2026

FRM®

Exam Prep

Schweser's Secret Sauce®

Part I

KAPLAN SCHWESER

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FRM Part 1

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SCHWESER'S SECRET SAUCE®: 2026 FRM® PART I

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ABOUT THIS REVIEW GUIDE

Schweser's Secret Sauce® is intended to serve as a focused and practical companion after your initial studies. This concise book distills the most critical concepts, definitions, and exam strategies from the extensive FRM Part I curriculum. It is designed for efficient review, portability, and quick reference during the final phase of exam preparation.

It is important to emphasize, however, that not every learning objective in the curriculum is addressed in detail. To build a comprehensive understanding, we strongly encourage you to utilize this guide as a review of the material from the SchweserNotes™, the official FRM curriculum, and additional practice resources. Repetition and consistent review are important components of successful mastery on exam day.

As a reminder, the 2026 FRM Part I topic area coverage and weightings assigned by GARP are as follows:

Book	Topic Area	Exam Weight	Exam Questions
1	Foundations of Risk Management	20%	20
2	Quantitative Analysis	20%	20
3	Financial Markets and Products	30%	30
4	Valuation and Risk Models	30%	30

Earning the FRM designation is a significant undertaking. The breadth and depth of the material require diligence, discipline, and perseverance. There are no shortcuts to genuine understanding of the material. Your preparation should be thorough and systematic, making full use of the suite of study tools available to you, including the SchweserNotes™, OnDemand Classes, SchweserPro™ QBank, and Mock Exams.

By pursuing the FRM credential, you are joining a distinguished global community of investment professionals dedicated to advancing the practice and principles of risk management. Whether you are seeking career advancement, a transition to a new role, or an enhancement of your investment acumen, the knowledge and skills you acquire in this program will serve you well throughout your professional journey.

On behalf of the entire Kaplan Schweser team, we thank you for selecting us as your educational partner. We extend our best wishes for your studies and look forward to your future achievements as a certified Financial Risk Manager.

FOUNDATIONS OF RISK MANAGEMENT

Study Sessions 1–3

Weight on Exam	20%
SchweserNotes™ Reference	Book 1

STUDY SESSION 1: RISK MANAGEMENT OVERVIEW

The Building Blocks of Risk Management

Cross-reference to GARP FRM Part I Foundations of Risk Management, Chapter 1.

Risk

In an investing context, **risk** is the uncertainty surrounding outcomes. Investors are generally more concerned about negative outcomes (unexpected investment losses) than they are about positive surprises (unexpected investment gains). Additionally, there is an observed natural tradeoff between risk and return; opportunities with high risk have the potential for high returns while those with lower risk have lower return potential.

The concept of **risk taking** refers to the active acceptance of incremental risk in the pursuit of incremental gains. In this context, risk taking can be thought of as an opportunistic action.

Risk Management Process

The **risk management process** is a formal series of actions designed to determine if the perceived reward justifies the expected risks. A related query is whether the risks could be reduced and still provide an approximately similar reward.

The four components of the risk management process are as follows:

1. Identify risks.
2. Analyze and measure risks.
3. Evaluate the impact of risk events.
4. Manage risks.

The risk management process involves a four-way decision. The company might decide to *avoid* risk directly by selling a product line, avoiding certain markets or jurisdictions, or offshoring production. They also might decide to *retain* risk, depending on the expected rewards relative to the probability and frequency of any expected losses. Another option is to *mitigate* risk by reducing either the magnitude or the frequency of exposure to a given risk factor. Finally, risk managers could *transfer* risk to a third party using derivatives or structured products. They could also purchase insurance to outsource risk to an insurance company.

One of the challenges in ensuring that risk management will be beneficial to the economy is that risk must be sufficiently dispersed among willing and able participants in the economy.

Another challenge of the risk management process is that it has failed to consistently assist in preventing market disruptions or preventing financial accounting fraud (due to corporate governance failures).

In addition, the use of derivatives as complex trading strategies could assist in overstating the financial position (i.e., net assets on the balance sheet) of many entities and complicating the level of risk assumed by many entities.

Finally, risk management may not be effective on an overall economic basis because it only involves risk transferring by one party and risk assumption by another party.

Measuring and Managing Risk

Value at risk (VaR) calculates an estimated loss amount given a certain probability of occurrence. For example, a financial institution may have a one-day VaR of $2.5 million at the 95% confidence level. This would be interpreted as having a 5% chance that there will be a loss greater than $2.5 million on any given day. VaR is a useful measure for liquid positions operating under normal market circumstances over a short period of time. It is less useful and potentially dangerous when attempting to measure risk in non-normal circumstances, in illiquid positions, and over a long period of time.

Note that VaR does not capture the extent of risk in the tails of the distribution. A way to address this limitation is by measuring the **expected shortfall (ES)**. ES is computed by averaging the VaRs that surpass a specified tail probability (i.e., ES measures extreme losses beyond the VaR threshold).

Economic capital is the amount of liquid capital necessary to cover unexpected losses. For example, if one-day VaR is $2.5 million, and the entity holds $2.5 million in liquid reserves, then they have sufficient economic capital (i.e., they are unlikely to go bankrupt in a one-day expected tail risk event).

Scenario analysis is a process that considers potential future risk factors and the associated alternative outcomes.

Stress testing is a form of scenario analysis that examines a financial outcome based on a given "stress" on the entity. With **reverse stress testing**, the firm evaluates its potential losses and then analyzes how those losses are connected to its activities and exposures.

In practice, the term **enterprise risk management (ERM)** refers to a general process by which risk is managed within an organization. An ERM system is highly integrative in that it is deployed at the enterprise level and not siloed at the department level. The value of this top-down approach is that risk is not considered independently, but rather in relation to its potential impact on multiple divisions of a company.

Expected and Unexpected Loss

Expected loss (EL) considers how much an entity expects to lose in the normal course of business. These losses can be calculated through statistical analysis with relative reliability over short time horizons. The EL of a portfolio can generally be calculated as a function of (1) the probability of a risk occurring, (2) the dollar exposure to the risk event, and (3) the expected severity of the loss if the risk event does occur.

In a banking context, EL could be modeled as the product of a borrower's probability of default (PD), the bank's exposure at default (EAD), and the magnitude of the loss given default (LGD).

$$EL = PD \times EAD \times LGD$$

Unexpected loss (UL) considers how much an entity could lose in excess of their average (expected) loss scenarios. There are considerable challenges involved with predicting unexpected losses because they are, by definition, unexpected.

Relationship Between Risk and Reward

There is a natural tradeoff between risk and reward. In general, 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 (EL), whereas the portion that is not measurable could be thought of as uncertainty (UL).

One of the biggest structural concerns is the potential for **conflicts of interest**. Those in the position to be most aware of the presence, probability, and potential impact of various risk factors are sometimes the ones who try to profit from its presence. This reality could be seen in the actions of rogue traders. It may also be seen from managers who conceal knowledge of a risk factor to maximize short-term stock price movements to enhance personal compensation through stock-based remuneration structures.

Types of Risk

All firms face risks. These risks can be sub-categorized as market risks, credit risks, liquidity risks, operational risks, legal and regulatory risks, business and strategic risks, and reputation risks.

Market risk refers to the fact that market prices and rates are continually in a state of change. The four key subtypes of market risk are interest rate risk, equity price risk, foreign exchange (currency) risk, and commodity price risk. The key to mitigating these risks is to understand the relationship between positions. As these relationships change, risk management methods need to change as well.

Credit risk refers to a loss suffered by a party whereby the counterparty fails to meet its contractual obligations. Credit risk may 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) counterparty/settlement risk.

Liquidity risk is subdivided into two parts: (1) funding liquidity risk and (2) market liquidity risk. If liquidity risk becomes systemic, it could lead to elevated credit risk (e.g., a potential default scenario).

Operational risk refers to potential losses flowing from inadequate (or failed) internal processes, human error, or an external event.[1] The details of operational risk could relate to factors such as inadequate computer systems (*technology risk*), insufficient internal controls, incompetent management, fraud (e.g., losses due to intentional falsification of information), employee mistakes (e.g., losses due to incorrect data entry or accidental deletion of a file), natural disasters, cyber security risks, or rogue traders.

Legal risk is the potential for litigation to create uncertainty for a firm. **Regulatory risk** refers to uncertainty surrounding actions by a governmental entity.

Business risk refers to variability in inputs that influence either revenues (e.g., customer demand trends, product pricing policies, etc.) or cost structures (e.g., the cost of production inputs, supplier negotiations, etc.). Diverse business elements such as new product innovations, shipping delays, and production cost overruns could also be labeled as business risks.

Strategic risk involves long-term decision-making about fundamental business strategy. These long-term strategic initiatives may involve large capital investments in either equipment or human capital.

Reputation risk is the danger that a firm will suffer a loss in public perception (or consumer acceptance) due to either (1) a loss of confidence in the firm's financial soundness or (2) a perception of a lack of fair dealing with stakeholders. Reputation risk is often one of the outcomes of experiencing a loss in another risk category.

Risk Factor Interactions

A significant danger in risk management occurs when independent risk factors are correlated. For example, a granular factor that leads to default risk for a loan could ultimately spill over into credit risk, operational risk, business risk, and reputation risk. This is most dangerous with unexpected losses. Realizing the potential for correlation between risks will help a risk manager measure and manage unexpected losses with marginally more certainty. For example, a risk manager could consider historical correlations between identified risk factors and forecast the nature of these relationships to measure the risk planning process.

VaR and economic capital are both useful metrics that provide valuable information to risk managers. Risk-adjusted return on capital (RAROC) can also be calculated for comparison purposes. However, VaR should not be relied upon as a stand-alone risk metric because it is based on certain assumptions, is sensitive to input parameters, and there are various types of VaR calculations. Despite these limitations, VaR, economic capital, and RAROC are helpful tools for risk managers to better understand a firm's overall aggregate risk exposure.

How Do Firms Manage Financial Risk?

Cross-reference to GARP FRM Part I Foundations of Risk Management, Chapter 2.

Strategies for Risk Management

At a high level, a firm can pick from four different risk management strategies. Senior management and the board of directors are ultimately responsible for strategy selection, but risk managers can help inform the decision-making process. The risk management strategies are as follows:

1. Accept the risk.
2. Avoid the risk.
3. Mitigate the risk.
4. Transfer the risk.

Risk acceptance could be done to actively include a risk factor in company performance or because the risk is being passed through to customers. Risk could also be avoided. If risk is retained, then it may be desirable to mitigate it through deal enhancement (i.e., more collateral on a loan or investing in new technology to offset a known risk). Risk can also be transferred to a third party, but this introduces counterparty risk into the equation.

Risk Appetite Relative to Risk Decision-Making

Risk appetite refers to the level (and types) of risk that a firm is willing to retain. There are two very important subcomponents: risk willingness and risk ability. *Risk willingness* relates to a firm's desire to accept risk in pursuit of its business goals, while *risk ability* can put a cap on risk willingness for various reasons. The most common reasons for reduced risk ability are internal risk controls (to keep risk in a desired range) and regulatory constraints.

After a firm establishes its risk appetite, it should assemble an inventory of all known risks. This process is called **risk mapping**, and it is the next logical step in the risk management process. This robust approach systematically considers any risk with a known (or potential) cash impact on the firm. Every type of risk (i.e., market risk, credit risk, liquidity risk, operational risk, legal and regulatory risk, business and strategic risk, and reputation risk) is considered. Risk managers should incorporate any known interactions between risk factors in terms of correlation risk or the possibility that one risk might cancel out the cash impact of another risk (i.e., there might be a risk netting that occurs).

Hedging Risk Exposures

Some of the benefits of deploying a hedging strategy include reduced costs, smoother operating performance, enhanced business planning, and the ability to lock in positive results in the short term. Some of the disadvantages include the potential for managerial focus to be shifted away from core operations, compliance costs, the possibility that new risks might be introduced in an attempt to minimize other risks, and the high level of complexity associated with many hedging strategies. Common challenges in the risk management process include misunderstanding or mismapping risk exposures, managing changes with risk variables in dynamic markets, and internal communication breakdowns.

Hedging Operational and Financial Risks

Hedging operational risk covers a firm's activities in production and sales (i.e., expenses and revenue). These operational risks can be considered income statement risks. However, financial risk relates to a firm's balance sheet (i.e., assets and liabilities). By making the realistic assumption that there are some imperfections in the financial markets, a firm could benefit from hedging financial risk. Hedging activities should cover both the firm's assets and liabilities to fully account for the risks.

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.

Impact of Risk Management Tools

A firm needs to decide if its hedging strategy is a one-off event or if it is part of a broader risk management need. This decision is sometimes referred to as *rightsizing* a risk management program. The financial markets are very dynamic, and a broadly applied risk management strategy requires investment in complex systems and the hiring of experienced traders. There are several risk limits that need to be understood and potentially controlled depending on the results of the risk mapping process (e.g., stop-loss limit, notional limit).

Derivative instruments could be used to physically manage risk, including forward contracts, futures contracts, swap contracts, call option contracts, put option contracts, exotic option contracts, and swaption contracts.

Financial instruments used to hedge risks can be classified as exchange traded or over the counter (OTC). **Exchange-traded instruments** cover only certain underlying assets and are quite standardized (e.g., maturities and strike prices) in order to promote liquidity in the marketplace. **OTC instruments** are privately traded between a bank and a firm and thus can be customized to suit the firm's risk management needs. In exchange for the customization, OTC instruments are less liquid and more difficult to price than exchange-traded instruments. In addition, there is credit risk by either of the counterparties (e.g., default risk) that would generally not exist with exchange-traded instruments.

The Governance of Risk Management

Cross-reference to GARP FRM Part I Foundations of Risk Management, Chapter 3.

Governance After the Global Financial Crisis

The financial crisis of 2007–2009 has been linked to several risk management failures.

The following is a list of some of the key lessons learned from risk management failures during the financial crisis, with respect to the banking industry:

- The needs of all stakeholders must be considered.
- The board needs to have competent and independent directors.
- The board needs to take a highly proactive role in the firm's risk management process.
- The firm's risk appetite needs to be clearly articulated by the board.
- Compensation should be structured to better align management behavior with long-term stakeholder priorities as determined by the board.

Basel III and the Dodd-Frank Act were also issued in response to the financial crisis of 2007–2009. Their goals are to focus banks on capital adequacy measures and to prevent commercial banks from engaging in proprietary trading (among other things).

Governance of Risk Management Best Practices

Best practices in corporate governance include factors like board member independence, competency standards for board members, consideration of all stakeholders, and structuring managerial compensation packages to flow out of risk management goals. There should also be a separation between the CEO and the chairperson of the board so that there is true accountability (i.e., there needs to be two different individuals, not one). One of the duties of

the board is to supervise the risk management process. Best practices for risk management include adequately mapping risks and specifying an enterprise-level risk appetite, which needs to be communicated throughout the organization.

Risk Governance

The board of directors has ultimate responsibility for enterprise-level risk management. If the board does not have sufficient expertise to adequately understand, map, and manage the firm's risk exposures, then they need to recruit a **risk advisory director** (an independent expert in industry-specific risk factors) to the board and to the risk management committee. The **risk management committee** will make all risk appetite decisions and then bring these discussions back to the full board for its awareness. The **compensation committee** is charged with aligning managerial compensation with long-term stakeholder needs.

Risk Appetite vs. Business Strategy

A firm's risk appetite reflects its tolerance (especially willingness) to accept risk. The subsequent implementation of the risk appetite in defining the firm's risk limits sets some bounds to its business strategy and to its ability to exploit business opportunities. The board needs to develop/approve the firm's risk appetite as well as assist management in developing the firm's overall strategic plan.

Interdependence of Functional Units

The various functional units within a firm are dependent on each other when it comes to risk management and reporting. Senior management, business units, finance and operation functions, and risk management all work together to conduct the firm's risk management process. Frontline managers are vital in this process, and the CRO communicates progress to senior management and the risk committee on a very regular basis.

Audit Committee

The audit committee is a subcommittee of the full board. Members traditionally monitor compliance with accounting standards, but they also have a role to play in the supervision of risk management policies. They need to verify that policies are being followed and offer opinions on the variables used in testing exposures, as well as the functional value of the current risk management systems. These opinions are informed by internal auditors and are collected and transferred to the full board for further consideration.

Credit Risk Transfer Mechanisms

Cross-reference to GARP FRM Part I Foundations of Risk Management, Chapter 4.

Types of Credit Derivatives

Credit risk, the risk of a borrower defaulting, is the core risk exposure held by a bank. Three derivative products helped to transfer credit risk leading up to the financial crisis of 2007–2009: credit default swaps (CDSs), collateralized debt obligations (CDOs), and collateralized loan obligations (CLOs).

Credit default swaps (CDSs) are financial derivatives that pay off when the issuer of a reference instrument (e.g., a corporate bond or a securitized fixed-income instrument) defaults. This is a very direct way to measure and transfer credit risk. These derivatives

function like an insurance contract in which a buyer makes regular (quarterly) premium payments, and in return, they receive a payment in the event of a default.

A **collateralized debt obligation (CDO)** is a structured product that banks can use to unburden themselves of credit risk. These financial assets are repackaged loans, which are then sold to investors on the secondary markets. A CDO could include some combination of **asset-backed securities (ABSs)** which could include mortgages (commercial or residential), auto loans, credit card debt, or some other loan product. Typically, the loans included in a CDO are heavily biased toward mortgage debt through a securitized basket of mortgages called a **mortgage-backed security (MBS)**. When a CDO consists only of mortgage loans, it is technically known as a **collateralized mortgage obligation (CMO)**.

A **collateralized loan obligation (CLO)** is a structured product that is very similar to a CDO. Like a CDO, they are a bundle of repackaged loans that are organized into tranches. However, a CLO's constituent loans are predominantly bank loans, which have typically been exposed to a rigorous underwriting process. CLOs did not experience the same level of defaults that plagued the CDO market (largely due to heavy exposure to mortgages in the CDO space). For this reason, CLOs continued to attract investor interest in the wake of the financial crisis of 2007–2009, while CDOs quickly lost interest.

Reducing Credit Risk Exposure

Beyond the direct use of credit derivatives, banks have several traditional approaches that can be used to transfer credit risk. These mechanisms include purchasing third-party insurance, exposure netting, marking-to-market, requiring collateral, adding termination clauses, and possibly loan reassignment. Another option is to syndicate a loan. In this approach, a lead bank will retain some of the loan and find other banks to hold the remainder of the desired loan amount. These approaches may involve credit derivatives as part of the risk mitigation strategy.

Credit Derivatives in the Global Financial Crisis

The existence of credit derivatives did not cause the financial crisis of 2007–2009, but the misuse of these products certainly did. Investors used CDS contracts for speculation rather than risk mitigation. Collateralized debt obligations also held a very complex mixture of mortgages that included both subprime loans and adjustable-rate loans.

There was a perfect storm when the Federal Reserve began raising rates, adjustable-rate loans attained their reset date and produced unaffordable payments, and the housing market declined, causing home prices to drop. This confluence of factors led to massive defaults that rippled through the MBS and CDO markets. Banks then became reluctant to lend to each other while some were going bankrupt. As typically happens after a crisis, new regulation was created. Dodd-Frank was formed to better regulate the credit derivatives space and to keep bank trading in check. The SEC also added Section 15G to further protect investors.

Securitization and Special Purpose Vehicles

Securitization is the general process of repackaging loans into a bundled new product that can be sold to investors on the secondary markets. This process involves four key steps:

Step 1: Create a **special purpose vehicle (SPV)**, which is an off-balance sheet legal entity that functions as a semi-hidden subsidiary of the issuing parent company. An SPV will

hold financial assets in such a way that is opaque for investors to analyze.

Step 2: The SPV will use borrowed funds to purchase loan assets from one bank or possibly several banks to create structured products (e.g., CMO, CDO, or CLO).

Step 3: The SPV's constituent loans will be arranged either by seniority or credit rating and structured into tranches to form risk layers within the SPV.

Step 4: The various tranches are then sold to investors on the secondary markets.

When sourcing loans, banks can choose between two high-level business models. The traditional model is referred to as the **buy-and-hold strategy**. In this approach, banks will source a loan and then retain it on their books. They enjoy periodic interest payments to compensate for holding credit risk. The innovation enabled by securitization is the **originate-to-distribute (OTD) model**. The OTD model involves banks sourcing loans with the explicit intention of securitizing them and selling the structured products to investors. With this model, banks do not retain credit risk, and they are paid a fee for sourcing the loans that feed into the securitized products rather than receiving interest payments, which belong to the investors in the structured products. The incentive in the OTD model is to generate high loan volume, not high-quality loans, which is the incentive in the buy-and-hold model.

STUDY SESSION 2: PRICING MODELS AND ENTERPRISE RISK MANAGEMENT

Modern Portfolio Theory (MPT) and The Capital Asset Pricing Model (CAPM)

Cross-reference to GARP FRM Part I Foundations of Risk Management, Chapter 5.

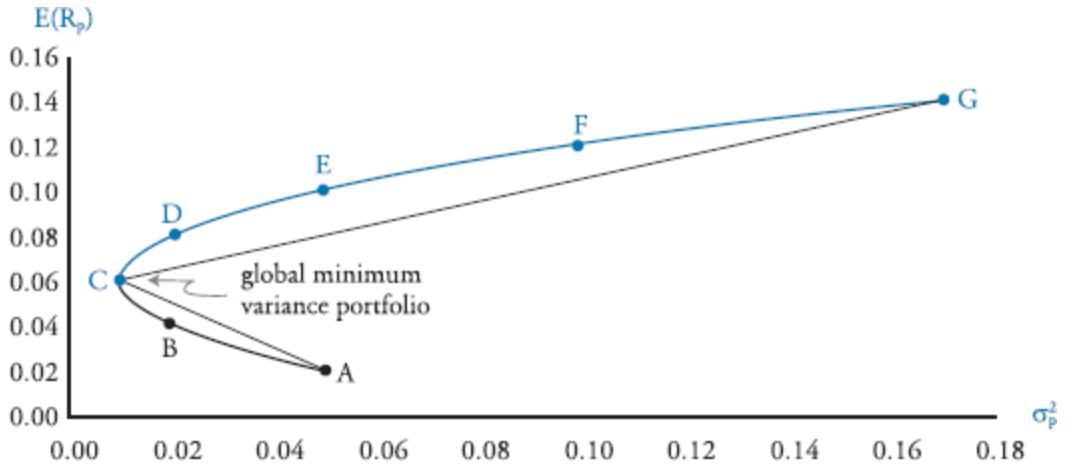
Modern Portfolio Theory

One of the most notable market risk researchers was Harry Markowitz. He laid the foundation for modern portfolio theory in the early 1950s. Markowitz's portfolio theory makes the following assumptions:

- *Returns are normally distributed*. This means that when evaluating utility, investors only consider the mean and the variance of return distributions.
- *Investors are rational and risk-averse*. Markowitz defines a rational investor as someone who seeks to maximize utility from investments.
- *Capital markets are perfect*. This implies that investors do not pay taxes or commissions.

Rational investors maximize portfolio return per unit of risk. Plotting all those maximum returns for various risk levels produces the **efficient frontier**, which is represented by the blue curve passing through C-D-E-F-G, shown in Figure 1.1.

Figure 1.1: Efficient Frontier



In general, any portfolio below the efficient frontier is, by definition, inefficient, whereas any portfolio above the efficient frontier is unattainable. In the absence of a risk-free asset, the only efficient portfolios are the portfolios on the efficient frontier. Investors choose their position on the efficient frontier depending on their relative risk aversion.

Capital Market Line

In the presence of riskless lending and borrowing, the efficient frontier transforms from a curve to a line tangent to the previous curve. Investors will choose to invest in some combination of their tangency portfolio and the risk-free asset. Assuming investors have identical expectations regarding expected returns, standard deviations, and correlations of all assets, there will be only one tangency line, which is referred to as the **capital market line (CML)**.

The equation of the CML is:

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

Capital Asset Pricing Model

The **capital asset pricing model (CAPM)** was developed by William Sharpe and John Lintner in the 1960s. It builds on the ideas of modern portfolio theory and the CML in that investors are assumed to hold some combination of the risk-free asset and the market portfolio. Its key assumptions are:

- Information is freely available.
- Frictionless markets.
- Fractional investments are possible.
- Perfect competition.
- Investors make their decisions solely based on expected returns and variances.
- Market participants can borrow and lend unlimited amounts at the risk-free rate.
- Homogenous expectations.

Estimating and Interpreting Systematic Risk

The expected returns of risky assets in the market portfolio are assumed to depend only on their relative contributions to the market risk of the portfolio. The systematic risk of each asset represents the sensitivity of asset returns to the market return and is referred to as the asset's **beta**. Beta is computed as follows:

$$\beta_i = \frac{\text{covariance of Asset i's return with the market return}}{\text{variance of the market return}}$$

$$= \frac{\text{cov}_{i,M}}{\sigma_M^2} = \rho_{i,M} \times \frac{\sigma_i}{\sigma_M}$$

Deriving and Applying the CAPM

A straightforward CAPM derivation recognizes that expected return

- only depends on beta (company-specific risk can be diversified away) and
- is a linear function of beta.

The CAPM equation is:

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

This implies that the expected return of an investment depends on the risk-free rate R_F, the MRP, $[R_M - R_F]$, and the systematic risk of the investment, β. The expected return, $E(R_i)$, can be viewed as the *minimum required return*, or the *hurdle rate*, that investors demand from an investment, given its level of systematic risk. Estimating hurdle rates accurately is very important. If investors use an inflated hurdle rate, they may incorrectly forgo valuable investment opportunities. If, on the other hand, the rate used is too low, investors may purchase overvalued assets. The graphical depiction of the CAPM equation is known as the **security market line (SML)**.

EXAMPLE: Expected return on a stock

Assume you are assigned the task of evaluating the stock of Sky-Air, Inc. To evaluate the stock, you calculate its required return using the CAPM. The following information is available:

Expected market risk premium	5%
Risk-free rate	4%
Sky-Air beta	1.5

Using the CAPM, **calculate** and **interpret** the expected return for Sky-Air.

Answer:

The expected return for Sky-Air is:

$$E(R_{SA}) = 0.04 + 1.5(0.05) = 0.115 = 11.5\%$$

Measures of Performance

The **Sharpe measure** is equal to the risk premium divided by the standard deviation, or total risk:

$$\text{Sharpe ratio} = \left[\frac{E(R_P) - R_F}{\sigma_P}\right]$$

The **Treynor measure** is equal to the risk premium divided by beta, or systematic risk:

$$\text{Treynor ratio} = \left[\frac{E(R_P) - R_F}{\beta_P}\right]$$

The **Jensen measure** (or Jensen's alpha or just **alpha**) is the asset's excess return over the return predicted by the CAPM:

$$\text{Jensen's alpha} = \alpha_P = E(R_P) - \{R_F + [E(R_M) - R_F]\beta_P\}$$

In all three cases, for a given portfolio, the higher the better. The two that are most similar are the Treynor and Sharpe measures. They both normalize the risk premium by dividing by a measure of risk. Investors can apply the Sharpe measure to all portfolios because it uses total risk, and it is more widely used than the other two measures. The Treynor measure is more appropriate for comparing well-diversified portfolios. Jensen's alpha is the most appropriate for comparing portfolios that have the same beta.

Tracking error is the term used to describe the standard deviation of the difference between the portfolio return and the benchmark return. This source of variability is another source of risk to use in assessing the manager's success.

The **information ratio (IR)** divides the portfolio expected return in excess of the benchmark expected return by the tracking error:

$$IR = \frac{E(R_P - R_B)}{\text{tracking error}} = \frac{\text{active return}}{\text{active risk}}$$

The **Sortino ratio** is reminiscent of the Sharpe measure except for two changes. First, we replace the risk-free rate with a *minimum acceptable return*, denoted R_{MIN}. This return could be determined by the needs of the investor, or it can sometimes be set equal to the risk-free rate. Second, we replace standard deviation with *downside deviation*:

$$\text{Sortino ratio} = \frac{R_P - R_{MIN}}{\text{downside deviation}}$$

The Arbitrage Pricing Theory and Multifactor Models of Risk and Return

Cross-reference to GARP FRM Part I Foundations of Risk Management, Chapter 6.

Arbitrage Pricing Theory

The capital asset pricing model (CAPM) measures the expected return of a financial asset with respect to the broad market only. Arbitrage pricing theory (APT) is a type of multifactor model that expands upon the CAPM to consider any number of macroeconomic factors that may add additional explanatory power to the expected returns of a financial asset. There is not a set series of macroeconomic factors to consider, which presents analysts with a great deal of flexibility. APT also has simplified assumptions relative to the CAPM.

According to arbitrage pricing theory, the expected return for security *i* can be modeled as shown here. The idea is to model systematic risk on a more granular level using a series of risk factors.

$$R_i = E(R_i) + \beta_1 F_1 + \beta_2 F_2 + \ldots + \beta_k F_k + e_i$$

where:

R_i = actual return on stock *i*
$E(R_i)$ = expected return on stock *i*
β_1 = beta (factor sensitivity) for factor 1
F_1 = first in a series of risk factors that could add return deviation from the expected return
β_k = beta (factor sensitivity) for factor *k*
F_k = last in a series of risk factors that could add return deviation from the expected return
e_i = random error term that accounts for company-specific (idiosyncratic) risk

Multifactor Model Inputs

The first input is the expected return for the stock in question. This type of multifactor model will then offer a series of adjustments that attempt to capture known variables that would influence the returns of a stock (or portfolio). A beta (factor sensitivity) is needed for each variable included in the model, and a value is needed for each factor as well. The error term (e_i) represents a firm-specific return that is otherwise unexplained by the model.

Calculating Expected Returns

A single-factor model will only consider the impact of one factor on a dependent variable (a stock's return). This leaves the potential for either company-specific risk or uncaptured systematic risk to influence asset returns. A multifactor model enables analysts to better model the impact of all systematic risk exposures to improve forecasting ability.

Accounting for Correlation

The part of an individual security's risk that is uncorrelated with the volatility of the market portfolio is that security's **nonsystematic risk** (or *diversifiable risk*). The part of an individual security's risk that arises because of the positive covariance of that security's returns with overall market returns is called its **systematic risk**. As the number of securities in a portfolio becomes large, the portfolio's nonsystematic risk approaches zero. In other

words, portfolio risk reduction through diversification comes from reducing nonsystematic risk. Therefore, when a risky security is added to a well-diversified (efficient) portfolio, the portfolio's risk is only affected by the systematic risk of that security.

Hedging Exposure to Multiple Factors

Consider an investor who manages a portfolio with the following factor betas:

GDP beta = 0.50

consumer sentiment beta = 0.30

Assume the investor wishes to pursue strategies to hedge exposure to GDP risk, or to consumer sentiment risk, or to both factor risks. The following explanation makes use of **factor portfolios**, which are well-diversified portfolios with a beta equal to one for a single risk factor and a beta equal to zero on all remaining factors.

Now, assume the investor wishes to hedge away GDP factor risk yet maintain the 0.30 exposure to consumer sentiment. To do so, the investor should combine the original portfolio with a 50% short position in the GDP factor portfolio. The GDP factor beta on the 50% short position in the GDP factor portfolio equals –0.50, which perfectly offsets the 0.50 GDP factor beta on the original portfolio. The combined long and short positions hedge away GDP risk but retain the consumer sentiment exposure.

Fama-French Three-Factor Model

A major weakness of APT is that it provides no guidance on which other factors to include in a multifactor model. In 1996, economists Eugene Fama and Kenneth French famously specified a multifactor model with three factors: (1) a risk premium for the market, (2) a factor exposure for "small minus big," and (3) a factor exposure for "high minus low."[2] *Small minus big (SMB)* is the difference in returns between small firms and large firms. This factor adjusts for the size of the firm because smaller firms often have higher returns than larger firms. *High minus low (HML)* is the difference between the return on stocks with high book-to-market metrics and ones with low book-to-market values. A high book-to-market value means that the firm has a low price-to-book metric (book-to-market and price-to-book are inverses). This last factor basically means that firms with lower starting valuations are expected to potentially outperform those with higher starting valuations.

The **Fama-French three-factor model** is as follows:

$$E(R_i) = R_F + \beta_{i,M}RP_M + \beta_{i,SMB}F_{SMB} + \beta_{i,HML}F_{HML} + e_i$$

Principles for Effective Data Aggregation and Risk Reporting

Cross-reference to GARP FRM Part I Foundations of Risk Management, Chapter 7.

Benefits of Risk Data Aggregation

According to the Basel Committee on Banking Supervision, **risk data aggregation** means "defining, gathering and processing risk data according to the bank's risk reporting requirements to enable the bank to measure its performance against its risk

tolerance/appetite." The aggregation process includes breaking down, sorting, and merging data and datasets. Risk management reports should reflect risks in a reliable way.

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.

Financial models are used by banks for everything from analyzing risk exposures to guiding daily operations. Even small errors that occur in the model development process may result in serious consequences for a bank. Models rely on data, so data acquisition is an important component of model risk, specifically input risk. Model developers must demonstrate that the data used in model development is consistent with the theory and methodologies behind the model. Models must be vetted and validated.

Governance

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 ensure that adequate resources are devoted to risk data aggregation and reporting.

Data Architecture and Infrastructure

The data architecture and IT infrastructure principle (Principle 2) states that a bank should design, build, and maintain data architecture and IT infrastructure that 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.

Risk Data Aggregation Capabilities

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 hold high standards for one principle at the expense of another. Aggregated risk data should display all relevant features collectively rather than in isolation.

Effective Risk Reporting Practices

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 confidentiality (Principle 11).

Enterprise Risk Management (ERM) and Future Trends

Cross-reference to GARP FRM Part I Foundations of Risk Management, Chapter 8.

Enterprise Risk Management

An integrated and centralized approach under **enterprise risk management (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.

ERM Motivations

There are three primary motivations for a firm to implement an ERM initiative: (1) integration of risk organization, (2) integration of risk transfer, and (3) integration of business processes. The respective benefits are better organizational effectiveness, better risk reporting, and improved business performance. However, implementation of an integrated firm-wide initiative is costly (both capital and labor intensive) and time consuming. This process could last several years and requires ongoing senior management and board support.

ERM Best Practices

Corporate governance is critical in the implementation of a successful ERM program and ensures that senior management and the board have the requisite organizational practices and processes to adequately control risks.

A successful corporate governance framework requires that senior management and the board adequately define the firm's risk appetite and risk and loss tolerance levels. In addition, management should remain committed to risk initiatives and ensure that the firm has the required risk management skills and organizational structure to successfully implement the ERM program.

ERM Program Dimensions

ERM is organized around the following five important dimensions:

1. *Targets.* Banks should set the correct risk targets. Targets include the following:
   - Risk appetite.
   - Strategic goals in light of the firm's risk appetite.
2. *Structure*. As part of the ERM structure, the roles of relevant parties are defined (i.e., Chief Risk Officer, global risk committee, other risk committees) along with a description of the firm's governance structure.
3. *Identification and metrics*. Enterprise risks must be measured in terms of the impact on the firm, the severity of the risks, and, ideally, the frequency of occurrence.
4. *ERM strategies*. Firms must articulate the methods and strategies that will be used to manage risks at the whole-firm and business-line levels.
5. *Culture*. A firm must instill in its employees the importance of risk management through the goals, practices, and behaviors of those in top management positions on down through the ranks of the firm.

Risk Culture Characteristics and Challenges

The **risk culture** of a firm is the goals, customs, values, and beliefs (both implicit and explicit) that influence the behavior of employees. These corporate norms guide individuals in their understanding and responses to risk.

Firms need methods to measure progress in terms of risk culture. One method is to identify the *key risk culture indicators* of the firm. The Financial Stability Board (FSB) has specified four risk indicators:

1. Tone from the top of the organization.
2. Effective communication and challenge.
3. Incentives.
4. Accountability.

Scenario Analysis and Stress Testing

Sensitivity analysis involves changing one variable at a time and assessing the sensitivity of the model (e.g., assessing the impact on net income) to that one variable. **Scenario analysis**, on the other hand, looks at multiple variables at once and involves developing a narrative to explain why variables change and the effects of those changes. Sophisticated financial models are developed to assess the impact of various scenarios on the risks and performance of the enterprise.

Since the financial crisis of 2007–2009, regulators have required banks to use scenario analysis and stress testing in capital planning. U.S. stress testing of banks began in 2009 with the initial Supervisory Capital Assessment Program (SCAP). Since 2011, the Federal Reserve has conducted annual stress tests. In addition, the Dodd-Frank Act required stress testing (Dodd-Frank Act stress tests or DFAST) and the Comprehensive Capital Analysis and Reviews (CCAR) to be conducted at year-end for banks with $50 billion or more in assets. While the scenarios for DFAST and CCAR are the same (devised by supervisors), DFAST is more prescriptive, requires less reporting, and has limited capital action assumptions. Results from stress testing are used to help banks in capital planning and in maintaining capital adequacy.

STUDY SESSION 3: CASE STUDIES AND CODE OF CONDUCT

Learning from Financial Disasters

Cross-reference to GARP FRM Part I Foundations of Risk Management, Chapter 9.

Interest Rate Risk

Interest rate risk is the potential for loss due to fluctuations in interest rate levels. The degree of sensitivity to interest rate risk is classically measured with **duration**. The magnitude of this risk can be illustrated using an example of the **savings and loan (S&L) industry** in the 1980s. All commercial banks, S&Ls included, accept short-term demand deposits from customers and use those funds to make long-term loans. Their goal is to capture the spread between the rate paid for short-term deposits (liabilities from the bank's perspective) and the rate received on longer-term loans (assets from the bank's perspective).

When short-term interest rates were raised by the Federal Reserve (in response to elevated inflation), S&Ls lost their profit center. Many entered into riskier loans to make up the difference. The result was the collapse of their industry, which required a federal bailout. Banks have risk mitigation tools in the form of duration matching between assets and liabilities and various derivatives products.

Liquidity risk is the risk that an entity might not be able to meet short-term cash requirements. This risk can materialize from external market conditions, from internal operational issues, from structural (i.e., balance sheet) challenges, or from a mix of these three. The collapses of Lehman Brothers, Continental Illinois, and Northern Rock all illustrated the danger inherent in this risk. Each of these banks funded long-term assets (i.e., loans) with short-term funding sources. This created a financial disaster when the short-term funding was no longer available due to external events. Banks must balance the need to reduce liquidity risk with the cost of doing so.

Hedging Strategies

Devising an effective hedging strategy is a challenging and potentially rewarding undertaking. It requires access to relevant data, access to appropriate statistical tools, and the right model for the analysis task at hand. Once a firm decides that it wants to hedge a known risk, it needs to decide whether it wants to deploy a static or a dynamic strategy.

A **static hedging strategy** involves buying a hedging instrument that closely matches the position to be hedged.

A **dynamic hedging strategy** deploys a hedging instrument and then rebalances the hedged position on a frequent basis (e.g., daily, monthly, quarterly).

In 1991, **Metallgesellschaft Refining and Marketing (MGRM)**, an American subsidiary of Metallgesellschaft (MG), an international trading, engineering, and chemicals conglomerate, implemented a marketing strategy designed to insulate customers from price volatility in the petroleum markets for a fee.

MGRM offered customers contracts to buy fixed amounts of heating oil and gasoline at a fixed price over a 5- or 10-year period. The fixed price was set at a $3 to $5 per barrel premium over the average futures price of contracts expiring over the next 12 months. Customers were given the option to exit the contract if the spot price rose above the fixed price in the contract, in which case MGRM would pay the customer half of the difference between the futures price and contract price. A customer might exercise this option if she did not need the product or if she were experiencing financial difficulties. In later contracts, the customer could receive the entire difference in exchange for a higher fixed contract price.

The customer contracts effectively gave MGRM a short position in *long-term forward contracts*. MGRM hedged this exposure with long positions in *near-term futures* using a **stack-and-roll hedging strategy**.

Gains and losses on forward contracts are realized at the agreement's expiration, whereas futures contracts are marked to market such that the gains and losses are realized on a daily basis. In MGRM's case, gains and losses on its customer contracts were realized if and when the customers took delivery, which would occur over a 5- to 10-year period.

During 1993, oil prices dropped from a high of about $21 per barrel to about $14 per barrel, resulting in losses of $900 million on MGRM's long positions, which were realized immediately as the futures contracts were marked to market. The offsetting gains on their customer

contracts, however, would not be realized for years to come, which created potential short-term cash outflows and resulted in **funding liquidity risk**. Declining oil prices also created margin calls that exacerbated the cash flow problem. Due to these losses, MG ordered MGRM to close out its customer contracts. This forced the firm to unwind its positions at very unfavorable terms.

The cash outflows might have been tolerable and possibly balanced out by cash inflows over the life of the hedge were it not for the sheer size of MGRM's position, which would have taken 10 days to liquidate. To liquidate without affecting market prices would have taken 20 to 55 days. As a result, the company lacked the liquidity to unwind its positions, if necessary, without significant market impact, and was therefore subject to **trading liquidity risk**. To make matters worse, MGRM was carrying a heavy debt load and had little equity to withstand losses and cash flow problems on positions of this size.

Model Risk

Sophisticated financial products use mathematical models to determine their current value. These models could be theoretical (e.g., capital asset pricing model [CAPM]) or statistically based (e.g., term structure of interest rates). The use of models introduces model risk, which potentially involves the following:

1. Using the wrong model for estimation
2. Incorrectly specifying a model
3. Using incomplete data
4. Deploying the wrong estimators
5. Making the wrong assumptions

Niederhoffer Case

Victor Niederhoffer was a very successful hedge fund trader. He developed what he thought was a low-risk strategy to harvest put option premiums. He would write very large quantities of deeply out-of-the-money (OTM) put options on the S&P 500 Index. In October 1997, a crisis in Asia spilled over to the U.S. markets and produced a 7% drop in a single trading session. The result was a $50 million margin call, which Niederhoffer could not meet. His fund's brokers liquidated all put contracts, which locked in substantial losses and wiped out the entire fund's equity position.

Long-Term Capital Management (LTCM) Case

LTCM was founded in 1994. The hedge fund's principals included former Federal Reserve Board Vice-Chairman David Mullins, Nobel laureates Robert Merton and Myron Scholes, and a collection of highly experienced traders from Salomon Brothers' bond arbitrage trading desk. Before LTCM's collapse in the late 1990s, it had $4.8 billion in equity and $125 billion in assets. This translated into a 25:1 leverage ratio. A 1% return from its core strategy (i.e., spread normalization) would feel like a 25% gain for the levered fund. This **balance sheet leverage** does not account for the true underlying **economic leverage**. The notional value of LTCM's assets was over $1 trillion at this time! The staggering use of leverage was possible because financial institutions often waived initial margin requirements based on the reputation of the principals, freeing up capital to take on even more leverage.

Long-Term Capital Management's downfall was triggered by an action of the Russian government in August 1998. In a surprise move, the Russians defaulted on their own debt

and devalued their currency. This created a *flight to quality* (i.e., an extreme movement to assets perceived as safe) where investors rushed to buy the exact assets that LTCM had been shorting (i.e., U.S. Treasuries and German bunds). The result was a decline in the value of LTCM's assets by just over 40% ($2 billion of their $4.8 billion in equity) in one month.

The failure of LTCM was due to model error. Management did not properly anticipate increased correlations in the event of a global crisis. They actually adjusted correlations higher in their models, but the adjustment did not go anywhere close to the actual correlation spike caused by the cascading external economic shocks. They also did not properly forecast the volatility that actually appeared in the markets. The model risk led to a liquidity risk crisis for LTCM, which ultimately destroyed the company.

London Whale Case

JPMorgan is one of the largest financial holding companies in the United States. It is also one of the largest derivatives dealers (particularly credit derivatives) in the world. In early 2012, its Chief Investment Officer (CIO) was tasked with managing $350 billion in excess demand deposits. It used this money to make massive bets on synthetic credit derivatives that ultimately cost the bank $6.2 billion in trading losses and temporarily disrupted global markets. The London Whale case highlighted that when risk limits are breached or trades look unprofitable, risk managers should never adjust assumptions or valuation models to make bad decisions look better.

Barings Bank Case

The bank was founded in London in 1762, and it was the world's second-oldest merchant bank. In 1992, an employee named Nick Leeson moved to Singapore to become the local head of operations. His mission was to execute client trades on the Singapore stock exchange.

From an accounting perspective, Leeson's trading actions looked like they were making a large return for Barings Bank. The reality was that Leeson also controlled the back-office accounting of his own trades, and he managed the reporting through a hidden reconciliation account that was never reported to the home office. What appeared to be a £102 million profit in 1994 was actually a £200 million loss. This could have been prevented with better internal controls flowing out of a healthy skepticism at reported results that differed from what should have been expected given the types of trades placed.

Financial Engineering

The building blocks for financial engineering are forwards, futures, swaps, options, and securitized products. By using these tools, a risk manager could hedge either a granular risk exposure or a basket of risk exposures.

Risk managers need to be careful about which goal a hedging strategy is pursuing. In its purest sense, a hedging strategy can be used for risk mitigation. Alternatively, some firms have used hedging strategies to enhance returns. This second strategy usually adds more layers of risk rather than mitigating current exposures. From considering cases on Bankers Trust, Orange County, and Sachsen Landesbank, risk managers should clearly see the need to fully understand hedging tools before deploying them.