Foundations of Risk Management

FRM一级培训项目-强化班

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Framework

- **Part One：Introduction to Risk management**
  - Basic risk types
  - The importance of risk management
  - The governance of risk management
  - The process of risk management
  - Main measurement tools
  - Main management tools
  - Enterprise risk management

Basic Risk Types

Typology of Risk Exposures

- **Market risk is the risk that changes in financial market prices and rates will reduce the value of a security or a portfolio.**
  - Equity price risk
  - Interest rate risk
    - ✓ Trading risk
    - ✓ Gap risk (the risk that arises in the balance sheet of an institution)
  - Currency (Foreign exchange) risk
  - Commodity price risk
- **Market risk is driven by:**
  - General market risk (systematic risk).
  - Specific risk (idiosyncratic risk).

Typology of Risk Exposures

- **Credit Risk:** the risk of an economic loss from the failure of a counterparty to fulfil its contractual obligations, or from the increased risk of default during the term of the transaction.
- **Credit risk is driven by:**
  - Probability of default
  - Exposure amount at default
  - Loss given default
- **Credit risk type:**
  - Default risk
  - Bankruptcy risk
  - Downgrade risk
  - Settlement risk

Typology of Risk Exposures

- **Operational Risk** refers to potential losses resulting from inadequate or failed internal processes, people, and systems or from external events.
- It **includes legal risk,** but **excludes business, strategic and reputational risk.**
  - **Human factor risk**
    - ✓ ***Human factor risk*** is a special form of operational risk. Such as pushing the wrong button on a computer.
  - **Technology risk**
    - ✓ ***Technology risk,*** principally computer systems risk, also falls into the operational risk category.
  - **AML Risk**
    - ✓ Anti-money laundry and financing for terrorism.

Typology of Risk Exposures

- **Cyber Risk**
  - ✓ The risk of hackers stealing and destroying data and compromising systems
- **Data Privacy Risk**
- **Model risk**
  - ✓ The risk of potential indirect costs of relying on models

Typology of Risk Exposures

- **Business Risk:** lies at the heart of any business and includes all the usual worries of firms, such as customer demands, pricing decisions, supplier negotiations, and product innovation management.
- **Strategic Risk:** involves making critical, long-term decisions about the firm's direction, often accompanied by major investments of capital, human resources, etc.
- **Reputation Risk:** the danger that a firm will suffer a sudden fall in its market standing or brand with economic consequences.

The Importance of Risk Management

Is Risk Management Useful?

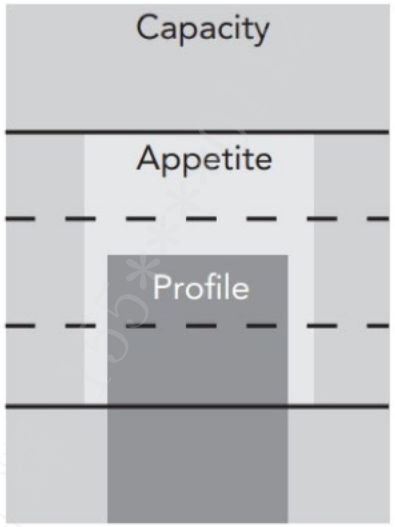
- **Risk management and risk taking aren't opposites, but two sides of the same coin.**
  - Together they drive all our modern economies.
  - It's all about making forward-looking choices about risk in relation to reward.
- **Blames for Risk Management**
  - Fail to prevent market disruptions or accounting scandals.
  - Derivative markets make it easier to take on large amount of risk.
  - Sophisticated financial engineering lead to the violent implosion of firms.
  - Only transfer risks to other firms.
  - Work to the short-term benefit.

How Does Risk Management Add Value?

- **The goal of risk management for banks:**
  - To determine the optimal level of risk that maximizes bank value;
  - Subject to the constraints imposed by regulators, laws, and regulations.
- **A tradeoff between return and risk:**
  - Cost of taking on a single new risk < gain.
  - Risk-taking decisions must be assessed in terms of their impact on the overall risk.
  - Major challenge: the tradeoff cannot be made in real time.
- **Two ways that risk management can destroy value:**
  - Fail to ensure that the bank has the right amount of risk.
  - Fail to exercise the right amount of flexibility.

Risk Appetite

- The risk appetite is set well below the firm's total risk bearing capacity, and above the amount of risk the firm is exposed to currently (labeled here as the firm's risk profile).



Risk appetite as a metric.

The Governance of Risk Management

Introduction

- **Corporate governance**
  - The way in which companies are run.
  - Describes the roles and responsibilities of a firm's shareholders, board of directors, and senior management, etc.
  - Three main regulatory acts making standards of corporate governance
    - ✓ Sarbanes-Oxley Act
    - ✓ Basel III
    - ✓ Dodd-Frank Act

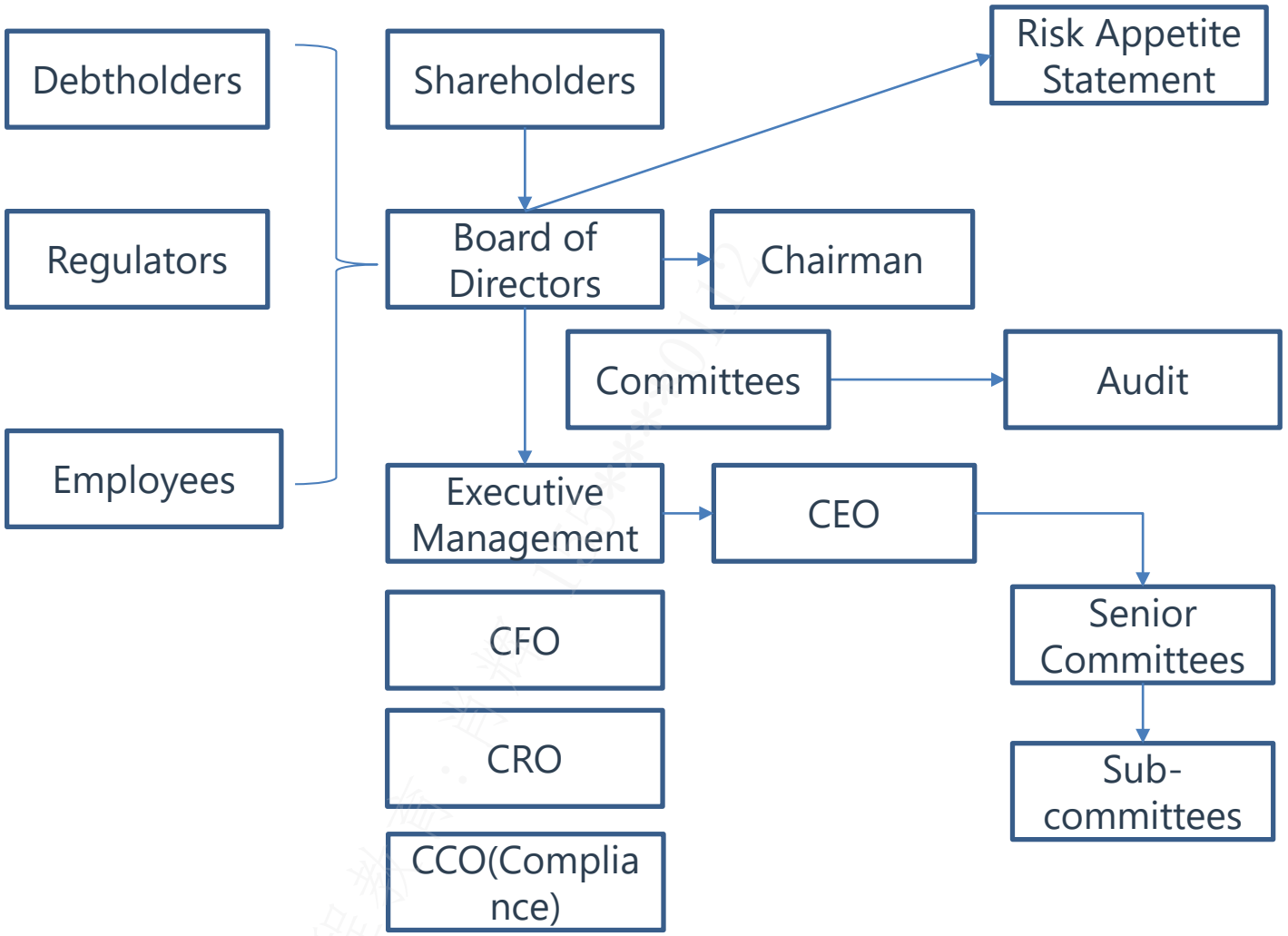
Dodd-Frank Act

- The Dodd-Frank Act aims to prevent another significant financial crisis by creating new financial regulatory processes that enforce transparency and accountability while implementing rules for consumer protection.
  - Strengthening the Federal Reserve's regulatory reach for systemic risk.
  - Ending too-big-to-fail by creating an orderly liquidation authority.
  - Resolution plan called "living will".
  - Helping derivatives markets participants with counterparty risk.
  - The Volcker Rule
  - Protecting consumers
  - Stress testing

Key Post Crisis Corporate Governance Concerns

- **Stakeholder Priority**
  - Depositors, debt holders, and taxpayers have a much stronger interest in minimizing the risk of bank failure than do most shareholders.
- **Board Composition**
  - Analyses of failed banks do not show any clear correlation between success and a predominance of either insiders or outsiders. Eg. Northern Rock had several banking experts on its board.
- **Board Risk Oversight**
  - Boards should be proactive in risk oversight.
- **Risk Appetite**
- **Compensation**

The Infrastructure of Corporate Governance



The Infrastructure of Corporate Governance

- **The board should (Basic functions)**
  - Look after the interests of shareholders (gatekeeper).
  - Be responsible for the concerns of other stakeholders (debtholders and employees).
  - Oversee executive management and alert for any conflict of interests between the management and stakeholders (agency problems).
  - **Separate** the role of the CEO and the chairman of the board.
- **The board should (Advanced functions)**
  - Decide appropriate risk appetite.
  - Assess firm's risk management systems and procedures.
  - Ensure major transactions are consistent with the risk authorized.
  - Keep the disclosure adequate and transparent.
  - Balance the risk and rewards.
  - Take the ultimate responsibility.
  - Be trained on risk issues.

Committees

The board often delegates its power to some professional committees to implement risk appetite and break it down into a set of practical restrictions and limitations.

1. Risk Management Committee

- Set risk appetite on annual basis.
- Translate the overall risk appetite into a set of limits.
- Approve and independently review risk levels.
- Report back to the board on a variety of items, such as all loans and credits over a specified dollar limit.

Committees

2. Audit Committee of The Board

- Independently verify whether the firm is doing what it claims to be doing.
- Check for discrepancies and infringements in regulatory, legal, compliance, and risk management activities.
- Assess the quality of reporting, compliance, internal control, and risk management processes.
- Audit committee members are required to be knowledgeable, capable of independent judgement, financially literate, and have the utmost integrity.

Committees

3. Risk Advisory Director: is a member of the board who specialises in risk matters.

4. Compensation Committee

- Determine the compensation of top executives.
- Be aligned with the long-term interests of stakeholders, and with risk-adjusted return on capital.
- Removal of guaranteed bonuses.
- Stock-based compensation can encourage risk-taking.

The Chief Risk Officer

- **A CRO is responsible for**
  - Providing the **overall leadership** for enterprise risk management.
  - Establishing an integrated **risk management framework** for all aspects of risks.
  - **Allocating economic capital** to business activities.
  - **Communicating** the company's risk profile to key stakeholders.
  - Responsible for **risk policies**, analysis approaches, and methodologies.
  - Make day-to-day decisions within the delegation of senior risk committee (e.g. approve the exception of limit).
- **Key lessons from the financial crisis**
  - CROs should not just be after-the-fact risk managers but also risk strategists.
  - Be **independent** of line business management.
  - Have a strong enough voice.
  - Must evaluate all new financial products to verify that the expected return is consistent with the risks undertaken.

The Chief Risk Officer

- **Reporting**
  - The heads of individual risk department report to the CRO.
  - The CRO reports to the CFO or CEO.
  - A **dotted-line reporting** relationship between the CRO and the board. (**dual position**)

The Right Degree of Independence for Risk Managers

- **Risk management is not an audit.**
  - Auditors only have a verification function.
- **If risk managers are viewed as policemen ⇒ face obstacles in gathering information.**
- **The reporting lines of risk managers should be completely separate from the businesses.**
  - Business lines have a strong commitment to managing risk ⇒ business lines collaborate with risk managers.

Three Lines of Defense

- **First line**: business line that generates, owns, and manages risk;
- **Second line**: risk managers that specialize in risk management and day-to-day oversight;
- **Third line:** periodic independent oversight and assurance, such as internal audit.

True Risk Governance

- **Risk Appetite statement** - "a written articulation of the aggregate level and types of risk that a firm will accept or avoid in order to achieve its business objectives."
  - The board must characterize an appropriate " risk appetite" for the firm.
  - Be connected to a firm's overall business strategy and capital plan.
  - Clear communication throughout the firm of the firm's risk appetite and risk position.
  - Effective risk management program should be consistent with fundamental strategic and risk appetite choices.
  - Risk appetites can be expressed in a number of ways, including quantitative and qualitative statements.

Limits and Limit Standard Policies

- **Tier 1 limits: the top limits of bank including**
  - An overall limit by asset class
  - An overall stress-test limit
  - A maximum drawdown limit
- **Tier 2 limits: considered as sub-limits aggregated by**
  - Credit rating
  - Industry
  - Maturity
  - Region, etc.

Limits and Limit Standard Policies

- Stop Loss Limits
- Notional Limits
- Risk Specific Limits
- Maturity/Gap Limits
- Concentration Limits
- Greek Limits
- Value-at-Risk (VaR)
- Stress, Sensitivity, and Scenario Analysis

Standards for Monitoring Risk

- **How should a bank monitor those limits?**
  - Market risk is most time-sensitive and requires continual monitoring.
  - All market risk positions should be valued **daily**.
  - All the assumptions should be verified.
  - **Timely** and meaningful reports.
- **Data used in limit monitoring must be**
  - **Independent** of the front office.
  - **Reconciled** with the entries in the bank's official books.
  - In a proper format.

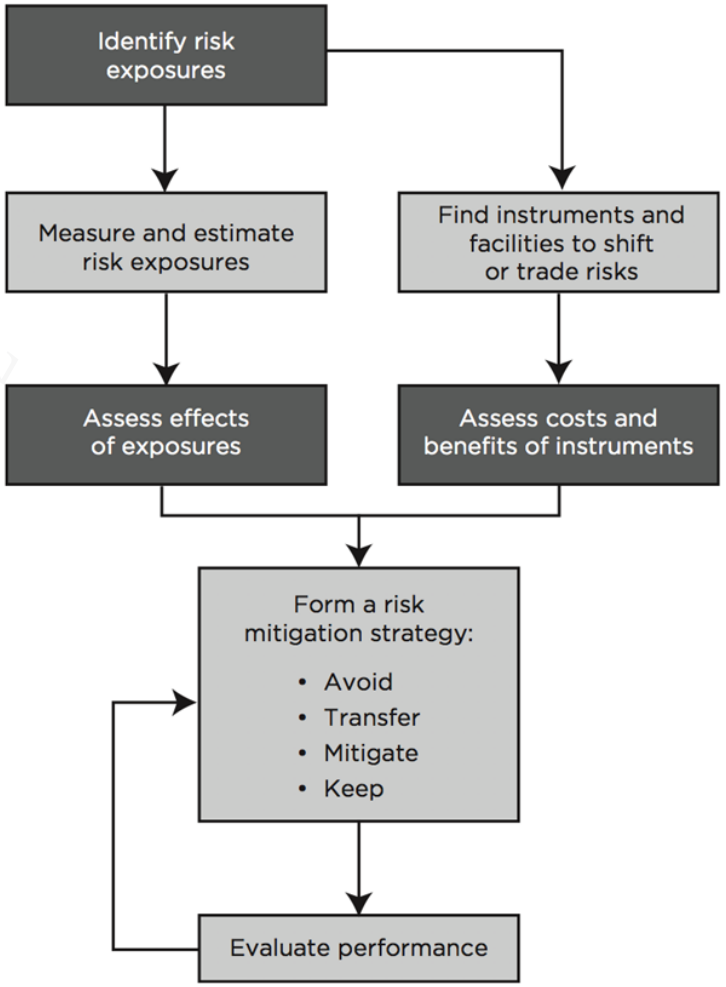
Standards for Monitoring Risk

- **Threshold alert**
  - e.g. 80% of the limit
- **Tier 1 limit exceedances are very dangerous for the bank and thus must be corrected immediately.**
- **Tier 2 limit exceedances are less urgent and can be cleared within a few days or a week.**

The Process of Risk Management

Risk Management Process

1. Identify the risk
2. Analyze and measure risk
3. Assess the effects of all risk
4. Manage the risk using different kind of tools
5. Evaluate Performance



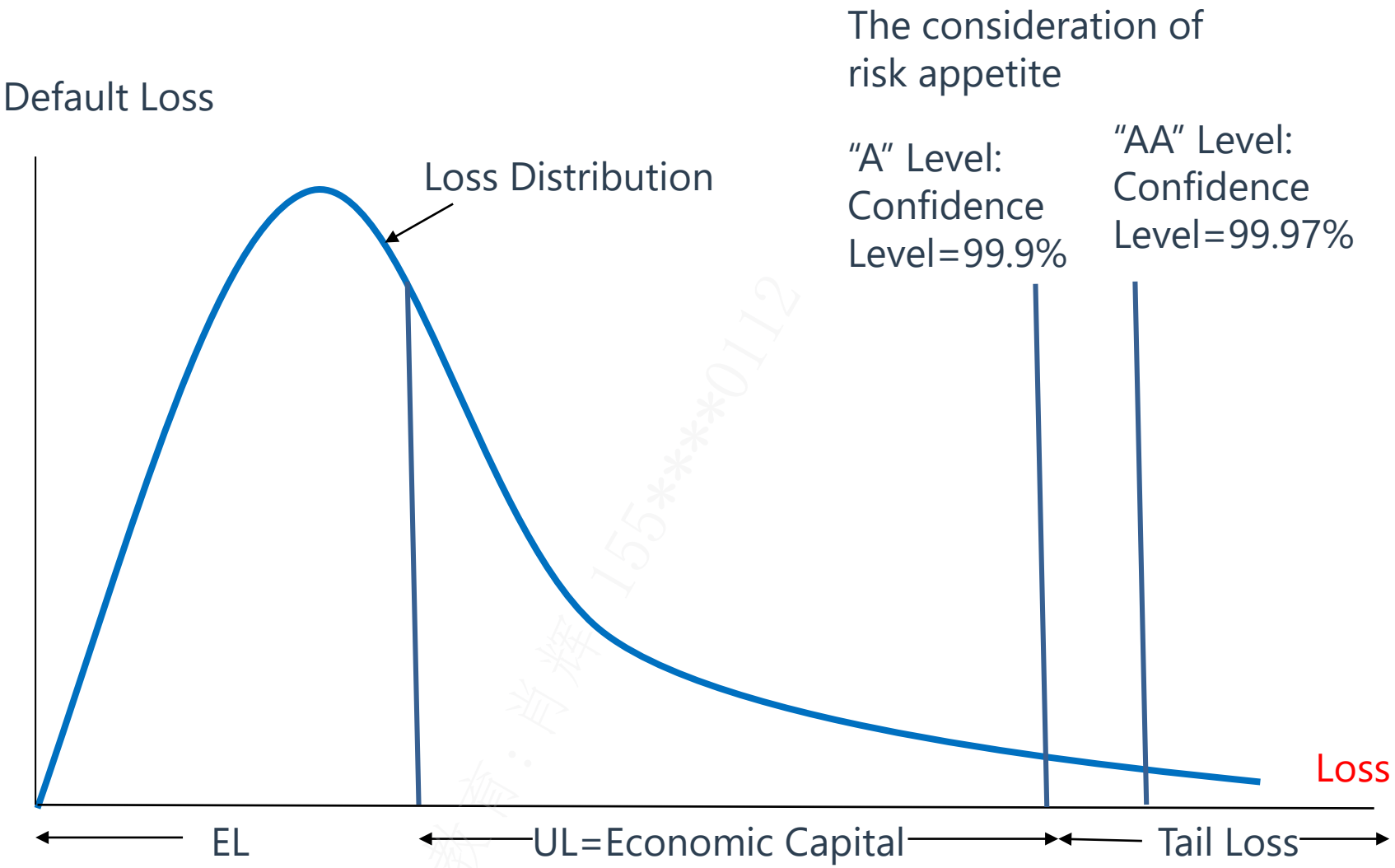
Limitations of Risk Management

➢ **Real-world banks cannot control risk**

1. **Limitations in risk measurement technology.**
   - Real-time risk measures do not exist.
   - Risk measurement can be highly imprecise.
   - Behavioural biases.
2. **Limitations of hedging.**
   - Some risks cannot be hedged.
3. **Limitations of control resulting from incentives.**

Main Measurement Tools

Measurement of Risk



Expected Loss(EL)

EL is the average loss expected to incur from a position or a portfolio. It can be estimated by historical data of a period of time.

It can be treated as a predictable expense rather than a risk or uncertainty

- EL=EAD×LGD×PD for credit risk
- EL can be calculated by the distribution of loss for market risk and operation risk

Unexpected Loss(UL)

UL is the surprising loss that above the EL in bad days

- Value at risk (VaR) uses the loss distribution to estimate losses at a given level of likelihood(confidence).
- UL= VaR - EL

Extreme Value - Tail Risk

From the crisis lesson, we focus on the tail risk beyond confidence level which cannot be explained by VaR.

- **Extreme value theory(EVT) focuses on tail distribution to understand the black swans**
- **Expected shortfall is the EL of tail distribution**

Balance Between Risk and Reward

Reward should be considered by risk-adjusted return

- **Risk adjusted return on capital (RAROC)**
- **RAROC = reward/risk**
- **Reward: after-tax risk-adjusted expected return**
- **Risk: economic capital**
- **Risk-Adjusted Return on Capital (RAROC)**

$$\text{RAROC} = \frac{\text{After Tax Risk}-\text{Adjusted Return(RAR)}}{\text{Economic Capital(EC)}}$$

- **After tax risk-adjusted return**

$$\text{RAR} = \text{Revenues} - \text{Costs} - \text{Losses} - \text{Taxes} + \text{Return on EC} \pm \text{Transfer}$$

- **Economic capital=** Risk capital + Strategic capital

Balance Between Risk and Reward

- **A loan portfolio:**
  - Revenues: 85 million USD
  - Expected Loss: 10 million USD
  - Operating Cost (business unit to make the loan): 13 million USD
  - Interest expense:50 million USD
  - Return on EC: 5 million USD
  - EC: 75million USD
- **Answer:**

$$\text{RAROC} = \frac{85 + 5 - 13 - 50 - 10}{75} = 22.7\%$$

Balance Between Risk and Reward

- For an activity/portfolio to add value to shareholders (and the stock price), RAROC should be higher than the cost of equity capital or the bank's equity (i.e., the hurdle rate or minimum return on equity capital required by the shareholders to be fairly compensated for risk).
- Most firms use a single hurdle rate for all business activities: the after-tax weighted-average cost of equity capital.

Main Management Tools

Use of Credit Risk Transfer Tools

- **Traditional transfer of credit risk**
  - Requiring collaterals
  - Purchasing insurance from third-party counterparties
  - Netting of exposures to counterparties
  - Marking to market / Margining
  - Termination by a set of trigger events
  - Reassignment of a credit exposure to another party
- **Credit derivatives create new transfer strategies.**
  - Forward, Futures, Swap, Option, Swaption… …

From Buy-and-hold to Originate-to-distribute (OTD)

- Originators benefited from greater capital efficiency (by Basel capital adequacy requirements) and enhanced funding opportunities, as well as lower earnings volatility.
- Investors benefited from a wider array of investments, allowing them to diversify their portfolios and better sync their risk/return profiles.
- Borrowers benefited from the expansion of available credit and product options, as well as from the lower borrowing costs.

Originate-to-distribute (OTD)

- **Risk transfer and securitization enables institutions to effectively tailor pools of credit-risk exposures by repackaging of risk.**
  - The issuance of securitized loans soared from 0 in the early 1990s to almost $5 trillion in 2006.
  - A robust, liquid, and transparent market was built, and credit derivatives contributed to the process of credit price discovery.

Issues Addressed in Securitization

- **Securitization amplified systemic risk during the crisis by allowing massive leverage and risk concentration in the financial sector**
  - Loan origination: compensation was tied to high loan volumes
  - Securitization: the risk embedded was not transparent for investors
  - Credit rating: overreliance on the accuracy and transparency of credit ratings
  - Risk management: poor risk management in many segment (e.g., assessment, stress test)

Enterprise Risk Management

ERM Definitions

- ERM is a comprehensive and integrated framework at the top of enterprise for managing the entire portfolio of risks in order to achieve business objectives, to minimize unexpected earning volatility, and to maximize firm value.
- Focus on the threats to a firm.

The Benefits of ERM

ERM is all about integration

- **ERM requires an integrated risk organization.**
  - The CRO reports to the CEO and the board to support their risk oversight responsibilities.
- **ERM requires the integration of risk transfer strategies.**
  - Take a portfolio view of all types of risk within a company.
- **ERM requires the integration of risk management into the business processes of a company.**

The Benefits of ERM

1. Helping firms define and adhere to enterprise risk appetites.
2. Focusing on most threatening risks.
3. Identifying enterprise-scale risks generated from business lines.
4. Managing risk concentrations across the enterprise .
5. Managing emerging enterprise risks (e.g., cyber risk, AML (anti-money laundering) risk, reputation risk).
6. Supporting regulatory compliance and stakeholder reassurance.
7. Helping firms understand risk-type correlations and cross-over risks.
8. Optimizing risk transfer expenses in line with risk scale and total cost.
9. Incorporating stress scenario capital costs into pricing and business decisions.
10. Incorporating risks into business model selection and strategic decisions.

Components of ERM

1. **Corporate Governance**
   - Appropriate organizational processes and corporate controls to measure and manage risk.
2. **Line Management**
   - Align business strategy with corporate risk policy.
3. **Portfolio Management**
   - Set portfolio targets and risk limits.
   - Ensure optimal portfolio returns.

Components of ERM

4. **Risk Transfer**
   - Lower the cost of transferring out undesirable risks.
5. **Risk Analytics**
   - Quantify the company's risk exposures.
6. **Data and Technology Resources**
   - Improve the quality of data.
7. **Stakeholder Management**
   - Communicate and report the company's risk information to its key stakeholders.

Framework

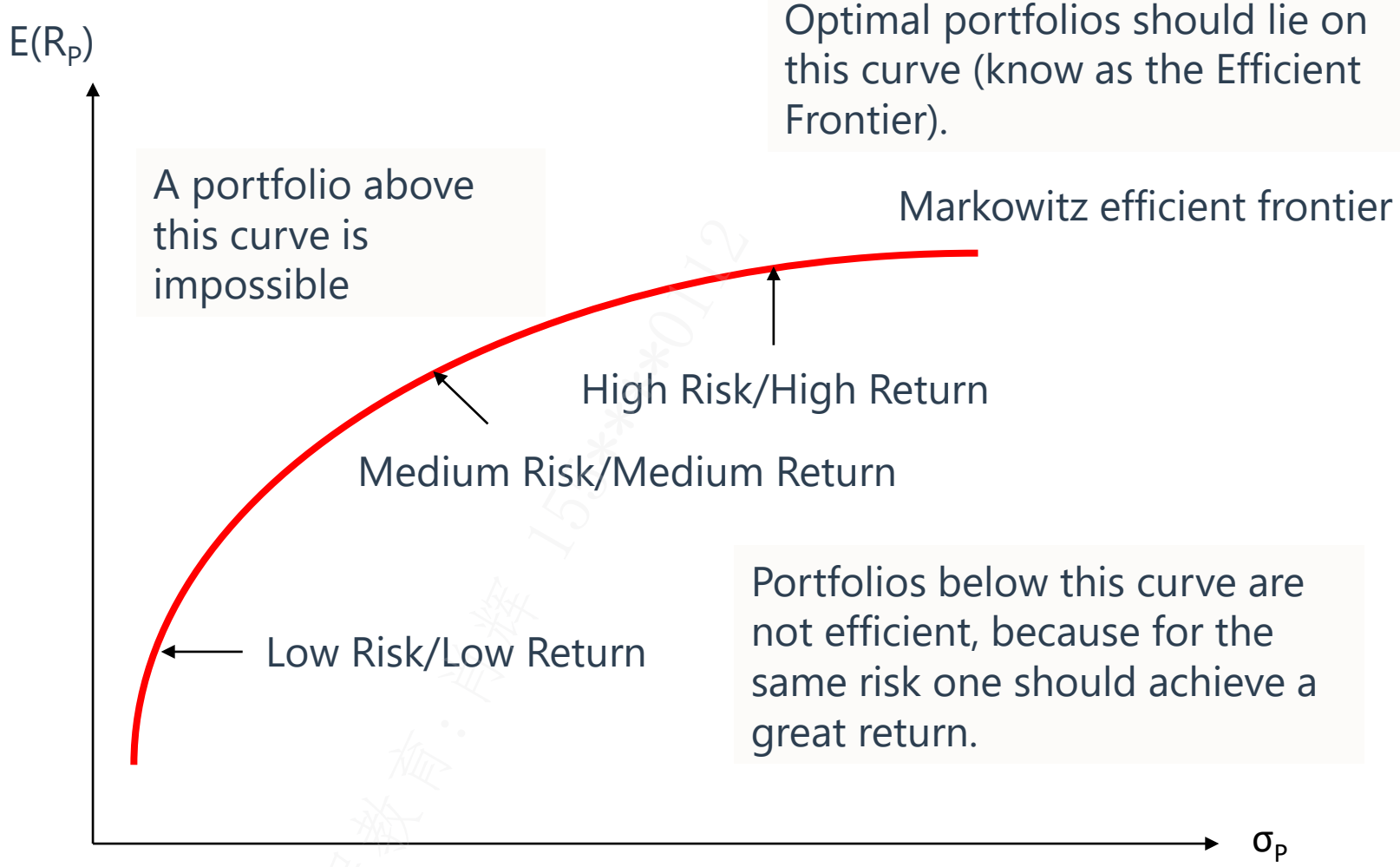
- **Part Two：Portfolio Management Theory**
  - The standard capital asset pricing model
  - Applying the CAPM to performance measurement
  - Arbitrage pricing theory

The Standard Capital Asset Pricing Model

Markowitz portfolio theory

- **Assumptions about a Markowitz investor**
  - Investors are risk averse.
  - Investors want utility maximization.
  - Investors only care about expected return and volatility of an asset.
  - The market is frictionless.

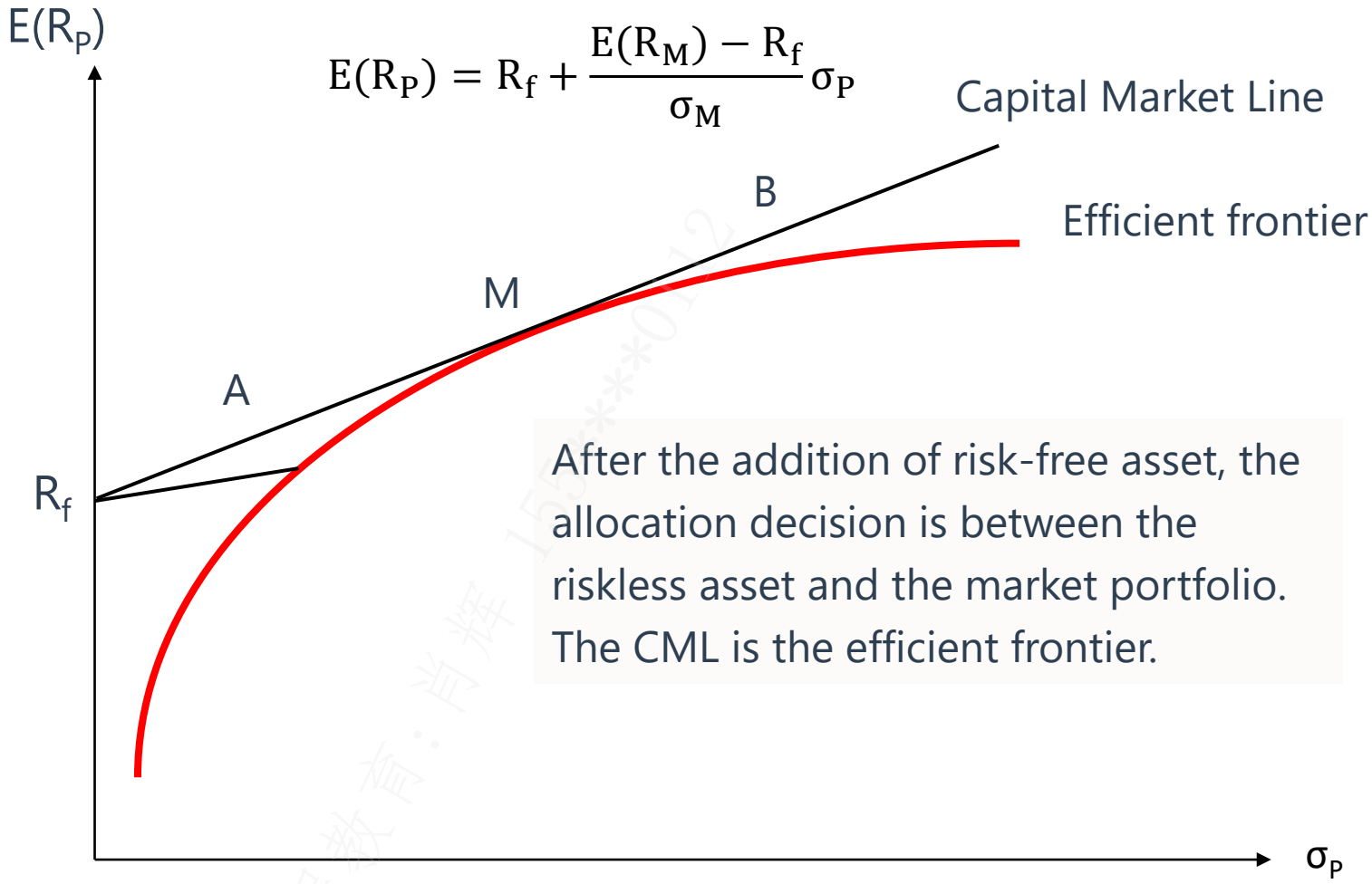
Markowitz efficient frontier



Minimum variance portfolio

- **Definition: the portfolio with the smallest variance among all possible portfolios on a portfolio possibilities curve.**
- **The shape of the portfolio possibilities curve is best described in two pieces:**
  - The portion of the portfolio possibility curve that lies above the minimum variance portfolio is concave.
  - The portion of the portfolio possibility curve that lies below the minimum variance portfolio is convex.

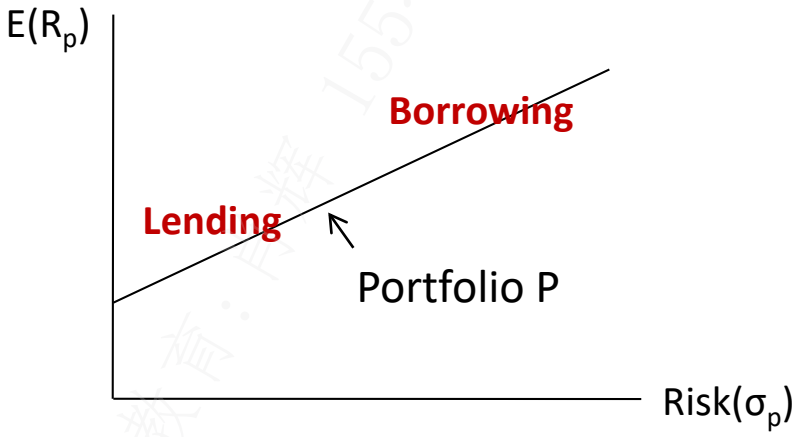
Capital Market Line (CML)



After the addition of risk-free asset, the allocation decision is between the riskless asset and the market portfolio. The CML is the efficient frontier.

Capital Market Line (CML)

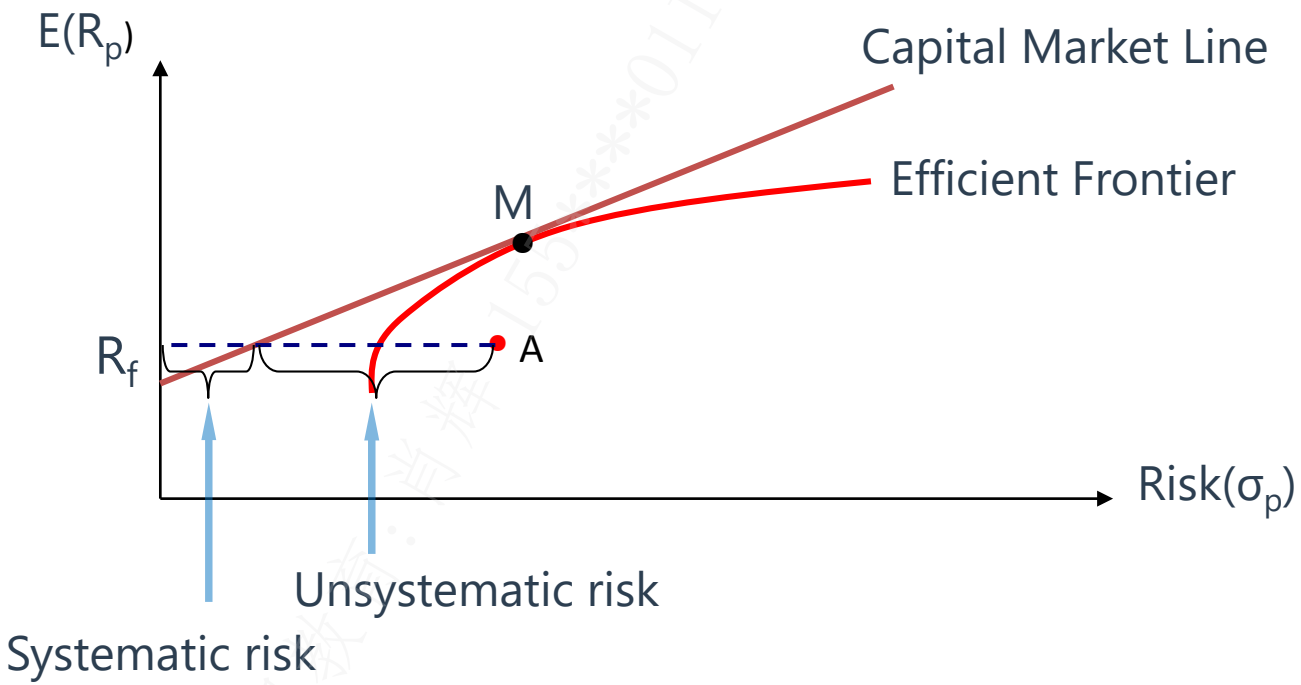
- The point of tangency – Portfolio P, is known as the market portfolio. When one can lent or borrow money use riskless rate, investor will hold a combination of the market portfolio and the risk-free asset.
- Risk-averse investors will create lower risk portfolios by lending (i.e., investing in the risk-free asset). More risk-tolerant investors will increase portfolio return by borrowing at the risk-free rate.



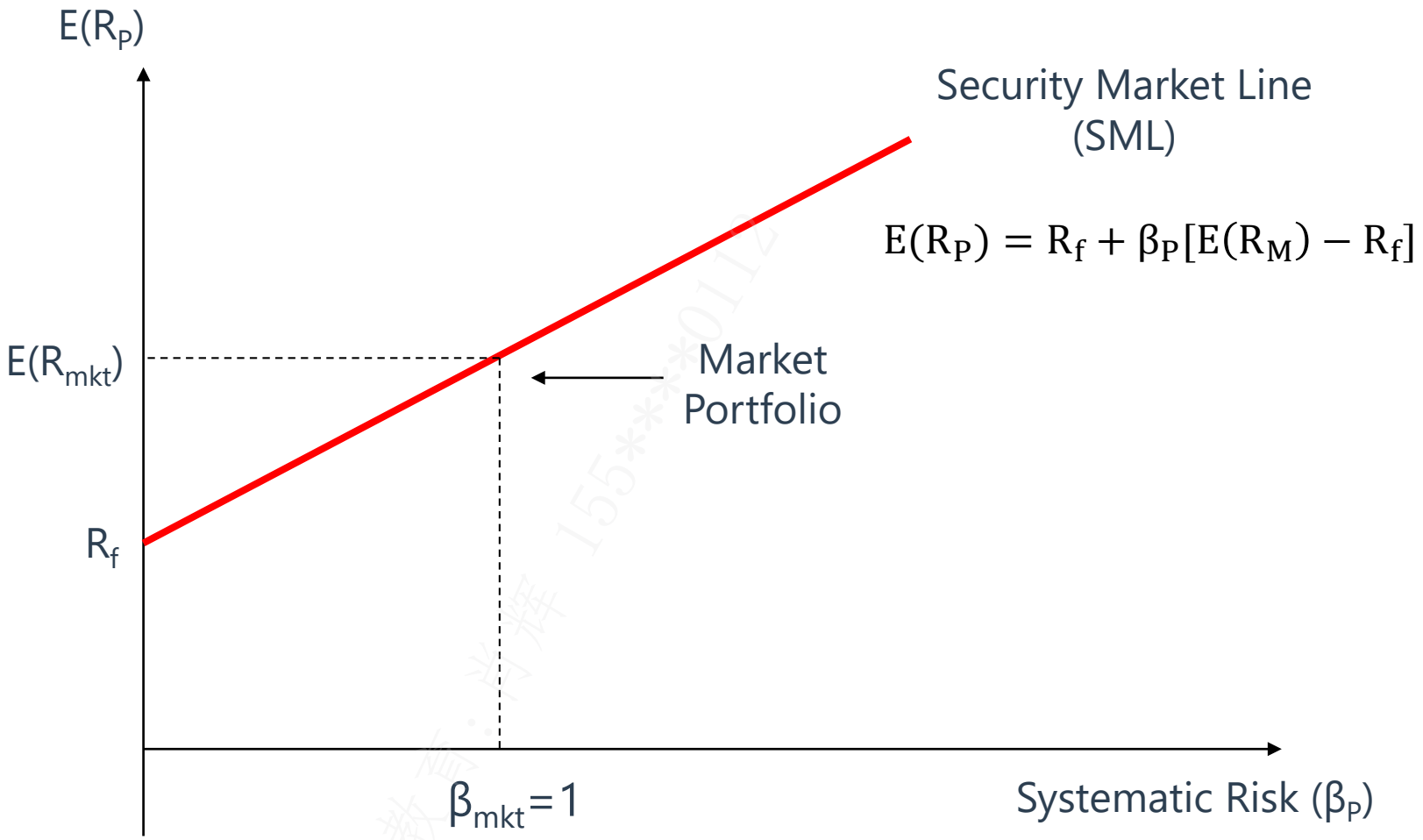
Systematic and Unsystematic Risk

Total risk= systematic risk+ unsystematic risk

Systematic risk is the only important ingredient in determining expected returns and that nonsystematic risk plays no role.



Security Market Line (SML)



$$E(R_P) = R_f + \beta_P[E(R_M) - R_f]$$

Capital Asset Pricing Model (CAPM)

- $E(R_P) = R_f + \beta_P[E(R_M) - R_f]$
- $\beta_P = \frac{Cov(P,M)}{\sigma_M^2} = \rho_{P,M}\frac{\sigma_P}{\sigma_M}$
  - $E(R_P)$: expected return on risky asset
  - R_f : risk-free rate
  - $E(R_M)$ - R_f : market portfolio risk premium
  - β_P : systematical risk of asset P
  - $\beta_P \times [E(R_M) - R_f]$: beta-adjusted market risk premium

Performance Measurement

Sharpe ratio

- **Measures the ratio of the average rate of return $E(R_P)$, in excess of the risk-free rate R_F, to the absolute risk $\sigma(R_P)$.**

$$SR = \frac{E(R_P) - R_F}{\sigma(R_P)}$$

  - Widely used for measuring portfolio performance that are not very diversified.
  - A better method for measuring historical performance.
  - Suitable for evaluating the performance of a portfolio that represents an individual's total investment.

Treynor ratio

- **Treynor ratio is equal to the risk premium divided by beta (systematic risk)**

$$TR = \frac{E(R_P) - R_F}{\beta_P}$$

  - More appropriate for comparing well-diversified portfolios and a more forward-looking measure.

Sortino ratio

- **MAR (minimum acceptable return)** is the return below which the investor does not wish to drop.
- **Sortino ratio** measures the ratio of the average rate of return $E(R_P)$, in excess of MAR (minimum acceptable return), to the semi-standard deviation, which considers only data points that represent a loss.

$$\text{Sortino Ratio} = \frac{E(R_P) - MAR}{\sqrt{\frac{1}{N-1}\sum_{t=1}^{N}(R_{Pt} - MAR)^2}} \qquad (R_{Pt} < MAR)$$

  - Where T is the number of observed losses.
  - The Sortino ratio is more relevant than the Sharpe ratio when the return distribution is skewed to the left.

Jensen's alpha

- **Jensen's alpha is the asset's excess return over the return predicted by the CAPM.**

$$E(R_P) - R_F = \alpha_P + \beta_P[E(R_M) - R_F]$$

  - Most appropriate for comparing portfolios that have the same beta and can be used to rank portfolios within peer groups.

Information Ratio

- **The tracking error (TE) measures the difference between a portfolio's returns and those of a benchmark. The first way to calculate TE is:**

$$R_P - R_B$$

- Another way to measure TE is to calculate the standard deviation of the differences in the portfolio and the benchmark returns over time. It is also called the tracking error volatility (TEV).

$$\text{TE(TEV)} = \sigma(R_P - R_B)$$

- **The information ratio measures the ratio of the residual return of the portfolio compared with its residual risk (tracking error).**

$$\text{IR} = \frac{E(R_P) - E(R_B)}{\sigma(R_P - R_B)} = \frac{\alpha_P}{\sigma(\alpha_P)}$$

  - To check that the risk taken by the manager, in deviating from the benchmark, is sufficiently rewarded.

Arbitrage Pricing Theory

Arbitrage Pricing Theory

- The APT was initially proposed in 1976 by Professor Stephen Ross. Unlike CAPM, APT does not assume investors hold efficient portfolios and does not assume risk aversion. Instead, APT has three underlying assumptions.
  - Asset returns can be explained by systemic factors that affect all securities.
  - By using diversification, investors can eliminate specific risk from their portfolios.
  - There are no arbitrage opportunities among well-diversified portfolios. If any arbitrage opportunities were to exist, investors would exploit them away.

Arbitrage Pricing Theory

- The basic premise of APT is that investors can create a zero beta portfolio with zero net investment.
  - If such a portfolio yields a positive return, however, then a sure profit can be realized through arbitrage.
  - The absence of arbitrage opportunities requires the expected return on all well-diversified portfolios to satisfy

$$E(R_P) = E(R_Z) + \beta_{P1}[E(I_1) - E(R_Z)] + \cdots + \beta_{PK}[E(I_K) - E(R_Z)]$$

    - ✓ where $E(R_Z)$ is the expected rate of return on the zero-beta portfolio (i.e., the risk-free rate);
    - ✓ β_{PK} is the factor loading for the portfolio P related to factor k.
    - ✓ $E(I_i)$ as the expected return on factor portfolio i. Each factor portfolio is a well-diversified portfolio that has a beta equal to one for a single risk factor, and betas equal to zero on the remaining factors.

Arbitrage Pricing Theory

- The logical under models:
  - CAPM: If a security is mispriced, then investors will tilt their portfolios toward the underpriced and away from the overpriced securities, each by a relatively small dollar amount.
  - APT: a few investors who identify an arbitrage opportunity will mobilize large dollar amounts and quickly restore equilibrium.
- The differences between CAPM and APT:
  - CAPM is a one-factor model and APT is a multi-factor model.
  - CAPM is a special case of APT.
  - APT is often used to decompose the factors' respective contributions to the expected return.

Multifactor Models

Multifactor Model

- Macroeconomic factor models seek to explain returns using macroeconomic variables.
- Important factors
  - ✓ The spread between long-term and short-term interest rates(reflecting shifts in time preferences);
  - ✓ Expected and unexpected inflation;
  - ✓ Industrial production (reflecting changes in cash flow expectations);
  - ✓ The spread between high-risk and low-risk corporate bond yields (reflecting changes in risk preferences);
  - ✓ investor confidence (confidence risk);
  - ✓ real business activity (business cycle risk);
  - ✓ market index (market timing risk).

Fundamental Factor Models

- **A fundamental factor is an attribute of a company or an industry.**
  - A company's price/earn ings ratio, book/price ratio, estimated revenue growth, and market capitalization are examples of fundamental factors.
- **The most well-known factor model: The Fama-French three-factor model**

$$E(R_P) - r = \alpha_P + \beta_{P,M}[E(R_M) - r] + \beta_{P,SMB}E(SMB) + \beta_{P,HML}E(HML)$$

  - SMB = Small minus big (the return of a portfolio of small stocks – return on a portfolio of large stocks)
  - HML = High minus low (the return of a portfolio of stocks with a high book-to-market ratio – return on a portfolio of stocks with a low book-to-market ratio)
  - F&F have observed: firms with high ratios of book-to-market value are more likely to be in financial distress and that small stocks may be more sensitive to changes in business conditions.

Statistical Factor Models

- In a statistical factor model, historical and cross-sectional data on stock returns are used in the model.
  - The statistical technique of principal components analysis is used is to explain the observed stock returns with "factors" that are linear return combinations and uncorrelated with each other.
    - ✓ For example, suppose that the monthly returns for 2,000 companies for 10 years are computed. The goal of principal components analysis is to produce factors that best explain the observed variance in the stock returns.

Factor Analysis in Hedging Exposure

- Idiosyncratic (specific) risk can theoretically be eliminated through diversification, but this is not true for systematic risk.
- **Challenges to the hedge:**
  - The selection of appropriate systematic factors
  - The frequency of adjusting a hedge
    - ✓ there is a tradeoff between the cost of hedging and the need to keep the hedge aligned to the portfolio(low tracking error).
  - Model risk

Framework

- **Part Three：Case Study**
  - Learning from financial disasters
  - Anatomy of the Great Financial Crisis of 2007-2009

Learning from Financial Disasters

1. Interest Rate Risk

- **1980s Savings and Loan Crisis in the US**
  - Rising inflation led to a restrictive monetary policy.
  - The increase in short-term rates pushed up funding costs for S&Ls.
- **Result**
  - A long-running crisis in the United States was sparked.
  - The industry lost more money through poorly controlled credit and business risks.
  - The world's most expensive banking system bailouts: USD 160 billion.
- **Lessons**
  - Firms should manage their balance sheet to ensure that effect of interest rate movement on assets remains correlated with the effect on liabilities.
  - The use of classical duration matching tools and more sophisticated methods (e.g., caps, floors, and swaps).

2. Funding Liquidity Risk

- **Liquidity Crisis at Lehman Brothers**
  - The institution sold mortgages to residential customers and MBS to investors.
  - Lehman's growth strategy was aggressive and it made outsized bets on real estate.
  - It borrowed short-term money to finance long-term investment.
  - After the collapse of Bear Stearns, investors lost confidence in Lehman, which led Lehman to lose its funding source, and to bankruptcy.
- **Liquidity Crisis at Continental Illinois**
  - Aggressive growth strategy: commercial and industrial lending from USD 5 billion to over USD 14 billion.
  - Main funding source: federal funds and large issues of CDs.
  - The failure of Penn Square caused Continental to suffer heavy losses.
  - It was unable to fund its operations from the U.S. markets and borrowed at much higher rates in foreign money market.
  - Rumors led to run on the bank, and regulatory authorities stepped in.

2. Funding Liquidity Risk

- **Northern Rock-Liquidity and Business Models**
  - An excessive use of short-term financing for long-term assets and a sudden loss of market confidence triggered a funding liquidity crisis.
  - Northern Rock accepted emergency government support and then public ownership.
- **Lessons**
  - Liquidity stress testing programs are important.
  - Banks may also mitigate funding liquidity risk by reducing the maturity of their assets.
  - Firms need emergency liquidity cushions to ensure they can meet their commitments.
  - Asset/liability management (ALM) decisions need to be considered by trade-offs: trade-off between funding liquidity and interest rate risk, and trade-off between cost and risk mitigation.
  - All the components of an ALM policy are linked and must be part of a holistic and integrated approach to balance-sheet management.

3. Implementing Hedging Strategies

Metallgesellschaft Case

- MGRM: long-term contracts to supply customers with gas and oil products at fixed costs and to hedge these contracts with short-term gas and oil futures, which is known as a rolling hedge.
- In 1993, a large decrease in gas and oil prices had resulted in funding needs of around $900 million.
- MG negotiated unwinds of these contracts at unfavorable terms.

Lessons

- When we use shorter-term hedges against longer-term contracts, the strategy can be successfully carried out only if proper risk controls are applied.
- It's important to select appropriate models to use for both pricing and hedging.
- Accounting issues and potential tax implications need to be considered when devising a hedging strategy.

4. Model Risk

➢ Niederhoffer Case

- The strategy was writing large quantities of uncovered deep out-of-the-money put options on the S&P 500 Index and collected the option premiums. It failed when the stock market fell by over 7% in one day, which caused the fund's equity to be wiped out by brokers.
- Financial markets rarely offer a "free lunch".

➢ Long-Term Capital Management

- LTCM's Presumed Positions
  - ✓ Long U.S. interest rate swaps and short U.S. government bonds at a time when these spreads were at historically high levels.
  - ✓ Over the life of the trade, this position will make money as long as the average spread narrows.
  - ✓ LTCM sold equity options at historically high implied volatilities.

4. Model Risk

- LTCM's Funding Sources
  - ✓ Deal in over-the-counter markets as well as on futures exchanges.
  - ✓ LTCM always negotiated terms that avoided posting the initial margin.
- The Crisis
  - ✓ The triggers: Russian debt default in 1998.
  - ✓ The LTCM fund's equity began to decline, and it was reluctant to cut positions in a turbulent market.
  - ✓ As competitors learned more about the actual positions, their pressure on market prices in the direction unfavorable to LTCM intensified.
- Lessons of LTCM
  - ✓ LTCM failed to supplement VaR measures with a full set of stress test scenarios.
  - ✓ LTCM failed to account for the illiquidity of its largest positions.

4. Model Risk

➢ The London Whale

- In 2012, the Chief Investment Office (CIO) of JP Morgan Chase placed a massive bet on a complex set of synthetic credit derivatives that lost at least USD 6.2 billion.
- The CIO took a trading strategy that called for purchasing additional long credit derivatives, which ended up increasing the portfolio's size, risk, and Risk Weighted Assets (RWA) and taking the portfolio into a net long position.
- As the CIO changed valuation methodology and mismarked its books, operation risk was included in the case.
- Poor risk culture of corporate governance was a big problem.
- VaR model was manipulated in favor of CIO.

5. Rogue Trading and Misleading Reporting

- **Barings Bank**
  - A loss of $1.25 billion due to the unauthorized trading of a trader Nick Leeson forced Barings into bankruptcy.
  - Leeson disguised his speculative position and manufactured substantial reported profits for his own accounts.
  - The loss was not detected as Leeson was allowed to function as head of trading and the back office => depriving the firm of an independent check on his activities.
- **Lessons**
  - The absolute necessity of an independent trading back office.
  - Outsized profits need to be independently investigated and rigorously monitored.
- **Leeson's trading involved two strategies**
  - First, selling straddles on the Nikkei 225 and arbitraging price differences on Nikkei 225 futures contracts that were trading on different exchanges.
  - Second, in order to recover the losses, Leeson abandoned the hedged posture in the long-short futures arbitrage strategy and initiated a speculative long-long futures positions on both exchanges in hope of profiting from an increase in the Nikkei225 which finally led to much more loss.

6. Financial Engineering and Complex Derivatives

Bankers Trust

- BT offered P&G and Gibson a probable but small reduction in funding expenses in exchange for a potentially large loss under some less probable circumstances.
- Both P&G and Gibson claimed that they had suffered large losses in derivatives trades they had entered into with BT due to being misled by BT as to the nature of the positions.
- BT was forced into an acquisition by Deutsche Bank.

Lessons of Banker Trust

- Banks should match the degree of complexity of trades to the degree of financial sophistication of customers.
- Be cautious about how to use any form of communication.

6. Financial Engineering and Complex Derivatives

➢ Orange County

- Orange County treasurer Robert Citron borrow USD 12.9 billion through the repo market and used the borrowed funds to purchase complex inverse floating-rate notes.
- Before 1994 in the favorable upward-sloping environment, Citron was able to increase the return of the fund by 2% with yield curve play. But after a 250-basis point interest rate increase, he lost USD 1.5 million by December 1994.
- Orange County bankrupted as some of the fund's lenders stopped rolling over their repo agreements.

➢ Lessons of Orange County

- Leverage need to be used carefully and properly.
- Firms need to understand the risks that are inherent in their business models.

6. Financial Engineering and Complex Derivatives

➢ Sachsen Landesbank

- Sachsen opened a unit in Dublin to set up vehicles for holding large volumes of highly rated U.S. MBS.
- While the vehicles were off the parent bank's balance sheet, they benefited from Sachsen's guarantee.
- The operation was too large compared to the size of Sachsen's balance sheet. When the subprime crisis struck in 2007, Sachsen's capital was wiped out and it was sold to another German state bank.

➢ Lessons of Sachsen Landesbank

- Funding liquidity commitment should be considered as a credit or liquidity risk rather than only an operation risk.

7. Reputational Risk

➢ Volkswagen Emission Cheating Scandal

- Volkswagen programmed certain emissions controls. Its diesel engines would be activated only during regulatory testing, which made the nitrogen oxide levels appear to meet U.S. standards.
- From 2009 through 2015, Volkswagen put this programming in place in over ten million cars worldwide.
- In September 2015, the United States Environmental Protection Agency (EPA) announced the scandal. The share price of the company fell by over a third and it faced potential billions of dollars of fines and penalties.

8. Corporate Governance

Enron

- Enron, which had been named "America's Most Innovative Company", with 20,000 employees and revenues of nearly USD 101 billion in 2000, declared bankruptcy in December 2001.
- It turned out to be a poster child of corporate governance failure and poor risk management.

Reasons for Enron's bankruptcy

- Senior management acted in their own self interest and against the interests of shareholders.
- The board failed to fulfill its fiduciary duties to the shareholders.
- Enron also used fraudulent accounting practices to hide flaws in its actual financial performance.

9. Cyber Risk

➢ The SWIFT Case

- SWIFT is the world's leading system for transferring funds electronically among banks.
- In April 2016, an article published in the New York Times revealed that hackers used the SWIFT network to steal USD 81 million from the account of Bangladesh Bank (the central bank of Bangladesh) at the New York Fed.
- The malware sent unauthorized SWIFT messages to move the funds to the hackers' account and the database record was deleted.

Anatomy of the Great Financial Crisis of 2007-2009

A. The Lending Boom Housing Frenzy

- **The U.S. economy was experiencing a low interest rate environment**
  - Large capital inflows from abroad, especially from Asian countries.
  - The Federal Reserve had adopted a lax interest rate policy after the bursting of the internet bubble.
- **Decline in lending standards**
  - The traditional banking model, in which the issuing banks hold loans until they are repaid, was replaced by the "originate and distribute" banking model, in which loans are pooled, tranched, and then resold via securitization.

B. Overview and Timeline of the Crisis

- **A banking crisis by the existence of one of two types of events:**
  - **Bank runs** that lead to the closure, merging, or takeover by the public sector of one or more financial institutions;
  - The **closure, merging, takeover**, or **large-scale government assistance** of an important financial institution or group of institutions, that marks the start of a string of similar outcomes for other institutions.

B. Overview and Timeline of the Crisis

- **The Progress of the Crisis**
  - Disruptions in the U.S. short-term debt markets created a shortage of U.S. dollars in global markets.
  - The failure of Lehman ⇒ run on money market mutual funds.
  - Reduction in policy rates.
  - Banks hoarding liquidity ⇒ transmitting the crisis to the real sector.

C. The Crisis Build-Up

- **Shadow Banks**
  - Raise funds by lending short-term asset-backed commercial paper.
  - The short-term assets are backed by a pool of mortgages.
  - In the case of default, owners of the asset-backed commercial paper have the power to sell the underlying collateral assets.
  - But exposes the banks to funding liquidity risk (borrow short and invest in long).
- **Why were Shadow Banks Growing?**
  - The traditional banking model became less profitable.
  - Institutional cash pools have a demand for insured deposit alternatives.
  - And the shadow banking system rose to fill this gap.

C. The Crisis Build-Up

- **Credit Boom (Foreign Factors)**
  - In the US: national saving < U.S. capital investment.
  - Large and persistent capital inflows from foreigners seeking U.S. assets.
  - Institutional cash pools had to find substitutes such as repo.
- **Credit Boom (Domestic Factors)**
  - The increase in the production of asset-backed securities appears to be a credit boom.
  - House prices were rising.

D. The Panics

1. Asset-backed Commercial Paper(2007.8)

- **What is ABCP?**
- **Why ABCP Becoming Prevalent?**
  - More transparent ⇒ lowering funding costs.
  - Save on regulatory capital.
- **ABCP Run**
  - Lenders are unwilling to refinance CP when it comes due.
  - Programs were more likely to experience a run if they had high credit risk or high liquidity risk.

D. The Panics

2. Money Market Mutual Funds(2008.9)

- **A Chain Effect**
  - MMFs saw the values of their stakes decline when ABCP yields rose ⇒ were forced to sell their underlying assets ⇒ further downward pressure on asset classes held by many MMFs.
- **The Lehman bankruptcy was a major shock to MMFs.**
  - It led to run on many MMFs.
  - Investors moved to government-only MMFs.

D. The Panics

3. Repo(2007.7~2008.9)

- Repo is the shadow-banking equivalent of a deposit market.
- Haircuts continued a steady rise throughout 2007-2008.
- Following the Lehman failure, the haircut rose by an additional 20% to 100%.

➢ **Subprime crisis turned into the collapse of global financial institutions.**

E. Amplifying Mechanisms and Recurring Themes

➢ Loss Spiral And Margin Spiral

- Loss Spiral
  - ✓ Decline in the value of assets ⇒ eroding the investors' net worth ⇒ selling for money ⇒ these sales depressing the price further ⇒ inducing more selling.
- Margin/haircut Spiral
  - ✓ As margins or haircuts rise ⇒ the investor has to sell more assets ⇒ a lower price ⇒ increasing margins further and forcing more sales.

E. Amplifying Mechanisms and Recurring Themes

➢ Lending Channel

- Moral Hazard
  - ✓ Most lending is intermediated by banks.
  - ✓ The net worth of the intermediaries' stake falls ⇒ intermediaries may then reduce their monitoring effort.
- Precautionary Hoarding
  - ✓ Lenders are afraid that they might suffer from interim shocks ⇒ precautionary hoarding arises ⇒ sharp spikes in LIBOR.

F. Systematic Risk in Action

- The confidence that lenders used to had in collateral in the ABCP and repo markets disappeared.
- Money market funds, typically large purchasers of ABCP and active participants in the repo markets, began to flee to quality.
- The collapse of ABCP and repo markets caused a big problem in the whole financial system, including hedge funds, banks, etc.

G. The Role of Financial Intermediaries

1. Banks

- "Originate and distribute" model: banks repackaged loans and passed them on to various other financial investors.
- Collateralized Debt Obligations (CDOs).
- Tranches: senior, equity, mezzanine tranches.
- Credit Default Swaps (CDS): buyers of these tranches can protect themselves by purchasing CDS contracts insuring against the default.

G. The Role of Financial Intermediaries

2. Rating Agencies

- CDO trust partners would pay credit rating agencies to rate CDOs.
- They could structure the payment waterfalls and associated liabilities to obtain a high percentage of AAA-rated bonds.
- The data problem for rating agencies.
- More favorable ratings: higher rating fees, high return.
- Rating agencies collected higher fees for structured products than corporate bond.

H. Central Banks to The Rescue

- Creating long-term lending facilities against high quality collateral
- Opening the discount window to investment banks and securities firms
- Providing funds to be lent against high-quality illiquid asset-backed securities
- Providing funds to finance the purchase of unsecured CP and ABCP
- Providing liquidity to money market funds
- Purchasing assets from Fannie Mae and Freddie Mac

Framework

- **Part Four：Regulations**
  - About aggregation and reporting
  - GARP code of conduct

About Aggregation and Reporting

I. Data Architecture and IT Infrastructure

- **Principle 1**
  - Governance - A bank's risk data aggregation capabilities and risk reporting practices should be subject to strong governance arrangements consistent with other principles and guidance established by the Basel Committee.
- **Principle 2**
  - Data architecture and IT infrastructure - 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.

II. Risk data aggregation capabilities

- **Principle 3**
  - Accuracy and Integrity – A bank should be able to generate accurate and reliable risk data to meet normal and stress/crisis reporting accuracy requirements. Data should be **aggregated on a largely automated basis** so as to minimize the probability of errors.
- **Principle 4**
  - Completeness – A bank should be able to capture and **aggregate all material risk data** across the banking group. Data should be available by business line, legal entity, asset type, industry, region and other groupings, as relevant for the risk in question, that permit identifying and reporting risk exposures, concentrations and emerging risks.

II. Risk data aggregation capabilities

- **Principle 5**
  - Timeliness – A bank should be able to generate aggregate and up-to-date risk data **in a timely manner**. The precise timing will also depend on the bank-specific frequency requirements for risk management reporting, under both normal and stress/crisis situations.
- **Principle 6**
  - Adaptability – A bank should be able to generate aggregate risk data to meet a broad range of **on-demand, ad hoc risk management reporting requests**, including requests during stress/crisis situations, requests due to changing internal needs and requests to meet supervisory queries.

III. Risk reporting practices

- **Principle 7**
  - Accuracy - Risk management reports should accurately and precisely convey aggregated risk data and reflect risk in an exact manner. Reports should be **reconciled and validated**.
- **Principle 8**
  - Comprehensiveness - Risk management reports should cover all material risk areas within the organization. The **depth and scope** of these reports should be consistent with the size and complexity of the bank's operations and risk profile, as well as the requirements of the recipients.

III. Risk reporting practices

- **Principle 9**
  - Clarity and usefulness - Risk management reports should communicate information **in a clear and concise manner**. Reports should be **easy to understand** yet comprehensive enough to facilitate informed decision-making. Reports should include meaningful information **tailored to the needs of the recipients.**
- **Principle 10**
  - **Frequency** – The board and senior management (or other recipients as appropriate) should set the frequency of risk management report production and distribution. The frequency of reports should be increased during times of stress/crisis.

III. Risk reporting practices

- **Principle 11**
  - Distribution - Risk management reports should be distributed to the relevant parties while ensuring **confidentiality** is maintained.

IV. Supervisory review, tools and cooperation

- **Principle 12**
  - Review - Supervisors should periodically **review and evaluate a bank's compliance** with the eleven Principles above.
- **Principle 13**
  - **Remedial actions** and supervisory measures - Supervisors should have and use the appropriate tools and resources to require effective and timely remedial action by a bank to address deficiencies in its risk data aggregation capabilities and risk reporting practices.
- **Principle 14**
  - **Home/host cooperation** - Supervisors should cooperate with relevant supervisors in other jurisdictions regarding the supervision and review of the Principles, and the implementation of any remedial action if necessary.

GARP Code of Conduct

117-122

Sample questions

- Junaid Manzoor has been hired as head of risk management by KDB Asset Management, a small investment firm in Pakistan. Manzoor implements a risk measurement framework to gauge portfolio risk for the firm. Unfortunately, the methodology he implements for risk measurement has changed considerably in recent years and is no longer used internationally. Neither Manzoor nor anyone else at the firm is aware of the changes to risk measurement approaches. As a GARP member, has Junaid violated the GARP Code of Conduct?

  A. No, this is not a violation of the GARP Code of Conduct because neither Manzoor nor the firm is aware of the changes to risk measurement approaches.

  B. No, this is not a violation as the methodology worked when Manzoor took his FRM exams.

  C. This is only a violation of the GARP Code of Conduct if investment decisions are made based on Manzoor's risk reports.

  D. Yes, this is a violation of the GARP Code of Conduct.

- Correct Answer： D

Sample questions

- Which of the following is a potential consequence of violating the GARP Code of Conduct once a formal determination is made that such a violation has occurred?

  A. Formal notification to the GARP Member's employer of such a violation.

  B. Suspension of the GARP Member's right to work in the risk management profession.

  C. Removal of the GARP Member's right to use the FRM designation.

  D. Required participation in ethical training.

- Correct Answer: C

Sample questions

- GARP Members agree to uphold and implement Rules of Conduct, which includes each of the following EXCEPT for:
  - A. Shall exercise reasonable judgment in the provision of risk services while maintaining independence of thought and direction.
  - B. Shall be knowledgeable about probable future regulations in order to ensure their recommendations can endure future developments.
  - C. Shall be diligent about not overstating the accuracy or certainty of results or conclusions and shall clearly disclose the relevant limits of their specific knowledge and expertise concerning risk assessment, industry practices and applicable laws and regulations.
  - D. Shall endeavor to be mindful of cultural differences regarding ethical behavior and customs, and to avoid any actions that are, or may have the appearance of being unethical according to local customs.

- Correct Answer：B

It’s not the end but just beginning.

By training your thoughts to concentrate on the bright side of things, you are more likely to have the incentive to follow through on your goals. You are less likely to be held back by negative ideas that might limit your performance.

试着训练自己的思想朝好的一面看，这样你就会汲取实现目标的动力，而不会因为消极沉沦停滞不前。

问题反馈

- 如果您认为金程课程讲义/题库/视频或其他资料中存在错误，欢迎您告诉我们，所有提交的内容我们会在最快时间内核查并给与答复。
- 如何告诉我们?
  - 将您发现的问题通过电子邮件告知我们，具体的内容包含：
    - ✓ 您的姓名或网校账号
    - ✓ 所在班级（**eg.2111FRM一级长线无忧班**）
    - ✓ 问题所在科目（若未知科目，请提供章节、知识点）和页码
    - ✓ 您对问题的详细描述和您的见解
  - 请发送电子邮件至：**academic.support@gfedu.net**
- 非常感谢您对金程教育的支持，您的每一次反馈都是我们成长的动力。后续我们也将开通其他问题反馈渠道（如微信等）。