods and decreased loss reserves in strong economic periods.

- *Capital requirements*: banks hold more capital when credit quality diminishes and hold less capital when credit quality improves.
- *Deposit insurance fees*: lower before financial crises and higher during and after financial crises.
- *Fair value accounting*: when asset book values exceed fair values, financial distress may arise, leading to forced sales, reduced prices, and write-downs.

The following examples are specific risk-mitigating steps taken by many individuals and firms at the same time. The result is an exacerbation of risk for all parties involved.

- *Bank run*. A lone customer begins the cycle by withdrawing all funds from a potentially unstable (and uninsured) bank. The bank may end up failing if enough customers subsequently follow suit.
- *Portfolio insurance*. The use of put options that promote selling in a falling market. Although this is a useful investment strategy if used only by a few market participants, it may be disastrous to the financial system if used extensively (e.g., the 1987 stock market crash).
- *Deleveraging of hedge funds to reduce risk*. This strategy may have worked for an individual fund, but the problem during the financial crisis was that many funds holding similar investments were attempting to sell at the same time.
- *Collateral calls in the event of a downgrade of a counterparty*. With diminishing cash resources resulting from meeting collateral calls, further downgrades would occur that would lead to large losses.
- *Hedging counterparty risk through the use of credit default swaps (CDSs)*. CDS have both risk measurement and risk mitigation roles. Therefore, the increased risk associated with an increased CDS spread leads to an increased purchase of CDS and further increases in the CDS spread.

Prior to the financial crisis, some investment banks attempted to hold varying levels of assets in order to meet a certain value at risk (VaR) level. During periods of low volatility (e.g., 2003–2006), there would be high levels of assets held. However, during the sudden increase in volatility in 2007, many firms tried to liquidate some of their assets to reduce risk. The excess amount of selling activity reduced prices rapidly and further increased volatility and risk.

RISK MANAGEMENT BEST PRACTICES

LO 71.5: Explain practices to address and alleviate amplified risk.

Based on the discussion above, best practices should aim to avoid activities that are procyclical in nature and should encourage activities that are countercyclical in nature.

Key best practices include:

- *Longer time periods*. Looking back at only a few years of data has been shown to not provide a full understanding of financial risk. A much longer period of analysis, say 20 years or more, may be required to spot key trends. Looking forward, the Basel II.5 regulations (incremental risk charge) increases the VaR market risk horizon from two weeks to one year and it assumes portfolios are rebalanced to a specific risk level rather than remaining constant, which accounts for possible illiquidity. The frequency of rebalancing is dependent on the liquidity of the underlying assets.

- *Stress testing.* More stress testing scenarios should be used to take into account regime changes. Stress tests should not merely examine rare or outlier events but should also consider the possibility of longer periods of high volatility in multiple markets.
- *Simultaneous actions of others.* The risk management team must not look at its actions in isolation. Although a risk-mitigating action may appear to be optimal for the firm, one must consider if that remains the case if many other firms take the same action at the same time.

The above best practices would motivate firms to come up with more accurate and sensitive risk measures. Of course, the problem with such precise measures is that they may have a procyclical effect in that risk is amplified if all firms are taking the same risk-mitigating actions in response to the measurement results.

Ultimately, firms want to have accurate risk measurement as well as protection from the amplified risk resulting from simultaneous responses from other firms. These two activities need to be managed individually (e.g., separate current VaR and stressed VaR). Two activities that help in achieving both objectives include:

- *Provisions for loan losses:* financial institutions establish reserves prior to the deterioration of credit quality (i.e., risk measurement) and use those reserves in a downturn (i.e., countercyclical risk management)
- *Clearing of derivatives through a central counterparty:* the central counterparty serves as the buffer between dealers, and the need for default fund contributions and margin payments encourages all parties to monitor counterparty risk.

KEY CONCEPTS

LO 71.1

The trends and developments within the areas of risk management that have been most affected by the 2007–2009 financial crisis are as follows:

- Longer term view of risk.
- Greater controls over counterparty risk.
- Lack of short-term funding has resulted in more stringent rules pertaining to repos and money market funds and the imposition of liquidity buffers on banks.
- Increased use of the credit value adjustment (CVA) in derivatives markets.
- Less reliance on credit ratings.
- Increased overall levels of sovereign risk.
- Increased focus on stress scenarios.
- Increased regulatory activity.

LO 71.2

There is significant evidence of the presence of volatility regimes in market data in the form of intermittent patterns of increases and decreases in volatility over time.

Volatility regimes are often difficult to detect if market participants are only looking back the usual two to four years when making risk estimates. Instead, a longer period of time, say 20 years or more, may be required.

LO 71.3

The risk arising from volatility regime changes is exacerbated when multiple firms react with the same risk-mitigating steps. A general example could include any procyclical changes, which are changes that are positively correlated to the state of the economy.

LO 71.4

Examples of specific risk-mitigating steps taken by many individuals and firms at the same time include bank runs, portfolio insurance, deleveraging of hedge funds, collateral calls, and credit default swaps.

LO 71.5

Key best practices to address and alleviate amplified risk include: looking back and forward over longer time periods, more stress testing scenarios that take into account regime changes, and considering the simultaneous risk-mitigating actions of other firms.

Ultimately, firms want to have accurate risk measurement as well as protection from the amplified risk resulting from simultaneous responses from other firms. Two activities that help in achieving both objectives include the use of provisions for loan losses and the clearing of derivatives through a central counterparty.

CONCEPT CHECKERS

1. Which of the following statements regarding the impact on risk management as a result of the 2007–2009 financial crisis is most likely accurate?
 - A. The level of sovereign risk has remained relatively stable.
 - B. There has been a noticeable decrease in the three-month LIBOR-OIS spread.
 - C. Credit ratings are a part of regulatory requirements per the Dodd-Frank Act.
 - D. For over-the-counter (OTC) derivatives, it is normal to have different quoted prices based on different funding rates.
2. Which of the following statements regarding volatility regimes is most likely accurate?
 - A. In order to detect volatility regimes, a period of at least 20 years is suggested.
 - B. A GARCH model is superior to a regime-switching model because only a GARCH model is able to capture persistence in volatility.
 - C. A regime-switching model approach requires an analysis of a long historical period that includes at least two or three regime changes in order to have accurate calculations.
 - D. With respect to the historical returns of the S&P 500 that exhibit volatility regimes, the measured level of kurtosis is higher for shorter intervals of time compared to longer ones.
3. Which of the following items is most likely an example of a procyclical activity?
 - A. Historical accounting.
 - B. Deposit insurance fees.
 - C. Central clearing of derivatives.
 - D. Portfolio insurance.
4. Which of the following risk-mitigating steps is most likely associated with the stock market crash of 1987?
 - A. Collateral calls.
 - B. Portfolio insurance.
 - C. Deleveraging of hedge funds.
 - D. Hedging counterparty risk through the use of credit default swaps.
5. Which of the following statements regarding best practices in addressing and alleviating amplified risk is most likely accurate?
 - A. Stress tests should focus on rare or outlier events.
 - B. The Basel II.5 regulations assume that portfolios remain constant over the relevant market risk horizon.
 - C. When developing more accurate and sensitive risk measures, one of the problems is that these measures may have a procyclical effect.
 - D. The clearing of derivatives through a central counterparty reduces risk for all parties involved and reduces the incentive for all parties to monitor counterparty risk.

CONCEPT CHECKER ANSWERS

1. D Within OTC derivatives, it is now the norm to have differing quoted prices based on differing funding rates; pricing is a function of the funding and collateral arrangements.

Response A is not correct because downgrades in the United States and Europe have increased overall sovereign risk levels. Response B is not correct because there has actually been a noticeable increase in the three-month LIBOR-OIS spread (once in August 2007 and then in September 2008). Response C is not correct because the Dodd-Frank Act removes credit ratings from regulatory requirements.

2. A Volatility regimes are often difficult to detect if market participants are only looking back at the usual two to four years when making risk estimates. Instead, a longer period of time, say 20 years or more, may be required.

Response B is not correct because both a regime-switching model and a GARCH model capture the persistence in volatility. Response C is not correct because the historical record should have more than five regime changes in order to have accurate calculations. Response D is not correct because the measured level of kurtosis is *lower* for shorter intervals of time compared to longer ones. The higher level of kurtosis results from mixing periods of low volatility and high volatility (i.e., volatility regimes).

3. B A procyclical activity tends to amplify risk. Deposit insurance fees are an example of a procyclical activity—the fees are lower before financial crises and higher during and after financial crises.

Fair value accounting (not historical accounting) is an example of a procyclical activity. With fair value accounting, when asset book values exceed fair values, financial distress may arise leading to forced sales, reduced prices, and write-downs.

Central clearing of derivatives is a countercyclical activity (in direct contrast to a procyclical activity) that assists in reducing the amplifying effects of simultaneous reactions by multiple parties.

Portfolio insurance is an example of a risk-mitigating technique that may exacerbate risk for all market participants.

4. B The use of put options that promote selling in a falling market is often associated with the stock market crash of 1987. Although it is a useful investment strategy when used by only a few market participants, it may be disastrous to the financial system if used extensively.

Response A is not correct because collateral calls are associated with the financial crisis of 2007–2009. Response C is not correct because the simultaneous deleveraging of many hedge funds was associated with the financial crisis of 2007–2009. Response D is not correct because credit default swaps did not exist in 1987; they originated in 1994.

5. C One of the problems with having more accurate and sensitive risk measures is that such measures may have a procyclical effect in that risk is amplified if all firms are taking the same risk-mitigating actions in response to the measurement results.

Response A is not correct because stress tests should also consider the possibility of longer periods of high volatility in multiple markets. Response B is not correct because the Basel II.5 regulations assume that portfolios are rebalanced to a specific level. Response D is not correct because the need for default fund contributions and margin payments encourages all parties to monitor counterparty risk.

CASE STUDIES ON DISRUPTIONS DURING THE CRISIS

Topic 72

EXAM FOCUS

This topic examines the various funding mechanisms used in financial markets, including commercial paper, asset-backed commercial paper, money market mutual funds, repurchase agreements, credit commitments, and dollar funding of non-U.S. banks. For each of these mechanisms, we describe the nature of the distress during the financial crisis of 2007–2009, and the policy responses put in place to alleviate the distress and improve market liquidity. For the exam, be able to discuss each funding mechanism, and be able to compare and contrast the various mechanisms. Pay special attention to policy responses, including how they were specifically tailored to mitigate distress and restore market liquidity.

FUNDING MECHANISMS

LO 72.1: Understand the use and purpose of funding mechanisms and describe the distress in the markets during the recent credit crisis.

Funding mechanisms allow large institutional players, including corporations and financial institutions, to obtain short-term financing from other market participants, including banks. These mechanisms include commercial paper, asset-backed commercial paper, money market mutual funds, repurchase agreements, credit commitments, and dollar funding of non-U.S. banks.

Funding mechanisms allow institutions to obtain debt, loans, or other forms of financing primarily to finance their funding requirements, including asset purchases. While these mechanisms are typically short-term, the assets funded tend to have long-term maturities. This maturity mismatch exposes institutions to rollover risk, that is, the risk of having to renew their maturing short-term obligations over time at prevailing (and changing) rates.

During the financial crisis of 2007–2009, including the subprime crisis in the asset-backed securities market, the market for short-term borrowings became distressed. Investor confidence in certain higher risk assets declined, and investors pulled back and reduced their lending. When liquidity for short-term lending dried up, borrowers were forced to find alternative funding options. In response, governments needed to step in and provide emergency liquidity and lending, either on a temporary or permanent basis.

COMMERCIAL PAPER VS. ASSET-BACKED COMMERCIAL PAPER

LO 72.2: Distinguish between Commercial Paper and Asset-Backed Commercial Paper and describe the policy responses to recent market collapses.

Commercial paper is a short-term, unsecured debt obligation issued by corporations or financial institutions primarily as a source of working capital or receivables financing or to meet other short-term obligations. **Asset-backed commercial paper** is a category of commercial paper that is secured by collateral and is issued by conduits of corporations as a form of off-balance sheet financing.

Commercial Paper (CP)

CP is a form of money market financing primarily by large U.S. corporations (corporate CP) and financial institutions (financial CP). Immediately prior to the financial crisis in mid-2007, the U.S. CP market stood at \$2.2 trillion, of which over half comprised of asset-backed commercial paper, with the rest in both financial and non-financial CPs. Following the crisis, by late 2013, the CP market shrunk half its size to \$1.1 trillion, over half of which was now comprised of financial CP.

The primary issuers of financial CP are U.S. subsidiaries of foreign banks or financial entities, while corporate CP is mainly issued by large, highly rated public corporations. The typical use of CP includes short-term funding of operating expenses or current assets. CPs have maturities of 270 days or less, with typical maturities averaging 30 days.

The main risk of CP is **rollover risk**, or the risk that because of a liquidity crisis, a borrower is unable to roll over the maturing CP into a new instrument. This increases funding costs, may lead to forced asset sales to raise cash, and could put pressure on credit lines extended by commercial banks as alternative funding measures. Two of the largest disruptions in the CP market occurred in the summer of 2007 at the onset of the financial crisis (this primarily affected the asset-backed commercial paper market), and in September 2008 following the collapse of Lehman Brothers (this mainly affected the unsecured CP market). The loss of confidence in the markets triggered widespread redemptions from money market funds and the funds increasingly reduced their holdings in CP. Investors were also more reluctant to invest in CPs, which led to a liquidity crisis and further increased rollover risk, especially of longer dated CPs. As liquidity in the CP market diminished, those institutions with weaker credit were completely shut out of the market.

As the liquidity crisis in the CP market created distortions, policymakers were forced to respond. In October 2008, the U.S. Federal Reserve created the **Commercial Paper Funding Facility (CPFF)** to provide a liquidity backstop as temporary support to troubled CP issuers. Under the CPFF program, the Federal Reserve purchased three-month CP directly from eligible issuers as a form of guarantee that the issuer can roll over its CP at maturity. By February 2010, the Federal Reserve became the single largest investor in the CP market with purchases of up to \$370 billion.

Asset-Backed Commercial Paper (ABCP)

ABCP is a secure short-term financing used primarily for: (1) warehousing of assets prior to a securities issuance, (2) arbitrage investing in related securities, (3) providing leverage for mutual funds, and (4) off-balance sheet financing of certain assets. The ABCP market grew to its largest size in mid-2007 at \$1.2 trillion in the United States, falling to under \$300 billion by the end of 2013. Some of the largest users of ABCP were money market funds.

ABCP is typically issued by off-balance sheet conduits of large financial institutions as a form of maturity transformation, by holding long-term assets that are financed by short-term liabilities. During the crisis, this maturity mismatch exposed the strategy to rollover risk, or the risk that investor demand for ABCPs may dry up and borrowers may be unable to roll over maturing ABCPs. To protect against this risk, ABCPs were often guaranteed by a sponsor institution. The rating of the ABCP by rating agencies therefore reflected the rating (risk) of the sponsor. Although there were U.S. regulatory attempts to have the sponsoring institution consolidate the ABCPs on their balance sheets, sponsors were ultimately able to exclude ABCPs from consolidation requirements. In fact, sponsors received favorable capitalization rules for providing the guarantees.



Professor's Note: The ABCP conduits were special purpose vehicles (SPVs). They were called off-balance sheet because the assets and liabilities of these vehicles were not included on the financial institution's balance sheet.

The ABCP market is particularly sensitive to investor sentiment of its quality, and a large loss in investor confidence could trigger a massive disruption in this market. When the uncertainty about the quality of ABCPs increased considerably during periods of market stress, it ultimately triggered a liquidity crisis and created a run on the conduits' liabilities, which led to the collapse of the ABCP market in August 2007 and precipitated a further decline following the Lehman Brothers bankruptcy.

The immediate policy response following the 2007 collapse in the ABCP market manifested in government liquidity support to struggling banks by extending term loans for longer-term financing and by reducing the discount window rates. This was shortly followed by the creation of the Term Auction Facility (TAF) in late 2007. By 2008, policymakers focused specifically on the CP market and in the fall of 2008, the Fed created the Asset-Backed Commercial Paper Money Market Mutual Fund Liquidity Facility (AMLF). The AMLF extended nonrecourse loans to commercial banks that were able to purchase eligible ABCPs from money market mutual funds. Shortly afterwards, the Fed also began to purchase CPs directly from issuers through the CPFF program. These initiatives ended in 2010 when U.S. accounting rules were amended requiring consolidation of most ABCP conduits on the sponsor's balance sheet.

SOURCES OF MARKET DISRUPTION

LO 72.3: Compare and contrast sources of disruption in the money market mutual funds, repo markets, and credit commitments.

Money market mutual funds, repo markets, and credit commitments experienced different sources of fragility during the financial crisis and saw different levels of policy responses.

Money Market Mutual Funds (MMFs)

MMFs are large institutional players and an important source of liquidity in the wholesale lending markets and are intermediaries in allocating short-term funding to financial institutions. Under U.S. regulations, MMFs must maintain stable principal with a share price of \$1, which increases their importance as cash management tools.

Investors in MMFs tend to be highly risk averse and are sensitive to changes in the perceived risk of a fund. When a MMF experiences weaknesses, investors are inclined to redeem their shares primarily because redemptions shift the risks and costs to the remaining shareholders. Because MMFs round their share price to the nearest cent, any loss less than 0.5% of the principal value may still receive a full payout at \$1, with the loss spread across the remaining shareholders. In order to satisfy early redemptions, the funds typically sell their most liquid assets first in order to avoid quickly selling less liquid assets at unfavorable prices. When redemptions increase during times of stress, as was the case during a run on MMFs in September 2008, liquid fund assets are sold and the remaining investors are left with a portfolio of assets with increasingly lower liquidity. This may cause the share price to drop below \$1, which in turn may trigger further redemptions.

Policy responses to the MMF distress during the financial crisis included both short-term, emergency measures, and long-term solutions. Short-term measures included the Temporary Guarantee Program instituted by the U.S. Treasury, which temporarily guaranteed investors against any principal losses in participating MMFs. In addition, the AMLF by the Fed provided liquidity through nonrecourse loans to purchase eligible ABCPs from MMFs. Long-term solutions included the U.S. Securities and Exchange Commission's (SEC) enhancing fund transparency by easing the requirements by boards to close troubled funds, and by limiting the liquidity, market, and credit risks of MMFs.

Repurchase Agreements (Repos)

A **repurchase agreement**, or **repo** for short, is essentially a short-term loan collateralized by securities, under which a security is sold by a borrower with the promise to buy back the security at a future period for a predetermined, higher price. The difference between the two security prices is referred to as the *repo rate* and represents implied interest on the loan. The secured nature of the transactions is intended to reduce credit risk. Under the majority of repo transactions, the market value of securities exceeds the value of the loan, which implies that the loan is overcollateralized. Bilateral repos settle directly between the two counterparties. Third-party repos use a clearing bank like JPMorgan Chase and the Bank of New York Mellon for settlement and collateral management.

The repo market grew tremendously up to its financial crisis peak of \$2.8 trillion in April 2008, although by some estimates the aggregate notional value of repo markets subsequently increased to nearly \$10 trillion. The largest groups of cash investors tend to be MMFs and securities lenders.

Risks in the repo market primarily relate to the term of the security, quality of the collateral, and counterparty credit strength:

- Short maturities create rollover risk, or the risk that due to lack of investor demand, borrowers are unable to renew maturing repos at favorable terms (or at all in severe cases). In addition, since repos are exempt from the automatic stay provision of a bankruptcy, an investor can sell securities (collateral) in the event of a borrower default. However, under stressed markets, the investor may be forced to sell assets at fire-sale prices and as a result incur losses.
- Investors prefer higher quality collateral, and require higher haircuts¹ for less liquid, riskier collateral. Haircuts increased from zero to nearly 50% for certain collateral during the crisis in 2007, and in fact, certain repos could not be financed with collateral at all.
- These problems were more pronounced in the bilateral repo market, although disruptions in the tri-party repo markets have also been seen, especially for institutional players like Bear Stearns and Lehman Brothers.

The government policy response to distress in the repo market during the financial crisis included establishing funding programs to provide emergency liquidity to dealers, strengthening investor confidence, and backstopping the tri-party repo market. The Fed, as lender of last resort, introduced the Term Securities Lending Facility (TSLF) and the Primary Dealer Credit Facility (PDCF) as temporary measures in March 2008 in order to provide collateralized loans for 28-day terms (for TSLF) and overnight (for PDCF) to primary dealers. In September 2008, the Fed revised these facilities to accept a wider range of collateral. The facilities were closed in early 2010.

Credit Commitments

In addition to providing corporations with credit, banks in the U.S. have also historically provided loan and **credit commitments**. Under a credit commitment, banks promise to extend loans and lines of credit to corporations as a form of liquidity insurance. Corporations favor commitments since they provide protection against changing interest rates and help signal credit quality. Banks, on the other hand, are willing to provide commitments in exchange for access to deposit funding, as long as any withdrawals from deposits remain uncorrelated with loan drawdowns. As securitized products gained popularity, banks began originating loans specifically to sell them to other investors rather than to hold them to maturity. In turn, banks financed these structured products with short-term commercial paper, often with sweeteners including credit enhancements or liquidity backstops against losses.

¹ A haircut is the percentage discount from the market value of securities received as collateral used to calculate purchase price under the repo transaction.

Sources of disruption in the credit commitment market can arise from two factors:

1. When there is uncertainty about the financial condition of a bank, investors withdraw deposits at the same time as borrowers draw down credit lines. This puts liquidity pressure on the bank. Such a run was observed during the financial crisis, which was coupled with an increase in drawdown rates.
2. Banks that provide credit commitments to ABCP or CP programs have liquidity exposure to the CP market and are exposed to all the risks and sensitivities of this market. Such risks were evident during the financial crisis as investors lost confidence in the CP market, and short-term funding dried up, affecting banks' liquidity.

As a policy response to pressures in the market, the deposit insurance coverage was increased from \$100,000 to \$250,000 (initially temporarily, then permanently). In addition, a full guarantee was provided for non-interest-bearing transaction accounts. Other measures also alleviated some of the banks' liquidity pressures, including the Temporary Guarantee Program for MMFs and adjusting the discount window.

DOLLAR FUNDING MODEL OF NON-U.S. BANKS

LO 72.4: Evaluate the implications of the dollar funding model of non-U.S. banks during the recent crisis.

The U.S. dollar assets of non-U.S. banks grew rapidly until late 2010. The growth in dollar assets has been attributed to three factors: (1) greater investment opportunities, as non-U.S. banks extended loans to U.S. companies and invested in highly rated tranches of U.S. structured products; (2) European investment regulations, which focused on the amount of capital against a bank's risk-weighted assets; and (3) the importance of the U.S. dollar in global trade and investments.

Non-U.S. banks also accumulated sizeable dollar liabilities. Directly establishing a U.S. commercial bank—in order to qualify for federal deposit insurance—was costly and had considerable restrictions. As a result, most banks met their dollar liability funding requirements through issuing dollar wholesale debt, including commercial paper and certificates of deposits. The primary buyers, and therefore sources of funding, were the MMFs.

These funding arrangements and the dependence on wholesale funding made non-U.S. banks vulnerable to liquidity risk. During the financial crisis, as MMFs reduced their wholesale lending in response to greater investment risks, non-U.S. banks were forced to look for alternative funding arrangements. These alternative arrangements included (1) “deleveraging,” or reducing their dollar assets and therefore reducing their dollar requirements; (2) intrafirm dollar transfers, by a foreign parent transferring dollars to their U.S. branch subsidiaries; (3) the use of foreign exchange (FX) swaps; or (4) borrowing dollars from central bank dollar liquidity facilities for a fixed term. The most commonly used approach was the use of FX swaps.

The policy response to the crisis was multifold. The Fed used the discount window and the TAF to extend dollar loans to the U.S. branches of non-U.S. banks. This approach was used

during the period from late 2007 to early 2010. Non-U.S. banks received close to 40% of the total TAF loans, although their participation in the discount window was smaller at only 3%. An alternative arrangement by the Fed in conjunction with central banks was the use of foreign exchange swaps. During the crisis, foreign banks relied on dollar borrowing from their central banks. The central banks in return used dollar swap facilities by converting domestic currency liabilities into dollars. The outstanding notional value of central bank liquidity swaps exceeded \$550 billion at the end of 2008. In the post financial crisis period, and given the negative perception of using central bank liquidity swaps, the European Central Bank (ECB), the Bank of England, the Swiss National Bank, the Bank of Canada, and the Bank of Japan lowered the cost of dollar borrowing in late 2011. Subsequently the ECB also expanded the list of eligible collateral to facilitate access to dollar liquidity.

KEY CONCEPTS

LO 72.1

Funding mechanisms are primarily short-term financing options and include commercial paper, asset-backed commercial paper, money market mutual funds, repurchase agreements, credit commitments, and dollar funding of non-U.S. banks. They allow institutions to obtain debt and loan financing for funding requirements. A maturity mismatch typically exists between the short-term funding mechanism and the long-term assets that are funded, which creates rollover risk.

When investor sentiment declines, investors are less inclined to continue lending, and the market for funding mechanisms declines. When the supply of short-term financing dries up, governments may be forced to provide emergency liquidity and lending.

LO 72.2

Both CP and ABCP are forms of short-term debt obligations issued by corporations for working capital or receivables financing or to meet short-term obligations. CP is generally unsecured. ABCP is a category of CP that is secured by collateral and issued by conduits of corporations as a form of off-balance sheet financing.

The primary risk of CP and ABCP is rollover risk, and disruptions in these markets can increase rollover risk leading to higher funding costs and forced asset sales. Two such disruptions occurred in the summer of 2007 at the onset of the financial crisis and in the fall of 2008 with the collapse of Lehman Brothers.

The policy response to the crisis in the CP market included the creation of the Commercial Paper Funding Facility (CPFF) by the U.S. Federal Reserve to provide a liquidity backstop as temporary support to troubled CP issuers.

The policy response to the crisis in the ABCP market initially included providing liquidity support to struggling banks and the creation of various liquidity facilities. In 2010, these initiatives ended with the change in U.S. accounting rules that require consolidation of most ABCP conduits on the sponsor's balance sheet.

LO 72.3

Money market mutual funds (MMFs) provide short-term funding to financial institutions and are important sources of liquidity in the wholesale lending markets. Given the high risk sensitivity of MMF investors, MMFs tend to be more sensitive to changes in market risk. To cover increased shareholder redemptions during market stress, MMFs first sell liquid investments, leaving less liquid investments to nonredeeming shareholders.

Policy responses to MMF troubles during the financial crisis included both short-term, emergency measures, and long-term solutions, including: (1) the Temporary Guarantee Program guaranteeing investors against any principal losses in participating MMFs, (2) providing nonrecourse loans to purchase eligible ABCPs from MMFs; and (3) the SEC

easing the requirements by boards to close troubled funds, and to limit the liquidity, market and credit risks of MMFs.

Repurchase agreements (repos) are short-term loans collateralized by securities, whereby a security is sold by a borrower with the promise to buy it back in the future at a higher price. Repos tend to be overcollateralized; that is, the value of assets as collateral typically exceeds the repurchased security's price.

Risks in the repo market relate to the term of the security (short maturities create greater rollover risk as maturing contracts must be renewed), quality of the collateral (investors prefer higher quality collateral), and counterparty credit strength (investors prefer more creditworthy borrowers).

Policy responses to troubles in the repo market during the financial crisis included establishing funding programs to provide emergency liquidity to dealers, strengthening investor confidence, and backstopping the tri-party repo market.

Credit commitments refer to banks' promises to provide liquidity insurance to corporations by extending them lines of credit and loan commitments. During stressed times, depositors who are worried about the financial condition of the bank withdraw deposits at the same time as borrowers draw down credit lines, which puts liquidity pressure on the bank.

Policy responses to distresses during the financial crisis included federal government actions that included increasing the deposit insurance coverage from \$100,000 to \$250,000 (initially temporarily, then permanently) and providing a full guarantee for non-interest-bearing transaction accounts. Alternative measures included instituting the Temporary Guarantee Program for MMFs and adjusting the discount window.

LO 72.4

Non-U.S. banks met their dollar liability funding requirements primarily through issuing dollar wholesale debt, including commercial paper and certificates of deposits, primarily to MMFs. As MMFs reduced their wholesale lending during the financial crisis, non-U.S. banks needed to find alternative funding arrangements. These included reducing their dollar assets and dollar requirements (deleveraging), intrafirm dollar transfers, using foreign exchange swaps, and borrowing dollars from central bank dollar liquidity facilities.

Policy responses to the financial crisis included the use of the discount window and the TAF by the Fed, and the use of foreign exchange swaps through central bank liquidity swaps. In the post financial crisis period, the ECB, in conjunction with several major central banks, lowered the cost of dollar borrowing, followed by the ECB expanding the list of eligible collateral to facilitate access to dollar liquidity.

CONCEPT CHECKERS

1. Which of the following descriptions is least applicable to financial commercial paper?
 - A. Rollover risk, or the risk of renewing maturing instruments.
 - B. Off-balance sheet financing.
 - C. Short-term debt instrument.
 - D. Primary issuers are U.S. subsidiaries of foreign banks or financial entities.
2. During a mutual fund industry conference, two participants are discussing the role of money market mutual funds (MMFs) during the recent financial crisis. The participants make the following observations:

Participant 1: *When stress events cause shareholders to redeem their shares, MMFs respond by first selling their less liquid securities to satisfy redemptions.*

Participant 2: *The good news for redeeming shareholders is that if a fund incurs a loss of 0.3%, the shareholder may still receive \$1 per share.*

Which participant's statement is accurate?

 - A. Participant 1 only.
 - B. Participant 2 only.
 - C. Both participants.
 - D. Neither participant.
3. A borrower in the repo market sells a security for \$99.80 today, and promises to buy it back in one week for \$100.00. The borrower posts collateral worth \$101.00 for the transaction. The difference between the \$99.80 sale price and \$100.00 repurchase price is referred to as the:
 - A. discount.
 - B. haircut.
 - C. repo rate.
 - D. overcollateralization.
4. Based on government policy responses to the 2007–2009 financial crisis, which of the following policy responses is considered least likely to occur in a stressed market scenario?
 - A. Temporarily increasing the deposit insurance coverage.
 - B. Permanently increasing the deposit insurance coverage.
 - C. Reducing the discount window rates.
 - D. Increasing the pressure on banks' liquidity demands.
5. Most non-U.S. banks meet their dollar funding needs by issuing dollar-denominated wholesale debt. This action was least likely the case because:
 - A. regulatory limitations exist on internal capital market transfers between related organizations.
 - B. there are costs associated with establishing a U.S. commercial bank, and issuing dollar-denominated debt is a cheaper alternative.
 - C. there are restrictions associated with qualifying for federal deposit insurance as a U.S. commercial bank.
 - D. dollar wholesale funding is preferred because non-U.S. banks are restricted from borrowing dollars from central bank dollar liquidity facilities.

CONCEPT CHECKER ANSWERS

1. **B** Financial commercial paper is a short-term, unsecured debt obligation issued by financial institutions as a short-term financing tool. Primary issuers in the financial CP market are U.S. subsidiaries of foreign banks or financial entities. Rollover risk is a concern for all CPs given that investors must roll over the maturing CP into a new instrument.

Asset-backed commercial paper, not financial commercial paper, is considered an off-balance sheet obligation.

2. **B** Participant 2 is correct. Because MMFs round their share price to the nearest cent, shareholders may still receive \$1 per share if the fund incurs a loss of less than 0.5%.

Participant 1 is incorrect. When shareholders redeem their shares, MMFs initially respond by selling their highly liquid assets to quickly meet redemptions without incurring material losses. This leaves the less liquid securities for nonredeeming shareholders.

3. **C** The repo rate represents the difference between the sale price of a security and the repurchase of the security at a higher price in the future. The repo rate represents implied interest on the transaction.

Haircut and overcollateralization relate to a discount from the value of the collateral, where the collateral pledged is in excess of the value of the security sold. Discount is not a term used in reference to repos.

4. **D** Policy responses may include temporary and permanent increases in the deposit insurance coverage, reducing the discount window rate, and any measure that is aimed at helping the stability of the market and at *reducing* liquidity pressures.

5. **D** Non-U.S. banks have several alternatives to wholesale dollar issues, including intrafirm dollar transfers, converting domestic currency liabilities into dollar liabilities, or borrowing from central bank dollar liquidity facilities. In addition, issuing dollar debt is cheaper than setting up a U.S. commercial bank subsidiary.

WHY DO WE NEED BOTH LIQUIDITY REGULATIONS AND A LENDER OF LAST RESULT? A PERSPECTIVE FROM FEDERAL RESERVE LENDING DURING THE 2007–09 U.S. FINANCIAL CRISIS

Topic 73

EXAM FOCUS

This topic compares the efficacy of lender of last result (LOLR) solutions to liquidity regulations as a means of managing/stemming liquidity shocks in banks and other systemically important firms. Ultimately, the conclusion is that both are necessary and that the two complement each other. For the exam, understand under which circumstances each is appropriate for managing liquidity concerns and the relative advantages and disadvantages of each. Also, be able to describe how the Federal Reserve responded with LOLR lending during the 2007–2009 financial crisis, including the use of marketwide lending solutions such as the use of the core discount window lending program called the primary credit facility (PCF) and the term auction facility (TAF). Be able to compare that to the Fed's decisions to bail out individual firms such as Bear Stearns and American International Group (AIG), and be able to explain how the existence of a lender of last resort can create moral hazard. Finally, be able to apply the logic discussed in terms of deciding when LOLR solutions are necessary and when LOLR should not be used due to higher credit risk and moral hazard.

INTRODUCTION

During the 2007–2009 financial crisis, the **Federal Reserve (Fed)** used emergency lending facilities to provide liquidity to both depository and non-depository firms. By December 2008, the amount of credit outstanding provided by the Fed peaked at \$1.5 trillion. The magnitude of Fed intervention created significant controversy among regulators, academics, and policymakers about the appropriate role of the Fed. Specifically, policymakers debated the relative value of liquidity regulations versus central bank **lender of last resort (LOLR)** mechanisms to protect financial institutions and the market as a whole. Some argue that Fed lending is in and of itself bad, and that the safety net leads firms to take on more risk than they otherwise would. In other words, LOLR lending produces moral hazard. In addition, some have argued that the Fed was engaged in fiscal policy during the crisis and that the independence of the Federal Reserve was threatened during the period.

Lawmakers have taken steps to prevent future financial crises and have further tried to reduce the need for Fed intervention even if a crisis occurs. The Fed's ability to lend to individual non-bank firms has been eliminated. Additionally, Basel III has established liquidity standards to protect internationally active banks from both short-term and longer-term liquidity emergencies.

LIQUIDITY REGULATIONS VS. LENDER OF LAST RESORT

LO 73.1: Compare the advantages and disadvantages of liquidity regulations and a lender of last resort in managing liquidity and systemic risk during a financial crisis, and identify situations where each is more effective.

There are two general reasons firms face liquidity shortfalls. They are:

1. **Marketwide “pure liquidity” events.** In this case, sound financial institutions face liquidity shortfalls due to market failures. If the Fed does not act as LOLR, these sound firms may be forced to fire-sell illiquid assets, which can ultimately cause formerly sound institutions to fail. In this case, LOLR loans are not costly to the Federal Reserve and do not result in moral hazard.
2. **Troubled institutions cause creditors to pull back.** Institutions facing solvency issues face liquidity shortfalls as lenders reevaluate risks. In this case, LOLR lending should be avoided if possible. In these circumstances it is impossible to correctly price (or eliminate) credit risk, and moral hazard is unavoidable. As such, liquidity and capital regulations should be used to the greatest extent possible instead of loans from the Federal Reserve.

There are advantages associated with Federal Reserve LOLR lending. They include:

- **Liquidity creation for societal good.** The Fed has the power and authority to lend in the face of market failures, resulting in societal good. Central banks are designed to create liquidity when needed. While there is historical evidence that the Fed is sometimes too loose with credit, (e.g., 1950s and 1980s) and sometimes too tight (1960s and 2000s), the established doctrine of LOLR is that in a crisis, the Fed should act quickly and forcefully.
- **Promotes optimal levels of liquidity and maturity transformation.** If last resort lending does not exist, healthy banks will be forced to hold greater liquidity buffers to protect against systemic crises, like the financial crisis of 2007–2009. If banks hold excessive liquid assets, they will lend at suboptimal levels, worsening a liquidity shortage. Optimal levels of liquidity can be maintained if an emergency lending facility exists and banks will not stop lending, even in periods of uncertainty.

There are advantages associated with liquidity regulations as a means of managing liquidity. They include:

- **Tax on liquidity risk.** According to Basel III, banks must hold low yielding, liquid assets in proportion to illiquid assets and off-balance sheet exposures (i.e., in proportion to their liquidity risk). This gives institutions an incentive to minimize the occurrences of liquidity crises.
- **Mitigation of the costs of moral hazard.** Liquidity regulations, combined with regulatory tools, can complement LOLR and mitigate moral hazard issues and other costs that arise from the Fed lending to troubled banks in times of crisis.
- **Can “buy time” for the central bank.** It may be difficult for the central bank to determine why a liquidity event is occurring. Liquidity regulations combined with regulatory oversight can help provide the central bank with sufficient time to determine the nature of the situation and respond appropriately.

The key criticism levied against LOLR is that it is difficult to distinguish between true market liquidity events, which should be managed with LOLR, and solvency problems, which should not. The classical view is that the Fed should provide funds freely to solvent but illiquid institutions. However, at least in the short run it can be difficult to discern the difference between illiquid troubled institutions and illiquid sound institutions. Many academic studies regarding LOLR focus on moral hazard costs, arguing that the costs offset the benefits of the liquidity creation provided by the Fed.

On one extreme is the argument that the Fed should not lend to individual institutions but should only provide liquidity to the market as a whole via open market operations. The opposite extreme argues that the Fed should lend to banks with or without solvency issues, at non-punitive rates, because charging troubled banks penalty rates will only exacerbate the problems the bank already faces and will push the institution toward insolvency. Still others note that moral hazard will not occur as long as the Fed provides liquidity backed by properly valued collateral. Finally, some argue that policies such as constructive ambiguity (i.e., introducing uncertainty such that on an individual basis a bank will not know if it will or will not receive support, allowing the central bank to keep banks more in line) and regulation can mitigate moral hazard.

One of the key issues underlying this discussion is that banks fund long-term assets like mortgage loans with short-term liabilities that can be withdrawn at any point (i.e., runnable liabilities), such as demand deposits, or wholesale funding such as repurchase agreements. Given this mismatch, there are several ways a liquidity crunch can arise from market failures, despite the soundness of institutions. Alternatives are described below.

Marketwide “Pure Liquidity” Situations

1. **“Sunspot” bank runs.** Depositors run for extrinsic, random (i.e., not because of economic fundamentals) reasons, despite the soundness of the institution. In this case, depositors withdraw unneeded funds even though there are no concerns regarding the soundness of the institution. This type of extrinsic, random variable is known as a “sunspot” in economics.
2. **Interbank relationships result in liquidity crunches.** Interbank claims may indicate that a failure of one bank results in a loss of liquidity at another bank in the same network.
3. **Shocks in other markets cause increased demand for bank funds.** In some cases, a liquidity shock in one market, such as the commercial paper market, can increase the demand for bank funds. In addition, customers may draw on lines of credit as a result, resulting in a liquidity crunch at a healthy bank. The interbank market (e.g., the Federal funds market) is generally used to solve these types of liquidity issues. However, if there is an aggregate shortfall, the interbank market will be insufficient to meet liquidity requirements. Banks may also curtail lending if they do not believe they can borrow in the interbank market to meet liquidity needs.

As noted above, in pure liquidity situations LOLR is the best alternative to solve the shortfall. In fact, just the presence of LOLR can theoretically eliminate bank runs, even without actual lending by central banks. Institutions are sound which means moral hazard is not an issue. In addition, the central bank can provide liquidity at a nominal cost to itself.

Credit risk is also of little concern since the institutions themselves are sound. Requiring banks to hold liquidity buffers to handle situations like these is, in essence, an unnecessary tax on banks. The level of liquidity required to protect against these marketwide pure liquidity events is sub-optimal from a societal point of view.

In addition, banks slow lending in these situations and lower levels of lending exacerbate liquidity problems. If banks know that they can borrow when necessary to meet unexpected demands on liquidity, they will continue to lend and will not contribute to economic contractions, defaults, and self-fulfilling downward liquidity spirals. It is necessary though, under this scenario, that the central bank is certain of the solvency of the institution. This means strong capital regulations are critical. The reality is that solvency and liquidity are often linked, especially in periods of stress. In addition, central banks are not necessarily better at pricing credit risk than other market participants and generally over-collateralize loans because they must take only small risks.

Potential Solvency Situations

There are significant costs associated with LOLR liquidity solutions if there is uncertainty regarding the solvency of the institution. These costs include:

- **Credit risk.** The central bank may be taking more credit risk than it would like because the lines between solvent and insolvent institutions can be blurry and the central bank cannot always discern the true risks (and is not necessarily better than the market as a whole at disentangling and understanding risks in this situation).
- **Moral hazard.** In solvency situations, risks are related to liquidity and credit, not just liquidity. Several issues result:
 - ◆ The central banks take more risk than it would prefer to avoid the social costs of potentially avoidable default that may occur because of a loss of liquidity.
 - ◆ The central bank may not be able to eliminate or price the credit risk appropriately.
 - ◆ Short-term creditors will require minimal risk spreads because they understand that they will be repaid (by the central bank) regardless of the true credit risk. This incentivizes institutions to rely more on short-term credit and take on more liquidity risk. The central bank is thus forced to intervene more frequently, and a vicious cycle ensues.

Increasing collateral does not fix the problem. If the central bank takes collateral, it increases the risk to other short-term creditors, as evidenced by the financial crisis. In addition, it can put more pressure on the Federal Deposit Insurance Corporation (FDIC) if central bank lending causes uninsured depositors to leave the problem bank.

In the case of potentially insolvent banks, it appears that the regulation of liquidity is the optimal solution (as opposed to LOLR). Banks do not tend to take into account externalities associated with liquidity crises including the costs of selling illiquid assets at fire sale prices, when deciding on the appropriate amount of liquidity to maintain. Liquidity regulations will help ensure that banks have liquidity buffers in place, commensurate with their liquidity risk profiles. Contagion is another concern. A liquidity shock that is created from fears regarding an institution's solvency may spread to other institutions. LOLR lending may be required to stem the contagion. Thus, a combination of liquidity regulations and LOLR lending appears optimal.

LENDER OF LAST RESORT CREATING MORAL HAZARD

LO 73.2: Explain how the existence of a lender of last resort can create moral hazard.

Moral hazard was discussed in some detail above. In essence, when a bank or other institution believes that the central bank will provide liquidity when needed, regardless of the reason the funds are required (i.e., market forces vs. solvency concerns), the institution will imprudently manage liquidity and also credit risks. The bank will be shielded from the typical costs associated with risky decisions and will have no incentive to act prudently.

Many factors can create moral hazard. Consider the 2007–2009 financial crisis. Some institutions were considered “too-big-to-fail.” In theory, this leads managers of those institutions to make risky decisions because there is no real consequence to their actions; the institutions will not be allowed to fail no matter what they do. There was a similar argument when risk-based deposit insurance was implemented. If all banks pay the same insurance premium, there is an incentive to act in a riskier fashion because deposit insurance is subsidized by less risky institutions. A central bank acting as a lender of last resort has a similar effect; institutions do not have to manage liquidity responsibly because there is an expected “bailout” waiting in the wings if something goes wrong.

CENTRAL BANK LENDING BEFORE LIQUIDITY BUFFERS ARE EXHAUSTED

LO 73.3: Describe situations where a central bank should begin lending to banks before liquidity buffers are exhausted.

Liquidity regulations should not stand in front of LOLR solutions. Banks should not be forced to run down their liquidity reserves before the central bank will lend. If the bank’s liquidity reserves are shrinking due to solvency issues, the Fed should not lend at all due to high credit risk and moral hazard. If, however, the bank is seeing its liquidity reserves decline because of marketwide stresses, the Fed should not wait but should aggressively lend to provide liquidity to the economy before the bank’s liquidity buffers are used up. If liquidity buffers are run down, it diminishes the confidence the market has in the institution, despite the fact that the liquidity problem is not due to solvency concerns but is systemic.

In general, the rule is:

- If the situation is systemic, the Fed should lend immediately, before liquidity buffers have been exhausted.
- If the situation is firm specific and idiosyncratic, it is optimal to run down liquidity buffers and have supervisors intervene when needed. It may be that the intervention occurs to allow for an orderly default, assisted by bank supervisors.

LENDER OF LAST RESORT CHALLENGES AND CONSTRAINTS

LO 73.4: Describe challenges and constraints to a central bank acting as a lender of last resort.

As will be discussed in LO 73.5, the Federal Reserve made loans to Bear Stearns and to American International Group (AIG), both nonbanks, during the financial crisis. The Federal Reserve did not, however, lend to Lehman Brothers during the crisis and the firm failed. The Fed knew that the failure of Lehman would affect the market as a whole, but faced some challenges. First, it had already bailed out Bear Stearns and was afraid that the bailout of another large, nonbank financial institution would create greater moral hazard problems. Second, the Fed could provide short-term funding for liquidity purposes with adequate collateral from the borrower, but Lehman did not have adequate collateral. Lehman needed capital and the Fed was not authorized to provide capital or an unsecured loan; thus, there was no path available to bail out Lehman Brothers. In this case, stronger ex ante liquidity regulations, combined with an orderly resolution mechanism, may have made it possible to at least lessen some of the damage to financial markets that occurred when Lehman failed.

A second challenge to the Fed is related to collateral. If the Fed takes too much collateral, that, in and of itself, can cause a run on a financial institution in times of stress. Had the Fed taken enough collateral to fully protect itself during the crisis, it would have likely done more damage overall as it would have increased risk to remaining stakeholders and investors. Those investors would have pulled capital from banks and the runs would have intensified, so the Fed absorbed some of the risk as a means of halting the runs.

FED LENDING POLICIES AND DECISIONS DURING THE FINANCIAL CRISIS

LO 73.5: Analyze the Federal Reserve's lending policies and lending decisions during the 2007–2009 financial crisis, and describe the effectiveness of each.

PCF and TAF Lending

At the outset of the 2007–2009 financial crisis, there were problems in the commercial paper market and structured financial products markets. Firms drew down lines of credit and banks brought bank loans they had previously securitized back on their balance sheets. These assets needed funding. Banks became disinclined to lend to each other, afraid they would be short funds. Interbank loan rates increased dramatically and maturities shortened as a result.

The Federal Reserve first stepped in with its core discount window lending program called the **primary credit facility (PCF)**. They later introduced the **term auction facility (TAF)**, in December 2007, during the financial crisis. The Fed lowered the spread between the PCF rate and the target fed funds rate from 100 basis points to 50 basis points and then to 25 basis points. The first drop was in August 2007, the second in March 2008. During the same period, terms were extended from overnight to 30 days to 90 days. Because there is a stigma associated with using the PCF (bankers perhaps feared they would be perceived

as unable to borrow in the usual channels at reasonable rates), borrowers avoided it. Term money market rates were much higher than the PCF rate.

TAF was introduced when the financial system was really starting to meltdown, in late 2007. Rates were determined through an auction and funds were distributed a few days following the auction. There did not appear to be a stigma associated with TAF money, perhaps because the institution had to wait a few days before receiving the funds and thus could not be perceived as an imminent danger. In addition, TAF rates were closer to market rates.

The Fed was generally confident about the health of bank borrowers as they were subject to regulation. The Fed was a senior creditor but required borrowers to pledge more collateral than the value of the loan in case senior creditors were not paid back fully in the event of a default. A schedule of haircuts for different types of collateral was published, further protecting the Fed. PCF borrowings peaked in October 2008 at approximately \$110 billion and TAF borrowings peaked in March 2009 at approximately \$495 billion. All PCF and TAF loans were paid back in full, despite the fact that seven of the borrowing banks ultimately failed.

PDCF Lending

The **primary dealer credit facility (PDCF)** was also used to address marketwide pure liquidity emergencies during the financial crisis. The PDCF provided overnight loans to primary dealers. Primary dealers are largely subsidiaries of large financial intermediaries with which the Fed conducts monetary policy, although the Fed did not have supervisory control over the primary dealers themselves. The merger between Bear Stearns and JPMorgan was in the works and there were some liquidity issues regarding other primary dealers in the market. The Fed believed it important to keep this segment of financial markets functioning properly. PDCF loans peaked in October 2008 at about \$146 billion. All loans were paid back on time and with interest. Also, the collateral backing the loans, which was investment grade securities initially, and then broadened a bit later in the crisis, remained above the value of the loans in nearly all cases.

AMLF Lending

The Fed also created the **asset-backed commercial paper money market mutual fund liquidity facility (AMLF)** to allow money market mutual funds (MMMFs) the ability to avoid fire sales to meet the rising tide of redemptions. Loans were provided to banks and other financial institutions that in turn used the funds to buy highly rated asset-backed commercial paper from mutual funds. The loans were collateralized with the purchased assets, were non-recourse, and had no haircuts so banks could realize a positive spread just by participating. Total loans reached a peak in October 2008 of \$152 billion but use of AMLF became sporadic in just a few days once mutual fund redemptions declined. The system worked and alleviated the pressure on MMMFs.

Shortly after, the Fed created the **direct money market mutual fund lending facility (DMLF)** to lend directly to MMMFs. However, mutual funds were reluctant to borrow from the Fed, fearing that investors would recognize that the leverage increased risk for remaining investors, and that they would run. As a result, the fund was never operationalized.

In sum, in the cases of PCF, TAF, PDCF, and AMLF lending, the Fed appears to have made low risk loans that were paid back in full. However, the Fed also made loans to more troubled institutions, discussed below, and while there is evidence that those loans were riskier, in the end the Fed was still paid back in full.

Loans to Troubled and Nonbank Institutions

The first loan to a nonbank financial institution since the 1930s was made to Bear Stearns in March 2008. On March 13, 2008, Bear Stearns informed the Federal Reserve that it would not be able to repay its repurchase agreements (repos) the following day. Policymakers were afraid that if Bear Stearns, one of the largest securities dealers in the U.S., failed, there would be severe disruptions to financial markets. As such, the Fed loaned Bear Stearns \$12.9 billion backed by \$13.8 billion of collateral. JPMorgan (JPM) announced on March 16 that it would acquire Bear Stearns. To aid the merger, the Fed also loaned \$29 billion (a non-recourse loan) to a limited liability corporation (LLC) called Maiden Lane, LLC, to acquire \$30 billion of Bear Stearns' less liquid assets. JPM also loaned Maiden Lane \$1.1 billion in a subordinated loan that would take any early losses.

Additionally, the Fed made a loan to American International Group (AIG) in September 2008. The market was concerned about the solvency of AIG. A run ensued and had the Fed not intervened, a fire sale of assets and bankruptcy were likely. Systemic risk was the concern. The Fed and other government officials were afraid of a massive disruption to financial markets if a systemically important firm like AIG was allowed to fail. The Fed, with the support of the Treasury, gave AIG an \$85 billion line of credit. Eventually the line was reduced and two LLCs, Maiden Lane II and Maiden Lane III, were established. The Fed provided loans to the LLCs to buy AIG's assets. Maiden Lane II purchased illiquid residential mortgage assets and Maiden Lane III bought collateralized debt obligations (CDOs) on which AIG had written credit default swaps (CDSs). The government also received equity participation rights amounting to a 79.9% equity interest in AIG.

In testimony to Congress, Ben Bernanke, Chairman of the Board of Governors of the Federal Reserve, noted that loans were made such that there were significant costs borne by AIG's owners, managers, and creditors, to "mitigate concerns that this action would exacerbate moral hazard and encourage inappropriate risk-taking in the future."

Difference between Broad Market Loans and Individual Loans

The difference between the loans to Bear Stearns and AIG, compared to broader market loans funded via the PCF, TAF, PDCF, and AMLF, is that risks were higher to the Fed when lending to firms where solvency was in question. Some of the factors contributing to the added risk were:

- The loans had to be made quickly, without proper due diligence regarding the solvency of potential borrowers.
- Loans were made to help firms deal with liquidity risks, but underlying those risks were solvency issues.

- In the cases of AIG and Bear Stearns, the firms were nonbanks. The Fed did not have supervisory authority over the companies and were thus less familiar with the firms than they would have been with actual banks. Bear Stearns' oversight was conducted by the Securities and Exchange Commission (SEC), which is primarily concerned with investor protections.
- Lending to Maiden Lane, LLC, a special purpose vehicle that acquired specific Bear Stearns assets, protected JPM by capping potential losses to the subordinated loan it made to Maiden Lane. The balance of the risk was transferred to the special purpose vehicle, and thus to the Fed.
- The loans were non-recourse loans. The collateral backing the loans was the only protection for the Fed. While initially, the value of the collateral was greater than the value of the loans, as the crisis worsened the value of assets fell, sometimes to below the loan value. For instance, at its worst in June 2009, the value of Maiden Lane collateral was \$25 billion while the loan balance was approximately \$29 billion.

As the economy strengthened, asset values increased. By mid-2010, asset values had increased to the point that they exceeded loan values. In the end, despite the higher risk to the Fed relative to marketwide pure liquidity funding, the loans were repaid in full, with interest. But in terms of analyzing the effectiveness of each type of loan (i.e., marketwide pure liquidity lending vs. lending to individual institutions) it appears that marketwide lending is generally less risky and most effective. Having said that, individual lending ended up working in the end and we do not know what would have happened to financial markets if the Fed had not bailed out AIG, Bear Stearns, and others.



Professor's Note: One of the main things the Fed was concerned about during the crisis was keeping institutions from failing in a disorderly fashion. Thus, this topic highlights "orderly resolutions" and the prevention of banks defaulting in a "disorderly fashion." In the event that an institution defaulted, bankruptcy was the only recourse. The Fed believed that bankruptcy would not necessarily lead to an orderly resolution and would add to the stress of an already extremely stressed financial system. This played into Federal Reserve leaders' decisions about whether to act as a lender of last resort, or not, even to nonbank firms like AIG.

MANAGING SYSTEMIC RISK DURING FINANCIAL DOWNTURNS

LO 73.6: Explain how a combination of liquidity regulations and lender of last resort can lead to an optimal policy mix to manage systemic risk during financial downturns.

Based on the discussion above, it appears that the optimal policy regarding liquidity risk management is a combination of liquidity regulations to mitigate moral hazard and LOLR solutions for solvent institutions. The two act as complements to each other. Liquidity regulations are not sufficient by themselves but do reduce instances where the Fed has to act and provides time for the Fed and other supervisors to manage orderly defaults. For example, the **liquidity coverage ratio (LCR)** requires banks to hold enough high-quality liquid assets (HQLA) to cover net cash outflows over the next 30 days (i.e., $HQLA / \text{net cash outflow over next 30 days} \geq 100\%$). The 30-day buffer would allow the Fed time to examine and address the situation.

The central bank is necessary to manage systemic liquidity events, such as the 2007–2009 financial crisis. However, the Fed cannot discern the level of risk and the true nature of the crisis (marketwide or firm specific) in an instance. Liquidity regulations provide breathing room. In the case of the LCR and HQLAs, one could consider lending against those assets (i.e., using the HQLAs as collateral to back a loan from the central bank) as a means of liquidating the assets of firms facing solvency issues, rather than actual LOLR lending. However, when the liquidity shortage is marketwide, the Fed should lend against the least liquid assets, with a suitable haircut to account for risk, to better support the overall market.

There is a balancing act at work with respect to a bank's use of HQLAs. For liquidity regulations to work, banks must be able to use the liquid assets (i.e., sell them) to weather a temporary liquidity situation. However, regulators need to address a situation when an institution is running down their HQLAs. There is a provision that allows the ratio to fall below 100% while policy responses are being ramped up.

Because the regulations address liquidity issues related to solvency concerns, but do not prevent LOLR lending in the event of marketwide liquidity events, liquidity regulations should reduce the stigma attached to borrowing from the central bank. The stigma was noted as a threat to financial stability by the President's Working Group on Financial Markets and the Financial Stability Forum in 2008.

Liquidity crises can lead banks to increase liquid assets to above socially optimal levels and to hoard liquidity. There is evidence that this occurred during the 2007–2009 financial crisis. Banks increased balance sheet liquidity rather than running down their liquidity buffers. This is a case (i.e., a systemic shock) where the Fed should lend aggressively. The Fed should not lend to institutions with solvency issues, however. The Dodd-Frank Act prohibits the Fed from lending to individual, troubled institutions. It requires the central bank to lend only through broad-based facilities, like the PCF and TAF, described earlier.

In general, some of the goals of liquidity regulations and LOLR solutions are to make institutions:

- Less vulnerable to runs.
- Less in need of liquidity support.
- Less likely to engage in fire sales.

There is a link between liquidity and capital regulations. If an institution had a potentially high level of liquidity risk, holding more capital would mitigate the above risks and protect the broader market as well. The Fed has proposed a more direct link—large banks' capital requirements increase with their reliance on short-term wholesale funding.

KEY CONCEPTS

LO 73.1

There are advantages associated with Federal Reserve lender of last resort (LOLR) lending including the creation of liquidity to aid society as a whole and the promotion of optimal levels of liquidity and maturity transformation. LOLR can help stem a liquidity crisis before it worsens, especially if it is the result of marketwide “pure liquidity” factors. Advantages of liquidity regulations to manage liquidity shocks include the mitigation of the costs of moral hazard, the tax on liquidity risk, which gives institutions an incentive to minimize liquidity risk and thus minimizes liquidity crises and the cushion that allows the central bank more time to discern whether the liquidity problem is marketwide or institution specific.

Marketwide “pure liquidity” events may result from random “sunspot” runs on banks, interbank relationships and other shocks that affect the demand for bank funds such as a crisis in the repurchase agreement market increasing the demand for bank funds. These marketwide liquidity events are best managed by LOLR solutions. Bank specific liquidity shocks that result from solvency issues increase credit risk for the Fed if they solve the problem with LOLR lending and create moral hazard. As such, these situations are best solved by liquidity regulations. Even if the bank ultimately fails, higher liquidity requirements initially give the Fed more time to figure out the type of problem and the best solution for resolution and/or an orderly default.

LO 73.2

Moral hazard occurs when one party acts risky because it knows the risk will be borne by someone else. When a bank or other institution believes that the central bank will provide liquidity when needed, regardless of the reason the funds are required, the institution has an incentive to manage liquidity imprudently.

LO 73.3

In general, if the loss of liquidity is a systemic, marketwide liquidity event, the Fed should lend immediately, before liquidity buffers have been exhausted. If instead the situation is firm specific and idiosyncratic, it is optimal to run down liquidity buffers and have supervisors intervene when needed.

LO 73.4

The Federal Reserve has two basic challenges related to LOLR lending in the event of a liquidity crisis. First, it takes time to figure out if the problem is a marketwide pure liquidity event. The Fed should lend quickly and aggressively if it is a systemic problem, but should wait until liquidity buffers are run down before lending if it is a firm specific, related to solvency, event. Second, if the central bank takes too much collateral, in other words, enough collateral to protect it from unknown risks, that, in and of itself, can cause a run on a financial institution in times of stress. Remaining investors will pull their funds out of fear, worsening a crisis.

LO 73.5

The Federal Reserve took two approaches to lending during the 2007–2009 financial crisis. First, they tapped existing and newly created sources that were meant to provide liquidity to the overall market. These sources include the following: (1) the Fed's core discount window lending program called the primary credit facility (PCF); (2) the term auction facility (TAF), which was created during the crisis and did not appear to have a stigma associated with it; (3) the primary dealer credit facility (PDCF), which provided overnight loans to primary dealers; and (4) the asset-backed commercial paper money market mutual fund liquidity facility (AMLF), which was created to help money market mutual funds (MMMFs) avoid fire sales to meet the rising tide of redemptions during the crisis. The second approach involved bailing out individual firms like Bear Stearns and AIG, because the central bank and other government officials were concerned about systemic risk. The Fed did allow Lehman Brothers to fail, in an attempt to stem the rising tide of moral hazard. The Fed was paid back in full on all loans made but it appears that broad market lending programs are generally more effective and less risky than the bailouts of individual firms.

LO 73.6

It appears, based on all of the evidence and arguments, that the optimal policy regarding liquidity risk management is a combination of liquidity regulations to mitigate moral hazard in the market and lender of last resort (LOLR) solutions for solvent institutions. The two mechanisms act as complements to each other. Liquidity regulations are not sufficient by themselves but do reduce instances where the Fed has to act and provide time for the Fed and other supervisors to manage orderly defaults.

CONCEPT CHECKERS

1. One of the key arguments for lender of last resort lending (LOLR) in the face of a liquidity crisis is:
 - A. it eliminates moral hazard.
 - B. banks will not be forced to hold suboptimal levels of liquidity to act as a buffer in the event of a liquidity shock.
 - C. it protects taxpayers because the institution will not fail, and thus, the Federal Deposit Insurance Corporation (FDIC) will not be required to pay.
 - D. banks cannot afford the liquidity tax that results from liquidity regulations and will not have to incur the tax if the central bank acts as a lender of last resort.
2. It is best to run down liquidity buffers before providing lender of last resort funding:
 - A. never.
 - B. always.
 - C. if the liquidity crisis is idiosyncratic.
 - D. if the liquidity crisis is a marketwide pure liquidity event.
3. Which of the following statements is least likely accurate regarding the Federal Reserve's decision to lend or not lend to Lehman Brothers to prevent the firm's failure in 2008?
 - A. The Federal Reserve was concerned about moral hazard.
 - B. Lehman Brothers did not have sufficient collateral to back a loan from the Federal Reserve.
 - C. The Federal Reserve did not have authority to lend to any single institution, regardless of the reason.
 - D. The Federal Reserve did not have authority to provide an unsecured loan to an individual institution.
4. The primary credit facility (PCF):
 - A. is the core discount window lending facility of the Federal Reserve.
 - B. was created to lend longer term funds to nonbank institutions during the financial crisis.
 - C. was never used during the financial crisis because there was stigma associated with borrowing through this mechanism.
 - D. was created to provide overnight loans to primary dealers during the financial crisis.
5. Which of the following statements is least likely a goal of lender of last resort funding by the Federal Reserve?
 - A. To make institutions less likely to have to engage in fire sales of assets.
 - B. To protect the broader economy from potentially disastrous liquidity shocks.
 - C. To make banks less vulnerable to runs on deposits and short-term wholesale funding sources.
 - D. To supplement the federal funds market so that banks are not forced to borrow in non-regulated wholesale funding markets such as the commercial paper and repurchase agreement markets.

CONCEPT CHECKER ANSWERS

1. **B** Having a lender of last resort option can create moral hazard. If individual banks believe the Fed will lend in the event of a liquidity shock, the bank will be less inclined to responsibly manage liquidity and maintain appropriate liquidity buffers to help weather a liquidity crisis. However, without a lender of last resort option, banks will be forced into suboptimally high liquidity buffers to protect against shocks. Also, some argue that the tax is unnecessary but no one makes the argument that “banks cannot afford the liquidity tax” created by liquidity regulations. Thus, a lender of last resort option allows for the creation of liquidity for society as a whole, allowing banks to hold optimal levels of liquidity and engage in maturity transformation.
2. **C** In general, if the liquidity problem is firm specific and idiosyncratic, liquidity buffers should be run down and supervisors intervene only when needed. If the problem is a marketwide pure liquidity event, then the central bank should immediately and aggressively lend, before liquidity buffers are shrunk or exhausted.
3. **C** The Federal Reserve made loans to Bear Stearns and to American International Group (AIG), but not Lehman Brothers, during the financial crisis. The Fed knew that the failure of Lehman would impact the market as a whole, but was afraid that the bailout of another large, nonbank financial institution would create greater moral hazard problems. The Fed could provide short-term funding for liquidity purposes with adequate collateral from the borrower, but Lehman did not have adequate collateral. Lehman needed capital and the Fed was not authorized to provide capital or an unsecured loan, thus there was no path available to bail out Lehman Brothers.
4. **A** The Federal Reserve first stepped in with its core discount window lending program called the primary credit facility (PCF). The Fed later introduced the term auction facility (TAF) in December 2007. There were fewer stigmas associated with TAF than with the PCF, perhaps because the institution was required to wait for a short period before receiving funds from TAF, signaling to the market the firm was not in a dire liquidity situation.
5. **D** In general, some of the goals of liquidity regulations and LOLR solutions are to make institutions less vulnerable to runs, less in need of liquidity support, and less likely to engage in fire sales. Also, LOLR, as noted by Ben Bernanke, former Chairman of the Federal Reserve, is to provide a source of liquidity and stability in financial markets. LOLR is not meant to supplement the Federal funds market and is not meant for routine borrowing by banks.

GLOBAL FINANCIAL MARKETS LIQUIDITY STUDY

Topic 74

EXAM FOCUS

This topic presents a significant amount of factual event information on market liquidity; however, the focus should be on how the events fall into one or more of the general symptoms of a decrease in market liquidity: (1) difficulty in executing trades, (2) decreased depth in financial markets, (3) rises in volatility, and (4) bifurcation of liquidity. For the exam, be able to describe the dimensions of liquidity and explain how liquidity is provided in different financial markets. Also, be able to describe the four broad market factors impacting global liquidity conditions. Finally, obtain a general understanding of the liquidity changes in the nine major segments of the financial markets (without memorizing specific changes).

DIMENSIONS OF LIQUIDITY

LO 74.1: Define liquidity and describe the dimensions by which liquidity can be measured.

Well-functioning financial markets generally have few impediments to trading. These markets tend to have little friction (e.g., taxes and various costs), with low transaction costs and quick trade execution. **Liquidity** can be best described as the ability to execute large trades with limited price impact. This liquidity is critical for financial markets to allow for efficient allocation of capital and risk as well as the dissemination of issuer-specific information.

Existing and proposed regulatory changes internationally have a significant impact in shaping the definitions and dimensions of liquidity. For example, in Europe, the Markets in Financial Instruments Directive II (MiFID II) and the Markets in Financial Instruments Regulation (MiFIR) consider the availability of willing buyers and sellers in the definition of liquid markets by looking at trade frequency and size, spread, and number and type of market participants.

The **bid-ask spread** has historically been regarded as a good measure of market liquidity, especially in quote-driven markets for instruments such as sovereign and corporate bonds. Bid-ask spreads are impacted by the cost of market making, the cost of capital of holding inventories, and operating costs. Given the variability in spreads even for the same financial instrument, coupled with an absence of continuous two-way pricing, bid-ask spreads may be considered less of an indicator of actual liquidity and more of an indicator of how trades are being executed. In addition, bid-ask spreads from liquid instruments may be poor proxies for spreads of less liquid instruments.

The multi-dimensional nature of liquidity is summarized in Figure 1.

Figure 1: Dimensions of Liquidity

<i>Dimensions of Liquidity</i>	<i>Description</i>	<i>Measures</i>
Immediacy	Time to complete a transaction. Market makers act as source of immediacy.	• Number of market participants • Number of market makers • Number of no trading days • Average trade size and frequency • Availability of quotes
Depth and resilience	Frequency of large trades and level of willingness and interest to transact. Deep and resilient markets exhibit lower volatility with lower price impact of larger trades.	• Trading volumes • Inventory holdings by dealers • Price impact • Turnover ratios • Intraday volatility
Breadth	Consistency in distributing liquidity within assets and across markets. Impacted by number of market participants and by segmenting liquidity.	• Segmentation of liquidity • On/off-the-run spreads
Tightness	Cost of completing a transaction.	• Bid-ask spreads
Multi-dimensional	A combination of the above factors. Includes price based measures (volatility) and market impact measures (liquidity risk premiums).	• Liquidity risk premiums • Liquidity scores

Benefits of Liquidity

The primary benefit of market liquidity is that it enables the efficient allocation of economic resources. This can be accomplished through the following ways:

1. Liquidity facilitates global capital flow by increasing productivity growth, and reducing liquidity premiums and issuance costs.
2. Liquidity allocates risks to those willing and able to bear the risks, and allows hedgers and investors to prudently manage risks.
3. Liquidity allows for the effective dissemination of issuer information, including price movements.
4. Financial market liquidity can influence the effectiveness of monetary policy, where higher liquidity risk premiums can hinder policy effectiveness.
5. Liquidity and depth are important for financial stability and maintaining market resiliency, and allow for the effective management of financial risks, including hedging with derivatives.

PROVIDING LIQUIDITY

LO 74.2: Explain how liquidity is provided in different financial markets, including the role of market makers and the economics of market making.

Liquidity in financial markets depends on market trading models, which include: order-driven markets, quote-driven markets, and request for quote markets.

In **order-driven markets**, buyers and sellers display their preferred asset prices and quantities. The exchanges enable participants to trade standardized contracts based on matching supply and demand. Liquidity in these markets tends to be strong given high levels of supply and demand.

In **quote-driven markets**, asset quotes are provided by market makers to market participants. Market makers bear the risk of price movements and therefore provide their own capital to ensure continuous trading, improving market liquidity for both immediacy and depth of trades.

In **request for quote (RFQ) markets**, quotes are provided on request by market makers who provide liquidity and price quotes where there is insufficient buying and selling interest.

The Role of Market Makers

Not all markets are standardized and traded on exchanges. Financial instruments including fixed income and many derivatives are often traded over-the-counter (OTC) in the absence of continuous trading. OTC markets are supported by **market makers** who trade out of their own inventory to offset supply and demand imbalances. Market makers therefore provide liquidity by reducing these imbalances while reducing market volatility and improving price discovery. Market makers are compensated for bearing this risk through both **facilitation revenues** (i.e., fees) and **inventory revenues** (i.e., coupon and dividend payments from assets held). It is important to note that market makers essentially fulfill the role of intermediaries by continuously providing liquidity and quotes. In this regard, they are different than traders, who do not hold inventory positions, and financial firms that conduct proprietary trading, which are largely concerned with trading profit.

Given that primary and secondary markets are strongly interlinked, securities underwritten by market makers also benefit from secondary market liquidity and lower liquidity premiums.

The market maker's decision of whether to enter or exit a particular market depends on the following four factors:

1. *The rate of transactions*: Higher volume of transactions (e.g., investment grade corporate bonds) reduces price volatility, which increases market making activities and fees. A lower rate of transactions (e.g., high-yield bonds) results in lower fee revenues and may force the market maker to hold assets for longer.

2. *Price elasticity of demand*: Low price elasticity of demand implies that transactions are less sensitive to prices dictated by market makers.
3. *Variability of inventory value*: Higher price variability results in higher risk to market makers as inventory price deviates from desired levels, which implies that the transaction risk may outweigh the expected returns.
4. *Risk aversion*: Market makers with higher risk aversion are unlikely to trade particular securities with higher perceived risks.

Liquidity Across Markets and Liquidity Shortages

Liquidity differences across financial assets and markets are driven by a variety of factors, including issuer-specific and instrument-specific characteristics. Issuer-specific characteristics include financial performance, creditworthiness, issuance frequency and volume, and microeconomic factors. Instrument-specific factors include size, maturity, and coupon. The market for sovereign bonds, for example, tends to be more liquid than the market for equities or emerging markets. Markets with lower liquidity typically have higher risk premiums and wider spreads.

The increase in cross-border and foreign currency denominated bonds and loans can create liquidity contagion effects, where liquidity problems in one market can lower liquidity in others. When one market cannot absorb supply and demand imbalances, illiquidity in these markets can lead to higher volatility and costs. This was particularly evident during the U.S. subprime crisis in 2007–2009, when liquidity for short-term funding dried up and created a ripple effect across markets, increasing volatilities and spreads, which worsened liquidity conditions further.

Excess Money Supply

A build-up of liquidity has also been cited as a contributing factor to subsequent market stress. As a result, we need to make a distinction between market liquidity and excess money supply. Market liquidity describes how easily financial instruments can be traded or converted to cash. In contrast, excess money supply (macro liquidity) refers to money created in excess of what is required within an economy. Excess money supply can therefore be detrimental to liquidity, especially in markets which exhibit structural imbalances, including leverage, and may lead to inflation and asset price bubbles. Excess money supply can be moderated through the use of existing monetary policy tools and prudent regulation.

FACTORS IMPACTING MARKET LIQUIDITY

LO 74.3: Describe current global trends and factors which have impacted liquidity in financial markets and explain their liquidity impact.

There are four broad market factors impacting global liquidity conditions:

1. Stable global monetary conditions.
2. Greater electrification and digitalization of financial markets.

3. Growth in the size of financial markets.
4. Weak growth and profitability in the banking sectors.

Stable Global Monetary Conditions

Given a lack of comprehensive global market liquidity measures, U.S. government bond liquidity trends can be used as a proxy for several reasons. First, the U.S. government bond market is important globally and in the dollar repo market. U.S. government bonds are perceived to be default risk-free and therefore represent a proxy for risk-free interest rates. Second, U.S. government bonds represent proxies for analysis and price forecast of other securities internationally. Changes in liquidity in the U.S. government bond sector therefore affect the liquidity of other securities markets.

One measure of liquidity in the U.S. government bond market is looking at the spread between **off-the-run issues** (previously issued) and **on-the-run issues** (most recently issued) 10-year Treasury notes. This spread widened significantly during the financial crisis, capping in 2009 before declining to historical levels in 2013–2014.

Unconventional monetary policy measures, including **quantitative easing** (QE) and large-scale asset purchases also impact market volatility and liquidity. QE is a monetary tool used recently in the United States, United Kingdom, and Eurozone. It involves central banks purchasing financial assets with newly printed money. Asset purchases increase asset prices, encourage trading and portfolio rebalancing by substituting one asset for another, reduce yields and firms' borrowing costs, and in turn increase investor wealth and spending. The increased asset prices result in reduced liquidity risk premiums, which represent a reduction in liquidity risk. QE also has a policy signaling effect to the market of the central bank's commitment to meet inflation targets, leading to increased spending. The net result is a better functioning financial market with improved liquidity.

In the United States, the Federal Reserve used various QE programs between 2008 and late 2014, purchasing bank debt, U.S. agency MBS, and Treasury notes. By November 2014, the Federal Reserve had purchased \$4.5 trillion worth of assets. In the United Kingdom, the Bank of England used QE between March 2009 and July 2012, and its purchases reached GBP375 billion. In the Eurozone, a form of QE is used to combat deflationary risks. The European Central Bank (ECB) began an asset purchasing program in March 2015 that is expected to last until at least September 2016.

As a result of QE, liquidity risk premiums declined to artificially low levels, hiding some of the negative effects on liquidity. The pressures on liquidity arise partly from regulatory changes and performance pressures, which have caused banks to reduce their market making activities. This reduced capacity results in a structural reduction in liquidity which may become more apparent once QE policies are reversed.

Greater Electronification and Digitalization of Financial Markets

As markets move toward electronic and digital platforms, the structure of how securities are traded changes. **Electronic trading platforms (ETPs)**, **high-frequency trading (HFT)**, and **algorithmic trading** offer alternatives to traditional trading venues like exchanges, and

were driven both by the migration of traditionally OTC products to exchanges and centrally cleared platforms, and by the need to offer more cost-effective business models. ETPs and HFT increase trading speed, lower transaction costs, improve transparency, and help pool liquidity through increased interaction among market participants (although the impact on market liquidity of certain asset classes may be limited).

Growth in the Size of Financial Markets

As financial markets grow in size, the issuance of new debt and equity also increase. Newly issued assets increase the size of investable assets, which are increasingly held by institutional investors including pensions, insurance funds, money market funds, sovereign wealth funds, and exchange-traded funds (ETFs). The growth in assets under management (AUM) improves market activity which has a positive impact on liquidity. However, any pressures on market liquidity, including the winding down of QE, will impact secondary market trading, which is essential for investors to easily liquidate assets.

Weak Growth and Profitability in Banking Sectors

Offsetting some of the positive impacts on liquidity, the global banking sector has seen weak growth and profitability. This has been due in part to regulatory pressures which led to reduced returns from market making activities, and in fact resulted in a partial withdrawal from market making. In addition, higher regulatory costs could lead to higher barriers to entry for new participants, negatively affecting market liquidity since this limits the ability of participants to build up sufficient scale to replace banks' market making activities.

LIQUIDITY OF FINANCIAL MARKETS

LO 74.4: Summarize trends over the past 10 years in the volume and liquidity of the following financial markets: interest rates and interest rate derivatives, sovereign bonds, repos, corporate bonds, CDS, securitized products, foreign exchange, equities, and emerging market financial products.

In analyzing interest rate-based financial instruments, the important interest rates to consider are central bank policy rates, interbank rates (e.g., LIBOR, EURIBOR), and government bond yields.

Sovereign Bonds

Because of the wide variety of government bonds and large transaction sizes, market makers are essential in providing liquidity in sovereign bond markets.

After the 2007–2009 financial crisis, many governments greatly increased bond issuances. In the United Kingdom, government bonds are known as gilts. Gilt trading activity increased between 2008 and 2012 but not as much as gilt issuances for the same period, resulting in lower turnover and liquidity. In the United States, trading activity of Treasury bonds was flat between 2008 and 2012 but issuances have increased, thereby having the same end result as in the United Kingdom (i.e., lower turnover and liquidity). Average trade sizes for U.S. Treasury bonds have also decreased by more than 50% since 2010.

It appears that price volatility has increased in general for sovereign bond markets, including in the supposedly more liquid segments. In addition, price impact costs of transacting in sovereign bonds have increased. These factors suggest reduced liquidity.

The median bid-ask spreads for U.K. gilts have been on a declining trend between 2010 and 2015 from over 5 bps to under 5 bps, which suggests increasing liquidity. With U.S. Treasury bills, the spread between off-the-run issues and on-the-run (most recent) issues has decreased significantly since 2009, thereby suggesting high liquidity (i.e., low liquidity risk). Bid-ask spreads for sovereign bonds in Asia have varied for the period; they have risen in some countries but fallen in others.

Overall, sovereign bond markets have demonstrated reductions in liquidity over the past 10 years.

Repos

The repo market is highly connected to the sovereign bond market because of the collateral (e.g., sovereign bond) required to reduce credit risk. The policy rate targeted by central banks, the interbank loan rate, and the short-term government bond yield could all serve as proxies for the short-term repo rate.

The amount of U.S. dollar-denominated repo financing decreased significantly during the crisis between 2007 and 2009 and fell more gradually between 2009 and 2014. A similar decrease was seen in the European and global repo markets as well.

Interbank daily trading volumes in the European repo market have shown significant decreases since the credit crisis and, as of 2013 to 2015, have fallen to below pre-crisis levels.

Between 2010 and 2014, the following trends in terms of nominal values of general collateral financing (GCF) repos submitted for clearing have been noted:

- Gradual declining trend for mortgage-backed securities (MBSs) repos.
- Volatile but declining trend for Treasury-backed repos.
- Gradual declining trend (but slower decline since 2014) for agency-backed repos.

Interest Rate Derivatives

Two common interest rate derivatives are **interest rate swaps (IRSs)** and **short-term interest rate futures (STIRs)**. IRSs and STIRs are usually very standardized and, therefore, more liquid than customized interest rate derivatives. The interest rate derivatives market is generally illiquid in nature so it is necessary for banks to serve as market makers to increase liquidity.

The notional amount of interest rate derivatives has increased by about 13% from December 2011 to June 2014. Although average trading volumes have increased between 2013 and 2014, they have since begun to decrease, especially for forward rate agreements (FRAs). As a result, trading volumes are trailing issuance volumes, thereby resulting in lower turnover ratios and lower liquidity. (Turnover ratios will be discussed later in the corporate bonds section.)

An analysis of the underlying currencies of interest rate derivatives shows that the average daily trading volumes of the dollar-denominated derivatives have maintained their levels throughout 2013 to 2015, thereby suggesting stable liquidity. Meanwhile, trading volumes of interest rate derivatives in other key currencies have decreased, especially for the EUR- and GBP-denominated ones. The overall trend here is a divergence in liquidity among different currencies.

The trend between 2013 and 2015 has been an increase in average daily trading volumes for both cleared and non-cleared interest rate derivatives. The cleared derivatives have had greater growth, thereby suggesting higher liquidity compared to non-cleared derivatives.

Corporate Bonds

Post-crisis, the corporate bond markets overall have seen significantly increased issuance volumes but not the same increase in trading volumes, which suggests an overall decrease in liquidity.

Investment Grade Bonds and High Yield Bonds

In general, corporate bond markets are not as liquid as sovereign bond markets for advanced economies. The average transaction size for government bonds is about 20 times that of corporate bonds. In addition, the differing needs of investors in corporate bonds means that they are more often traded OTC than on exchanges, thereby reducing liquidity. Within the corporate bond market, liquidity differences can be seen in the form of a wide range of trading frequencies between the different bonds. As a result, there is a need for market makers to provide liquidity in the secondary market.

With regard to U.S. investment grade bonds, the average trade size for all trades has remained steady between 2010 and 2014. However, the average trade size for larger trades (e.g., greater than \$1 million) has decreased over the same period. The same trend has occurred in Europe with a very gradual and noticeable drop in average trade size between 2010 and 2015. In Asia, the same trend has been occurring for both corporate and sovereign bonds since 2010. As a result, in the U.S., European, and Asian markets, there are high impact costs involved with large trades that are indicative of lower liquidity.

Trading volumes for U.S. corporate bonds (both investment grade and high yield) have been increasing steadily since 2010 with more rapid increases since 2013. In contrast, the Japanese market has seen an overall decrease in trading volumes of locally denominated bonds between 2008 and 2014. In Europe, the trading volumes of all bonds (especially corporate bonds) have fallen dramatically between 2010 and 2015 together with decreases in average trade sizes.

With the U.S. corporate bonds, the issuance volumes have increased to a greater degree than the trading volumes, resulting in lower turnover ratios (volume traded divided by total value of bonds issued for a given time period) and lower liquidity. Therefore, trading volume alone is not an appropriate measure of liquidity. In examining the turnover ratio, it has been steadily declining since 2010 and is currently below the level it was during the crisis. In contrast, there has not been the same degree of change in some developed Asian markets,

and in fact, Japan has seen a slight increase in turnover in its corporate bond market from 2010 to 2014.

The **Amihud measure of liquidity** looks at price impact as follows:

$$\frac{\text{Daily absolute price change in bps}}{\text{Trading volume}}$$

- These amounts are averaged for each month, and this monthly average can then be plotted across time and compared to annual averages.
- The lower the ratio, the lower the price impact, and the greater the liquidity in the market.

Looking at European corporate bonds between 2010 and 2015, the ratio has dramatically increased (i.e., greater price responsiveness) in times of greater price volatility, which suggests decreased liquidity (or increased illiquidity).

In analyzing trading volumes of U.S. corporate bonds on the basis of credit rating, the relative proportion of investment grade and high yield bonds has not had much change between 2005 and 2014. Within investment grade, the trading volumes of the lower end (e.g., BBB-rated) have increased over the higher end (e.g., A or above). Because lower-rated bonds tend to have fewer market makers, there would be an expected decline in liquidity. The empirical evidence on market makers for both European investment grade and high yield corporate bonds between 2011 and 2014 supports this conclusion (i.e., the number of market makers decreased much more for the lower-rated high yield bonds).

Given the greater diversity of corporate bonds compared to government bonds, an analysis of bid-ask spreads for a sample of European bonds showed spreads of about 100 bps for corporate bonds and about 5 bps for sovereign bonds. After the crisis, both larger and smaller issuances of European corporate bonds experienced large decreases in their bid-ask spreads. There have been some differences noted between the bid-ask spreads of larger versus smaller issuances, thereby suggesting a separation of liquidity within corporate bond markets. Within the international markets, the fall in bid-ask spreads has also occurred with greater impacts for high yield corporate bonds. Within the U.S. markets, the spreads have also decreased since 2009.

The lower bid-ask spreads discussed above should not be immediately interpreted as an increase in overall liquidity. For example, the spreads are very specific for a given trade size at a given time and may not be representative of less commonly traded bonds that may be subject to larger spreads. In addition, changes in business practices such as holding fewer bonds in inventory and making up for the smaller number of bonds by increasing trading volumes may be contributing to the lower spreads.

Credit Default Swaps

Credit derivatives are meant to provide protection against credit risk or to speculate on credit risk. CDSs are the most frequently encountered form of credit derivative. CDS transactions have largely been OTC so the trading frequency and size of transactions may vary considerably. As a result, market makers are crucial to provide liquidity. The use of CDS indices (i.e., standardized features) allows for ease of pricing and trading, thereby

providing ample liquidity. The greatest amount of liquidity is with on-the-run indices with significantly more trading volume than off-the-run indices. With sovereign single-name CDSs, the highest level of trading activity (i.e., liquidity) occurs in instruments with tenors between five and six years.

The CDS market grew dramatically between 2004 and 2007, but since the crisis, the market has generally been declining due to reduced demand and increased regulation. Since 2012, CDS spreads have decreased significantly.

From 2011 to 2015, single-name CDS trading volumes have decreased by about 50% even though the average daily number of transactions only decreased by about 38%. The difference is due to the average sizes of individual transactions (both cleared and non-cleared) becoming smaller over time. Transaction sizes for CDS indices have also become smaller over time. Additionally, the ratio of days for which a single-name CDS does not trade over the total number of days has held steady at about 70% over time.

The number of transactions per day has fallen for both European single-name CDSs between 2011 and 2015 and for CDS indices between 2013 and 2015.

A further indication of a decrease in liquidity is evidenced by an overall decrease in the number of market participants providing CDSs, especially single-name CDSs.

Bid-ask spreads for CDSs in 2009 tended to remain higher than their pre-crisis levels even though there has been a reduction in spreads in most markets, specifically by 1 to 3 bps in European markets between 2009 and 2015. The exception has been in Japan and some Asian markets that have consistently maintained higher spreads.

Compared to single-name CDS, CDS indices are usually more liquid, in part due to their standardized features. The result is wider spreads for single-name CDS and narrower spreads for CDS indices. In Europe, bid-ask spreads on indices usually vary by about 1 bp, but the spreads on the underlying (single-name) CDS vary between 4 and 14 bps.

Overall, the reduction in liquidity in CDS markets is being seen in the form of reduced trading volume.

Securitized Products

The process of securitization involves packaging together a set of illiquid stand-alone assets into a relatively liquid tradable security. Securitized products are traded primarily in the OTC market through market makers. Until 2008, the securitization market was stable in the United States and rapidly growing in Europe in terms of issuances. However, after the crisis, the issuance levels fell dramatically in both markets. As of now, U.S. markets are beginning to recover somewhat, but in European markets, the outstanding amounts of securitized products continue to fall.

Internationally, the primary market for securitizations continues to be relatively illiquid even though most securitization classes have had low defaults. The secondary market has seen its trading volumes either remain stable or decrease in the past few years.

Some trends in average daily volumes in the U.S. markets include:

- *Agency mortgage-backed securities (MBSs)*: decreased from \$321 billion to \$178 billion between 2010 and 2014.
- *Non-agency MBSs*: stable at \$4 billion between 2010 and 2014.
- *Asset-backed securities (ABSs)*: stable at \$1.5 billion between 2011 to April 2014.

Through an analysis of dealer inventory holdings, dealer holdings of residential MBS and commercial MBS have generally remained steady between April 2013 and April 2015. As a result, one could infer that the secondary market liquidity for securitized assets has not changed much in the past two years. There is hope that the liquidity in the market will increase in the future after some key regulatory changes.

Foreign Exchange (FX)

Overall, FX markets have seen decreased liquidity in longer-term forward contracts versus shorter-term contracts.

Spot Markets

Some smaller hedge funds and day traders have declined to participate in FX transactions due to increasing transaction costs, which have decreased overall liquidity in the FX markets. An example of an increasing transaction cost would be the increased margins required for futures transactions involving certain currencies.

Overall trading volumes in FX markets (spot and derivatives) have increased from about a daily average of \$3.3 trillion in 2007 to \$5.3 trillion in 2013. For spot transactions only, the daily average was \$518 billion in 2001 and increased to \$2.5 trillion in 2013.

The increase in FX trading volumes between 2013 and 2015 could be explained by:

- Bank of Japan's monetary policy change in April 2013 that caused high trading volumes in FX (as well as other asset classes).
- Investors' desire for additional return and diversification led to investing in additional asset classes that involved FX.
- Investors seeking higher returns in foreign currencies that had strong returns on their bonds; the bonds are denominated in the local currency of the foreign country.

FX trading volumes are highest in the U.S. dollar, followed in order by the euro and the Japanese yen. The U.S. dollar has retained a relatively stable share of total volume since 1995 while the euro has experienced a 6% decrease between 2010 and 2013.

The average daily FX spot trading volumes in 2013 are as follows:

- Category 1: \$1.2 trillion between reporting dealers and other financial institutions.
- Category 2: \$0.7 trillion of inter-dealer transactions.
- Category 3: \$0.2 trillion between reporting dealers and non-financial customers.

Between 1995 and 2013, the share of trades in Categories 1 and 2 have risen and fallen, respectively for two main reasons:

- The use of prime brokerage agreements to create more FX trading opportunities for hedge funds and other customers.
- FX flows becoming more concentrated within the major banks, thereby allowing them to meet their customers' trade requests with less reliance on inter-dealer transactions.

An analysis of standard deviations of exchange rates for key currencies in 2005, 2008, and 2015 shows that exchange rate volatility has declined since the crisis and in some cases, has fallen below pre-crisis levels. Shock events have resulted in higher levels of intraday volatility, but generally, FX markets tend to rapidly return to equilibrium levels afterward.

FX liquidity changes or movements are often highly correlated between key currencies as demonstrated through an analysis of bid-ask spreads between 2005 and 2015. The spreads tend to be very narrow and within 2 to 6 bps. In general, there was a steady decline in the spreads between 2005 and 2008, followed by a sharp rise to 2009, which was indicative of a tightening of liquidity. Many key currency pairs had spread increases of about 30% between August 2008 and January 2009.

The following post-crisis trends in bid-ask spreads have been noted for select key currencies:

- Stable for the British pound.
- Generally stable for the Euro, although a few instances of increased spreads due to specific events.
- Decreased for the Australian and Canadian dollar.
- Gradual increase to 2012 and then a subsequent decrease to pre-crisis levels for the Japanese yen.
- No post-crisis decline for the Swiss franc and there was even a sharp increase simultaneous with the Swiss franc appreciation (30% against the euro in one day) in January 2015.

Derivatives

FX derivatives include forwards, futures, and swaps. Most of these products are customized, thereby resulting in a heterogeneous market with a wide range of liquidity among the various products.

Trading volumes increased from \$949 billion to \$3.2 trillion between 1995 and 2013. Swaps have consistently been the most popular instrument in terms of trading volumes, followed by forwards and then options.

In 2013, swaps made up about 42% of the total FX transaction volumes in terms of notional amounts. They were followed by spot transactions and then forwards, with forwards consisting of about 13% of transaction volumes.

In terms of the counterparties involved, transactions between reporting dealers and other reporting dealers and between reporting dealers and other financial institutions totaled about 90% of overall trading volumes. Specifically, there was more inter-dealer trading in the swap markets and more trading with other financial institutions in the options and forwards markets.

In looking at turnover, the following have been noted:

- About 50% of total transactions were between reporting dealers.
- About 40% of total transactions were between reporting dealers and other financial institutions (non-reporting banks frequently use FX swaps to meet their funding needs, thereby increasing the volume of transactions in swaps).
- About 10% of total transactions were between reporting dealers and non-financial customers (most notably with forwards and cross-currency interest rate swaps).

In terms of currencies used in the FX derivatives market, the U.S. dollar is clearly the dominant currency. In comparing EUR-USD bid-ask spreads between 2006 and 2014, it appears that longer-term forwards (e.g., one-year) have larger (and widening) spreads compared to shorter-term forwards (e.g., three months) that have smaller (and narrowing) spreads. Such contracts do have higher regulatory capital charges that result in reduced liquidity.

An analysis of other bid-ask spreads between 2007 and 2015 for one-month contracts involving U.S. dollar and the Japanese yen, the Great Britain pound, and the euro have shown slight decreases since 2009 and have hovered near or below pre-crisis levels throughout 2013 to 2015.

Equities

Overall, within the equities market, there has been reduced depth and liquidity over the past 10 years as suggested by reduced trading volumes and transaction amounts.

Large-Cap Equities

Because equities tend to be quite standardized, they are frequently traded on exchanges rather than OTC. Exchanges have designated market makers (DMM) and their existence does increase liquidity. In addition, algorithmic or day traders may also increase liquidity by frequently trading during the day and trading when there are perceived arbitrage opportunities due to mispricing.

The average transaction sizes for equities have decreased as follows:

- Euronext: 55% decrease between 2004 and 2015.
- New York Stock Exchange (NYSE): 14% decrease between 2004 and 2015.
- Hong Kong Stock Exchange (HKSE): 60% decrease between 2007 and 2015.

The average trading volumes for major equity indices such as the DAX 30, FTSE 100, and S&P 500 have decreased by over 40% between 2008 and 2015. There has also been a decline in average trading volumes for off-exchange equities (e.g., 15% decline between April 2014 and April 2015).

Given that equity markets have become less liquid over time, voice broking (speaking to clients directly on the phone) is becoming increasingly favored over electronic broking when it comes to attempting to minimize the market impact of large trades.

It appears that decreasing liquidity has led to smaller transaction sizes and trading volumes, thereby resulting in greater difficulty in executing block trades. That is demonstrated by the

decrease in block trades (e.g., greater than 10,000 shares) in U.S. equity markets from 25% of trading volume in the early 2000s to under 5% in 2012.

We will now slightly modify the Amihud measure of liquidity (discussed previously in the corporate bonds section) to be in the context of *illiquidity*:

$$\frac{\text{Daily absolute stock return}}{\text{Trading volume}}$$

- These amounts are averaged for each month.
- The greater the ratio, the greater the price impact, and the greater the *illiquidity* in the market.

Since 2009, the **Amihud measure of illiquidity** has decreased in all major stock indices with the exception of the DAX 30, which saw an increase in early 2015. It is suggested that high-frequency trading strategies have contributed to the general decrease. Empirical evidence has seen a decrease in the ratio of price responsiveness to execution costs over time although recent years have seen an increase in price responsiveness. Those results are similar to the ones obtained using the Amihud measure.

A measure of liquidity resilience is the **Gabrielsen, Marzo, Zagaglia market efficiency coefficient (MEC)**, which is computed as follows:

$$\frac{\text{Variance of long-term stock returns}}{\text{Variance of short-term stock returns}}$$

The greater the MEC, the greater the illiquidity in the market.

The DAX 30 and the FTSE 100 had high MECs in 2008, which is consistent with the height of illiquidity at that time.

Price volatility is quantified as the standard deviation of equity prices. Price volatility was generally at its highest in late 2008 in most countries. It decreased in subsequent years after the crisis but there was a noted increase in August 2011. Since 2012, volatility has remained stable at pre-crisis levels but there was a clear increase at the end of 2014 and the beginning of 2015. A study has shown that in the United States and United Kingdom, most decreases in equity volatility have occurred close to when central banks made quantitative easing (QE) announcements. One hypothesis here is that QE increases liquidity in equity markets.

The dramatic decreases in trading volumes previously discussed saw some countries experiencing widening spreads, others experiencing little or no spread changes, and others even experiencing negative spreads.

In examining bid-ask spreads for five major equity indices between 2004 and 2014, three of them saw their highest spreads in 2004. There was a decrease in spreads over the 10-year period to near record lows in three cases but in the other two cases, the spreads were near or higher than their 2004 levels.

Mid-Cap Equities

Compared to large-cap equity markets, mid-cap and small-cap equity markets generally have a fewer number of transactions and are not as liquid. DMMs essentially control the liquidity in mid-cap and small-cap markets. For example, the average transaction values for FTSE 100 and FTSE 250 equities declined by over 75% between 2004 and 2009 and have remained relatively stable since 2009.

Significant decreases in trading volume since 2008 in three of five major mid-cap indices may be indicative of decreasing liquidity in the mid-cap equity market. In examining the Amihud illiquidity measure between 2005 and 2015 and changes in trading volume since 2008, Germany experienced high volatility levels together with large drops in trading volume, which is consistent with decreasing liquidity. In contrast, Japan experienced low volatility levels together with high trading volumes, which is consistent with increasing liquidity. However, France experienced both increased volatility levels and trading volume, which do not appear to go hand in hand.

Consistent with large-cap equities, mid-cap equities saw spikes in volatilities in 2008 and 2011 together with subsequent decreases. Data for 2014 and 2015 suggest increasing volatility in European mid-cap equities.

The MEC for mid-cap equities between 2004 and 2015 follows a similar pattern to that of large-cap equities (e.g., spikes in late 2008 and late 2011), although the spikes were not as large. The overall level of volatility in all equity markets has been increasing over time.

Market capitalizations for mid-cap equities have increased substantially since the crisis, thereby indicating increased issuances. There has also been distinct narrowing of the relative bid-ask spreads between large- and mid-cap equities since 2009 partly because the bid-ask spreads for mid-cap equities have decreased (to below pre-crisis levels).

Equity Derivatives

The equity derivatives market can be divided between exchange-traded contracts and over-the-counter (OTC) contracts. Exchange-traded contracts use a central clearinghouse and in general, are much more liquid than OTC contracts.

Trading volumes for exchange-traded equity-linked futures and options have increased more than two-fold since 2009.

Although the equity derivatives market is large, the trading is highly concentrated. For example, the five most commonly traded contracts account for 98% of trading volume and the most popular contract, the Euro Stoxx 50 index futures, accounted for 52% of the trading volume from March 2013 to March 2014.

Emerging Markets (EM)

The EM nations consist primarily of the BRICS (Brazil, Russia, India, China, and South Africa) and the MINT (Mexico, Indonesia, Nigeria, and Turkey).

Overall, EM trading volumes have increased significantly since 2000, hovering around \$200 billion of capital flows between 2000 and 2002 to \$1.1 trillion to almost \$1.4 trillion between 2010 and 2014. Average stock market capitalizations for EM nations have increased from 28% of GDP to 34% of GDP in 2012.

EM issuance volumes have increased much faster than trading volumes in the past few years, reaching a historical high at \$480 billion in 2014. The fact that EM issuance volumes have increased more than trading volumes suggests decreasing market depth and hence, decreased liquidity.

Fixed Income Volume

Total trading volumes have increased from approximately \$2.5 trillion to \$6 trillion between 2000 and 2014; the increase between 2013 and 2014 was 6% from \$5.6 trillion to \$5.9 trillion. Local-currency denominated bonds have increased four-fold between 2000 and 2013 although there is a rising amount of foreign (Euro- and dollar-) denominated debt.

The EM hard currency corporate bond market has increased from \$107 billion in 1994 to \$2 trillion in 2015. It has now exceeded that of the U.S. high yield corporate bond market and is four times as large as Europe's high yield bond market.

Brazil and Mexico are the two largest players and make up a significant portion of the overall EM fixed income trading volumes. Brazil has seen a drop in trading volumes from about \$1.5 trillion in 2005 to about \$1 trillion in 2013. However, it has seen the highest increase in debt issuance in Latin America, followed by a significant increase with Mexico as well. Trading volumes in Mexico fell significantly during the years of the financial crisis and have since risen to about 70% of the pre-2008 amounts.

In Turkey, trading volumes have been relatively unchanged at about \$360 billion since 2008. In India, trading volumes rose significantly in 2010, fell back in 2011 and 2012 to similar levels in 2008 and 2009, and then increased significantly in 2013 to about \$411 billion.

The nations other than the four noted above (Brazil, Mexico, Turkey, and India) made up about 75% of the overall EM trading volume in 2010 but decreased to 70% in 2013.

Fixed Income Liquidity

Overall, there has been a steady reduction in bid-ask spreads between 2005 and 2015, with the exception of some minor periods of volatility. In late 2010 and early 2011, there was a notable rise in Brazil due to an isolated political/economic issue.

However, an examination of the consolidated turnover ratios (approximated as volume traded divided by volume issued) for Brazil, Mexico, Turkey, and India between 2005 and 2014 show falling turnover ratios for both sovereign and corporate bonds. That suggests decreased market depth. There has been a significant decrease in the turnover ratio from 3.1 in 2005 to 0.8 in 2014 for sovereign bonds. Specifically between 2010 and 2014, the trading volume increased by 8.5% and the issuance volume decreased by 0.7%. Overall, this suggests an inability to maintain trading volumes compared to issued volumes. For

corporate bonds, the turnover ratio has decreased from 0.2 in 2005 to 0.1 in 2014. Specifically, between 2010 and 2014, the trading volume only increased by 9% although the issuance volume increased by 16%.

Within the Asian EMs, there was a steady increase in the turnover ratios between 2001 and 2012 (up to about 0.8 for sovereign bonds and up to about 0.45 for corporate bonds). However, since 2012, corporate bond turnover ratios have decreased to 2003 levels and sovereign bond turnover ratios have fallen from approximately 0.8 to 0.5.

Equities Volume and Liquidity

EM equity issuances have risen significantly since 2001 and have shown a steady increase from 2008 to 2014 to about \$102 billion. Capital flows have seen a huge increase from \$157 billion to \$656 billion between 2000 and 2014.

Similar to equities in developed equity markets, there is evidence of segmentation. For example, specific EM equities are considered highly liquid based on high daily trading volumes while others are considered less liquid based on low daily trading volumes. Compared to developed markets, EM equity markets are far less liquid. An analysis of the bid-ask spreads in market indices in Brazil, Mexico, India, and Turkey show steady declines in the spreads between 2005 and 2013 (with the exception of a spike in 2009 during the crisis). However, since 2013, there has been an upward trend in the spreads.

Trading volumes in EM equity markets reached a peak in 2008 and then dropped dramatically between 2008 and 2009 during the crisis. The volumes have since increased and maintained stable levels.

The CBOE Emerging Markets ETF Volatility Index Options shows a steady drop in volatility since 2011 that is very similar to the price volatility of the main EM equity indices.

Foreign Exchange Volume and Liquidity

EM currency trading volumes (daily average OTC) have increased from \$625 billion in 2007 to slightly over \$1 trillion in 2013. The Russian ruble, Chinese yuan, Hong Kong dollar, and Mexican peso are the key currencies and make up 40% of EM foreign currency trading volumes.

Bid-ask spreads between a selection of advanced economy currencies (e.g., United States, Canada, Euro, Switzerland, Sweden, and Australia) and EM currencies showed spreads of about 17 bps in 2015 that steadily declined to zero by about 2009/2010. In some cases, between 2010 and 2013 the EM currencies traded at negative spreads (i.e., more liquid and less risky).

Exchange rate volatility for a selection of EM currencies increased significantly during the crisis in 2009 but declined quickly afterward. However, there were some brief but significant spikes in 2011 and 2012 and especially at the end of 2014 and especially for the Russian ruble. Overall, the generally low level of volatility is indicative of a good level of liquidity in the EM currencies.

KEY CONCEPTS

LO 74.1

Liquidity can be best described as the ability to execute large trades with limited price impact. Dimensions of liquidity include immediacy, depth and resilience, breadth, tightness, and multi-dimensional aspects.

Benefits of liquidity include facilitating global capital flows, allocating risks to those willing and able to bear them, effectively disseminating issuer information, improving the effectiveness of monetary policy, and improving financial stability and market resiliency.

LO 74.2

The provision of liquidity in financial markets depends on whether the market is order driven (exchanges, standardized), quote driven (market makers), or request for quote (market makers).

Market makers trade out of their own inventory and reduce supply/demand imbalances, reduce market volatility, and improve price discovery. The entry or exit of a market maker in a market depends on the rate of transactions, price elasticity of demand, variability of inventory value, and market maker risk aversion.

Liquidity differences across financial assets and markets are driven by issuer-specific characteristics (financial performance, creditworthiness, issuance frequency and volume, microeconomic factors) and instrument-specific factors (size, maturity, coupon). Increased international trading and lending can create liquidity contagion effects.

Market liquidity, which is the ease of trading financial instruments, should be distinguished from excess money supply, which is money created in excess of what is required within an economy and which can be detrimental to liquidity.

LO 74.3

The four broad market factors impacting global liquidity conditions include stable global monetary conditions, greater electronification and digitalization of financial markets, increased size of financial markets, and weak growth and profitability in the banking sector.

LO 74.4

Sovereign bond markets have demonstrated overall reductions in liquidity over time with lower turnover and higher price impact costs.

The amount of repo financing has decreased in all markets globally. In addition, interbank daily trading volumes and nominal values of general collateral financing repos submitted for clearing have been declining.

Interest rate derivatives have seen some changes in the breadth of liquidity as demonstrated through bifurcation through various currencies and between cleared and non-cleared derivatives.

Post-crisis, corporate bond markets have seen significantly increased issuance volumes but not the same increase in trading volumes, which suggests an overall decrease in liquidity.

Credit default swaps (CDSs) have seen an overall reduction in liquidity most often in the form of reduced trading volume, reduced transactions, and reduced number of market participants providing CDSs.

Securitized products have seen dramatic drops in issuance levels since the crisis. Secondary markets for securitized products have seen stable or reducing trading volumes since the crisis. Overall, liquidity has declined further since the crisis, although there are hopes of liquidity improvements after some key regulatory changes.

Foreign exchange markets have seen decreased liquidity in longer-term forward contracts versus shorter-term contracts.

Equity markets have seen reduced trading volumes and transaction amounts over the years, which suggests reductions in depth and liquidity.

Emerging markets have seen increasing trading volumes that have not kept pace with issuance volumes, thereby resulting in lower turnover ratios and lower liquidity over the last several years.

CONCEPT CHECKERS

- Which of the following dimensions of liquidity is best described as the cost of completing a transaction?
 - Breadth.
 - Depth and resilience.
 - Immediacy.
 - Tightness.
- Brendan Fehr is an economist at a policy think tank. In his latest research report, Fehr notes that excess money supply may contribute to inflation and asset price bubbles. He further notes that in order to moderate excess money supply, newly created monetary policy tools are needed. With regard to these statements, is Fehr correct or incorrect?

	<u>Effects of excess money supply</u>	<u>Moderating excess money supply</u>
A.	Correct	Incorrect
B.	Incorrect	Correct
C.	Correct	Correct
D.	Incorrect	Incorrect
- A research report on the performance of the banking sector noted that market liquidity is negatively affected by a decline in banks’ market making activities. The report also noted that market liquidity is positively affected by an increase in the barriers to entry for new participants to the banking sector. Regarding market making activities and barriers to entry, is the research report correct or incorrect?

	<u>Market making activities</u>	<u>Barriers to entry</u>
A.	Incorrect	Correct
B.	Correct	Incorrect
C.	Incorrect	Correct
D.	Correct	Incorrect
- Which of the following statements regarding trends in the volume and liquidity of foreign exchange (FX) markets is correct?
 - Overall trading volumes in FX markets have remained stable between 2007 and 2013.
 - Forward contracts make up the largest share of FX transaction volumes in terms of notional amounts.
 - FX markets have seen increased liquidity in longer-term forward contracts versus shorter-term contracts.
 - There is more inter-dealer trading in the FX swap markets and more trading with other financial institutions in the FX options and forward markets.

5. Which of the following statements regarding trends in the volume and liquidity of corporate bond markets is correct?
- A. The average transaction size for corporate bonds is greater than that of government bonds.
 - B. Lower bid-ask spreads within the U.S. corporate bond market should be interpreted as a sign of an increase in overall liquidity.
 - C. Within the U.S. corporate bond market, the relative proportion of investment grade and high yield bonds has remained stable over time.
 - D. The U.S. corporate bond market has seen higher trading volumes compared to issuance volumes, thereby resulting in lower turnover ratios and liquidity.

CONCEPT CHECKER ANSWERS

1. D Tightness is described as the cost of completing a transaction. Response A is not correct because breadth is described as the consistency in distributing liquidity within assets and across markets. Response B is not correct because depth and resilience is described as the frequency of large trades and level of willingness and interest to transact. Response C is not correct because immediacy is described as the time to complete a transaction.
2. A Fehr's first statement on the effects of excess money supply is correct. His second statement on moderating excess money supply is incorrect, because excess money supply can be moderated through the use of existing monetary policy tools and prudential regulation.
3. B The research report is correct with regard to its comment on market making activities. Its comment on barriers to entry however is incorrect, because higher barriers to entry negatively impact liquidity since this limits the ability of participants to build up sufficient scale to replace banks' market making activities.
4. D There is more inter-dealer trading in the FX swap markets and more trading with other financial institutions in the FX options and forward markets. Response A is not correct because overall trading volumes in FX markets have *increased* from a daily average of \$3.3 trillion to \$5.3 trillion. Response B is not correct because *swaps* make up the largest share of FX transaction volumes in terms of notional amounts. Response C is not correct because FX markets have seen *decreased* liquidity in longer-term forward contracts versus shorter-term contracts.
5. C Within the U.S. corporate bond market, the relative proportion of investment-grade and high-yield bonds has remained stable over time. Response A is not correct because the average transaction size for corporate bonds is *smaller* than that of government bonds. In fact, the average transaction size for government bonds is about 20 times that of corporate bonds. Response B is not correct because lower bid-ask spreads within the U.S. corporate bond market should *not* be interpreted as a sign of an increase in overall liquidity. The spreads are very specific for a given trade size at a given time. In addition, changes in business practices that result in increasing trading volumes may be contributing to the *lower* spreads. Response D is not correct because the U.S. corporate bond market has seen lower trading volumes compared to issuance volumes, thereby resulting in lower turnover ratios and liquidity.

REFORMING LIBOR AND OTHER FINANCIAL MARKET BENCHMARKS

Topic 75

EXAM FOCUS

This topic explores the disadvantages of LIBOR as an interest rate benchmark in the wake of the LIBOR manipulation scandal that came to light in 2008. For the exam, understand why benchmarks are important and where LIBOR falls short as an interest rate benchmark. Be able to explain agglomeration around LIBOR. Also, be able to discuss why so many transactions are now linked to LIBOR, despite the fact that it is easily manipulated due to the way it is measured, submissions by banks regarding their borrowing rates, and the fact that it contains a bank credit spread component. In that light, understand where LIBOR makes sense as a benchmark, primarily in the loan market, and where it may not, primarily in interest rate derivatives contracts. Be able to explain the incentives for manipulating a benchmark rate. Finally, explain the advantages and disadvantages of the four alternative benchmarks suggested for pure rate trading applications such as interest rate swaps.

BENCHMARK RATES

LO 75.1: Discuss the recommended principles to make benchmark rates such as LIBOR and other interbank offered rates less susceptible to manipulation.

The **London Interbank Offered Rate (LIBOR)** is the rate at which large banks can borrow from each other. Loans are short-term and unsecured. In the early 1980s, there was a boom in interest rate swaps, currency options, and related instruments. The market needed a uniform benchmark with which to reference these instruments. LIBOR had been created by a group of British banks in 1969, but liquidity in LIBOR-linked contracts was established in the 1980s and LIBOR became the official benchmark of the British Bankers Association in 1984. Many types of consumer and commercial loans are priced at a spread to LIBOR.

In 2008, it was reported that there was widespread manipulation of LIBOR. Unlike the commercial paper rate, which is determined by the supply and demand for funds (i.e., from transactions), LIBOR is determined by a poll of a group of banks. Banks are asked to estimate the rate they are actually paying or would expect to pay to borrow from other banks at specific maturities. Banks have incentives to manipulate rates. They include:

- Depending on the position, trading positions can be more profitable if LIBOR is pushed up or pushed down, relative to bank borrowing rates.
- Lower rates made polled banks appear more creditworthy during the 2007–2009 financial crisis.

Following the scandal, the Financial Stability Board commissioned two reports, asking academics and other market participants to recommend ways to make benchmark rates such as LIBOR, EURIBOR (Euro Interbank Offered Rate), and TIBOR (Tokyo Interbank Offered Rate) less susceptible to manipulation. The conclusions of the reports are based on recommended principles, which are:

1. **Base benchmark rates on transactions.** While this seems obvious and has been recommended previously by policy groups, it is difficult to implement. The “I” in the IBORs stands for “interbank.” It is the rate at which banks borrow and lend from and to each other from overnight to one year. However, this market is thin. There are few actual transactions, especially at longer maturities like the three month and six month maturities to which many other rates are referenced. The recommended fix for the “thinness” problem is to base the IBOR rates on a wider range of short-term, unsecured bank-borrowing transactions such as wholesale (i.e., jumbo) certificates of deposit (CDs) and commercial paper issued by banks to bank and nonbank investors.
2. **Alternative benchmark rates.** It is highly recommended that alternative benchmarks be used. Initially the IBORs were meant to measure bank borrowing costs and the spread between short-term bank credit and the risk-free rate. Over time, the benchmarks have been increasingly used for interest rate derivatives transactions—transactions intended to transfer risk. The IBOR markets are highly liquid and can accommodate very large derivatives positions. Traders with large positions can profit from even miniscule (i.e., one basis point or 0.01%) distortions in LIBOR. While alternative benchmarks like Treasury bills are desirable, it will be difficult to convince market participants to switch. Policymakers may have to steer market participants to IBOR alternative benchmarks.

USING BENCHMARKS

LO 75.2: Evaluate the implications, advantages, and disadvantages of using benchmarks.

There are several advantages and some disadvantages to traders and other market participants when using benchmarks such as LIBOR. They include:

- **Reduction of information asymmetries.** Benchmarks reduce asymmetric information between trading partners. For example, if two parties enter a forward contract for gold, the payment at the settlement date will depend on the spot price of gold. An independently determined gold benchmark assists in the settlement of the contract. Otherwise, the parties will disagree about the spot price and will go to more expensive lengths to settle, such as requiring the physical delivery of gold, or simply will not enter the contract in the first place due to information asymmetries. If there is a benchmark and one of the counterparties also plays a role in fixing the benchmark, there are significant incentives to manipulate. The resulting moral hazard may lead to reduced participation or a market breakdown.
- **Reduction of search costs.** For example, consider a retail certificate of deposit (CD) customer depositing funds at a bank. A benchmark interest rate increases transparency and allows the customer some confidence that the rate is competitive without the need to search nearby banks for alternative CD rates. Before LIBOR, banks quoted variable rate loans at a spread to the prime rate. However, each bank sets its own prime rate and while rates should be close across banks, experienced borrowers understood the advantages of shopping around for the best rate.

- **Better trade execution.** Counterparties can easily verify that a trade is made at a correct price if a benchmark exists. For example, if a party plans to sell euros and a broker indicates they can get \$1.1500 per euro, it substantiates the agent's claim if an independent benchmark values the euro at \$1.1498. Without a benchmark, the client may think the agent is dishonest and the deal may not be executed as a result. Less sophisticated investors are more likely to delegate trading to agents and thus benefit substantially from the existence of a benchmark.
- **Mitigates adverse selection costs.** If a bank wants to hedge its borrowing costs, it may find it difficult to identify a counterparty because the bank has private information regarding its true credit risk. Counterparties know this and, in attempt to avoid adverse selection, may decline to enter a contract based on the bank's future credit spread. If hedging contracts can be linked to marketwide credit spreads, rather than bank specific spreads, the bank may be more likely to find a counterparty willing to enter the contract.



Professor's Note: There is a tradeoff between the profits a firm can earn from potentially mispriced contracts (e.g., the CD in the above example) and the increased volume of trade that results from the confidence inspired by independently verified prices and/or rates. It was a group of British banks that first introduced LIBOR in 1969 as a way to attract outside borrowers. Independently verified rates are important to foreign borrowers and lenders.

AGGLOMERATION EFFECTS

LO 75.3: Assess the types of agglomeration effects after a benchmark has been established.

Agglomeration is a term used in economics that, in its simplest form, means a large group or collection of different things. It is often used to describe how businesses locate to the same area, such as car manufacturers in Detroit or technology firms in Silicon Valley. In this context, agglomeration means that the establishment of a benchmark results in the attraction of related trades using the benchmark. There are two primary forces that drive the agglomeration effect. They are:

1. **Information-related benefits.** The information-related benefits we described above include lower search costs, a reduction in information asymmetries, reduced adverse selection, greater market participation, better trade execution, and more efficient matching of counterparties. In general, a benchmark leads to lower costs associated with moral hazard. Market participants shift trading to take advantage of these benefits. For example, a foreign exchange trade may optimally be executed at 5:00 p.m. London time (i.e., 5:00 p.m. is the “best-fit-for-purpose” time) but may shift to a 4:00 p.m. execution time because the WM/Reuters benchmark has a 4:00 p.m. fixing time. This allows the firm to take advantage of the information related benefits associated with the benchmark, compared to making a non-benchmark trade.
2. **Reducing trading costs associated with illiquidity.** Lower bid-ask spreads, lower search costs, faster execution, and lower price impacts are generally associated with high volume trading. These benefits associated with liquidity drive the agglomeration of trades to an established benchmark. Traders will substitute less actively-traded instruments for those instruments that reference the benchmark.

MOTIVES FOR MANIPULATING BENCHMARKS

LO 75.4: Explain the motives for manipulating benchmarks and describe the processes to alleviate manipulation.

Motives for manipulating LIBOR include:

- **Appearing as creditworthy as the competition.** During the 2007–2009 financial crisis, banks were concerned about rising borrowing costs and, in the extreme, bank runs. Bank managers did not want their banks to appear less creditworthy than their competitors and thus, when polled, started “low-balling” their estimated borrowing rates. Academic studies conducted in the years following the crisis uniformly find a persistent, downward bias in LIBOR relative to actual bank borrowing rates during the crisis.
- **Profits on derivatives contracts are linked to LIBOR.** If a bank has an interest rate swap (or some other derivatives contract) linked to LIBOR, it will have an incentive to see LIBOR higher or lower, depending on the obligation of the contract. For example, a bank receiving the variable rate in a plain vanilla interest rate swap will prefer a high rate while the bank paying the variable rate will prefer a low rate. Some traders asked bankers who provide estimated borrowing rates to the poll to bias their submissions. In some cases, the distortions were even more significant due to collusion among banks that coordinate their efforts to misreport borrowing rates. While incentives to manipulate LIBOR are clear in the context of the financial crisis, manipulation occurred well before that. One trader told the *Financial Times* that manipulation had been occurring at least since 1991. Emails from traders asking banks to “fix” LIBOR at a rate beneficial to their derivatives positions, dating back to 2005 and 2006, emerged during the investigation of the LIBOR manipulation scandal. The term “fix” refers to the actual LIBOR announcement on a given day.

Tighter monitoring and regulation of benchmarks such as LIBOR could help mitigate manipulation. This is especially important for benchmarks like LIBOR that are set by judgments rather than by transactions. However, the benchmark would still be vulnerable to manipulation because the market is thin (i.e., there are few actual transactions). The best solution would be to create a benchmark based on a large volume of transactions, rather than on the judgments of individuals. This would make the benchmark much more difficult to manipulate. This could be at least partially achieved by:

- Broadening the set of instruments used.
- Widening the time window over which rates/prices are averaged to calculate the benchmark.

There is a tradeoff associated with broadening the set of instruments used to set a benchmark. The benchmark will likely be less easily manipulated, but may also be less useful to market participants as it will be less specific. As an extreme example, assume the instruments used to set an interest rate benchmark varied from 1-month to 30-year maturities. The benchmark would be difficult to manipulate due to the extremely large number of transactions available, but it is not very useful to those needing a short-term, long-term, or really any specific term reference rate for contracts. Data can be strategically weighted to produce a fixing that effectively trades off between the incentives to manipulate the benchmark and the measurement errors created by over broadening the set of instruments used to fix the benchmark.

U.S. DOLLAR LIBOR

LO 75.5: Describe how the US dollar LIBOR is used and identify the costs associated with the increase in trading of LIBOR-linked contracts.

LIBOR is calculated in five currencies: U.S. dollars, yen, euros, British pounds, and Swiss francs. Loans, securitizations, and derivatives contracts use LIBOR (and the other IBORs) as a reference rate. The issues are similar across the different currencies, but for simplification, this LO focuses on U.S. dollar LIBOR.

An examination of various dollar-denominated loans and derivatives contracts that use LIBOR as a reference rate reveals that the one-month and three-month LIBOR rates are the most commonly used. Trillions of dollars of loans and derivatives, both over-the-counter (OTC) and exchange-traded, are linked to LIBOR. Of the \$3.4 trillion of syndicated bank loans, 97% use LIBOR as the reference rate. Between 30% and 50% of corporate and non-corporate business loans and commercial real estate loans reference LIBOR. Credit card loans, auto loans, and consumer loans rarely reference LIBOR, and 7% of student loans use LIBOR as a reference rate. Eighty four percent of floating rate bonds reference the one- or three-month LIBOR and 60% of OTC interest rate and cross-currency derivatives, 82% of interest rate futures, and 98% of interest rate options reference LIBOR. The notional value of OTC interest rate swaps alone is nearly \$107 trillion, 65% of which are linked to LIBOR.

Costs Associated with LIBOR-based Contracts

The use of LIBOR as a reference rate in commercial lending makes sense. Embedded in LIBOR is an element of bank credit risk. Thus, when a bank makes a commercial real estate loan and funds the loan with short-term, unsecured wholesale funding, the bank's cost of funds will move with the general level of interest rates but also with changes in bank credit spreads. Compare this to referencing a variable rate loan to a Treasury bill. If the bank uses a three-month T-bill as a reference, it would only be protecting against rate changes tied to the risk-free rate. During the 2007–2009 financial crisis, bank credit spreads widened. Banks with loans tied to T-bills saw net interest margins narrow because the reference rate did not increase as bank credit risk increased. T-bill rates fell as LIBOR rates increased several percentage points during the period.

In contrast, using LIBOR as the reference rate for many currency and interest rate derivatives makes less sense as there is likely little or no exposure to bank credit spreads. However, liquidity trumps the inconvenience of hedging with an instrument that contains a bank credit spread component. This discussion also relates back to the tradeoff between manipulability versus relevance. LIBOR is relevant to bank lending, even if the rate, as measured today, is easily manipulated. There is also a deep, LIBOR-based derivatives market (i.e., highly liquid), which trumps manipulation and the lack of relevance and inconvenience of a benchmark that has an embedded bank credit spread.

Thus, there are two distinct costs associated with the agglomeration around LIBOR as a benchmark for loans, for which LIBOR is suited, and for interest rate derivatives, for which LIBOR is less suited. They are:

1. **LIBOR is not ideal for most derivatives contracts.** LIBOR is the dominant benchmark in the industry, so even if traders prefer another benchmark that does not have a bank credit risk component (i.e., one fit for the purposes), it will be difficult to move the market to an alternative such as Treasury bills.
2. **Derivatives trading activity dwarfs the primary market.** In many instances of the manipulation case, rates were under- or overstated by only a few basis points. However, traders who had accumulated large derivatives positions linked to LIBOR profited heavily from even miniscule differences. The scale of the two markets, derivatives versus the primary market from which LIBOR stems, does not match. Because the derivatives market is so enormous (i.e., hundreds of trillions of dollars), tiny rate changes can mean huge gains or losses. As a result, there is a real incentive to manipulate the benchmark rate.

LIBOR REFORM

LO 75.6: Explain and assess some proposed methodologies to reform LIBOR.

The **two-rate approach** is one possibility for reforming LIBOR. In it, there would still be a LIBOR like benchmark, but based on transactions rather than bank submissions. It would also be subject to greater oversight to deter manipulation. This benchmark would capture movements in overall interest rates and bank credit risk. The second benchmark, also based on transactions, would be better suited to many interest rate derivatives contracts in the sense that it would not include a bank credit risk component. It would be based on riskless securities like Treasury bills and would have a wide-ranging, deep market. Three questions must be addressed to make a two-rate approach a reality. They are:

1. How do we redesign LIBOR to make it transactions-based?
2. Which riskless rate should be used for the second benchmark?
3. How do policymakers break the lock that LIBOR has and make way for a second benchmark, useful for pure-rates trading purposes (e.g., many interest rate swaps, futures, and options)?

Designing LIBOR+

The new LIBOR, called LIBOR+ here, must be transactions-based. If the fixing methodology can be completely algorithmic, it will also eliminate the potential for banks to withdraw from LIBOR panels, fearing legal repercussions. In fact, the number of EURIBOR reporting banks has dropped from a high of 44 to 26 banks in 2014. Finding sufficient transactions is not easy however. For example, the loose monetary policy of the last several years has flooded banks with reserves, cutting down on the need to borrow from other banks. Banks borrow less from each other during periods of stress as well. Thus, transactions are scarce and can be uneven across time. As an example, from 2011 to 2014, the average number of transactions at the three-month tenor was 25–30 per day and

totaled around \$1 billion. However, on some days the number was a mere three to eight transactions. Transactions are fewer for longer maturities and for yen and Swiss francs. One possibility is to broaden the definition of a transaction to borrowings from all wholesale sources (e.g., commercial paper and jumbo CDs).

The Market Participants Group, established by the Financial Stability Board to consider reforms to major interest rate benchmarks, developed a LIBOR+ algorithm. In essence, available transactions are entered with a weight of one into the index. If no transaction is available on a particular day, the rate of the last available transaction is entered, with a lower weight reflecting the staleness of the data. When comparing LIBOR+ to actual LIBOR, it is clear that LIBOR+ is more volatile on a day-to-day basis, but reasonably close on one-month and three-month maturities. The measure performs poorly at the six-month maturity, underrepresenting the true cost of bank borrowing. This is in part due to a sample selection bias. In stress periods, only the most creditworthy banks are able to borrow at longer maturities.

The goal of the Group is to eventually capture all CD and commercial paper transactions as well. However, even if the algorithm works from an economic perspective, it is not clear that it will work legally. There could be a rash of litigation from counterparties of existing contracts (called legacy contracts) that reference LIBOR if the market moves from LIBOR to LIBOR+.

The Riskless Rate

Bank borrowing at the three-month tenor is roughly \$1 billion per day. However, the gross notional value of interest rate swaps that reference LIBOR is around \$100 trillion, or 100,000 times larger. This implies that the interbank borrowing rate is a mismatch, both due to scale and due to the bank credit risk component discussed earlier. This mismatch of scale encourages manipulation, even if LIBOR moves from judgment-based to transaction-based. Traders could aggressively borrow or lend, or get someone else to borrow or lend, to attempt to move rates one way or the other. As such, the benchmark should possibly move away from LIBOR or LIBOR+ to a risk-free rate. Possibilities include:

1. **A rate set by the central bank.** The Federal Reserve sets the rate it pays banks on excess reserves. It also sets the overnight reverse repo rate, the rate the Fed pays market participants to borrow against its holdings of government securities. One of these rates could be used as a benchmark. The rates cannot be manipulated by the market but are used in monetary policy, so they may not be appealing to some market participants as a benchmark. Also, many contracts are referenced to the three-month LIBOR, so an overnight rate may not be attractive for settling some floating rate contracts.
2. **Treasury bill rates.** The T-bill market is deeper and more active than the interbank loan market. Also, the Fed began issuing floating interest rate notes linked to 13-week T-bills in January 2014. This floating rate note market boosts liquidity. However, a poll by the Market Participants Group revealed little enthusiasm for the T-bill as a benchmark, in part because of the “flight to safety” during periods of stress. T-bill rates were generally lower than the overnight indexed swap (OIS) rate, another proxy for the risk-free rate, during the 2007–2009 financial crisis. This concern may be exaggerated however. During the period between December 2001 and July 2013, the correlation between the OIS rate and T-bill rates was 0.995 in levels and 0.560 in weekly changes.

3. **General collateral repurchase agreement (repo) rates.** These repos are signed without specifying a security. The repos are backed by the general class of Treasury and related securities. It is the rate on overnight borrowings secured by Treasury securities. The market is highly liquid; approximately \$590 billion is financed daily in this manner, and thus is not likely to be manipulated. Like the T-bill rate, this rate falls in stress periods. Also, because of the short maturity, one day, there is no averaging of volatility as you would see with a three-month T-bill rate. Additionally, the market is thin at maturities greater than one week. One proposed possibility to counteract these problems is to calculate a three-month lagged general collateral repo rate.
4. **Overnight indexed swap (OIS) rate.** The OIS rate pays a predetermined fixed rate in exchange for the compounded daily federal funds rate over the three-month terms of the contract. It is a forward looking rate, unlike the general collateral repo rate, which is backward looking. It is a proxy for a risk-free rate and does not have the “safe haven” disadvantage of Treasury bills. One disadvantage is that the market is thin, approximately \$30 billion per day in notional volume, with approximately 31 U.S. dollar transactions per day, based on a study using data from June to August 2010. Thus, it has one of the key disadvantages of the benchmark it is meant to replace.

None of these alternatives are perfect for all situations, but they each have some advantages relative to LIBOR.

KEY CONCEPTS

LO 75.1

There are two main recommendations for making interest rate benchmarks such as LIBOR less susceptible to manipulation. They are:

1. Base benchmark rates on transactions rather than on submissions by banks regarding their borrowing rates or their expected borrowing rates. This is difficult to implement. There are few interbank transactions, especially at longer maturities. The recommended fix for the “thinness” problem is to base the IBOR rates (i.e., LIBOR, EURIBOR, and TIBOR) on a wider range of short-term, unsecured bank-borrowing transactions such as wholesale (i.e., jumbo) CDs and commercial paper issued by banks to bank and nonbank investors.
2. Another option is to consider alternative benchmark rates such as Treasury bills or the overnight indexed swap rate. Policymakers highly recommend that alternative benchmarks be used in place of, or in addition to, LIBOR.

LO 75.2

There are several advantages that result when traders and other market participants use benchmark interest rates such as LIBOR. Reliable benchmarks reduce information asymmetries, reduce search costs, create better trade executions, and mitigate the costs of adverse selection.

LO 75.3

Agglomeration is an economics term that is often used to describe how businesses locate to the same area, such as car manufacturers in Detroit. In the context of interest rate benchmarks, agglomeration means that the establishment of a benchmark results in the attraction of related trades to the benchmark. There are two primary forces that drive the agglomeration effect. They are: (1) information-related benefits such as reduced search costs and reduced information asymmetries and (2) reducing trading costs associated with illiquidity including lower bid-ask spreads and faster executions that are generally associated with high volume trading.

LO 75.4

Because LIBOR is based on submissions by banks regarding borrowing costs, rather than on transactions, it is easily manipulated. There are two primary motives for manipulating LIBOR. First, banks do not want to appear less creditworthy than their competitors and thus have an incentive to “low ball” their estimated borrowing rates. This motive is especially present in times of financial stress, like the 2007–2009 financial crisis. Second, profits on trillions of dollars of derivatives contracts are linked to LIBOR. Because the size of positions is so large, even tiny moves in the rate one way or the other can result in significant profits (or losses). As such, traders have an incentive to encourage banks to under- or overestimate their borrowing costs when submitting reports.

LO 75.5

One-month and three-month LIBOR rates are most commonly used as reference rates for trillions of dollars of loans and derivatives. The notional value of OTC interest rate swaps alone is nearly \$107 trillion, 65% of which is linked to LIBOR.

It appears that there are two distinct costs associated with the agglomeration around LIBOR as a benchmark for loans, for which LIBOR is suited, and for interest rate derivatives, for which LIBOR is less suited. They are:

1. LIBOR is not ideal for most derivatives contracts because LIBOR has a bank credit risk component. Despite this mismatch, it will be difficult to move the market to an alternative benchmark such as Treasury bills because the market is “set” on LIBOR.
 2. Derivatives trading activity dwarfs the primary market. Traders who have accumulated large derivatives positions linked to LIBOR profit heavily from even miniscule differences in the rates. This also provides the motive for manipulating LIBOR.
-

LO 75.6

The two-rate approach is one possibility for reforming LIBOR. In it, there would still be a LIBOR-like benchmark, but based on transactions rather than bank submissions. This benchmark would capture movements in overall interest rates and bank credit risk. The second benchmark, also based on transactions, would be better suited to many interest rate derivatives contracts in the sense that it would not include a bank credit risk component. It would be based on riskless securities, like Treasury bills, and would have a wide-ranging, deep market.

There are four suggested possibilities for a riskless rate that could be used as the second benchmark. They are: (1) a rate set by the central bank such as the rate the Federal Reserve pays banks on excess reserves or the overnight reverse repo rate, the rate the Fed pays market participants to borrow against its holdings of government securities; (2) Treasury bill rates; (3) general collateral repurchase agreement (repo) rates which are the rates on repos that are backed by the general class of Treasury and related securities; or (4) the overnight indexed swap (OIS) rate.

CONCEPT CHECKERS

1. Alan Braverman, a commercial real estate investor, is considering the purchase of a piece of property to develop. In the past, Braverman has been forced to interview several banks regarding loan rates because they all priced loans at a spread to the prime rate. For this latest investment, Braverman decided to use a bank that prices commercial real estate loans at a spread to LIBOR. He doesn't visit any additional banks because:
 - A. the LIBOR related loan will have better trade execution.
 - B. the bank uses a benchmark rate rather than a rate set by each individual bank as its reference rate.
 - C. regulations require all banks to use LIBOR as a reference rate for commercial real estate loans so every bank will now price at a spread over LIBOR.
 - D. adverse selection costs are reduced when a bank references a benchmark rate rather than a Treasury bill rate or prime rate.
2. After the widespread adoption of LIBOR in the 1980s, trillions of dollars of loans and derivatives positions referenced LIBOR in contracts. In many cases, such as interest rate swap contracts, LIBOR is not the best fit as a reference rate, yet it is still used. This "piling on" LIBOR is referred to as:
 - A. accumulation.
 - B. best fit for purpose.
 - C. agglomeration.
 - D. the cluster effect.
3. Barry English, a New York based interest rate swap trader, has developed a relationship with a LIBOR "submitter" while attending industry conferences over the last several years. He has, on a few occasions, asked the banker to "make the 3-month rate as low as possible at this fixing." English's likely motive for trying to manipulate LIBOR is to:
 - A. make his firm's borrowing costs look as low as possible.
 - B. profit on a swap from the lower LIBOR rate.
 - C. reference LIBOR in more contracts if he determines he can control the rate to some extent.
 - D. push LIBOR in the direction of the 3-month Treasury bill rate in order to profit from the convergence of the two rates.
4. LIBOR is used as the reference rate in approximately what percentage of syndicated loans in the United States?
 - A. A negligible amount—Treasury bills are used as reference rates for U.S. loans.
 - B. Approximately 50%.
 - C. Approximately 72%.
 - D. Approximately 97%.

5. What is a disadvantage of using the overnight indexed swap (OIS) rate as a riskless benchmark rate if a two-rate regime is adopted?
- A. There is significantly more risk embedded in the OIS rate relative to other alternatives such as Treasury bills.
 - B. The rate is easily manipulated.
 - C. There is no bank credit spread component of the OIS, making it unacceptable to use in interest rate swap contracts.
 - D. Trading is thin, making it similar to LIBOR in terms of the scale of transactions in the potential benchmark versus the scale of derivatives positions.

CONCEPT CHECKER ANSWERS

1. **B** Braverman's search costs are reduced because the bank is using a benchmark rate to price the loan. A benchmark interest rate increases transparency and allows the customer some confidence that the rate is competitive without the need to search nearby banks for alternative rates. Before LIBOR, banks quoted variable rate loans at a spread to "prime." However, each bank sets its own prime rate and while the rates should be close across banks, experienced borrowers, like Braverman, understood the advantages of shopping around for the best rate. He no longer needs to shop around, at least in terms of the loan's reference rate.
2. **C** Agglomeration is a term used in economics that, in its simplest form, means a large group or collection of different things. It is often used to describe how businesses locate to the same area. Here, agglomeration means that the establishment of a benchmark resulted in the attraction of related trades to the benchmark.
3. **B** One of the primary motives for manipulating LIBOR is to profit on derivatives contracts linked to LIBOR. If a bank has an interest rate swap (or some other derivatives contract) linked to LIBOR, it will have an incentive to see LIBOR higher or lower, depending on the obligation of the contract. Because of the scale of derivatives positions relative to the primary market that sets LIBOR, small manipulations can mean very large profits for derivatives traders.
4. **D** Trillions of dollars of loans and derivatives, both over-the-counter (OTC) and exchange traded, are linked to LIBOR. Of the \$3.4 trillion of syndicated bank loans, 97% use LIBOR as the reference rate. Between 30% and 50% of corporate and non-corporate business loans and commercial real estate loans reference LIBOR.
5. **D** The overnight indexed swap (OIS) rate has been proposed as a possible riskless rate if a two-rate regime is adopted. The OIS rate pays a predetermined fixed rate in exchange for the compounded daily federal funds rate over the three-month terms of the contract. However, one disadvantage is that the market is thin—approximately \$30 billion per day in notional volume, and approximately 31 U.S. dollar transactions per day, based on a study using data from June to August, 2010. Thus, it has one of the key disadvantages of LIBOR, the benchmark it is meant to replace.

CENTRAL COUNTERPARTIES: ADDRESSING THEIR TOO IMPORTANT TO FAIL NATURE

Topic 76

EXAM FOCUS

This topic discusses the interconnections of central counterparties (CCPs) with other CCPs, global systemically important banks (G-SIBs), financial institutions, and financial markets. These connections can act as channels for contagion losses and increase systemic risks. For the exam, be able to discuss these connections as well as existing policy measures. Also, understand the systemic risks that still exist for CCPs related to loss sharing provisions of the loss waterfall, reliance on a few commercial banks for services, market volatility risks of simultaneous collateral sales for multiple CCPs, and diverging priorities for authorities in different countries. In addition, be able to explain proposed measures designed to decrease the impact of international interconnections and interdependencies for CCPs by strengthening international standards, analyzing and supervising network connections, providing a common approach for central bank services, and providing a direct link for CCPs to a central securities depository.

BENEFITS OF CENTRAL COUNTERPARTIES

LO 76.1: Describe the benefits of central counterparties (CCPs) and the potential risks which can arise when clearing through a CCP.

A central counterparty (CCP) is an entity whose primary function is to clear all transactions of a market. The CCP provides a central location for settling and valuing derivatives transactions. The financial crisis of 2007–2009 demonstrated the benefits of a multilateral netting market through the CCPs' ability to efficiently restore markets in the short term following the default of large financial institutions. However, the long-term impacts and systemic risks of the CCP structure are unknown. Both the benefits and risks of the CCP framework must be considered.

The CCP framework mitigates counterparty and systemic risks, increases operating efficiencies, and provides trading and transparency benefits. The CCP acted as a *firewall* stopping systemic risk during the financial crisis of 2007–2009. Systemic risk refers to the “domino effect” where the failure of a large financial institution leads to severe financial problems for other financial intermediaries and the market. The **multilateral netting** feature is an important benefit that the CCP framework provides through improved risk management. In a multilateral netting market, the CCP settles all contracts with its members. Multilateral netting also *mitigates counterparty risk* and eliminates the need for members to monitor the creditworthiness of other members. Credit risk exposures are covered with high quality collateral and CCP member participant margins. In the event a CCP member defaults, the CCP is responsible for the loss mutualization process where

excess losses beyond the defaulted member's margins and reserves are absorbed by the CCP and the surviving members. This process acts as a firewall to reduce systemic risk as losses are shared through a network of members.

Multilateral netting also provides *operational efficiency* by lowering margin costs and reducing the number of settlement positions required in the event a member defaults. The multilateral netting also provides *trading benefits* through enhanced market *liquidity* as asset values are set daily for computing variation margins. In addition to increasing liquidity, the process of daily valuation greatly improves trading efficiency by reducing transaction spreads. The CCP has access to private information of its members. The counterparties to the trade are anonymous, which keeps the information private but also allows the CCP to gather the information for regulatory reporting purposes. Thus, the process of daily valuation also greatly enhances the *transparency* of the market.

While the CCP structure provides many advantages, there are also costs associated with central clearing. There is concern that in the long run if a CCP defaults, the result could be severe national and global systemic problems. The default of a CCP would immediately impact clearing member participants and linked CCPs. The direct costs of a CCP structure are membership costs in the form of membership fees, collateral, and operational costs. Collateral and margin requirements can be very high for participating members. Members may also have costs if another member defaults and uses the default fund contributions of all clearing members of the CCP.

To protect clearing members and increase the CCP's probability of survival, a CCP requires daily and intraday variable margin calls. However, daily variable margin calls could create additional liquidity strains for a member when liquidity is needed most. Furthermore, the advantages of loss sharing can potentially lead to moral hazard and adverse selection as more creditworthy members pay higher costs for less creditworthy member's actions. There is also less incentive for end users to monitor the creditworthiness of the members knowing their position will be transferred in the event of a default. Finally, in the event a CCP fails, it could freeze the market. Trading may halt because CCP members and linked CCPs rely on the CCP to settle transactions and provide liquidity in a financial crisis. Thus, the advantages of the CCP can lead to undesirable consequences in the event the CCP fails.

Benefits of a CCP framework include:

- Multilateral netting reduces total credit exposures in a market.
- CCP framework creates a firewall of protection that helps mitigate systemic risk in the event of a crisis through loss sharing and loss waterfall systems.
- Operational efficiency is created by reducing the number of transactions for settlement and more direct processing through the multilateral netting.
- Trading efficiencies are enhanced through increased liquidity, anonymous trading, and reduced transaction spreads.
- Transparency is produced by gathering private information in a central location for regulatory reporting.

Costs of a CCP framework include:

- Systemic risk may increase due to risk concentration if a CCP fails resulting in a liquidity crisis and market failure.
- High participation costs exist in the form of collateral, margins, membership fees, and operational costs.

INTERCONNECTIONS BETWEEN CCPs AND OTHER FINANCIAL INSTITUTIONS

LO 76.2: Explain the interconnections between central counterparties and other financial institutions, including banks, clearing members, financial markets, and other CCPs.

A CCP reduces counterparty risk and the reliance on interconnections between large financial institutions. The CCP provides settlement and guarantees on all transactions in the market for all participating members. This multilateral netting provides a firewall of protection in a crisis. Conversely, new connections are created with the multilateral netting that can lead to a contagion effect. If one CCP fails and it is interconnected with multiple CCPs, this could lead to the contagion effect of all CCPs failing.

The degree to which CCPs are interconnected with other CCPs and financial institutions is an important determinant in the level of systemic risk. A small CCP servicing participants on a national level is a much smaller concern than a large CCP that is linked to other financial institutions and global CCPs. Greater global connections lead to higher global systemic risks. The interconnections of CCPs to other CCPs and financial institutions are potential channels for spreading contagion.

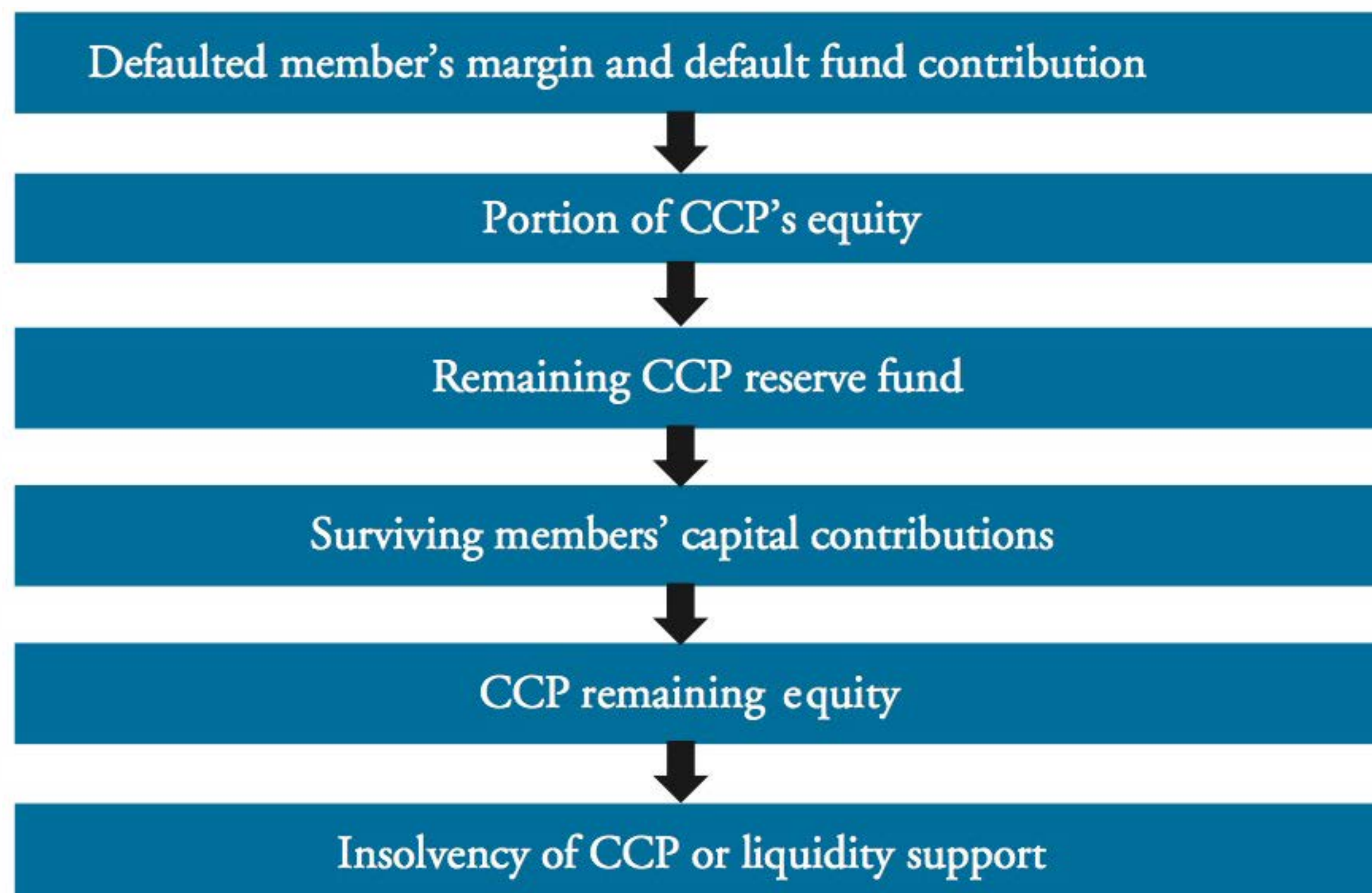
Interconnections with Clearing Members through Loss Waterfall

The CCP structure has a loss waterfall (i.e., a risk waterfall) that defines how losses are absorbed in the event a CCP member defaults. The loss waterfall is the plan of action that is designed to contain losses and help the market recover. Layers of protection in the form of collateral, margin, and equity make up the firewall of protection. As illustrated by Figure 1, losses are first absorbed by the defaulted member's initial and variation margins. Thus, the CCP structure is designed with the intent that a defaulting member covers its own losses. Increasing margin calls for members introduces added liquidity stress for the troubled member.

If margins are not sufficient to cover the losses, the defaulted member's default reserve fund contribution is used. In theory, the initial and variation margins of the defaulting member should cover the defaulted positions. However, as the CCP is exposed to the position for a longer period of time, the margins and default member's default reserve fund contributions may not be sufficient.

If the defaulted member is unable to pay for the losses, the next steps of the loss waterfall are then used to cover losses. The first step beyond the defaulter involves the CCP covering losses with CCP equity in the form of current annual profits. Next the remaining reserve funds from surviving member contributions are used. Events where losses are beyond the reserve funds capacity are predicted to be highly unlikely. However, if such an event occurs, then surviving members are required to provide additional support to the CCP. In order to reduce the impact of moral hazard, this additional required support is capped. Beyond this point, the CCP uses any of its remaining equity to cover losses. Without liquidity support from a central bank, the CCP will become insolvent if its remaining equity is not sufficient to cover the losses.

Figure 1: CCP Loss Waterfall in the Event of Member Default



Interconnections with Other CCPs

The margin calls of a CCP can increase the liquidity strains for members and reduce the probability that the CCP survives. Connections to other CCPs are then used when the loss waterfall is not sufficient to contain losses. The loss sharing arrangements with other CCPs can lead to a contagion effect as losses spread to interconnected CCPs and members. The loss sharing arrangements are intended to increase the probability that a CCP survives. Other CCPs and their members increase the probability a troubled CCP survives, while incurring contingent liabilities that may lead to their own failure. If the loss sharing arrangements include unlimited assessment calls, then the members of connected CCPs are exposed to unlimited losses.

Interconnections with Large Global Financial Institutions

The risks are even greater with greater reliance on **global systemically important banks** (G-SIBs). G-SIBs provide clearing, settlement, liquidity, and custodial services to the market. A G-SIB can provide clearing through a CCP for market participants that are not members of the CCP network. G-SIBs are large financial institutions that provide liquidity through credit lines for CCPs, hold deposits, and provide settlement services for CCPs. In addition, in the event of a default of a CCP member, the G-SIB may provide liquidity and take over the position of the defaulted member.

G-SIBs that fulfill multiple roles in the market are potentially exposed to severe stress in a financial crisis. In a financial crisis, difficulties in their own operations will be increased as they are contacted by interconnected CCPs that require liquidity and have defaulted members that require support in the settlement of defaulted positions. If a G-SIB struggles, CCPs may lose access to credit lines and liquidity. The contagion spread of losses caused by the interconnected relationships of CCPs increases systemic risk.

If a G-SIB is unable to provide liquidity during a financial crisis this could lead to default of the CCP. Clearing members would not have access to collateral, margins, or any remaining excess default fund contributions for an extended amount of time. Thus, the reliance on a G-SIB that fails will increase the liquidity crisis for all non-defaulting members in the network.

Interconnections with Financial Markets



Professor's Note: The term procyclicality refers to the change in a CCP's risk management procedures that are directly correlated to equity markets, credit markets, and business cycles.

Procyclicality of margin calls, increased collateral requirements, reduced collateral values, and market trade interruptions are all concerns that stem from the interconnections of CCPs with financial markets. In order to survive a financial crisis, a CCP will increase margin calls on a member that is at risk of default. Margin calls and collateral are increased at a time when the market is stressed, collateral values are falling, and market volatility is increased. A CCP may be forced to sell collateral following the default of a member. If a large G-SIB fails, it would impact multiple CCPs that clear through it and may simultaneously need to liquidate collateral. As the supply of collateral in the market from multiple CCPs increases, prices will fall substantially due to the lack of liquidity and market uncertainty.

Market trading will also be disrupted for CCPs who clear through a G-SIB that fails. The CCP will not be able to accept any trades or clear and settle transactions. The inability to trade causes even greater liquidity stress that could lead to more members defaulting. The halt in trading would also have adverse consequences for participants who use the market to hedge positions.

CCP FAILURES

LO 76.3: Explain how the failure of a CCP can spread systemic risk to other financial markets or institutions.

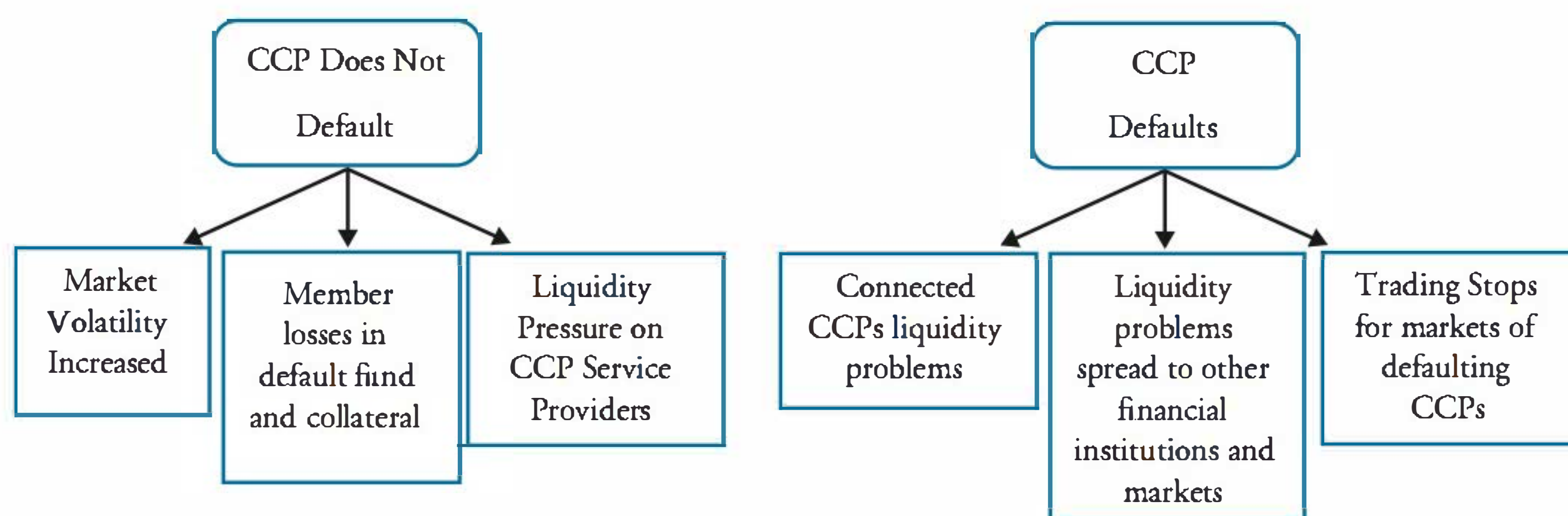
The interconnected links of a CCP to other CCPs, financial institutions, and CCP members can provide channels to contagion. Linking CCPs together has advantages of providing clearing services for non-member entities and sharing of losses to prevent the failure of a CCP. Conversely, if a CCP fails, these links could spread losses to other CCPs and their members and markets. CCPs often make contributions to a CCP default fund. If a CCP defaults, the connected CCPs will bear the loss of default fund contributions. Additional liquidity strains will also occur for linked CCPs who will not receive payments or have access to collateral from the CCP in default.

Payments for CCP transactions are often settled through payment systems of large central banks. The infrastructure of financial markets is set up with CCPs making securities transactions in central securities depositories. Thus, a default of a CCP will quickly impact other CCPs who are unable to settle transactions. The **contagion effect** will create a liquidity crisis and increase systemic risk within one country and globally, if a G-SIB is

involved. Thus, default in a CCP can lead to a domino effect where a chain reaction of losses leads to the default of multiple CCPs.

The left-hand side of Figure 2 illustrates that if the CCP manages default then the firewall stands in place and mitigates systemic risk by not spreading the losses directly to linked CCPs and financial institutions. There is a very low probability that a CCP will default, but it is possible. The right-hand side of Figure 2 illustrates that if the CCP defaults then in addition to the CCP member losses, connected CCPs and financial institutions and markets will also be impacted. The liquidity problems will spread to connected CCPs as they share in the losses of the defaulted CCP. The contagion effects are much greater if the CCP defaults.

Figure 2: Contagion Effects when a CCP Survives or Defaults



Contagion effects still occur when the CCP does not default. For example, contagion effects may spread to CCP members if risk management practices of a CCP trying to survive create a liquidity crisis by increasing margin calls for members and forcing collateral sales at stressed prices. The accuracy of stress tests and loss waterfall factors are important determinants in increasing the probability that the CCP survives and mitigates systemic risk.

The default of a G-SIB that clears transactions for multiple CCPs globally is the worst possible scenario. If the G-SIB was a key service provider for the CCPs, the problem would be even more severe. Default of a G-SIB would spread contagion to multiple markets and dramatically increase market volatility. Increased volatility would make it even more difficult for surviving CCPs to collateralize and value positions. Downward pressure on collateral prices would lead to large losses for CCPs and their members.

Furthermore, in the event of a global financial crisis, authorities from different countries may not agree on how to prioritize and coordinate corrective actions. Local jurisdictions may first seek the stabilization of their own local financial systems. For example, government securities could be used as collateral. If the creditworthiness of that government and banking system decreases, it would require increases in collateral for those government securities. This could lead to additional margin calls. In order to maintain global financial stability, coordination across global authorities is necessary.

Examining cleared volumes is a proxy to determine the degree of interconnectedness of CCPs. Data from 2013 reveals that over 99% of the daily average value of transactions in the over-the-counter (OTC) derivatives market is cleared by five CCPs. These top five CCPs

are LCH.Clearnet Group (U.K), Chicago Mercantile Exchange (CME) Group (U.S.), ICE Clear Credit (U.S.), Japan Securities Clearing Corporation (JSCC) (Japan), and ICE Clear Europe (U.K.).

In addition, the top five CCPs in the exchange-traded derivatives and equity markets clear 59% and 78% of all transactions for CCPs, respectively. Several large CCPs are considered too important to fail (TITF) because of the global market disruptions that would occur if they failed. For example, LCH.Clearnet, CME, and JSCC operate in the OTC derivatives market, and the exchange-traded derivatives and equity markets, making them TITF. The amount of cleared volumes for other large CCPs is also increasing.

To make matters even worse, there are a number of for-profit CCPs that may not have the same risk management standards in the loss waterfall. Higher collateral reserves and margins for CCP members may be viewed as too costly. Thus, the probability of default of these for-profit CCPs could be higher. The CME, LCH.Clearnet, and JSCC are all for-profit CCPs that are considered to be TITF.

Reducing the Probability and Impact of CCP Failures

LO 76.4: Identify policy measures designed to reduce the probability or impact of potential CCP failures, and describe limitations to these measures.

In order to maintain the benefits of CCPs, global authorities have identified policy measures to help mitigate systemic risks. Policy measures are first designed to decrease the probability that a CCP will fail. Second, resolution frameworks are identified to reduce the impact of a CCP failure. These policy measures primarily include increased requirements for CCPs and a clear recovery plan in the event of a CCP failure. Incentive programs in the form of reduced capital requirements are designed to help encourage CCPs and members to comply with strengthened requirements.

Currently, jurisdictions and CCPs are in the process of implementing increased standards known as Principles for Financial Market Infrastructures (P-FMI) developed in 2012 by the Committee on Payment and Settlement Systems of the International Organization of Securities Commissions (CPSS-IOSCO). These international standards outline new guidelines for CCPs that help address interconnectedness of CCPs and large financial institutions. P-FMI set forth new regulatory governance and calculation requirements for margins, stress tests, and liquidity risk. In addition, CCPs must regularly report on risks that are related to relationships with connected CCPs and financial institutions who are key service providers. As a further precaution to understand the degree of interconnectedness, CCPs can only use custody, liquidity, and settlement services from entities that are regularly supervised. However, global interconnectedness is not currently addressed and requirements are somewhat subject to interpretation.

The CPSS-IOSCO is also in the process of recovery and resolution planning designed to help CCPs maintain critical operations in a crisis. This recovery planning is intended to create a last line of defense prior to resolution and increase CCPs' understanding of risks. Unfortunately, these recovery plans are not currently addressing the degrees of interconnections of members and other CCPs. Thus, these recovery plans that incorporate loss sharing arrangements may lead to substantial losses for other entities.

The United States Dodd-Frank Act identifies central bank emergency liquidity assistance to help CCPs maintain stability in a financial crisis. The Bank of England is in the early stages of developing emergency liquidity guidelines as well. There are currently no consistent international guidelines for emergency liquidity. In order to keep markets operating in crisis environments, an emergency liquidity source is necessary. An additional concern for authorities is related moral hazard that results from the knowledge of the availability of emergency liquidity.

Another important area for policy measures is related to capital requirements. Capital requirements for CCP member banks are significantly lower for participation in a network with a “qualified” CCP. Capital requirements for banks help reduce the probability of a CCP failure and provide an added buffer in the event a CCP fails.

Policy measures are divided into two groups. The first group of measures is designed to decrease the probability of a failure and the second group of measures is designed to lessen the impact of a CCP failure.

1. Policy measures designed to *decrease the probability of a CCP failure* are:

- Increased regulation and standards for CCPs (P-FMI).
- Recovery planning as last line of defense in a crisis.
- Emergency liquidity available through a central bank.
- Bank capital requirements to cover CCP exposures.

2. Policy measures designed to *reduce the impact of a CCP failure* are:

- Resolution planning.
- Bank capital requirements to cover CCP exposures.

While these policy measures are important, many of them do not address the concerns that arise from the degree of interconnectedness of CCPs with other important entities. The following limitations of policy measures are still current concerns:

- In an attempt to survive, a CCP may increase margin calls and collateral haircuts. These actions and loss sharing arrangements may lead to contagion for surviving members, connected CCPs, and financial institutions.
- CCPs rely on only a few commercial banks as contracted service providers to fulfill liquidity, custody, settlement, and other services. Dependence on a small number of banks increases systemic risk and the risk the markets will shut down.
- If multiple CCPs liquidate collateral in a crisis, market volatility would increase. This risk is even greater if a G-SIB fails, impacting multiple CCPs and global markets.
- In a global financial crisis, authorities from different countries may have conflicting interests and fail to effectively coordinate recovery efforts.

MEASURES FOR MITIGATING SYSTEMIC RISKS

LO 76.5: Explain measures which can be adopted to mitigate systemic risks related to interconnections and interdependence of CCPs.

Four types of measures are proposed to mitigate systemic risk by reducing the interconnections and interdependence of CCPs. These four measures are: strengthen international standards, strengthen regulation and supervision, create a common global

central bank approach, and establish direct relationships between central securities depositories and CCPs.

Strengthen International Standards

There are several ways to strengthen international standards to reduce the interconnections and interdependencies of CCPs. CCPs should periodically report interconnections and interdependencies with other CCPs, financial institutions, and markets. Specifically, the analysis should estimate losses that could be incurred in the event a CCP service provider fails. Capital requirements should be increased for CCPs that rely on services from only a few commercial banks. The amount of the increased capital buffer would be used to cover potential losses resulting from the default of that service provider.

Collateral requirements should be increased to reduce the risk of market volatility caused by the liquidation of assets for multiple CCPs at the same time. International standards for CCP governance should be included in the loss waterfall, allowing more risk management control for those members who are at risk. Provisions of the loss waterfall should require that a CCP in default has a greater loss of capital before using capital of non-defaulting members.

Strengthen Regulation and Supervision

Supervision of CCP activities should include network analysis that outlines connections with market participants and clearing members. The network analysis should also include marketwide stress tests for recovery and resolution plans. Global interconnections should be reviewed with the impact on multiple CCPs analyzed in the event of a G-SIB default. Authorities across national borders should select resolution tools to mitigate systemic risk and contagion of losses.

Common Global Central Bank Approach

In order to reduce CCP dependence on commercial bank services, there should be an international central bank approach that includes the following services:

- CCPs should have direct access to the central bank payment system.
- CCPs should have a cash account with the central bank and settlement services for margin and collateral calls of CCP members.
- Credit lines should be established with the central bank for intraday liquidity needs. This would reduce reliance on connected CCPs for liquidity.
- In the event of a clearing member default, emergency liquidity should be available from the central bank for an overnight sale of collateral. In addition, CCPs connected globally should organize currency swaps between central banks of different currencies.

In order to mitigate systemic risk and provide these services to CCPs, the central bank should supervise CCP activities. Periodic reviews should ensure CCPs are in compliance with the CPSS-IOSCO P-FMI. This supervision could be directly from the central bank. Alternatively, the central bank could have access to information from other CCP supervisors.

Currently some central banks do offer some services to CCPs. However, there is no common international standard. A common international approach will ensure that jurisdictions across borders eliminate competitive advantages resulting from differences in government policies. Thus, a common international standard would level the playing field in terms of capital buffers and costs of services.

Direct Relationships between CCPs and Central Securities Depositories

In order to reduce the reliance of G-SIBs, central banks should provide a central securities depository for custody functions. Services related to a central security depository provide securities accounts for members, collateral management, and asset services. The direct account with the CCP would facilitate transaction settlements and provide intraday liquidity backed by collateral without the reliance of G-SIBs.

KEY CONCEPTS

LO 76.1

Benefits of CCP multilateral netting include: reduction in credit exposures, firewall of protection, operational efficiency, trading efficiency, and transparency. Costs of a CCP structure include: increased systemic risk due to risk concentration if a CCP fails and increased participation costs.

LO 76.2

Increased margin calls and collateral requirements during a financial crisis will create liquidity stress for CCP clearing members. The loss/risk waterfall process describes the process of loss sharing with other CCP members. Interconnections with other CCPs and G-SIBs increases systemic risk due primarily to lack of liquidity in a crisis and increased market volatility with simultaneous collateral sales for multiple CCPs. Failure of a G-SIB could lead to global market disruptions due to contagion loss effects for interconnected CCPs.

LO 76.3

The interconnected links of a CCP to other CCPs, financial institutions, and CCP members can provide channels to contagion. The Chicago Mercantile Exchange (CME) Group (U.S.), the LCH.Clearnet Group (U.K.), and the Japan Securities Clearing Corporation (JSCC) are CCPs responsible for large percentages of transactions across several markets and are therefore too important to fail (TITF).

LO 76.4

The following measures are proposed to decrease the probability and/or impact of a CCP failure: increased regulation and standards for CCPs, recovery planning, emergency liquidity available through the central bank, bank capital requirements to cover CCP exposures, and resolution planning.

LO 76.5

Four measures to reduce the interconnections of CCPs and mitigate systemic risk are: strengthen international standards, strengthen regulation and supervision, create a common global central bank approach, and establish direct relationships between central securities depositories and CCPs.

CONCEPT CHECKERS

1. The multilateral netting framework of a central counterparty (CCP) creates benefits and costs for market participants. Which of the following statements is not a benefit created by the CCP?
 - A. The loss waterfall structure provides protection in the event a CCP defaults.
 - B. Transparency is increased by central clearing of private information.
 - C. The CCP structure provides firewall protection in the event of a financial crisis.
 - D. Multilateral netting creates operational efficiencies through improved settlement processes.
2. The default of which of the following entities would most likely lead to the largest decrease in collateral prices for the collateral market where CCPs are interconnected?
 - A. CCP member.
 - B. CCP connected with other CCPs all in the same region or country.
 - C. Global systemically important bank (G-SIB).
 - D. Federal Reserve Bank (FRB).
3. Contagion is a greater concern for global CCPs that are very active in clearing transactions for CCP members in multiple markets. In addition, for-profit entities may have conflicting incentives for risk management practices with respect to loss waterfalls. Based on 2013 transaction clearing data, which of the following is not a CCP that is considered too important to fail (TITF)?
 - A. Chicago Mercantile Exchange (CME) Group.
 - B. New York Stock Exchange.
 - C. LCH.Clearnet Group.
 - D. Japan Securities Clearing Corporation.
4. Which of the following policy measures is designed to lessen the impact of a CCP failure in the event one occurs?
 - A. Increased regulation and standards for CCPs.
 - B. Recovery planning.
 - C. Emergency liquidity available through a central bank.
 - D. Resolution planning.
5. Providing a direct link between CCPs and a central security depository is one measure that is proposed to help mitigate systemic risk. Which of the following statements most accurately describes the major benefit of a direct link to a central security depository?
 - A. Reduces CCPs' reliance of global systemically important banks (G-SIBs).
 - B. Reduces the amount of collateral required for CCPs.
 - C. Standardizes loss waterfall structures internationally.
 - D. Standardizes capital, collateral, and margin requirements to make them consistent across national jurisdictions.

CONCEPT CHECKER ANSWERS

1. A The biggest concern of the CCP framework is the risk of default of a CCP. The failure of a CCP could lead to even greater systemic risk with no market liquidity or settlement process. The loss waterfall process does not provide a solution for the failure of a CCP, only the failure of a CCP member.
2. C The default of a G-SIB would impact multiple CCPs that clear through it creating liquidity problems for multiple CCPs and increasing market volatility from simultaneous collateral sales.
3. B The Chicago Mercantile Exchange (CME) Group (U.S.), the LCH.Clearnet Group (U.K.), and Japan Securities Clearing Corporation (JSCC) are all examples of for-profit CCPs that clear transactions in multiple markets and are considered to be too important to fail (TITF).
4. D Policy measures designed to reduce the impact of a CCP failure are: resolution planning and bank capital requirements to cover CCP exposures.
5. A The direct account with a central securities depository for custody functions would facilitate CCP transaction settlements and provide intraday liquidity backed by collateral without the reliance of G-SIBs.

STRESS TESTING CONVERGENCE

Topic 77

EXAM FOCUS

The year 2016 marks the seventh anniversary of regulatory stress testing for bank capital adequacy. Three key outcomes can be seen from today's vantage point. First, banks responded to the first stress testing with wide capital buffers, while current results suggest much more narrow buffers. Second, the stabilization of testing results and the financial market rewards have enabled these narrower buffers. Third, we are beginning to realize that managing capital requirements to meet Federal Reserve requirements may increase systemic risk, because market participants are working from the same assumptions and the same levels for key variables. This situation leaves the U.S. financial system open to potential modeling risk.

TRENDS IN STRESS TESTING AND CAPITAL MANAGEMENT

LO 77.1: Explain how trends in stress testing and capital management have evolved from 2009 SCAP to the 2015 CCAR.

In the wake of the 2007–2009 financial crisis, a bank stress testing process was established to determine if the largest U.S. financial institutions had sufficient capital buffers to withstand financial turmoil and another recession. This system was named the **Supervisory Capital Assessment Program (SCAP)** and the testing was conducted in 2009 by the Federal Reserve Bank (Fed). The actual test applied two different macroeconomic scenarios. The first scenario was a baseline condition based on the average estimate for key variables, like GDP and unemployment, from three different national publishers of projections. The baseline estimate of GDP for 2009 was –2.0% and for 2010 it was 2.1%. The second macroeconomic scenario was an adverse forecast chosen by the Fed; the adverse GDP estimate was –3.3% for 2009 and 0.5% for 2010. The objective was to choose a scenario materially worse than consensus and then determine what would happen to a financial institution's capital buffers. Capital was monitored in terms of firm-wide losses relative to loan portfolios, off-balance sheet commitments, contingent liabilities, and potential trading-linked losses. Of the 19 financial institutions tested in 2009, only nine banks were found to have adequate capital buffers.

The 2009 SCAP was a one-time test, but the Fed realized that an ongoing process was needed. In November 2011, the Fed implemented a system of annual capital plan compliance that is now known as the **Comprehensive Capital Analysis and Review (CCAR)** process. This process applies to any **bank holding company (BHC)** with \$50 billion or more in consolidated assets.

The capital plan rules specify the following four mandatory elements:

1. The first element requires an assessment of the BHC's expected uses and sources of capital over the company's planning horizon. This first element is further broken down into four subcategories:

The BHC must:

- (a) Disclose pro forma estimates of potential revenue and losses over the planning horizon for a baseline, a supervised stressed scenario (e.g., SCAP), and an internally-developed stressed scenario.
 - (b) Discuss how the company will maintain a Tier 1 capital ratio in excess of 5%.
 - (c) Discuss the results of stress testing and how the capital plan takes these results into consideration.
 - (d) Describe all planned capital actions over the planning horizon.
2. The second element is a detailed description of the BHC's process for measuring capital adequacy.
 3. The third element is disclosure of the BHC's formal capital policy.
 4. The fourth element is a discussion of any alterations to the BHC's business model that could materially impact capital adequacy.

Banks must submit their capital plan to the Fed annually. Some banks fail the testing outright and some banks pass with their desired capital plan. Other banks (typically only the largest banks are permitted) may declare a "mulligan" (i.e., resubmit plans to satisfy capital requirements).

There is much at stake for banks using the new CCAR process: only if the Fed finds a bank to be well-capitalized will the bank be allowed to continue paying dividends. The threshold for declaring a bank to be under-capitalized is a Tier 1 capital ratio of 3%; however, this target is gradually being transitioned upward over the time period from 2014 to 2019.

CAPITAL MANAGEMENT BY CCAR INSTITUTIONS

LO 77.2: Compare trends in capital management approaches by different classes of CCAR institutions from 2012 to 2015, and explain the motivations for each class of institutions to adopt their approach.

When banks first began to comply with the testing imposed by CCAR, they responded conservatively, with wide capital cushions over the regulatory minimum Tier 1 capital ratio threshold of 5%. As time progressed however, stress testing results have stabilized for most BHCs and the leverage ratio has gradually risen. This trend has caused banks to migrate to lower capital ratios that sit closer to the regulatory minimums in order to maximize profit potential.

The inclination to operate close to the minimum margin of safety is not shared by all classes of BHCs. According to the 2015 CCAR results, **investment banks** (e.g., Goldman

Sachs and Morgan Stanley), **universal banks** (e.g., Bank of America and JPMorgan), and **custodian banks** (e.g., State Street and BNY Mellon) all operate close to the regulatory minimum standards. Investment banks manage capital very tightly with a cushion of only 0.2% over the minimum levels set by the Fed. Universal banks have capital buffers of less than 1% over the minimum levels, while custodian banks have a 0.6% capital buffer.

Investment banks, universal banks, and custodian banks all have two traits in common that make them more likely to maintain a narrow capital buffer. First, they have a very flexible capital management process, which makes it easier to manage a small buffer. Second, these banks have high risk appetites and seek high returns through investing available funds.

Conversely, **regional banks** (e.g., Fifth Third and PNC) and **card monolines** (e.g., American Express and Capital One) have chosen not to maximize profits in favor of maintaining healthy capital buffers. Regional banks have buffers ranging from 2.2% to 3.0% depending on the bank, and card monolines have buffers ranging from 2.0% to 3.6%. Regional banks and card monolines are less able to maintain narrow buffers because their capital management processes are not as flexible as those of other types of financial institutions. In addition, they both have lower risk tolerances.

FACTORS STEERING BANKS TOWARD REGULATORY MINIMUM LEVELS

LO 77.3: Identify and describe factors that have encouraged banks to manage capital more closely to regulatory minimum levels.

There are two key factors that are encouraging BHCs to manage capital using narrower buffers. The first factor is that the equity markets are directly rewarding companies that pursue profits instead of conservative capital management. History has shown that corporate managers will do what they are incentivized to do. The second factor in favor of capital closer to regulatory minimum levels is the stability of CCAR results themselves: when testing results are acceptable over a multi-year period, managers may feel more comfortable being less conservative in pursuit of profit.

Citibank is an interesting case study in the way the financial markets view CCAR testing results. In March 2014, Citibank's capital plan was rejected. Once the markets learned of this result, Citibank's stock lost 6.1% (\$7.1 billion) of market cap over the next three trading sessions. This compares to a 0.4% decline in the S&P 500 and a 1.4% decline in the CCAR peer group over the same period. One might expect that this high cost of failing a capital test should result in less risk taking, but this is not what is observed in the actual markets. Stocks that have a more aggressive capital buffer policy and still pass the CCAR test typically experience an increase in stock price over the three-day time period following the release of the testing results. In fact, the highest-performing group of companies includes those that pursue such a narrow buffer that they are forced to resubmit their capital plans. This suggests that investors approve of management attempts to squeeze by with a marginal CCAR passing score. The reasons that banks, like Citibank, fail their tests are usually qualitative in nature. When the reasons for failing a stress test move from quantitative to qualitative factors, stock prices suffer because this reasoning is more difficult to fix.

As previously mentioned, it has been observed that stress testing results stabilize over time. The BHCs that have the most stable capital buffers are the universal banks, the regional banks, and the card monolines. Further contributing to the stability of the buffers is a difference between the Fed's projection for BHC's capital or leverage ratios and the bank's internal calculation of the same variable: the Fed's projections tend to be more conservative than the internal projections of investment banks, universal banks, and card monolines. This is due to decreases in the Fed's credit loss forecasts. Conversely, the forecasts of the regional banks and the custodian banks are trending toward convergence with Fed forecasts, indicating that these entities are working from similar assumptions. For those BHCs where the Fed remains more conservative, the gap of conservatism is narrowing, which is encouraging banks to manage their capital more closely to the regulatory minimums.

On a more granular level, there is also stabilization in projections for losses, pre-provision net revenue (PPNR), and risk-weighted asset (RWA) calculations. This stabilization is occurring for both Fed and BHC projections. For example, the cumulative nine-quarter loss rate used by the Fed for projections in 2009 was 11.6%, but in 2015 it has been nearly cut in half to 6.0%. By comparison, BHCs are using 4.6% as the loss forecast in 2015. The reasons for this decrease in loss forecast are macroeconomic improvements over that time horizon and improved loan quality from more rigorous underwriting standards. The more pronounced decreases in loss forecasts have been for mortgages and credit card loans. The average difference between the Fed forecasts and BHC forecasts dropped from a 2.2% spread in 2013 to a 1.4% spread in 2015. This narrowing spread has also helped banks operate with a narrower capital buffer.

CONSEQUENCES OF NARROW CAPITAL BUFFERS

LO 77.4: Describe potential consequences as stress test results from different banks have appeared to converge and more institutions begin to manage capital to Fed-projected results.

In managing capital in close relation to Fed-imposed minimum standards, BHCs are potentially increasing systemic risks. The reliance on the Fed for the risk infrastructure centralizes the risk focus onto whatever variables the Fed picks as well as the levels of those variables that the Fed chooses. This creates an obvious weakness and potential vulnerability should the Fed's standards either prove to be wrong and/or not conservative enough, which highlights the increasing importance of the Fed's models.

The heavy reliance on Fed supervision requires vigilance in monitoring risk benchmarks. For example, is a 5% capital ratio enough? If the standards are too loose, then the U.S. financial system may find itself materially undercapitalized, but if the modeled standards are too conservative, the U.S. financial system will be inefficient. The challenge with any model is that it is only as good as its assumptions and inputs. Independent models need to be developed to supplement Fed standards and the internal testing that all BHCs perform. New research can be informative for both regulators and banks. Market participants should also be aware that regulatory stress testing should not be equated to sound capital management.

KEY CONCEPTS

LO 77.1

The regulatory environment for bank capital management has evolved from the dual-scenario test of SCAP to the CCAR system where banks must annually submit a report to the Federal Reserve covering four key elements. This annual review process enables the Fed to have more timely information and to assess bank health on a frequent basis.

LO 77.2

There are several different types of bank holding companies (BHCs), each with different ways of managing capital that needs to be monitored using the CCAR system. They include investment banks (e.g., Goldman Sachs and Morgan Stanley), universal banks (e.g., Bank of America and JPMorgan), custodian banks (e.g., State Street and BNY Mellon), regional banks (e.g., Fifth Third and PNC), and card monolines (e.g., American Express and Capital One).

LO 77.3

There are two key factors that are encouraging BHCs to manage capital with narrower buffers. The first is that equity markets are directly rewarding companies that pursue profits above conservative capital management. The second factor is the stability of CCAR results themselves.

LO 77.4

Bank stress testing results hinge on the Fed's standards. This single focus has the potential to expand systemic risk because all testing is reliant on the same set of variables and the same levels of those variables. Model risk is therefore a concern.

CONCEPT CHECKERS

1. Which significant enhancement was added to the 2015 CCAR that was an improvement on the 2009 SCAP testing?
 - A. Testing a baseline scenario and a stressed scenario.
 - B. Annual testing that must be approved by the Federal Reserve.
 - C. Testing capital ratios for minimum compliance.
 - D. Testing an alternate scenario that is more conservative than the baseline scenario.
2. Which CCAR institution is likely to operate with a relatively wide capital buffer?
 - A. Investment banks.
 - B. Custodian banks.
 - C. Regional banks.
 - D. Universal banks.
3. Which of the following trends is most likely to be observed in the equity markets relative to CCAR testing results?
 - A. Companies that pass stress testing on the first attempt are the most highly rewarded in the equity markets.
 - B. Company share prices are not negatively impacted by a failure in CCAR testing.
 - C. Companies that operate close to regulatory minimums and need to resubmit capital plans are rewarded the most highly in the equity markets.
 - D. The equity markets are indifferent to the results of CCAR testing.
4. Which of the following trends have been observed regarding stabilization of stress testing results?
 - I. The BHCs with the most stable results are the investment banks, the universal banks, and the card monolines.
 - II. The forecasts of regional banks and custodian banks are converging with Fed forecasts.
 - A. I only.
 - B. II only.
 - C. Both I and II.
 - D. Neither I nor II.
5. Which of the following concerns have not emerged from the observed trends in CCAR testing?
 - A. Fed projections have become more restrictive than internal bank estimates.
 - B. Stress testing has become increasingly reliant on Fed-mandated variables.
 - C. Some banks have a narrower capital buffer than others.
 - D. Modeling risk has become apparent.

CONCEPT CHECKER ANSWERS

1. **B** The 2009 SCAP was a one-time dual-stage test that was replaced by the annual CCAR approval process.
2. **C** Investment banks, universal banks, and custodian banks are operating with more narrow capital buffers. Regional banks and card monolines are behaving more conservatively and thus are likely to operate with a wide capital buffer.
3. **C** Companies that declare a mulligan (i.e., must resubmit capital plans) are the most highly rewarded in terms of stock price increases.
4. **B** The BHCs that have the most stable capital buffers are the universal banks, regional banks, and card monolines. The forecasts of regional banks and custodian banks are converging with the estimates used by the Fed itself.
5. **A** Stress testing results have become increasingly reliant on Fed-mandated variables. This has greatly increased the possibility of modeling risk. The risk is amplified because many banks are operating with increasingly narrow buffers.

CYBERSECURITY IOI: A RESOURCE GUIDE FOR BANK EXECUTIVES

Topic 78

EXAM FOCUS

This non-technical topic provides specific coverage of the five key elements of the National Institute of Standards and Technology (NIST) Cybersecurity Framework. For the exam, focus on identifying the main cybersecurity risks facing financial institutions and how to mitigate them through best practices. It is particularly important to note how the protect and detect functions serve as primary and secondary lines of defenses, respectively, and to understand the underlying measures and tools.

CYBERSECURITY FRAMEWORK

LO 78.1: Identify the five core functions of the NIST's Cybersecurity Framework.

The five core functions of the National Institute of Standards and Technology (NIST) Cybersecurity Framework (that will each be discussed in detail in subsequent LOs) are as follows:

1. **Identify:** refers to identifying both internal and external cyber risks.
2. **Protect:** refers to protecting the firm's information systems, assets, and data.
3. **Detect:** refers to detecting system intrusions, data breaches, and unauthorized access.
4. **Respond:** refers to responding to any potential cybersecurity threat.
5. **Recover:** refers to how a bank recovers from a cybersecurity attack and involves the restoration of regular operations and services.

RISK ASSESSMENT PROCESS

LO 78.2: Explain the risk assessment process to identify threats to information or information systems.

A risk assessment for a firm is the first step needed to determine the probability of facing a cybersecurity threat and to determine any weaknesses or holes in information systems.

The four facets of the risk assessment process are as follows:

- Classifying information.
- Identifying threats and vulnerabilities.
- Measuring risk.
- Communicating risk.

The same person or group within the firm should perform all four facets of the risk assessment process.

Classifying Information

The first step prior to any risk assessment is to identify the firm's key information assets (known as **crown jewels**) together with their locations and methods of protection. Crown jewels consist of highly sensitive and crucial information to the firm. General examples include people (e.g., customers, employees), property, and information (e.g., databases, customer records, account balances).

Classifying the firm's information could be based on the following sensitivity scale that examines the impact on the firm, its key operations, or its stakeholders if such information were to be lost, damaged, or inappropriately disclosed.

- *Public information*: Little or no impact.
- *Internal use only information*: Little to limited impact.
- *Restricted information*: Limited impact.
- *Confidential information*: Significant impact.

The firm's crown jewels should receive a confidential classification rating. The ratings for all information should be noted on the information as well as on a centralized document such as a **crown jewels register**. Classification ratings should be reviewed on a regular basis and amended as needed to ensure that they remain appropriate. Finally, the process behind the rating system should be documented and transparent in order to properly communicate them to the firm's employees.

Identifying Threats and Vulnerabilities

Threats and vulnerabilities are interrelated and each term should be defined at the outset in order to be able to accomplish the fundamental step of identifying the firm's threats and vulnerabilities.

A **threat** is something or someone that may attempt to exploit a vulnerability in order to steal, compromise, or demolish an information asset. An example could include the risk of data loss due to an unsecured USB drive.

A **vulnerability** is any system weakness that a threat can utilize to obtain unauthorized access to the information asset. An example could include the lack of use of appropriate encryption methods to secure confidential data contained on a USB drive.

Key categories of threats to information security include:

- Internal threats such as employees.
- Physical threats such as intruders.
- Internet threats such as hackers.
- Natural disasters such as fire, floods, and earthquakes.

Identifying potential threats could be accomplished internally via audit reports or fraud detection tools or externally via information sharing networks [e.g., Financial Services–Information Sharing and Analysis Center (FS-ISAC)], annual updates of *Data Breach Investigations Report* (Verizon), or annual updates of *Internet Security Threat Report* (Symantec).

Identifying potential vulnerabilities could be accomplished by using a vulnerability scanner/analyzer with the ability to detect vulnerabilities using common network protocols and methods. As an extra step, it may also be able to determine whether the vulnerability was actually exploitable.

Measuring Risk

Various methods are possible for measuring cybersecurity risks, and one example from the Multi-State Information Sharing & Analysis Center (MS-IAC) is illustrated here.

There are three dimensions considered for each information asset (e.g., customer account balances):

- *Value*: Low, medium, high (high for customer account balances given the need to report liabilities accurately).
- *Level of risk*: Low, medium, high (high for customer account balances given large dollar value).
- *Firm's actions*. This would include any actions the bank has already taken to secure the asset.

In determining an overall measurement of risk, the firm's actions in response to the risk are crucial. Using the above example, if backups are performed several times a day and stored electronically off-site, then there is relatively low risk associated with the loss of customer account balances because the maximum loss at a given point is a few hours worth of data that would need to be reconstructed.

Communicating Risk

A system within the firm needs to be developed to communicate with top-level management and the board of directors regarding the cyber risks faced by the bank, how those risks are currently handled, how to mitigate those risks, and who is responsible for doing so. With regard to any mitigating steps that have been determined, these steps should be reviewed on an annual basis and updated if needed.

Managing Risk

Assessing risk is only part of the overall cyber risk management process. The risk management process should be robust and consist of sufficient oversight.

Important elements include:

- Assessing any new threats.
- Identifying and prioritizing problems with current policies, procedures, and controls.
- Updating and testing policies, procedures, and controls as needed.

An additional and specific issue within risk management focuses on proper identification and management of all hardware devices and software on the network. The objective is to only allow authorized items to have access to the system and to prevent unauthorized items from getting access and improperly obtaining sensitive company information.

PROTECTION MEASURES

LO 78.3: Describe various measures to protect banks' systems, assets, and data.

Although the bulk of the discussion on protecting a financial institution's crown jewels is focused on IT measures, the concept of cyber hygiene is also important. **Cyber hygiene** pertains to the actions that users can take to protect and maintain the firm's systems and devices. Proper cyber hygiene requires communication, training, and incentives for the employees to allow them to contribute to the protection of sensitive customer and company data.

There are five primary protection measures to consider:

- Customer authentication.
- Access controls.
- Data security.
- Secure configurations.
- Firewalls.

Customer Authentication

Firms need to have reliable measures in place to authenticate customers who are using the firm's website to process financial transactions. For example, it is necessary to have multifactor authentication over merely single factor authentication, especially when dealing with sensitive customer information or the transfer of large amounts of funds. Multifactor authentication is a type of layered security control that has multiple defenses to prevent a weakness in one defense to allow unauthorized access.

Proper customer authentication is also required under the **Gramm-Leach-Bliley Act** to reduce or eliminate money laundering and terrorist financing, fraud, and identity theft. The underlying controls must be reliable in order for the electronic agreements and transactions to be legally enforceable. In other words, should the controls be so weak as to allow online transactions to occur with unauthorized or incorrect parties, the financial institution

could suffer significant financial and reputational losses through fraud and unauthorized disclosure of customer information.

Access Controls

Further to the prior discussion on classifying information, the most important and/or sensitive information (e.g., crown jewels) requires a higher level of protection. Such information should have restricted access in that it is stored on a separate server that requires multiple security layers to access.

In the context of information that is provided on a need-to-know basis only, it is crucial to properly determine which employees should be privy to such information. Furthermore, access to the information must be tracked, controlled, and secured so as to prevent unauthorized individuals from accessing it.

For shared cloud environments, the cloud provider must provide the firm with assurance of strong controls that prevent unauthorized access.

Data Security

Data loss prevention methods required for financial institutions under the Gramm-Leach-Bliley Act and the Fair and Accurate Credit Transactions Act of 2003 include:

- Development and maintenance of a firm-wide information security program that is appropriate for the level of complexity of the firm's transactions.
- Assurance from service providers that they have sufficiently robust controls in place to ensure the security and confidentiality of customer information to which they have access.

Data encryption is usually employed as the first method to protect confidential information that is being transmitted wirelessly between parties as well as information that is “passive” within a firm. Encryption is not a perfect means of protection because of the existence of sophisticated hackers who may be able to bypass the encryption techniques and access the underlying information.

Some financial institutions provide a public wireless network for use by customers within the firm's offices or branches. In such a case, the public network must be distinct from the private network. Employees handling sensitive information must connect the devices only to the private network. High security standards apply to the private network and the devices used with the private network must be protected with anti-virus and anti-malware software.

Regarding the firm's public website and mobile apps, there are potential vulnerabilities on the webpages and access points. Therefore, any protection should extend beyond simply the login page (the most common access point) and apply to all pages.

Firms should also consider proactively contacting regulators to obtain best practices for protecting a firm's key information assets.

Secure Configurations

A rigorous configuration management and change control methodology is required in order to properly manage the security configurations for all of the firm's hardware and software and to foil any potential hackers. For example, the default configurations for passwords, controls, and protocols usually require significant changes in order to be sufficiently secure.

Best practices regarding securing configurations include:

- Use standard secure configurations for all operating systems; any superfluous accounts and services should be deleted.
- Use automated security patches for both operating systems and application software.
- Restrict administrative privileges to the select individuals who possess the technical knowledge and have valid reasons for changing the configurations.
- Use publicly developed and maintained security benchmarks, guidance, and checklists as a starting point.

Firewall Protection

Firms frequently utilize a **firewall**, which places a barricade between a secure and trusted network (e.g., the firm) and an unsecured and/or untrusted network. The firewall analyzes all of the data that flows in and out of a network by matching each data item to the pre-determined security parameters. Items that match the parameters will flow normally but items that do not (e.g., malware) will be blocked with an alert provided to the system administrator.

Hardware-based firewalls are strong at protecting single and multiple computers. Compared to software-based firewalls, hardware-based firewalls are distinct and have a separate operating system so as to provide an extra layer of protection but at a somewhat higher (but not unreasonable) cost.

Software-based firewalls are internal to an operating system. Because a computer system may initially lack protection, it is recommended to use the disc format of the firewall for initial installation. Because software-based firewalls are not distinct (like hardware-based ones) and are installed on the same computer as the information being protected, there is the risk that the firewall will be unable to block malicious traffic prior to its entry into the computer system.

A firewall on its own will not provide sufficient protection of a firm's systems. When a firewall is used together with other techniques such as encryption, the overall level of protection approaches a more sufficient level.

Mobile Banking

Within retail banking, the significant increase in the use of mobile banking applications by customers in the last five years has led to concerns regarding security. A bank could utilize the following best practices to protect its systems, assets, and data from losses:

- Communication through secure transmission protocols that present greater hacking challenges.
- Encryption of customer data that is transmitted or stored.

- PINs of at least six characters (e.g., combination of alphanumeric and upper/lower case).
- Two-factor authentication required for login (e.g., existing password plus a one-time valid, dynamic passcode consisting of digits sent to a mobile phone).
- Time out after a specified period of inactivity (maximum of 15 minutes).
- Real-time application monitoring to ensure that any bugs or problems are detected and resolved promptly.
- The ability for the mobile application to detect jailbroken mobile devices and prohibit them from use due to their potentially compromised security features.
- More due diligence performed in screening the other parties involved with the bank's mobile banking application to ensure that those parties maintain sufficient security standards.

DETECTION TOOLS

LO 78.4: Describe the approaches to detect system intrusions, data breaches, and unauthorized access.

As discussed previously, there are a series of primary protection tools such as access controls, encryption, and firewalls.

In detecting for system intrusions, data breaches, or unauthorized access, a benchmark level of activity and data traffic flows is established as regular operations. Detection tools (discussed in more detail below) are a series of automated tools that check for abnormal variances and reduce or eliminate unauthorized access. Those tools serve as a secondary or reinforcing level of defense. Overall, detection tools may bring recurring or significant security incidents to management's attention. These tools must be updated periodically to ensure that they continue to properly detect new threats, which are always evolving.

Intrusion Detection Systems

Intrusion detection systems find and process information from all parts of the network in order to detect potential internal and external intrusions. They have the advantage of raising potential red flags quickly, thereby allowing the firm to respond to any cyber events on a timely basis to limit any potential losses.

Network Behavior Anomaly Detection (NBAD)

NDAB tools provide ongoing network monitoring in search for any anomalies. Key baseline characteristics of the network ("normal state") are considered and compared to real-time characteristics. A red flag is raised in case of a significant deviation (e.g., abnormal traffic volume or bandwidth use).

Security Information and Event Management (SIEM) Systems

SIEM systems allow for the consolidation of monitored data from multiple sources to help avoid missing critical events. The ability to perform correlation functions (e.g., looking for common attributes) leads to an automated analysis of correlated events and immediate notifications of potential problems.

Configuration Management Tools

Configuration management tools provide a full listing of the firm's hardware and its locations and network addresses as well as the firm's software and all of the versions installed and updates applied. Through regular configuration scans, unauthorized configuration changes may be detected that may be indicative of a possible security threat.

Integrity Monitoring Tools

Integrity monitoring tools are similar to NBAD in terms of detecting abnormal deviations between current values and baseline values of specific items.

RESPONSE AND RECOVERY PLANS

LO 78.5: Explain the incident response plan and the recovery plan.

A starting point for addressing cyber attacks is for a firm to develop an incident response plan before any cybersecurity data breaches have occurred.

Incident Response Team

In developing such a plan, an incident response team needs to be established that includes the CEO, the IT director, the communications director, and relevant personnel from the legal and human resources departments. The team needs to appoint a leader and establish a reporting structure in order to properly communicate any data breaches. A detailed outline should be prepared containing the necessary steps, duties, and guidelines for the team to take in the event of a data breach. The overall objective is to discover the breach as soon as possible, limit the damage, repair the damage caused by the breach, and return the IT system back to normal as soon as possible. Finally, the team should participate in relevant training that simulates data breaches.

A fundamental task for the team is to determine which members of senior management are authorized to formally declare an incident.

Incident Response Plan

The **incident response plan** should include details on the approach to take with regard to potential losses and how to minimize them. There should be some guidance on maintaining evidence and on determining when forensic experts should be consulted. In addition, timelines or durations of proposed solutions should be provided.

From a big picture perspective, the incident response plan should detail the time, money, and other resources required for implementation. It should also discuss whether the plan would partially or completely remedy specific incidents.

The plan also needs to discuss how and when to inform customers, regulatory authorities, and the police of a data breach. For example, there may be a specific threshold or materiality level established and breaches below such a level would not be reported. However, in case a breach needs to be reported, the plan should consider the optimal mode of communication and the key elements to be contained in the communication. Finally, from a public relations perspective, there should be guidance on monitoring the media coverage of the breach.

Responding to a Cybersecurity Incident

The first step in responding to an incident is to analyze the incident to determine the extent of losses of any crown jewels and any data alteration. At the same time, the (pre-formulated) incident response plan should be immediately applied.

Additionally, legal counsel should be contacted promptly to discuss the following steps that should be taken within the first 24 hours:

- Recording the date and time of the discovery of the breach and the date and time when the first person on the incident response team is advised of the breach.
- Advising all members on the incident response team of the breach and having them begin performing relevant duties in the plan.
- Preserving evidence (e.g., lockdown of location where breach occurred).
- Preventing further data losses (e.g., shut down relevant computers).
- Documenting all facets of the breach in as much detail as possible.
- Interviewing all individuals who discovered or were aware of the breach.
- Determining whether and how to communicate the breach to stakeholders and the public.
- Determining priorities and risks resulting from the breach.
- Contacting regulatory authorities to advise of the breach, if applicable.
- Contacting the police to initiate an investigation of the breach, if applicable.

Recovery Plan

A **recovery plan** consists of both a restoration component and a review component. Depending on the severity of the incident, the restoration component could last anywhere from a few hours to many weeks in terms of resuming regular service.

Key elements involved in restoration include:

- Reconstructing any damaged IT assets based on the firm's most up-to-date IT infrastructure images/layouts. This could allow the firm's IT system to return to its pre-incident (normal) configurations.
- Restoring deleted or altered data from prior backups made.
- Reconnecting service with little or no disruption.

An important takeaway from any cyber incident is to determine which vulnerabilities were involved. Based on all the information gathered from the incident, the team should determine how to prevent future incidents. That leads into the review component, which should include auditing and testing the incident response plan as well as reviewing third-party vendors that have access to firm data.

In order to ensure that the incident response plan remains relevant, quarterly audits should be performed pertaining to the following items:

- Update the incident response plan members list.
- Ensure that the incident response plan is sufficiently thorough (e.g., modified due to any significant changes within the company).
- Re-examine vendor contracts (e.g., are vendors still suitable and contracts current?).
- Re-examine notification guidelines.
- Review of third parties that have access to the firm's data.
- Re-examine the firm's overall IT security.
- Re-examine staff security awareness (could be annually instead of quarterly).

Testing the incident response plan should be done on an annual basis. There are two general testing methods that utilize scenarios and simulation. The relevant personnel may participate in discussions regarding roles, duties, and actions based on a specific scenario. This is known as a **tabletop exercise**. Alternatively, the personnel may be required to demonstrate and apply skills in dealing with an incident in a simulation setting. This is known as a **functional exercise**.

A key element in auditing an incident response plan involves the review of third-party vendors who are in possession or are able to access the financial institution's data. Obviously, the most important aspect is to ensure that the vendors always have high data protection standards. The contract details should contain clauses pertaining to:

- Restricted use of the firm's data for only the stated purposes.
- Return or destruction of data periodically or after the fulfillment of contractual obligations.
- Timely notification to the firm of all potential and actual security incidents involving the firm's data.
- Compliance with all relevant data security laws.

KEY CONCEPTS

LO 78.1

The five core functions of the NIST's Cybersecurity Framework are as follows:

- Identify.
- Protect.
- Detect.
- Respond.
- Recover.

LO 78.2

The four facets of the risk assessment process are as follows:

- Classifying information.
- Identifying threats and vulnerabilities.
- Measuring risk.
- Communicating risk.

Classifying the firm's information could be based on the following information categories: public, internal use only, restricted, confidential.

A threat is something or someone that may attempt to exploit a vulnerability in order to steal, compromise, or demolish an information asset. A vulnerability is any system weakness that a threat can utilize to obtain unauthorized access to the information asset.

In measuring risk for each information asset, there are three dimensions to be considered: value, level of risk, and firm actions in response to the risk.

A system within the firm needs to be developed to communicate with top-level management and the board of directors regarding the cyber risks faced by the bank, how those risks are currently handled, how to mitigate those risks, and who is responsible for doing so.

LO 78.3

There are five primary protection measures to consider:

- Customer authentication.
- Access controls.
- Data security.
- Secure configuration.
- Firewalls.

Firms need to have reliable measures in place to authenticate customers who are using the firm's website to process financial transactions.

In the context of access controls, key information (i.e., crown jewels) should have restricted access in that it is stored on a separate server that requires multiple security layers to access.

Data encryption and separate private wireless networks are two key aspects of data security for a financial institution.

A rigorous configuration management and change control methodology is required in order to properly manage the security configurations for all of the firm's hardware and software and to foil any potential hackers.

Firewall protection can be hardware-based or software-based. A firewall on its own will not provide sufficient protection of a firm's systems. When a firewall is used together with other techniques such as encryption, the overall level of protection approaches a sufficient level.

LO 78.4

Five general categories of detection tools include:

- Intrusion detection systems.
- Network behavior anomaly detection (NBAD).
- Security information and event management (SIEM) systems.
- Configuration management tools.
- Integrity monitoring tools.

Intrusion detection systems find and process information from all parts of the network in order to detect potential internal and external intrusions.

NBAD tools provide ongoing network monitoring in search for any anomalies.

SIEM systems allow for the consolidation of monitored data from multiple sources to help avoid missing critical events.

Configuration management tools provide a full listing of the firm's hardware and its locations and network addresses as well as the firm's software and all of the versions installed and updates applied.

Integrity monitoring tools are similar to NBAD in terms of detecting abnormal deviations between current values and baseline values of specific items.

LO 78.5

An incident response team needs to be established in order to develop an incident response plan. The overall objective is to discover the breach as soon as possible, limit the damage, repair the damage caused by the breach, and return the IT system back to normal as soon as possible.

A recovery plan consists of both a restoration component and a review component.

Key elements involved in restoration include reconstructing any damaged IT assets based on the firm's most up-to-date IT infrastructure images/layouts, restoring deleted or altered data from prior backups made, and reconnecting service with little or no disruption. The review component should include auditing and testing the incident response plan as well as reviewing third-party vendors.

CONCEPT CHECKERS

1. In categorizing threats to information security, intruders would most likely be classified as a(n):
 - A. internal threat.
 - B. internet threat.
 - C. natural disaster.
 - D. physical threat.

2. Which of the following information classification levels would most likely be assigned to data pertaining to bank customers' account balances?
 - A. Confidential.
 - B. Internal use only.
 - C. Restricted.
 - D. Top secret.

3. Which of the following detection methods is focused on abnormal deviations between current values and baseline values of specific items?
 - A. Intrusion detection system.
 - B. Configuration management tool.
 - C. Integrity monitoring tool.
 - D. Security information and event management (SIEM) systems.

4. Which of the following protective measures is considered a secondary line of defense against cyber-attacks?
 - A. Access controls.
 - B. Data encryption.
 - C. Firewall.
 - D. Intrusion detection system.

5. Which of the following statements regarding incident response teams and plans is correct?
 - A. The incident response team must include the CFO of the firm.
 - B. Only the IT director of the firm should be authorized to formally declare an incident.
 - C. In order to ensure that the incident response plan remains relevant, annual audits should be performed.
 - D. In order to ensure that the incident response plan remains relevant, testing should be done on an annual basis.

CONCEPT CHECKER ANSWERS

1. D An example of a physical threat would be an intruder. An intruder is an external threat, not an internal threat.
2. A Customer account balances, if lost or inappropriately disclosed, would likely have a significant impact on the firm and therefore, should be classified as “confidential.”

An “internal use only” or “restricted” classification suggests little or limited impact, which would not be appropriate classifications for the sensitive nature of customer account balance information.

3. C Integrity monitoring tools detect abnormal deviations between current values and baseline values of specific items.

Intrusion detection systems find and process information from all parts of the network in order to detect potential internal and external intrusions.

Configuration management tools provide a full listing of the firm’s hardware and its locations and network addresses as well as the firm’s software and all of the versions installed and updates applied.

SIEM systems allow for the consolidation of monitored data from multiple sources to help avoid missing critical events.

4. D An intrusion detection system is a detection tool that finds and processes information from all parts of the network in order to detect potential internal and external intrusions. Detection tools are considered a secondary or reinforcing line of defense.

Access controls, data encryption, and firewalls are all examples of primary protection measures.

5. D Testing the incident response plan should be done on an annual basis. Testing methods include tabletop exercises and functional exercises.

The incident response team should include the CEO, the IT director, the communications director, and relevant personnel from the legal and human resources departments. Members of senior management (besides the IT director) may be authorized to formally declare an incident. *Quarterly* (not annual) audits should be performed on most elements of the incident response plan.

SELF-TEST: RISK MANAGEMENT AND INVESTMENT MANAGEMENT; CURRENT ISSUES IN FINANCIAL MARKETS

10 Questions: 30 Minutes

1. Given the following information, what is the percent of contribution to VaR from Asset A? There are two assets in a portfolio: A and B.

Asset A marginal VaR:	0.05687
Asset A value:	\$7,000,000
Asset B marginal VaR:	0.17741
Asset B value:	\$4,000,000

- A. 64.06%.
- B. 24.27%.
- C. 35.94%.
- D. 63.64%.

2. A portfolio is composed of two securities and has the following characteristics:

Investment in X:	USD 1.8 million
Investment in Y:	USD 3.2 million
Volatility of X:	8%
Volatility of Y:	4%
Correlation between X and Y:	15%

The portfolio diversified VaR at the 95% confidence level is closest to:

- A. \$14,074.
- B. \$206,500.
- C. \$404,740.
- D. \$340,725.

3. The buy side and sell side of the investment industry have different characteristics when it comes to turnover, investment horizon, leverage, and risk measures used. Which of the following does not characterize the side of the investment industry that would be inclined to use VaR as one of their primary risk measures?

- A. Long-term investment horizon.
- B. High leverage.
- C. Fast turnover.
- D. Stop-loss rules are an important form of risk control.

4. SkyLine Airways has a defined benefit pension scheme with assets of \$165 million and liabilities of \$150 million. The annual growth of the liabilities is expected to be 4.5% with 2.4% volatility. The annual return on the pension assets has an expected value of 7.8% with 12% volatility. The correlation between asset return and liability growth is 0.35. What is the 95% surplus at risk for SkyLine?
- A. \$24.97 million.
 - B. \$54.81 million.
 - C. \$18.84 million.
 - D. \$6.12 million.
5. Portfolio ACC has an expected return of 10%, volatility of 25%, and a beta of 1.2. Assume that the market has an expected return of 8% and volatility of 15%, and that the risk-free rate of return is 4%. What is Jensen's alpha for Portfolio ACC?
- A. 1.2%.
 - B. 2.0%.
 - C. 3.6%.
 - D. 10.8%.
6. Linda Hernandez, FRM, is a hedge fund analyst for a prominent hedge fund allocation firm. Hernandez is concerned about potential measurement errors and various biases in reported hedge fund returns prior to 1996. Looking at hedge fund returns for the largest hedge funds from 1987 to 1996, how would performance be best characterized, and how would various measurement biases affect the performance?
- A. There were so many hedge fund managers not reporting that performance information is deemed unreliable.
 - B. Large hedge fund returns were on par with equities, accompanied by a much higher standard deviation.
 - C. Selection bias caused large hedge fund returns to have little correlation with the average return of hedge funds in commercial databases.
 - D. Large hedge funds substantially outperformed equities, more than enough to account for any measurement biases.
7. Orange Tree Traders is implementing risk management best practices that encourage countercyclical activities. The company's objective is to develop accurate risk measures while protecting themselves from amplified risks resulting from simultaneous responses from other firms. Which of the following statements does not represent a key best practice for addressing and alleviating amplified risk?
- A. Consider longer time periods when analyzing key market trends.
 - B. Use collateral calls in the event of a downgrade of a counterparty.
 - C. Do not look at the actions of the risk management team in isolation.
 - D. Increase the number of stress-testing scenarios to account for regime changes.

8. John Bennett is discussing the primary benefits of market liquidity to a client, and he highlights the dimensions by which liquidity can be measured. He states that liquidity is critical for financial markets to allow for the efficient allocation of resources. Regarding the various dimensions of liquidity, which of the following accurately describes market breadth?
- A. The cost of completing a transaction.
 - B. The time it takes to complete a transaction.
 - C. The consistency in distributing liquidity within assets and across markets.
 - D. The frequency of large trades and the level of willingness and interest to transact.
9. Proprietary Traders, Inc., is analyzing policy measures that are designed to reduce the probability and impact of a potential central counterparty (CCP) failure. Which of the following policy measures would most likely be intended to measure both the probability and impact of a CCP failure?
- A. Increased regulation and standards for CCPs.
 - B. Bank capital requirements to cover CCP exposures.
 - C. Recovery planning as a last line of defense in a crisis.
 - D. Emergency liquidity available through a central bank.
10. Which of the following statements is correct with respect to the five core functions within the National Institute of Standards and Technology (NIST) Cybersecurity Framework?
- A. The core functions include identify, detect, and recover.
 - B. The core functions include prevent, respond, and monitor.
 - C. A risk assessment process allows a firm to recover from a cyber attack.
 - D. Developing an incident response plan allows a firm to identify threats to information.

SELF-TEST ANSWERS: RISK MANAGEMENT AND INVESTMENT MANAGEMENT; CURRENT ISSUES IN FINANCIAL MARKETS

1. C The component VaR factors in both the marginal VaR and the asset value.

For Asset A: $0.05687 \times \$7,000,000 = \$398,090$.

For Asset B: $0.17741 \times \$4,000,000 = \$709,640$.

Asset A's percent of contribution to VaR is A's component VaR as a percent of total VaR:
 $\$398,090 / (\$398,090 + \$709,640) = 35.94\%$.

Choice A is incorrect because it is the percent of contribution to VaR from Asset B.

Choice B is incorrect because it is the Marginal VaR weight for Asset A.

Choice D is incorrect because it is just the asset weight for Asset A.

(See Topic 64)

2. D Step 1: Calculate the volatility of the portfolio.

$$\text{Variance}_{X,Y} = w_X^2 \sigma_X^2 + w_Y^2 \sigma_Y^2 + 2 \times w_X \times w_Y \times \sigma_X \times \sigma_Y \times \text{Corr}_{X,Y}$$

$$\text{Variance}_{X,Y} = 0.36^2 \times 0.08^2 + 0.64^2 \times 0.04^2 + 2 \times 0.36 \times 0.64 \times 0.08 \times 0.04 \times 0.15$$

$$\text{Variance}_{X,Y} = 0.00082944 + 0.00065536 + 0.000221184$$

$$\text{Variance}_{X,Y} = 0.001705984$$

$$\text{Standard deviation} = \sqrt{0.001705984} = 4.13\%$$

Step 2: Calculate the VaR.

$$\text{VaR} = 1.65 \times \text{volatility} \times \text{portfolio value}$$

$$\text{VaR} = 1.65 \times 0.0413 \times \$5\text{m}$$

$$\text{VaR} = \$340,725$$

(See Topic 64)

3. A The sell side of the investment industry uses VaR and stress tests as their primary risk measures. The buy side of the investment industry uses asset allocation and tracking error. The sell side has a short-term investment horizon, uses high leverage, and has fast turnover. Risk controls used are position limits, VaR limits, and stop-loss limits.

(See Topic 65)

4. A Step 1: Calculate the expected surplus growth.

Expected surplus growth = growth in assets – growth in liabilities

Expected surplus growth = (\$165m × 0.078) – (\$150m × 0.045)

Expected surplus growth = \$12.87m – \$6.75m = \$6.12m

Step 2: Calculate the variance then the standard deviation of the A&L.

$$\text{Var}_{A\&L} = w_A^2 \sigma_A^2 + w_L^2 \sigma_L^2 - 2 \times w_A \times w_L \times \sigma_A \times \sigma_L \times \text{Corr}_{AL}$$

$$\text{Var}_{A\&L} = 165^2 \times 0.12^2 + 150^2 \times 0.024^2 - 2 \times 165 \times 150 \times 0.12 \times 0.024 \times 0.35$$

$$\text{Var}_{A\&L} = 392.04 + 12.96 - 49.896$$

$$\text{Var}_{A\&L} = 355.104$$

$$\text{Standard deviation} = \sqrt{355.104} = 18.84\text{m}$$

Step 3: Calculate VaR of the assets.

$$\text{VaR} = \text{Z-Score} \times \text{volatility}$$

$$\text{VaR} = 1.65 \times \$18.84\text{m}$$

$$\text{VaR} = \$31,086,000$$

Surplus at risk = expected growth in surplus – VaR

$$\text{Surplus at risk} = \$6.12\text{m} - \$31.086\text{m} = -\$24.97\text{m}$$

Note: Although it is a negative, it is usually expressed as a positive figure as it is assumed that it is a shortfall.

(See Topic 65)

5. A The Jensen measure of a portfolio is computed as follows:

$$\alpha = E(R_p) - \{R_F + \beta[E(R_M) - R_F]\}$$

$$\alpha = 10\% - [4\% + 1.2(8\% - 4\%)]$$

$$\alpha = 10\% - 8.8\%$$

$$\alpha = 1.2\%$$

(See Topic 67)

6. D There were concerns about measurement errors and biases, but the hedge fund outperformance was more than enough to account for any such errors. Large hedge fund returns were highly correlated to the average return of hedge funds in commercial databases.

(See Topic 69)

7. B Key best practices that encourage activities that are countercyclical in nature include considering longer time periods, using more stress scenarios to take regime changes into account, and not looking at risk management actions in isolation. Using collateral calls in the event of a downgrade of a counterparty may encourage further downgrades to occur, which would lead to large losses. This is an example of a risk-mitigating step that exacerbates risk for all parties.

(See Topic 71)

8. C Dimensions of liquidity include immediacy, depth and resilience, breadth, tightness, and multi-dimensional aspects. Breadth refers to the consistency in distributing liquidity within assets and across markets. It is impacted by the number of market participants and by segmenting liquidity.

(See Topic 74)

9. B Policy measures designed to *decrease the probability* of a CCP failure are:

- Increased regulation and standards for CCPs.
- Recovery planning as last line of defense in a crisis.
- Emergency liquidity available through a central bank.
- Bank capital requirements to cover CCP exposures.

Policy measures designed to *reduce the impact* of a CCP failure are:

- Resolution planning.
- Bank capital requirements to cover CCP exposures.

(See Topic 76)

10. A The five core functions are identify, protect, detect, respond, and recover. A risk assessment allows a firm to *identify* threats to information. Developing an incident response plan allows a firm to *respond* to any potential cybersecurity threat.

(See Topic 78)

FORMULAS

Risk Management and Investment Management; Current Issues in Financial Markets

Topic 63

$$\text{risk aversion} = \frac{\text{information ratio}}{2 \times \text{active risk}}$$

$$\text{marginal contribution to value added} = (\text{alpha of asset}) - [2 \times (\text{risk aversion}) \times (\text{active risk}) \times (\text{marginal contribution to active risk of asset})]$$

Topic 64

$$\text{diversified VaR: } \text{VaR}_p = Z_c \times \sigma_p \times P$$

$$\text{individual VaR: } \text{VaR}_i = Z_c \times \sigma_i \times |P_i| = Z_c \times \sigma_i \times |w_i| \times P$$

$$\text{standard deviation of a two-asset portfolio: } \sigma_p = \sqrt{w_1^2 \sigma_1^2 + w_2^2 \sigma_2^2 + 2 w_1 w_2 \rho_{1,2} \sigma_1 \sigma_2}$$

$$\text{VaR of a two-asset portfolio: } \text{VaR}_p = Z_c P \sqrt{w_1^2 \sigma_1^2 + w_2^2 \sigma_2^2 + 2 w_1 w_2 \rho_{1,2} \sigma_1 \sigma_2}$$

$$\text{undiversified VaR: } \text{VaR}_p = \sqrt{\text{VaR}_1^2 + \text{VaR}_2^2 + 2 \text{VaR}_1 \text{VaR}_2} = \text{VaR}_1 + \text{VaR}_2$$

standard deviation of equally weighted portfolio with equal standard deviations and correlations:

$$\sigma_p = \sigma \sqrt{\frac{1}{N} + \left(1 - \frac{1}{N}\right) \rho}$$

$$\text{marginal VaR: } \text{MVaR}_i = \frac{\text{VaR}}{P} \times \beta_i$$

$$\text{component VaR: } \text{CVaR}_i = (\text{MVaR}_i) \times (w_i \times P) = \text{VaR} \times \beta_i \times w_i$$

Topic 65

surplus = assets – liabilities

$\Delta\text{surplus} = \Delta\text{assets} - \Delta\text{liabilities}$

return on the surplus:

$$R_{\text{surplus}} = \frac{\Delta\text{Surplus}}{\text{Assets}} = \frac{\Delta\text{Assets}}{\text{Assets}} - \left(\frac{\Delta\text{Liabilities}}{\text{Liabilities}} \right) \left(\frac{\text{Liabilities}}{\text{Assets}} \right) = R_{\text{asset}} - R_{\text{liabilities}} \left(\frac{\text{Liabilities}}{\text{Assets}} \right)$$

Topic 66

liquidity duration: $LD = \frac{Q}{(0.10 \times V)}$

where:

LD = liquidity duration for the security on the assumption that the desired maximum daily volume of any security is 10%

Q = number of shares of the security

V = daily volume of the security

Topic 67

Sharpe ratio: $S_A = \frac{\bar{R}_A - \bar{R}_F}{\sigma_A}$

where:

$\bar{R}_A$ = average account return

$\bar{R}_F$ = average risk-free return

σ_A = standard deviation of account returns

Treynor measure: $T_A = \frac{\bar{R}_A - \bar{R}_F}{\beta_A}$

where:

$\bar{R}_A$ = average account return

$\bar{R}_F$ = average risk-free return

β_A = average beta

Jensen's alpha: $\alpha_A = R_A - E(R_A)$

where:

α_A = alpha

R_A = the return on the account

$E(R_A) = R_F + \beta_A[E(R_M) - R_F]$

information ratio: $IR_A = \frac{\bar{R}_A - \bar{R}_B}{\sigma_{A-B}}$

where:

$\bar{R}_A$ = average account return

$\bar{R}_B$ = average benchmark return

σ_{A-B} = standard deviation of excess returns measured as the difference between account and benchmark returns

statistical significance of alpha returns: $t = \frac{\alpha - 0}{\sigma / \sqrt{N}}$

where:

α = alpha estimate

σ = alpha estimate volatility

N = sample number of observations

standard error of alpha estimate = $\sigma / \sqrt{N}$

USING THE CUMULATIVE Z-TABLE

Probability Example

Assume that the annual earnings per share (EPS) for a large sample of firms is normally distributed with a mean of \$5.00 and a standard deviation of \$1.50. What is the approximate probability of an observed EPS value falling between \$3.00 and \$7.25?

If $\text{EPS} = x = \$7.25$, then $z = (x - \mu)/\sigma = (\$7.25 - \$5.00)/\$1.50 = +1.50$

If $\text{EPS} = x = \$3.00$, then $z = (x - \mu)/\sigma = (\$3.00 - \$5.00)/\$1.50 = -1.33$

For z-value of 1.50: Use the row headed 1.5 and the column headed 0 to find the value 0.9332. This represents the area under the curve to the left of the critical value 1.50.

For z-value of -1.33: Use the row headed 1.3 and the column headed 3 to find the value 0.9082. This represents the area under the curve to the left of the critical value +1.33. The area to the left of -1.33 is $1 - 0.9082 = 0.0918$.

The area between these critical values is $0.9332 - 0.0918 = 0.8414$, or 84.14%.

Hypothesis Testing – One-Tailed Test Example

A sample of a stock's returns on 36 non-consecutive days results in a mean return of 2.0%. Assume the population standard deviation is 20.0%. Can we say with 95% confidence that the mean return is greater than 0%?

$H_0: \mu \leq 0.0\%$, $H_A: \mu > 0.0\%$. The test statistic = $z\text{-statistic} = \frac{\bar{x} - \mu_0}{\sigma / \sqrt{n}}$
 $= (2.0 - 0.0) / (20.0 / 6) = 0.60$.

The significance level = $1.0 - 0.95 = 0.05$, or 5%.

Since this is a one-tailed test with an alpha of 0.05, we need to find the value 0.95 in the cumulative z -table. The closest value is 0.9505, with a corresponding critical z -value of 1.65. Since the test statistic is less than the critical value, we fail to reject H_0 .

Hypothesis Testing – Two-Tailed Test Example

Using the same assumptions as before, suppose that the analyst now wants to determine if he can say with 99% confidence that the stock's return is not equal to 0.0%.

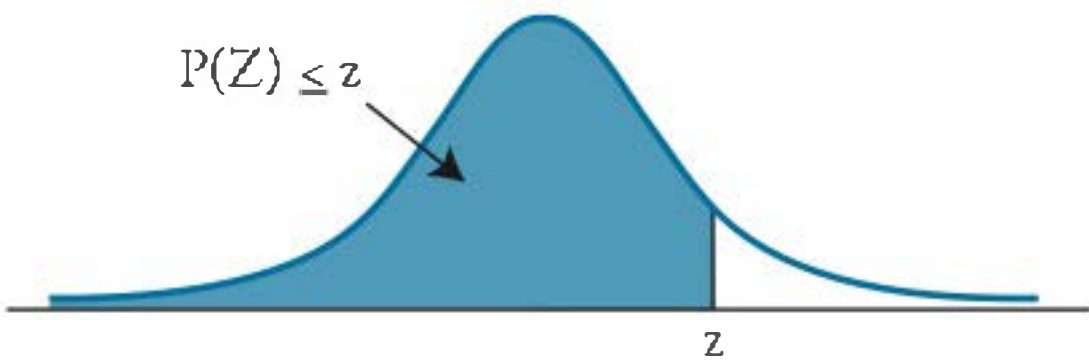
$H_0: \mu = 0.0\%$, $H_A: \mu \neq 0.0\%$. The test statistic (z -value) = $(2.0 - 0.0) / (20.0 / 6) = 0.60$.
The significance level = $1.0 - 0.99 = 0.01$, or 1%.

Since this is a two-tailed test with an alpha of 0.01, there is a 0.005 rejection region in both tails. Thus, we need to find the value 0.995 ($1.0 - 0.005$) in the table. The closest value is 0.9951, which corresponds to a critical z -value of 2.58. Since the test statistic is less than the critical value, we fail to reject H_0 and conclude that the stock's return equals 0.0%.

CUMULATIVE Z-TABLE

$P(Z \leq z) = N(z)$ for $z \geq 0$

$P(Z \leq -z) = 1 - N(z)$

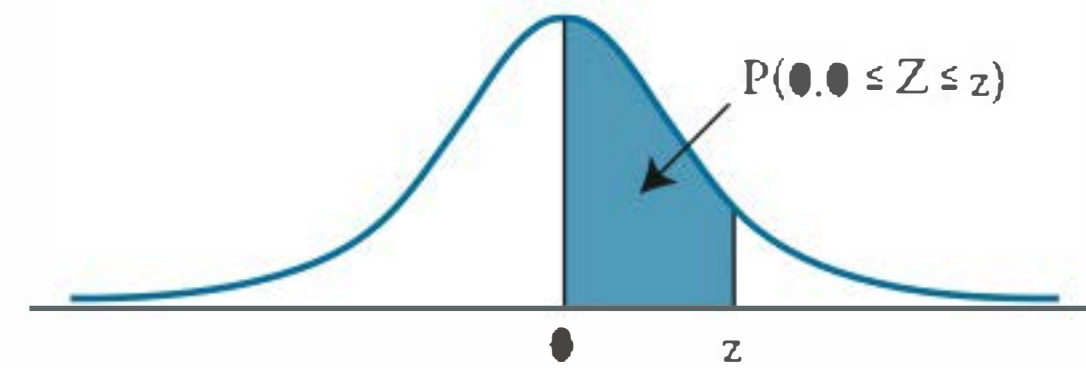


z	0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.937	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.983	0.9834	0.9838	0.9842	0.9846	0.985	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.989
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.994	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990

ALTERNATIVE Z-TABLE

$P(Z \leq z) = N(z)$ for $z \geq 0$

$P(Z \leq -z) = 1 - N(z)$



z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
0.6	0.2257	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.2549
0.7	0.2580	0.2611	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2967	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3356	0.3389
1.0	0.3413	0.3438	0.3461	0.3485	0.3508	0.3531	0.3554	0.3577	0.3599	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4345	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
2.0	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936
2.5	0.4939	0.4940	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
2.6	0.4953	0.4955	0.4956	0.4957	0.4959	0.4960	0.4961	0.4962	0.4963	0.4964
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.4970	0.4971	0.4972	0.4973	0.4974
2.8	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.4980	0.4981
2.9	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
3.0	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990

STUDENT’S T-DISTRIBUTION

Level of Significance for One-Tailed Test						
df	0.100	0.050	0.025	0.01	0.005	0.0005
Level of Significance for Two-Tailed Test						
df	0.20	0.10	0.05	0.02	0.01	0.001
1	3.078	6.314	12.706	31.821	63.657	636.619
2	1.886	2.920	4.303	6.965	9.925	31.599
3	1.638	2.353	3.182	4.541	5.841	12.294
4	1.533	2.132	2.776	3.747	4.604	8.610
5	1.476	2.015	2.571	3.365	4.032	6.869
6	1.440	1.943	2.447	3.143	3.707	5.959
7	1.415	1.895	2.365	2.998	3.499	5.408
8	1.397	1.860	2.306	2.896	3.355	5.041
9	1.383	1.833	2.262	2.821	3.250	4.781
10	1.372	1.812	2.228	2.764	3.169	4.587
11	1.363	1.796	2.201	2.718	3.106	4.437
12	1.356	1.782	2.179	2.681	3.055	4.318
13	1.350	1.771	2.160	2.650	3.012	4.221
14	1.345	1.761	2.145	2.624	2.977	4.140
15	1.341	1.753	2.131	2.602	2.947	4.073
16	1.337	1.746	2.120	2.583	2.921	4.015
17	1.333	1.740	2.110	2.567	2.898	3.965
18	1.330	1.734	2.101	2.552	2.878	3.922
19	1.328	1.729	2.093	2.539	2.861	3.883
20	1.325	1.725	2.086	2.528	2.845	3.850
21	1.323	1.721	2.080	2.518	2.831	3.819
22	1.321	1.717	2.074	2.508	2.819	3.792
23	1.319	1.714	2.069	2.500	2.807	3.768
24	1.318	1.711	2.064	2.492	2.797	3.745
25	1.316	1.708	2.060	2.485	2.787	3.725
26	1.315	1.706	2.056	2.479	2.779	3.707
27	1.314	1.703	2.052	2.473	2.771	3.690
28	1.313	1.701	2.048	2.467	2.763	3.674
29	1.311	1.699	2.045	2.462	2.756	3.659
30	1.310	1.697	2.042	2.457	2.750	3.646
40	1.303	1.684	2.021	2.423	2.704	3.551
60	1.296	1.671	2.000	2.390	2.660	3.460
120	1.289	1.658	1.980	2.358	2.617	3.373
∞	1.282	1.645	1.960	2.326	2.576	3.291

INDEX

A

absolute risk 32
active risk 32
adverse selection 177
agglomeration 177
algorithmic trading 157
alpha 52, 94
alpha-beta separation 94
alpha coverage 4
American International Group 146
Amihud measure of illiquidity 166
Amihud measure of liquidity 161
appraisal ratio 62
asset allocation attribution 71
asset allocation strategies 95
asset-backed commercial paper 130
asset-backed commercial paper money market
 mutual fund liquidity facility 130, 145
asset concentration 100
asymmetric information 81

B

bank holding company 201
bank run 123, 141
Bear Stearns 146
benchmark rates 175
beta 52
bid-ask spread 153
business model risk 112

C

capital requirements 123
capital structure 96
card monolines 203
central counterparty (CCP) 188
clientele effect 80
commercial paper 129
commercial paper funding facility 129
comparison universe 60
component VaR 20
comprehensive capital analysis and review 201
configuration management tools 215
contagion effect 192
convergence 99
convertible arbitrage strategy 96
corporate bonds 160

counterparty risk 119
credit arbitrage trades 96
credit commitments 132
credit default swaps 161
credit granting 122
credit risk 142
credit value adjustment 120
crown jewels 209
custodian banks 203
cyber hygiene 211
cybersecurity framework 208

D

deal risk 95
dedicated short bias 97
deposit insurance fees 123
detect 208
dispersion 7
distressed securities strategy 95
diversified VaR 13
Dodd-Frank Act 120, 148
dollar funding model 133
dollar-weighted rate of return 57
domino effect 105
due diligence process 106

E

economic risk 35
efficient frontier 23
electronic trading platforms 157
emerging markets 167
emerging markets strategy 97
equities market 165
equity long/short strategy 97
equity market neutral 97
excess money supply 156

F

facilitation revenues 155
Fair and Accurate Credit Transactions Act 212
fair value accounting 123
Federal Reserve 139
filtering algorithms 82
firewall 188, 213
fixed income arbitrage strategy 96
fixed income volatility trades 96
foreign exchange markets 163

fraud risk 113
functional exercise 217
funding constraints 81
funding liquidity 120
funding mechanisms 128
funding risk 33
fund of funds 94

G

global custodian 36
global macro strategy 95
global systemically important banks 191
Gramm-Leach-Bliley Act 211

H

hedge fund strategies 95
high-frequency trading 157

I

identify 208
illiquid assets 79
illiquidity risk premiums 83
incident response plan 215
incident response team 215
incremental VaR 18
individual VaR 14, 26
information asymmetries 176
information ratio 40, 52, 62
infrequent trading 82
integrity monitoring tools 215
interest rate derivatives 159
interest rate swaps 159
internal control assessment 110
intrusion detection systems 214
inventory revenues 155
investment banks 202

J

Jensen's alpha 62

L

Lehman Brothers 144
lender of last resort 139
linear programming 7
liquidity 153
liquidity buffers 143
liquidity coverage ratio 147
liquidity creation 140
liquidity duration 50
loan loss reserve accounting 122
London Interbank Offered Rate 175
long/short equity 97
Long-Term Capital Management 94
loss waterfall 190

M

managed futures 95
manager evaluation 107
marginal VaR 17
market efficiency coefficient 166
market imperfections 80
market maker 86, 155
market participation costs 80
market timing ability 69
maturity transformation 140
merger arbitrage strategy 95
mobile banking 213
money market mutual funds 131
moral hazard 142, 143
mortgage spread trades 96
M-squared (M^2) measure 63
multilateral netting 188

N

network behavior anomaly detection 214
neutralization 2

O

off-the-run issues 157
on-the-run issues 157
operational efficiency 189
order-driven markets 155
overnight indexed swap rate 182

P

peer group comparison 52
plan sponsor risk 35
policy mix 32
portable alpha 68
portfolio insurance 123
portfolio rankings 60
price impacts 81
primary credit facility 144
primary dealer credit facility 145
procyclical activities 122
procyclicality 192
protect 208

Q

quadratic programming 7
quantitative easing 157
quote-driven markets 155

R

recover 208
recovery plan 216
regional banks 203
relative risk 32

repo 131, 159, 182
reporting biases 81
request for quote markets 155
respond 208
risk-adjusted performance measures 60
risk assessment process 209
risk aversion 4
risk budgeting 30, 48
riskless rate 181
risk management evaluation 109
risk management unit 49
risk-mitigating steps 122
risk monitoring 48
risk planning 47
risk sharing asymmetry 99
rollover risk 129

S

sample selection bias 82
scaling 2
screens 6
search frictions 81
securitized products 162
security information and event management
(SIEM) systems 214
selection attribution 72
selection bias 94
self-reporting bias 94
Sharpe ratio 52, 60
Sharpe's style analysis 71
short-term interest rate futures 159
sovereign bonds 158
sovereign risk 120
standard error 67
stratification 6
stress testing 124

style analysis 71, 74
style drift 50
supervisory capital assessment program 201
surplus at risk 33
survivorship bias 52, 81
swap spread trade 96

T

tabletop exercise 217
term auction facility 130, 144
threat 209
time-weighted rate of return 59
tracking error 46
transaction costs 3, 81
Treasury bill rates 181
trend following behavior 95
Treydor measure 61
trimming 2
t-statistic 67
two-rate approach 180

U

undiversified VaR 15
universal banks 203
U.S. dollar LIBOR 179

V

value at risk 46
variance minimizing allocation 20
VIX volatility index 121
volatility regimes 121
vulnerability 209

Y

yield-curve spread trades 96

Required Disclaimers:

CFA Institute does not endorse, promote, or warrant the accuracy or quality of the products or services offered by Kaplan Schweser. CFA Institute, CFA®, and Chartered Financial Analyst® are trademarks owned by CFA Institute.

Certified Financial Planner Board of Standards Inc. owns the certification marks CFP®, CERTIFIED FINANCIAL PLANNER™, and federally registered CFP (with flame design) in the U.S., which it awards to individuals who successfully complete initial and ongoing certification requirements. Kaplan University does not certify individuals to use the CFP®, CERTIFIED FINANCIAL PLANNER™, and CFP (with flame design) certification marks. CFP® certification is granted only by Certified Financial Planner Board of Standards Inc. to those persons who, in addition to completing an educational requirement such as this CFP® Board-Registered Program, have met its ethics, experience, and examination requirements.

Kaplan Schweser and Kaplan University are review course providers for the CFP® Certification Examination administered by Certified Financial Planner Board of Standards Inc. CFP Board does not endorse any review course or receive financial remuneration from review course providers.

GARP® does not endorse, promote, review, or warrant the accuracy of the products or services offered by Kaplan Schweser of FRM® related information, nor does it endorse any pass rates claimed by the provider. Further, GARP® is not responsible for any fees or costs paid by the user to Kaplan Schweser, nor is GARP® responsible for any fees or costs of any person or entity providing any services to Kaplan Schweser. FRM®, GARP®, and Global Association of Risk Professionals™ are trademarks owned by the Global Association of Risk Professionals, Inc.

CAIAA does not endorse, promote, review or warrant the accuracy of the products or services offered by Kaplan Schweser, nor does it endorse any pass rates claimed by the provider. CAIAA is not responsible for any fees or costs paid by the user to Kaplan Schweser nor is CAIAA responsible for any fees or costs of any person or entity providing any services to Kaplan Schweser. CAIA®, CAIA Association®, Chartered Alternative Investment AnalystSM, and Chartered Alternative Investment Analyst Association® are service marks and trademarks owned by CHARTERED ALTERNATIVE INVESTMENT ANALYST ASSOCIATION, INC., a Massachusetts non-profit corporation with its principal place of business at Amherst, Massachusetts, and are used by permission.