KEY CONCEPTS

LO 1.a

Risk arises from the uncertainty regarding an entity's future losses as well as future gains. Risk management includes the sequence of activities aimed to reduce or eliminate an entity's potential to incur expected losses. Risk taking refers specifically to the active assumption of incremental risk in order to generate incremental gains.

LO 1.b

In its basic format, the risk management process is as follows:

Step 1: Identify the risks.

Step 2: Quantify and estimate the risk exposures or determine appropriate methods to transfer the risks.

Step 3: Determine the collective effects of the risk exposures or perform a cost-benefit analysis on risk transfer methods.

Step 4: Develop a risk mitigation strategy (i.e., avoid, transfer, mitigate, or assume risk).

Step 5: Assess performance and amend risk mitigation strategy as needed.

LO 1.c

Value at risk (VaR) states a certain loss amount and its probability of occurring.

Economic capital refers to holding sufficient liquid reserves to cover a potential loss.

Scenario analysis takes into account potential risk factors with uncertainties that are often non-quantifiable.

Stress testing is a form of scenario analysis that examines a financial outcome based on a given "stress" on the entity.

Enterprise risk management takes an integrative approach to risk management within an entire entity, dispensing of the traditional approach of independently managing risk within each department or division of an entity.

LO 1.d

Expected loss considers how much an entity expects to lose in the normal course of business. It can often be computed in advance (and provided for) with relative ease because of the certainty involved.

Unexpected loss considers how much an entity could lose usually outside of the normal course of business. Compared to expected loss, it is generally more difficult to predict, compute, and provide for in advance because of the uncertainty involved.

LO 1.e

There is a trade-off between risk and reward. In very general and simplified terms, the greater the risk taken, the greater the potential reward. However, one must consider the variability of the potential reward. The portion of the variability that is measurable as a probability function could be thought of as risk whereas the portion that is not measurable could be thought of as uncertainty.

LO 1.f

There are eight key classes of risk: (1) market risk, (2) credit risk, (3) liquidity risk, (4) operational risk, (5) legal and regulatory risk, (6) business risk, (7) strategic risk, and (8) reputation risk.

Market risk considers how changes in market prices and rates will result in investment losses. There are four subtypes of market risk: (1) interest rate risk, (2) equity price risk, (3) foreign exchange risk, and (4) commodity price risk.

Credit risk refers to a loss suffered by a party whereby the counterparty fails to meet its financial obligations to the party under the contract. Credit risk may also arise if there is an increasing risk of default by the counterparty throughout the duration of the contract. There are four subtypes of credit risk: (1) default risk, (2) bankruptcy risk, (3) downgrade risk, and (4) settlement risk.

Liquidity risk is subdivided into two parts: (1) funding liquidity risk and (2) trading liquidity risk. Funding liquidity risk occurs when an entity is unable to pay down or refinance its debt, satisfy any cash obligations to counterparties, or fund any capital withdrawals. Trading liquidity risk occurs when an entity is unable to buy or sell a security at the market price due to a temporary inability to find a counterparty to transact on the other side of the trade.

Operational risk considers a wide range of non-financial problems such as inadequate computer systems, insufficient internal controls, incompetent management, fraud, human error, and natural disasters.

Legal risk could arise when one party sues the other party in an attempt to nullify or terminate the transaction. Regulatory risk could arise from changes in laws and regulations that are unfavorable to the entity (e.g., higher tax rates, higher compliance costs).

Business risk revolves around uncertainty regarding the entity's income statement. Revenues may be uncertain because of the uncertainty surrounding the demand for the products and/or the price that should be set. Production and administration costs may also be uncertain.

Strategic risk can be thought of in the context of large new business investments, which carry a high degree of uncertainty as to ultimate success and profitability. Alternatively, it could be thought of from the perspective of an entity changing its business strategy compared to its competitors.

Reputation risk consists of two parts: (1) the general perceived trustworthiness of an entity (i.e., that the entity is able and willing to meet its obligations to its creditors and counterparties) and (2) the general perception that the entity engages in fair dealing and conducts business in an ethical manner.

KEY CONCEPTS

LO 2.a

There are some theoretical reasons for a firm not to hedge risk exposures but most of those reasons make the unrealistic assumption of perfect capital markets, which is not realistic. Also, they ignore the existence of the significant costs of financial distress and bankruptcy. However, in practice, there are some valid reasons not to hedge, including the distraction from focusing on the core business, lack of skills and knowledge, and transaction and compliance costs.

Many reasons exist for a firm to hedge its risk exposures. Key reasons include lowering the cost of capital, reducing volatility of reported earnings, operational improvements, and potential cost savings over traditional insurance products.

LO 2.b

Hedging operational risks tend to cover a firm's income statement activities while hedging financial risks tend to cover the balance sheet. Pricing risk could be thought of as a type of operational risk, requiring the hedging of revenues and costs. Foreign currency risk refers to the risk of economic loss due to unfavorable changes in the foreign currency exchange rate; to the extent that there is production and sales activity in the foreign currency, pricing risk would exist simultaneously. Interest rate risk refers to the risk inherent in a firm's net exposure to unfavorable interest rate fluctuations.

Hedging strategies could be categorized as either static or dynamic, with dynamic strategies being more complex and requiring additional monitoring and transaction costs. Additionally, factors such as time horizon, accounting, and taxation need to be considered within any hedging strategy.

LO 2.c

The board, together with management, should set the firm's risk appetite using one or more of the following tools: qualitative statements of risk tolerance, value at risk, and stress testing. A firm must know its risk and return goals before embarking on a risk management plan. These goals must be clear and actionable.

In hedging specific risk factors, it is necessary to consider the role of the board of directors as well as the process of mapping. There should be clarification whether accounting or economic profits are to be hedged. Likewise, there should be clarification whether short-term or long-term accounting profits are to be hedged. Other points the board should consider include the time horizon and the possibility of implementing definitive and quantitative risk limits.

Mapping risks requires clarification as to which risks are insurable, hedgeable, noninsurable, or nonhedgeable. Mapping risks could be performed for various risks such as market, credit, business, and operational. Essentially, it involves a detailed analysis of the impacts of such risks on the firm's financial position (balance sheet) and financial performance (income statement).

LO 2.d

Once the risks are mapped, management and the board need to determine which instruments to use to manage the risks. The relevant instruments can be classified as exchange traded or over the counter (OTC). Exchange-traded instruments are generally quite standardized and liquid. OTC instruments are more customized to the firm's needs and therefore less liquid. An element of credit risk is also introduced with OTC instruments.

KEY CONCEPTS

LO 3.a

There are numerous best practices in corporate governance, including:

- Board is comprised of a majority of independent members with basic knowledge of the firm's business and industry.
- Board watches out for the interests of all stakeholders, including shareholders and debtholders who may have somewhat differing interests.
- Board is aware of any agency risks and takes steps to reduce them (e.g., compensation committee).
- Board maintains its independence from management (e.g., CEO is not the chairman of the board).
- Board should consider the introduction of a chief risk officer.

There are numerous best practices in risk management, including:

- Board should focus on the firm's economic performance over accounting performance.
- Board should promote a robust risk management process within the firm (e.g., upward mobility for risk management careers).
- Board should set up an ethics committee to uphold high ethical standards within the firm.
- Board should ensure that compensation is based on risk-adjusted performance.
- Board should approve all major transactions.
- Board should always apply professional skepticism to ask probing and relevant questions to management.
- Board should have a risk committee in place.

LO 3.b

The role of the board of directors in governance would include the review and analysis of:

- The firm's risk management policies.
- The firm's periodic risk management reports.
- The firm's appetite and its impact on business strategy.
- The firm's internal controls.
- The firm's financial statements and disclosures.
- The firm's related parties and related party transactions.
- Any audit reports from internal or external audits.
- Corporate governance best practices for the industry.
- Risk management practices of competitors and the industry.

LO 3.c

A firm's risk appetite reflects its tolerance (especially willingness) to accept risk. There is subsequent implementation of the risk appetite into defining the firm's risk limits. Ultimately, there must be a logical relationship between the firm's risk appetite and its business strategy.

LO 3.d

Two mechanisms for transmitting risk governance throughout a firm are the audit committee of the board and the use of a risk advisory director. Additionally, the role of the risk management committee and the compensation committee further transmit risk governance.

LO 3.e

The various functional units within a firm are dependent on one another when it comes to risk management and reporting. Using an investment bank as an example, areas such as valuations, the profit and loss statement, and risk policy require input from more than one of the following units: (1) senior management, (2) risk management, (3) trading room management, (4) operations, and (5) finance.

LO 3.f

The audit committee is responsible for the reasonable accuracy of the firm's financial statements and its regulatory reporting requirements. It must ensure that the firm has taken all steps to avoid the risk that the financial statements are materially misstated as a result of undiscovered errors and/or fraud. In addition to the more visible verification duties, the audit committee monitors the underlying systems in place regarding financial reporting, regulatory compliance, internal controls, and risk management.

KEY CONCEPTS

LO 4.a

An integrated and centralized approach under ERM is significantly more effective in managing a company's risks than under the traditional silo approach of managing and centralizing risks within each risk/business unit. ERM is a comprehensive and integrated framework for managing a firm's key risks to meet business objectives, minimize unexpected earnings volatility, and maximize firm value.

LO 4.b

The key motivations of an ERM initiative include integration of risk organization, integration of risk transfer, and integration of business processes, which lead to increased organizational effectiveness, better risk reporting, and improved business performance, respectively.

LO 4.c

The chief risk officer (CRO) is responsible for all risks facing a company, including market, credit, and operational risks and is responsible for developing and implementing an ERM strategy. The CRO provides overall leadership for ERM and develops policies and standards, including setting the firm's overall risk appetite, measuring and quantifying risks and setting risk limits, and developing risk systems.

The CRO generally reports to the CEO or CFO but could also have a dotted line relationship to both the CEO/CFO and to the board to minimize any potential friction between the CRO and the CEO/CFO (due to excessive risk taking, regulatory issues, or fraud).

An ideal CRO possesses five critical skills: (1) leadership, (2) power of persuasion, (3) ability to protect the firm's assets, (4) technical skills to understand all risks, and (5) consulting skills to educate the board and business functions on risk management.

LO 4.d

A strong ERM framework has seven main components: (1) corporate governance, (2) line management, (3) portfolio management, (4) risk transfer, (5) risk analytics, (6) data and technology resources, and (7) stakeholder management.

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1. James Lam, *Enterprise Risk Management: From Incentives to Controls*, 2nd Edition, (Hoboken, NJ: John Wiley & Sons, 2014), 53.

KEY CONCEPTS

LO 5.a

Methods to determine the optimal level of risk exposure include targeting a certain default probability or credit rating and sensitivity or scenario analysis. In targeting a certain default probability or credit rating, a bank should not always aim to earn the highest credit rating possible because the rating would likely involve a large opportunity cost as the bank would have to forego risky projects that could otherwise provide high profits. Sensitivity or scenario analysis involves a bank determining its optimal level of risk exposure by the impact of specific shocks. There would be an analysis of the adverse impacts on the value of a bank due to changes in interest rates, foreign exchange rates, inflation, et cetera.

The optimal level of risk depends on the specific focus of the bank's activities (e.g., lending, deposits, derivatives), so it will differ among banks.

LO 5.b

Banks need to take on an optimal amount of risk in order to maximize shareholder value while satisfying the constraints imposed by bank regulators. If a bank takes on too little risk compared to its optimal level, it may not generate sufficient returns for its shareholders, which could decrease the value of the bank. Taking on too much risk may also decrease the value of a bank.

LO 5.c

Investing in risk management might not be worth its cost if incremental changes in risk taken do not result in much change in the value of a bank. On the other hand, risk management may add value if taking on incremental risk would otherwise result in excessive total risk and a significant decrease in the value of a bank.

If a bank adopts an inflexible risk management process in order to manage the bank's risk below a set acceptable threshold level, it may not allow for any value creation. In contrast, a more flexible risk management system may allow the bank to take on profitable risks and take advantage of investment opportunities that could increase its value.

The risk management function of a bank can add value by requiring business units to take the perspective of the entire bank when making decisions regarding risks.

LO 5.d

Risk management through hedging alone will not result in risk management becoming a passive activity due to (1) risk measurement technology limitations, (2) hedging limitations, and (3) risk taker incentive limitations.

Ideally, the risk management function within a bank would be independent of the activities of the business lines. However, risk management involves both a verification function and advising on whether to accept or reject a risky project based on established risk limits. Therefore, such independence is difficult to achieve in practice. In addition, if the risk management process is viewed as a form of internal policing, then the necessary dialogue between risk managers and business unit managers will not exist.

All individual banking units must consider their ability to adjust their VaR by trading efficiently to ensure that, overall, the bank is making optimal use of its ability to take risk and maximizing its profits.

Firmwide VaR is not likely to account for all of the bank's risks, especially operational risks. The aggregation of market, credit, and operational risks in arriving at a firmwide risk measure needs to consider the correlation estimates between such risks, although in practice, there is usually insufficient data available to make such estimates accurately. Different types of risk will lead to differing statistical distributions. For example, market risk can be approximated by a normal distribution, but credit and operational risks follow a non-normal distribution, which makes them more challenging to quantify.

LO 5.e

It is difficult to demonstrate that a bank's governance has a significant impact on its risk profile and performance for three main reasons. First, very limited data exists on how the risk function operates in banks. Second, risk function characteristics are also affected by the bank's risk appetite (in addition to governance). Third, it is possible that at the firm level, poor performance will occur even in the presence of strong governance.

Incentives must be designed so that they do not merely reward managers for performance based on their respective business units alone. Incentives should reward managers for taking risks that create value for the overall bank while at the same time penalize them for taking risks that destroy value.

Two studies examined the impact of culture. One of these studies concluded that companies where managers were perceived as honest and trustworthy were more profitable and were given higher valuations. The other study concluded that shareholder governance improvements would change a firm's culture from focusing on employee integrity and customer service to focusing on end results.

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1. Lingel, Anna, and Elizabeth Sheedy. "The Influence of Risk Governance on Risk Outcomes—International Evidence" (working paper, Macquarie University, 2012).

2. Berg, Tobias. "Playing the Devil's Advocate: The Causal Effect of Risk Management on Loan Quality" (working paper, Bonn University, 2014).

LO 6.a

Drysdale Securities was able to borrow $300 million in unsecured funds from Chase Manhattan by exploiting a flaw in the system for computing the value of collateral.

The head of the government bond trading desk at Kidder Peabody, Joseph Jett, reported substantial artificial profits. After the false profits were detected, $350 million in previously reported gains had to be reversed.

Hidden trading losses at Barings induced Nick Leeson to abandon hedging strategies in favor of speculative strategies. A lack of operational oversight and his dual roles as trader and settlement officer allowed him to conceal his activities and losses.

A currency trader for Allied Irish Bank, John Rusnak, hid $691 million in losses. Rusnak bullied back-office workers into not following-up on trade confirmations for imaginary trades.

UBS's equity derivatives business lost millions in 1997 and 1998. The losses were mostly due to incorrect modeling of long-dated options and the firm's stake in Long-Term Capital Management.

Jérôme Kerviel, a junior trader at Société Générale, participated in unauthorized trading activity and concealed this activity with fictitious offsetting transactions. The fraud resulted in $7.1 billion in losses and severely damaged the reputation of Société Générale.

Extreme leverage, a lack of diversification, and inadequate risk models put Long-Term Capital Management in a cash flow crisis when an economic shock created intolerable marked to market losses and margin calls. A forced liquidation of its huge positions drove prices down, further compounding their losses.

The financial crisis at Metallgesellschaft resulted fundamentally from cash flow timing differences associated with the positions making up its hedge. Cash flows on short forward contracts occurred over the distant future. Cash flows on long futures contracts occurred daily. In addition, the sizes of the positions were so large that it prevented the company from liquidating its positions without incurring large losses.

Bankers Trust developed derivative structures that were intentionally complex and prevented Procter & Gamble and Gibson Greetings from fully understanding the trade values and risks that were involved. In taped phone conversations, BT's staff bragged about how badly they fooled clients.

JPMorgan Chase and Citigroup were the main counterparties in Enron's derivative transactions. After the Enron scandal was revealed, these investment banks agreed to pay a $286 million fine for assisting with fraud against Enron shareholders.

KEY CONCEPTS

LO 7.a

The two main factors that led to the housing bubble were:

1. Cheap credit: Large capital inflows from abroad plus the Fed's lax interest rate policy lead to a low interest rate environment in the United States, making mortgages less expensive for borrowers.
2. Decline in lending standards: The originate-to-distribute model allowed banks to offload risk to investors, which led to falling lending standards because banks had less incentive to exercise care when approving and monitoring loans.

LO 7.b

The originate-to-distribute model and asset-liability maturity mismatches were two key banking industry trends that led to the mortgage crisis and resulting liquidity squeeze.

LO 7.c

The originate-to-distribute model refers to the process through which banks create securities based on an underlying pool of mortgages, bonds, or other loans and then sell the securities to investors. By originating and selling the securitized assets, the banks transfer the default risk of borrowers to the investors.

Banks, via structured investment vehicles (SIVs), used commercial paper and repurchase agreements (repos) to roll over short-term financing for investing in long-term assets. The banks' mismatches in asset-liability maturities exposed the banks to funding liquidity risk.

LO 7.d

The financial crisis that stemmed from rising mortgage delinquencies and falling housing prices led to a worldwide liquidity crisis because institutions had (1) taken on too much leverage, (2) generated large maturity mismatches between assets and liabilities, and (3) become too interconnected.

LO 7.e

Funding liquidity refers to the ability of an institution to settle its obligations when they are due. Market liquidity refers to the ease with which an asset can be sold without having to lower the price to attract a buyer.

Loss spiral refers to the forced sale of an asset by a leveraged investor to maintain margin or leverage ratio requirements. A margin spiral refers to the forced sale of an asset as a result of an increase in margins or, equivalently speaking, a decline in the leverage ratio.

LO 7.f

Network risk arises as a result of an increase in counterparty credit risk, which forces contracting parties to seek additional protection and liquidity enhancement. In the absence of a clearinghouse that could facilitate multilateral netting arrangements, an increase in

counterparty credit risk can produce systemic effects, as evidenced by the recent global financial crisis.

KEY CONCEPTS

LO 8.a

The main trigger of the financial crisis was the prospect of losses on subprime mortgages. In the first half of 2007, housing prices in the United States started to decline, causing several subprime mortgage lenders to file for bankruptcy and subsequently fail. These losses became amplified as they had a ripple effect that spread to the main vulnerabilities of the crisis, asset-backed commercial paper (ABCP) and repurchase agreements.

LO 8.b

When housing prices declined and homeowners defaulted on their mortgage loans, it reduced the value and prices of ABCP. These declining prices resulted in bank runs on shadow banks and money market mutual funds (MMFs) and signaled the start of a liquidity crisis.

The liquidity crisis continued to spread into repo agreements with the average haircut going from near zero at the beginning of 2007 to 25% by September of 2008 (Lehman Brothers bankruptcy).

LO 8.c

The Lehman Brothers bankruptcy filing in September 2008 is considered the tipping point in the financial crisis. It eroded confidence and caused a run on MMFs. This lack of confidence spread across markets and countries, amplifying losses in the subprime mortgage market.

LO 8.d

The recent financial crisis was not unique compared to previous banking crises. It followed a similar pattern of increased public and private debt, increased credit supply, and increased housing prices preceding and leading to the crises.

LO 8.e

The two main panic periods of the financial crisis were August 2007 and September 2008 through October 2008. The first panic period in August 2007 occurred when there were runs on ABCP. The start of the second panic period was September 2008 when Lehman Brothers filed for bankruptcy.

Lehman's failure caused a run on a particular MMF called Reserve Primary, which contained commercial paper issued by Lehman. The run on Reserve Primary spread to other MMFs, which started a contagion effect that spread to other assets that were falling in price in tandem with rising haircuts.

LO 8.f

The International Monetary Fund (IMF) studied 13 developed countries and their responses to the financial crisis. This resulted in 153 separate policy actions that were divided into 5 subgroups consisting of interest rate change, liquidity support, recapitalization, liability guarantees, and asset purchases.

To measure the impact of interest rate cuts, the IMF used the economic stress index (ESI) and the financial stress index (FSI). Liquidity support was measured using interbank spreads and the FSI. Recapitalization, liability guarantees, and asset purchases were measured using the FSI and an index of credit default swaps (CDSs) on banks.

The evidence suggests that the most effective measures taken were the liquidity support stabilizing the interbank markets before the Lehman failure and recapitalization (capital injections), which was considered the most effective tool after the Lehman failure.

LO 8.g

Studies done on the effects of the global financial crisis on corporations and consumers pointed out that as the global recession strengthened, the demand for credit decreased.

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2. Carmen M. Reinhart and Kenneth S. Rogoff, "From Financial Crash to Debt Crisis," *American Economic Review* 101(5) (2011): 1676–706.

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4. International Monetary Fund, *Global Financial Stability Report, October 2009: Navigating the Financial Challenges Ahead* (Washington, D.C.: International Monetary Fund, 2009).

5. Victoria Ivashina and David Scharfstein, "Bank Lending During the Financial Crisis of 2008," *Journal of Financial Economics* 97(3) (2010): 319–38.

6. Manju Puri, Jörg Rocholl, and Sascha Steffen, "Global Retail Lending in the Aftermath of the US Financial Crisis: Distinguishing Between Supply and Demand Effects," *Journal of Financial Economics* 100(3) (2011): 556–78.

7. Murillo Campello, John R. Graham, and Campbell R. Harvey, "The Real Effects of Financial Constraints: Evidence from a Financial Crisis," *Journal of Financial Economics* 97(3) (2010): 470–87.

KEY CONCEPTS

LO 9.a

Risk management involves assessing, communicating, monitoring, and managing risks.

A large loss does not necessarily mean that risk management has failed. Losses are the result of risk taking, which is required for value creation.

LO 9.b

Risk management can fail if the firm does not do the following: measure risks correctly, recognize some risk, communicate risks to top management, monitor and manage risks, and use appropriate metrics.

LO 9.c

Mismeasurement can occur when management does not understand the distribution of returns of a single position or the relationships of the distributions among positions and how the distributions and correlations can change over time. Mismeasurement can also occur when managers must use subjective probabilities for rare and extreme events. The subjective probabilities can be biased from firm politics.

Failing to take known and unknown risks into account can take three forms: (1) ignore a risk that is known, (2) failure to incorporate a risk into risk models, and (3) not finding all risks. All three of these are variations of the same concept and can have similar results (e.g., failure to measure overall risk or expanding operations to areas where risk is not being properly measured).

Senior managers must understand the results of risk management in order for it to be meaningful. Unless senior managers have the correct information to make decisions, risk management is pointless.

Risk managers must recognize how risk characteristics change over time. Many securities have complex relationships with market variables. Having an adequate incentive structure and firm-wide culture can help with the risk monitoring and managing process.

LO 9.d

Risk metrics such as VaR are usually too narrow in scope. For example, VaR usually assumes independent losses across periods of time. Risk metrics generally fail to capture the effect of a firm's actions on the overall market and behavior patterns such as predatory trading.

KEY CONCEPTS

LO 10.a

There are three major steps in deriving the CAPM:

1. Recognize that since investors are only compensated for bearing systematic risk, beta is the appropriate measure of risk.

2. By knowing that portfolio expected return is a weighted average of individual expected returns and portfolio beta is a weighted average of the individual betas, we can show that portfolio return is a linear function of portfolio beta. Since arbitrage prevents mispricing of assets relative to systematic risk (beta), an individual asset's expected return is a linear function of its beta.

3. Use the risk-free asset and the market portfolio, which are two points on the security market line, to solve for the intercept and slope of the CAPM. The equation for CAPM is:

$$E(R_i) = R_F + [E(R_M) - R_F]\beta_i$$

LO 10.b

The capital asset pricing model (CAPM), derived by Sharpe, Lintner, and Mossin, expresses the expected return for an asset as a function of the asset's level of systematic risk (measured by beta), the risk-free rate, and the market risk premium (the expected return of the market minus the risk-free rate). There are several assumptions underlying the CAPM.

- Investors face no transaction costs.
- Assets are infinitely divisible.
- There are no taxes.
- Investors are price takers whose individual buy and sell decisions have no effect on asset prices.
- Investors' utility functions are based solely on expected portfolio return and risk.
- Unlimited short-selling is allowed.
- Investors are only concerned about returns and risk over a single period, and the single period is the same for all investors.
- All investors have the same forecasts of expected returns, variances, and covariances.
- All assets are marketable.

LO 10.c

The capital market line (CML) expresses the expected return of a portfolio as a linear function of its standard deviation, the market portfolio's return and standard deviation, and the risk-free rate.

$$E(R_C) = R_F + \left[\frac{E(R_M) - R_F}{\sigma_M}\right]\sigma_C$$

LO 10.d

The expected return for an asset can be computed using the CAPM given the risk-free rate, the market risk premium, and an asset's systematic risk.

LO 10.e

Beta can be calculated using the following equation:

$$\beta_i = \frac{\text{Cov}_{i,M}}{\sigma_M^2}$$

Portfolio beta is the weighted average of the asset betas in a portfolio.

KEY CONCEPTS

LO 11.a

Three commonly used risk/return measures are:

- Treynor measure of a portfolio = $\left[\dfrac{E(R_P) - R_F}{\beta_P} \right]$

- Sharpe measure of a portfolio = $\left[\dfrac{E(R_P) - R_F}{\sigma_P} \right]$

- Jensen measure of a portfolio = $\alpha_P = E(R_P) - [R_F + [E(R_M) - R_F]\beta_P]$

These three risk measures give different perspectives and may give different rankings for portfolios. A portfolio with low diversification may have a higher Treynor measure, a higher alpha, but a lower Sharpe measure than another portfolio.

Alpha can be modified by the use of other reference portfolios.

LO 11.b

Tracking error and the information ratio build upon Jensen's alpha. Tracking error is the standard deviation of alpha over time. The information ratio is the average alpha over time divided by the tracking error.

The Sortino ratio should be used when there is more focus on the likelihood of loss:

$$\textbf{Sortino ratio} = \frac{E(R_P) - R_{min}}{\sqrt{MSD_{min}}}$$

The MSD_{min} is a semi-variance that only measures the variability of the portfolio's return observations below R_{min}.

LO 12.a

The inputs to a multifactor model, for any stock, are:

- Expected return for the stock.
- Factor betas.
- Deviation of macroeconomic factors from their expected values.
- Firm-specific return.

The factor beta equals the sensitivity of the stock return to a 1-unit change in the factor. The firm-specific return is that portion of the stock's return that is unexplained by the macro factors. The expected value of the firm-specific return equals zero, because, by definition, firm-specific events are random.

LO 12.b

The equation for a *k*-factor model is: $R = E(R) + \beta_1 F_1 + \beta_2 F_2 + \ldots + \beta_k F_k + e$. The return equals its expected value if none of the macro factors deviate from their expected values and if the firm-specific return equals zero. If macro factor F_j deviates from its expected value, then F_j is nonzero. If the firm experiences a nonfactor related surprise, then the firm-specific component, e, will be nonzero. The multifactor model can be used to calculate the expected return after new macroeconomic and/or firm-specific information is released.

LO 12.c

Risk reduction benefits achieved through diversification come from reducing nonsystematic risk. Therefore, the expected return on a well-diversified portfolio is determined by systematic risk as measured by beta.

A single-factor security market line (SML) is analogous to the capital asset pricing model (CAPM). In the single-factor SML, systematic risk is measured as the exposure of the asset to a well-diversified market index portfolio. The index portfolio can be any well-diversified portfolio thought to be highly correlated with the systematic factor that affects the returns of assets. The equation for the single-factor SML for any well-diversified portfolio is: $E(R_P) = R_F + \beta_P[E(R_M) - R_F]$, where R_F is the risk-free rate, M is an observable well-diversified market index, and β_P is the beta of any portfolio, P, relative to the market index.

LO 12.d

A multifactor model can be used to hedge away multiple factor risks. To do so, the investor can create factor portfolios, which are well-diversified portfolios with beta equal to one for a single risk factor, and betas equal to zero on the remaining risk factors. Factor portfolios can be used to hedge multiple risk factors by combining the original portfolio with offsetting positions in the factor portfolios.

LO 12.e

Arbitrage pricing theory describes expected returns as a linear function of exposures to common (i.e., macroeconomic) risk factors: $E(R_i) = R_F + \beta_{i1}RP_1 + \beta_{i2}RP_2 + \ldots + \beta_{ik}RP_k$, where RP_j is the risk premium associated with risk factor j.

The CAPM is a special case of the APT where there is only one priced risk factor (market risk).

The Fama-French three-factor model describes returns as a linear function of the market index return, firm size, and book-to-market factors. The firm size factor, SMB, equals the difference in returns between portfolios of small and big firms. The book-to-market factor, HML, equals the difference in returns between portfolios of high and low book-to-market firms.

LO 13.a

Benefits that accrue from effective risk data aggregation and reporting include:
(1) an increased ability of managers and the board to anticipate problems, (2) enhanced ability to identify alternative routes to restore financial health in times of financial stress, (3) improved resolvability in the event of bank stress or failure, and (4) an enhanced ability to make strategic decisions, increasing the bank's efficiency, reducing the chance of loss and ultimately increasing bank profitability.

LO 13.b

The governance principle (Principle 1) suggests that risk data aggregation should be part of the bank's overall risk management framework. The board and senior management should assure that adequate resources are devoted to risk data aggregation and reporting.

LO 13.c

The data architecture and IT infrastructure principle (Principle 2) states that a bank should design, build, and maintain data architecture and IT infrastructure which fully supports its risk data aggregation capabilities and risk reporting practices not only in normal times but also during times of stress or crisis, while still meeting the other principles. It stresses that banks should devote considerable financial and human resources to risk data aggregation and reporting.

LO 13.d

Principles 3–6 specify standards and requirements for effective risk data aggregation. Banks should ensure that the data is accurate and has integrity (Principle 3), is complete (Principle 4), is timely (Principle 5), and is adaptable to the end user (Principle 6). In addition, the bank should not have high standards for one principle at the expense of another. Aggregated risk data should exhibit all of the features together, not in isolation.

LO 13.e

Principles 7–11 specify standards and requirements for effective risk reporting practices. Risk reports should be accurate (Principle 7), comprehensive (Principle 8), and clear and useful (Principle 9). Principle 10 states that reports should be "appropriately frequent" (i.e., frequency depends on the role of the recipient—board members need reports less frequently than risk committee members). Reports should be distributed to relevant parties in a timely fashion while maintaining confidentially (Principle 11).

LO 13.f

Principles 12–14 specify standards and requirements for supervisory review, remedial actions, and cooperation. Supervisors should ensure compliance with the Principles on a regular basis (Principle 12), use remedial actions to address risk data aggregation and reporting deficiencies (Principle 13), and cooperate with supervisors in other jurisdictions regarding supervision of the Principles (Principle 14).