

# **FRM Part I Exam**

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Study Notes - Foundations of Risk Management

Last Updated: Jul 20, 2022

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## **Reading 1: The Building Blocks of Risk Management**

**After completing this reading, you should be able to:**

- Explain the concept of risk and compare risk management with risk-taking.
- Evaluate, compare, and apply tools and procedures used to measure and manage risk, including quantitative measures, qualitative risk assessment techniques, and enterprise risk management.
- Distinguish between expected loss and unexpected loss and provide examples of each.
- Interpret the relationship between risk and reward, and explain how conflicts of interest can impact risk management.
- Describe and differentiate between the key classes of risks, explain how each type of risk can arise, and assess the potential impact of each type of risk on an organization.
- Explain how risk factors can interact with each other and describe challenges in aggregating risk exposures.

## **Risk and Its Management**

Risk refers to the potential variability of returns around an expected return from a portfolio or an expected outcome. The financial risk that arises from uncertainty can be managed and mitigated. Modern risk management refers to the ability, in many instances, to price risks and to provide adequate compensation for the risk taken in business activities.

The building blocks of risk management include:

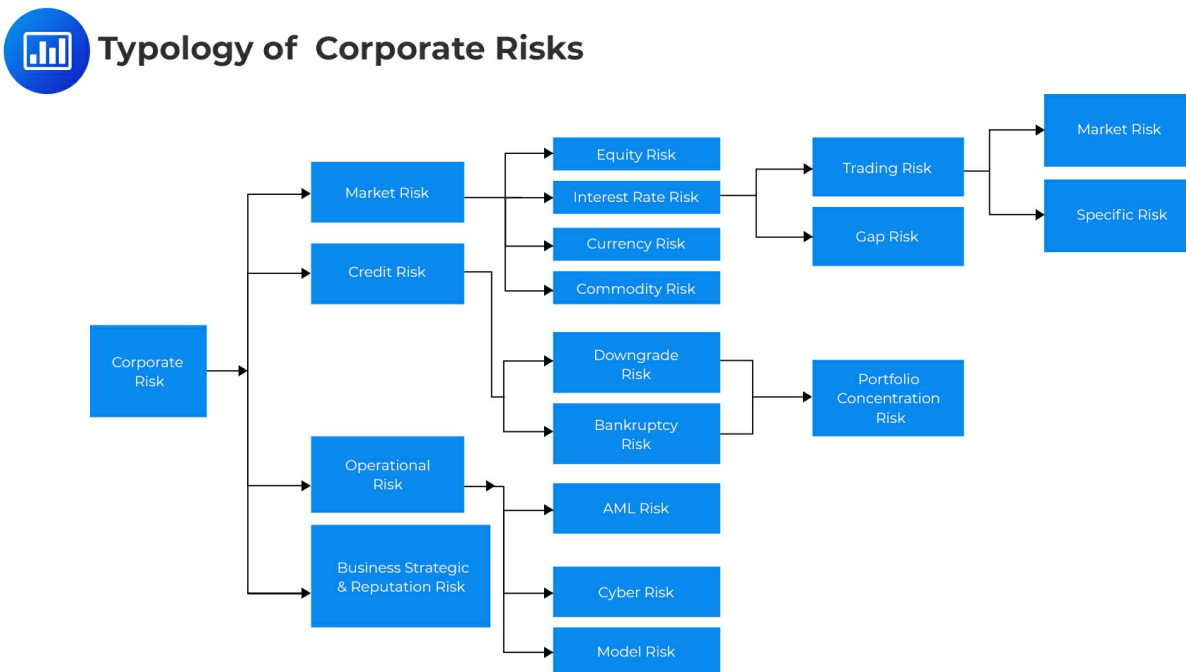
1. The classic risk management process
2. Identifying knowns and the unknowns
3. Expected loss, unexpected loss, and the tail loss
4. Risk factor breakdown
5. Structural change from tail risk to a systemic crisis

6. Human agency and conflicts of interest
7. Typology of risks and risk interactions
8. Risk aggregation
9. Balancing Risk and Reward
10. Enterprise risk management

## 1. Types of Risk and Their Interactions

Risk can be grouped depending on different types of business environments. Grouping the risks is essential for the business institutions to factor into specific risks while managing them. This is true because each type of risk needs different skills to manage it.

A typical typology of risks should always be flexible to accommodate new forms of risks that are ever-emerging (such as cyber risks). The following diagram gives the typical modern typology of corporate risks:



### Market Risk

This is the risk associated with the potential reduction in the value of a portfolio or security due to changes in financial market prices and rates. Price risk can be decomposed into a general market risk component (the risk that the market as a whole will fall in value) and a specific market risk component (idiosyncratic component), unique to the particular financial transaction under consideration. In trading activities, a risk arises from open (unhedged) positions imperfect correlations between market positions intended to offset one another.



## Decomposition of Price Risk



Market risk can be further classified into the following categories:

**Interest Rate Risk-** It arises from fluctuations in the market interest rates, which may cause a decline in the value of interest-rate-sensitive portfolios. For example, the bond market is affected by interest rates in the market. Curve risk can arise in portfolios in which long and short positions of different maturities are effectively hedged against a parallel shift in yields, but not against a change in the shape of the yield curve. If the rates of the positions are imperfectly correlated, basis risk may arise in offsetting positions having the same maturity.

**Equity Price Risk -** This is the risk that is associated with the volatility in the stock prices. The market risk component is the sensitivity of the equity or a portfolio to a change in the level of a market index. This risk cannot be done away with by diversification. The idiosyncratic or specific

threat is the component of volatility determined by firm-specific characteristics like its management, production line, etc. This can be done away with by diversification.

**Foreign Exchange Risk-** Due to operations that involve foreign currencies, imperfectly hedged positions in certain currencies may arise, which may cause exposure to exchange rates. Major factors influencing foreign exchange risk are imperfect correlations in currency prices and fluctuating international interest rates.

## **Credit Risk**

The risk associated with a counterparty not fulfilling its contractual obligations is the credit risk. For example, the default on a credit card loan is the scenario in which credit risk materializes for a credit card company.

Credit risk can be further classified into:

- **Bankruptcy Risk-** The risk associated with a borrower's inability to clear his debt leading to a takeover of his collateralized assets.
- **Downgrade Risk-** The risk that there might be a decline in the borrower's credit ratings because of a drop in his creditworthiness.

Credit risk is a matter of concern only when the position is an asset and not a liability. If the position is an asset, then a default by the counterparty may cause a loss of the position's total or a partial value. The value that is likely to be recovered is called recovery value, while the amount that is expected to be lost is called loss given default.

At the portfolio level, the issues to be addressed are the following:

- The creditworthiness of the obligor: Based on this, an appropriate interest rate or spread should be charged to compensate for the risk undertaken
- Concentration risk: The extent of diversification of the obligor should be a concern.
- The state of the economy: When the economy is booming, the frequency of defaults is comparatively lower than when there is a recession.

## **Liquidity Risk**

It comprises funding liquidity risk and market liquidity risk.

Funding liquidity risk is associated with the risk that a firm will not be able to settle its obligations immediately when they are due. It relates to raising funds to roll over debt and to meet margin calls and collateral requirements. Funding liquidity risk can be managed by holding highly liquid assets like cash.

Trading liquidity risk (also called market liquidity risk) is the risk associated with the inability of a firm to execute transactions at the prevailing market price. It may reduce the institution's ability to hedge market risk, and also it is the capacity to liquidate assets when necessary.

## **Operational Risk**

It refers to the risk that arising from operational weaknesses like management failure, faulty controls, inadequate systems. Human factor risk is one of the essential operational risks, and it results from human errors like entering wrong parameter values, using wrong controls, among others. Technology risk arises from a computer system's failure.

## **Business Risk**

It arises from the uncertainties in demands, the cost of production, and the cost of delivery of products. Business risk is managed by framing appropriate marketing policy, inventory policies, choices of products, channels, and suppliers, etc. Business risk is affected by the quality of a firm's strategy and its reputation too.

## **Strategic Risk**

It is the risk associated with the risk of significant investments for which the uncertainty of success and profitability is high. It is related to the strategic change in the company's policies to make it more competitive in the marketplace.

## **Reputation Risk**

It comprises the beliefs that an enterprise can settle its obligations to counterparties and creditors and secondly, it follows ethical practices. Trust and fair dealing are two essential things that drive businesses. For example, reputation is of crucial importance in the financial industry.

## Interactions of Risk Types

Risks can flow from one type to another. For instance, during hard business times, the risk can flow from the credit risk to liquidity risk and then to market risk. This kind of flow was seen in the 2007-2009 financial crisis.

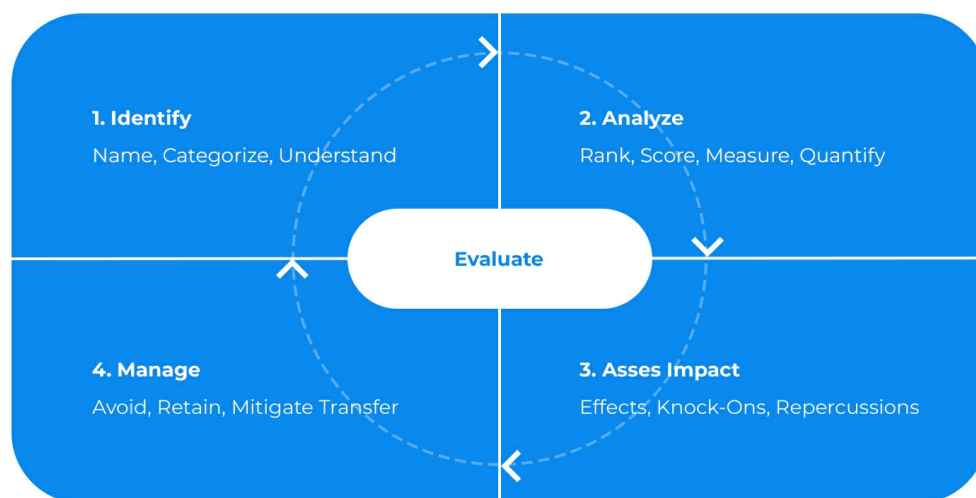
Another example is where operational risk (as a form of lousy trading activity by the traders) flows to market risks by creating unfavorable market positions. Moreover, this can move to become a reputation risk to the concerned company.

## 2. The Risk Management Process

Given below is the flow chart of the risk management process:



### Risk Management Process





Risk management includes identifying the type and level of risk that is appropriate for the firm to assume, analyze, and measure the risk, assess the possible outcomes of each risk. The final stage is the management of the risks.

## Methods of Risk Management

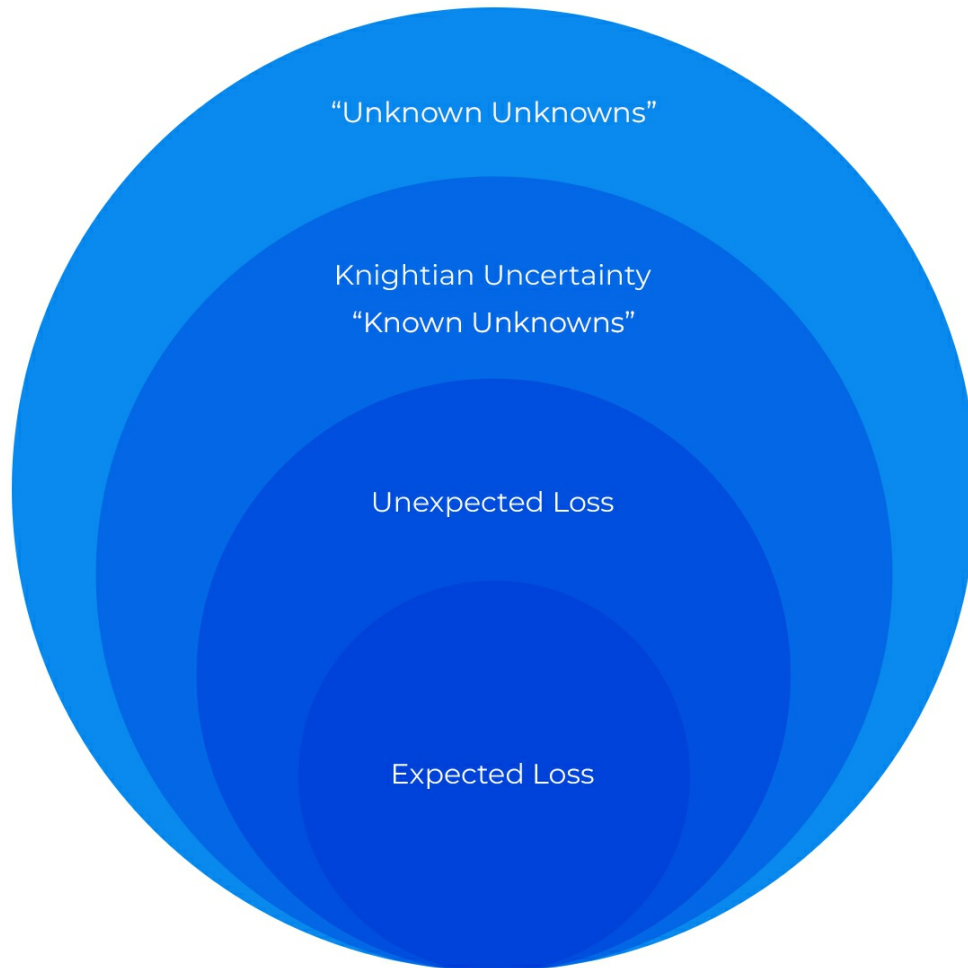
1. **Avoiding the risk:** some risks can be managed by avoiding them. For instance, closing down the business unit or changing the business strategy.
2. **Retaining or keeping the risk:** if the company can accommodate the risk, it can be retained by methods such as insurance of the risk.
3. **Mitigation of the risk:** this method involves an attempt to decrease the exposure, frequency, and severity of the risk. A good example is the improvement of a firm's infrastructure and putting collateral on credit exposure.
4. **Transfer risk:** this method applies to risks that can be transferred to a third party. An example is in derivative products where a company pays a premium to a party to accept a certain level of risk.

## 3. Known and Unknown Risks

According to Donald Rumsfeld (1921), risk managers should not concentrate on known risks only but also the unknown risks. He also classified the risks, as seen in the diagram below.



## Risk Classification - Donald Rumsfeld (1921)



Unknown risks can be very significant and essential, even though their measurement may be difficult or outright impossible. However, unknown risks can be managed using the usual forms of risk management.

Rumsfeld's classification implies that risk managers should focus not only on measurable risks but also on an unknown risk. They should strive to unravel the "unknown unknowns," which includes threats that do hide away.

## 4. Expected, Unexpected and Tail Loss

### The Expected Loss

The expected loss can be defined as the mean loss an investor (position taker) might expect to experience from a portfolio. The expected risks are those that may be large in size, are predictable, and could be avoided with the risk management process.

Theoretically, portfolios usually bear the loss that is near to the average loss, which can be statistically measured with some degrees of freedom.

Expected loss can be calculated from the underlying risk factors. Such factors include:

- The probability of occurrence of risk event
- The size (severity) of the loss
- The exposure to risk

Let us take an example of credit risk to the bank. Denote the probability of default by PD, bank's exposure at default by EAD, and severity of loss given default by LGD. So, the EL is given by:

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

So, how does the bank's manager make sure that they make a profit? The bank management should come up with the price that covers the expected loss. It is important to note that the computation of expected loss is based on assumptions.

### The Unexpected Loss

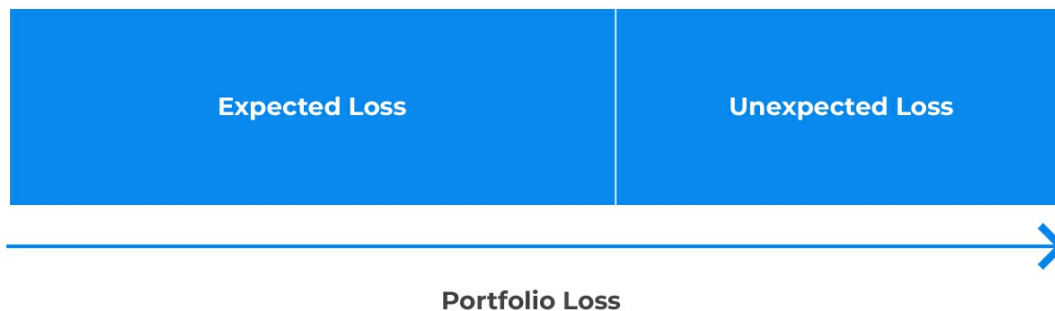
The unexpected loss is the level at which the losses in a portfolio defer from the average loss. Unexpected risks due to unanticipated variability in the losses.

For instance, in a credit portfolio, an unexpected loss can be caused by a difference in the number and severity of the loans. That is, a large number of small loans are diversified, and hence we can estimate the expected loss. However, if the EL continuously changes due to macroeconomic factors,

it leads to unexpected loss.



## Expected vs Unexpected Losses



In some cases, some portfolios (such as credit) can show extreme loss variance over some interval of time. In this case, the expected loss (EL) is calculated by averaging the loss from the long-run good years and the short-run bad years. However, in bad years, the losses can rise to an unexpected level and even to extreme levels. Consequently, the banks are forced to increase the risk capital and including an expected loss in pricing their products to guard themselves against huge unexpected losses, which can cause insolvency and defaults.

### Value-at-Risk (VaR)

VaR is a statistical measure that defines a particular level of loss in terms of its chances of occurrence, i.e., the confidence level of the analysis. In other words, VaR utilizes loss distribution relative to a portfolio or a position to approximate losses at a given level of confidence.

For example, suppose a position in an option has a one-day VaR of \$1 million at the 99% confidence level. In that case, the risk analysis will show that there is only a 1 percent probability of a loss that is greater than \$1 million on any given trading day.

The VaR measure works under normal market conditions and only over a short period, such as one trading day. Potentially, it is a poor and misleading measure of risk in abnormal markets, over more extended periods, or for illiquid portfolios. VaR also depends upon the control environment. Trading controls can be circumvented. This usually happens when back-office staff, business line managers, even risk managers do not have a proper understanding of the critical significance of routine tasks, such as an independent check on volatility estimates, for the integrity of key risk measures.

## **Expected Shortfall**

Despite the significant role VaR plays in risk management, it stops short of telling us the amount or magnitude of the actual loss in the tail. What it tells us is the maximum value we stand to lose for a given confidence level. This drawback can be overcome by a measure known as expected shortfall.

Expected shortfall (ES) is the expected loss given that the portfolio return already lies below the pre-specified worst-case quantile return, e.g., below the 5th percentile return. Put differently, expected shortfall is the mean percent loss among the returns found below the  $q$ -quantile. It helps answer the question: If we experience a catastrophic event, what is the expected loss in our financial position?

The expected shortfall (ES) provides an estimate of the tail loss by averaging the VaRs for increasing confidence levels in the tail. It is also called the expected tail loss (ETL) or the conditional VaR.

## **5. Breakdown and Interactions of Risk Factors**

The risk managers must subdivide the risk into discrete risk factors so that each factor and the interactions between these factors can be studied. An excellent example is the credit risk, which we have studied earlier-where credit risk was divided into the probability of default (PD), bank's exposure at default (EAD), and severity of loss given default (LGD).

However, there is an obvious challenge of how granular risk should be, given the loss data. Dividing the data into very small sub-factors is impractical since it is time-consuming and tiresome. Secondly, analytical resources might be limited. Moreover, the data might be limited in terms of quantity, quality, or descriptive ability.

The solution to this challenge is the emergence of machine learning. In machine learning and substantial cloud-based calculation, power can help in isolating risk granules into smaller details.

## **6. Structural Change from Tail Risk to Systemic Crisis**

Tail risks are those that rarely occur. They can be explained as the extreme version of unexpected loss that is hard to find in the given data. They are usually revealed in time series data of long periods. The tail risk can be detected using statistical methods such as the Extreme Value Theory (EVT).

When the structure of a financial system changes, the risks increase. That is, events associated with large losses may increase as well as risk factor levels. Unless the structural problem is fixed or proper risk management is adopted, new losses relative to a risk type might occur, which changes the amount of tail risk, expected and unexpected losses.

## **7. Human Agency and Conflicts of Interest**

Financial systems are run by intelligent human beings who can adapt to change in a personal and cunning manner. That is, those who are more experienced in risk management can play up their game by hiding their risk analysis from other participants for their gain.

Having said this, many financial firms have employed three ways to control human agency and conflicts of interest:

- i. Firms create business models that can identify and manage risk.
- ii. Employing risk managers that are qualified in risk management and day-to-day oversight.
- iii. Periodic independent oversight and assurance (e.g., internal audit)

These defense mechanisms do not always work due to industry innovations, which sometimes leave loopholes in the risk management sector. Moreover, sometimes traders and the industry leadership willingly alter the credibility of the risk management systems. That is why grasping the role of human agency, self-interest, and conflicts of interest are some of the cornerstones of risk management.

## 8. Risk Aggregation

The risk manager should be able to identify the riskiest businesses and determine the aggregate risks of a firm. For instance, market risks are easily quantified and controlled by comparing the notional amount in each asset held. This, most of the time is impractical since different stocks and industries have different volatilities.

Since the mushrooming of derivative markets in the 1970s, measurement of market risk became relatively achievable. This is because the value and the risk of the derivatives depend on the price of the underlying portfolio.

Derivative traders developed risk measures referred to as the Greeks. They include delta and theta. Greeks are still used up to date, but they cannot be added up, rendering them limited at the enterprise level.

Another measure of risk is VaR. VaR was a useful aggregation method up to the year before the crisis, but it involves too many assumptions. However, VaR is marred with shortcomings but remains to be essential to ask managers.

The disadvantages of these aggregate risk measurements have motivated the managers to come up with total risk measures to replace the traditional measures but, most of the time, fail to include critical dimensions of the risk and must be supplemented with other methods. Conclusively, understanding how risks are aggregated and the drawbacks and advantages that come with them, is an essential risk management building block.

## 9. Risk and Reward Equilibrium

Normally, the assumption of higher systematic risk is associated with higher returns from portfolios. However, the demanded returns from risky assets may not be apparent unless the asset's market is efficient and transparent. For example, the bond prices, solely, may not imply the return demanded, taking additional risks. This can be the case because of liquidity and tax effects. A key objective of risk management is to make transparent potential risks for the firm and identify activities that may be detrimental for the firm in the long term.

For instance, a bank can include the cost of both the expected and unexpected cost by using the following formula for risk-adjusted return on capital (RAROC):

$$\text{RAROC} = \frac{\text{Reward}}{\text{Risk}}$$

Note the Reward can be After-Tax Risk-Adjusted Expected return, and the risk is described as the economic capital so that:

$$\text{RAROC} = \frac{\text{After-Tax Risk-Adjusted Expected return}}{\text{Economic capital}}$$

If the RAROC is higher than the cost of equity capital, then the portfolio is valuable to the investor. The cost of equity capital is the minimum return on equity capital required by the shareholders to compensate for the risk.

Apart from the banking industry, RAROC is applied across different industries and institutions, with the formula varying accordingly (but its purpose remains constant).

## Uses of RAROC

1. **Investment Analysis:** RAROC formula is used to anticipate the likely returns from future investments.
2. **Comparing businesses:** RAROC can be used to compare different units of a company that needs varying amounts of economic capital.
3. **Pricing strategies:** A company can re-determine the pricing strategy of its products so the risk-adjusted returns.
4. **Risk management cost (benefit analysis):** A firm can use RAROC to compare the cost of risk management to the benefit of the firm.

## 10. Enterprise Risk Management (ERM)

Enterprise management risk (ERM) is the process of planning, organizing, leading, and controlling the activities of an organization in order to minimize the effects of risk on an organization's capital and



earnings as a whole. ERM overcomes the challenge of "siloe" risk management, where each unit of an institution manages its own risk independently.

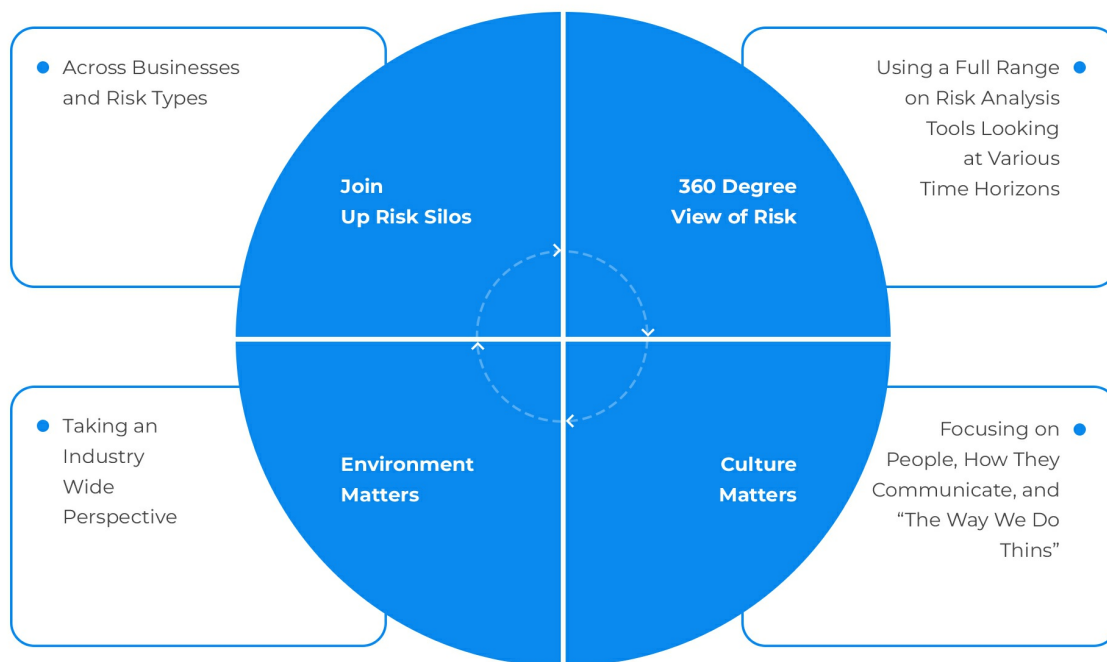
Since the financial crisis of 2007-2009, risk cannot be represented by a single number but rather:

- i. Risk is multi-dimensional. That is, it should be approached from all angles and using diverse methods.
- ii. Risk demands specialized judgment that is seconded by statistical science application.
- iii. Risk develops across all risk types, and thus one may miss the point by analyzing one risk at a time.

More clearly, firms need to adopt a 360-degree view on risk by using different tools and appropriate levels of curiosity. Thus, ERM is not only about aggregating the risk across the risk types and business lines but also taking a comprehensive risk management process while taking into consideration the strategic decisions of a business. A simplified ERM is shown below:



### Example ERM Process



## Question

Which of the following form is NOT included in the expected loss formula?

- A. Probability of default
- B. Loss given default
- C. Unexpected loss
- D. Exposure at default

## Solution

The correct answer is **C**.

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

Unexpected loss is the level at which the losses in a portfolio defer from the average loss as calculated by the expected loss.

## **Reading 2: How Do Firms Manage Financial Risk?**

After completing this reading, you should be able to:

- Compare different strategies a firm can use to manage its risk exposures and explain situations in which a firm would want to use each strategy.
- Explain the relationship between risk appetite and a firm's risk management decisions.
- Evaluate some advantages and disadvantages of hedging risk exposures and explain challenges that can arise when implementing a hedging strategy.
- Apply appropriate methods to hedge operational and financial risks, including pricing, foreign currency, and interest rate risk.
- Assess the impact of risk management tools and instruments, including risk limits and derivatives.

Financial institutions are required to manage financial risks. However, it is an uphill task given that risk management should go hand with the firm's owners' objectives, the reason for risk management strategy and the type of risks, risks to be retained, and types of instruments available.

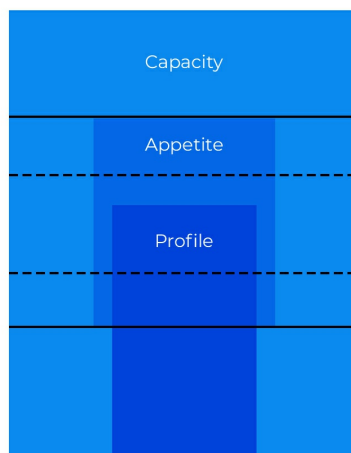
Modern risk management follows an iterative road map which involves five key areas:

### **Identification of the Risk Appetite**

This involves taking note of the corporate objectives and risks, and deciding whether to manage risk and in case risks are managed, what type of risks.

### **Risk Appetite**

Risk appetite refers to the types of risk the firm is willing to accommodate. It, however, should be differentiated with the **risk capacity, which is** the highest level of risk that a firm can handle. Another term is the **risk profile**, which the current level of risk to which the firm is exposed.



The practical risk appetite is stated in two ways:

1. A statement that gives the preparedness of a firm to accommodate risks in wanting to achieve its goals. This is usually an internal document which the board must approve.
2. The tools in which the risk appetite is related to the daily risk management operations of the firm. These include the risk policy of the firm, business lines' risk statements, and risk limits.

Many financial institutions have developed risk appetite as an essential factor. From the above diagram, the risk appetite of a firm should be below the risk capacity and above the risk profile of the firm. The dotted lined represents the upper and lower levels at which the risk must be reported.

## Risk Mapping

The assessment of magnitudes of risks is required after a general policy structure pertaining to risk management has been set up by the board of directors. First, the concerned officials from the firm should identify the risks affecting their divisions, record all the assets and liabilities that have exposure to the risks, and should list orders falling in the horizon set for hedging activities. Once the business risk, market risk, credit risk, and risks associated with operations are identified, the management should look into appropriate instruments to hedge the risks. For example, a firm with

foreign exchange rate exposure may list all the assets and liabilities, having exposure to the exchange rate on the horizon of hedging policy. It should also list sales and expenses that are exposed to the exchange rate. After this, it can find the appropriate financial instrument to hedge these risks.

## **Risk Management Strategies**

After understanding the firm's risk appetite and mapping risks, a risk manager can decide the best way to address the risk while prioritizing the most severe and urgent risks. Moreover, risk must put into consideration the cost and the benefits of each risk management strategy. Risk management strategies include:

- Avoiding the risk: some risks can be managed by avoiding them. For instance, closing down the business unit or changing the business strategy.
- Retaining the risk: some risks can be accommodated by the company, through insurance.
- Mitigating the risk: this method attempts to decrease the exposure, frequency, and severity of the risk. A good example is the improvement of a firm's infrastructure and putting collateral on credit exposure.
- Transferring the risk: involves transferring some portion of the risk to a third party. Such methods include insurance and the application of derivatives.

The type of strategy is decided by the senior management, the board, and the firm's risk manager. The strategy should enable the firm to operate efficiently within the risk appetite.

Now let us turn our attention a little bit on the transfer of risks. The tools of risk transfer (Hedging) include forwards, futures, options, and swaps.

- Forwards: A forward is an agreement where a given amount of asset is exchanged at a predetermined price in the future.
- Futures: A future is a financial agreement that obligates the parties involved to transact an asset at a predetermined future date and price. The buyer must buy, or the seller must sell

the underlying asset at the predetermined price, irrespective of the current market price at the expiration date.

- Options: These are financial instruments that are derivatives that give an investor the right, but not the obligation, to buy or sell a predetermined asset on a specified future date. Examples of the options include call option, put option, exotic option, and swaption.
- Swap: This is an over-the-counter (OTC) agreement to swap the cash value or the cash flows associated with a business transaction at (until) the maturity of the deal. For example, an interest rate swap involves paying a fixed interest rate on an agreed notional cash amount for a specified period while the other party agrees to pay a variable interest rate.

The type of transfer tool used depends on the desired goals of the firm. For instance, options might be more flexible than the forward contracts—moreover, the trading mechanism of the risk transfer instrument. For example, firms may decide to use either exchange-traded or over-the-counter (OTC) instruments to hedge their risks. Exchange-traded instruments are standardized products with maturities and strikes set in advance while over-the-counter derivatives are traded by investment banks, among others, and can be tailored to the firm's needs. For example, the size of the contract, strike, and maturity can all be customized. However, the credit risk is higher for OTC contracts as compared to exchange-traded instruments. In addition, a firm should take into account the liquidity and transaction costs related to the instrument that it wants to use for hedging.

## **Advantages of Hedging Risk Exposure**

Hedging can reduce the cost of capital, reduce cash flow volatility, check liquidity crunch, and improve the debt capacity of a firm. Firms with tight financial constraints might always want to minimize cash flow volatilities to capitalize on growth opportunities. If there are synergistic effects of hedging on the firm's operation, then it should actively hedge to reduce volatilities that may adversely affect its business. For example, if a firm's core business is to manufacture using some crop as an input, then it may use futures on the crop to hedge the price of that crop. In so doing, the firm may go about managing its core business rather than worrying about the price fluctuations in

the crop.

## **Disadvantages of Hedging Risk Exposure**

Hedging can only lead to stable earnings for a limited period. Moreover, hedging is costly (for example, an option requires premiums). Hedging might not be appropriate in a diversified portfolio because risk might be diversified away.

## **Challenges of Implementing Hedging Strategy**

A firm risk management team may miscomprehend the type of risk to which it is exposed, incorrectly measuring or mapping the risk, fail to detect variation in market structure or maybe among the rogue traders, is their own.

Moreover, hedging might involve complex derivatives or strategies which can be compromised by certain events such as interest rate movements.

Poor communication concerning the risk management strategy can lead to dire consequences. Therefore, a hedging program should be well communicated.

## **Operationalization of Risk Appetite**

As mentioned earlier, the risk management roadmap is iterative. To operationalize the risk appetite, the risk manager evaluates the risk policies, sets the risk limit, and rightsizes the risk management team.

A firm can choose to hedge against volatilities related to its operations. For example, a firm may hedge the cost of an input material required for a firm's operations. Since this type of hedging can help reduce the risks associated with the firm's inputs, a firm can concentrate on its core business. It has an impact on the prices of final products and also the scale of products being sold. Hedging currency exposures to reduce risks of losses in exports constitutes an example of hedging risks

related to operations. A tomato ketchup company may choose to hedge its exposure to tomato prices so that it may concentrate on the quality and marketing of its ketchup rather than worrying about the losses it may incur if the prices of tomatoes were to increase.

Hedging risks related to financial positions can be performed by hedging interest rate risks, interest rate swaps, among others. If the marketplace is assumed to be perfect, then there is no need for such hedging because this will not alter the financial health of a firm. However, if hedging is attempted, it would be even for both parties in the hedge, as both will have equal information about the markets. If the market is assumed to be inefficient, then there can be benefits from hedging to one party in the transaction. The benefits may be an increase in debt capacity and tax advantage, economies of scale, or having comparatively better information than individual investors. Firms should essentially hedge their operations, and if they hedge their financial positions, they should be transparent about their policies. So, accepting some form of risk, hedging other risks, and management of costs of hedging to benefit the firm constitute the activities underlying risk management.

## **Rightsizing Risk Management**

When the firm has a clear picture of its objectives in risky areas, it needs to see that the risk management team can come up and execute the approach. That is, risk management should fit its purpose.

Rightsizing of the risk management team ensures that if a firm uses complex risk management instruments, the firm is independent of risk management providers such as investment banks.

Rightsizing also involves ensuring that the risk management function has an elaborate accounting treatment, which can be cost or a profit center. Moreover, the firm should also decide whether to proportionally redistribute the cost of risk management to areas where risk management is concerned, depending on the risk culture and appetite of the firm.

## **Risk Limits**



Rightsizing risk management may also involve setting up a risk-limiting system. A good example is the stress, sensitivity, and scenario analysis limits. Scenario analysis limits are linked to determining how bad the situation in a hypothesized worst-case scenario. The stress test concentrates on unique stresses while the sensitivity looks at the sensitivity of the portfolio to variables changes. However, stress, sensitivity, and scenario analysis limits are sophisticated, require excellent expertise, and in the case of scenario analysis, is challenging to be sure if all bases are covered.

Value-at-Risk (VaR) limits give an aggregate statistical digit as a limit, but the management can easily misinterpret it. Moreover, it does not indicate the extent of an unfavorable condition in a stressed market.

The Greek limits provide the risk positions of options using Greeks such as delta, gamma, and theta. However, their calculations may be compromised, given the lack of management and independence.

Risk concentration limits can also be used. Recall that the risk concentrations include product and geographical risk concentrations. To set these limits, a risk manager ought to have expertise in dealing with correlations because capturing correlation risk in a stressed market is a bit challenging.

Risk-specific limits involve setting limits concerning specific risk types such as Liquidity ratios for Liquidity risks. On the contrary, these limits are difficult to aggregate and require expert knowledge.

Maturity (gap) limits state the limits of the transactions at maturity at each period. These limits are aimed to decrease the risk associated with large-size transactions in a given time frame. However, they are not evident in delivering price risk. Other limits include stop-loss limits and notional limits.

## **Risk Management Implementation**

Risk management involves choosing the right instruments, coming up with the day-to-day decisions, and establishing oversight authority. Consider risk hedging, for instance.

Access to all relevant information, data, and statistical tools is required to frame a strategy for hedging. The risk management team should know the background of the statistical tools being employed to create hedges. The nature of strategy, i.e., static or dynamic, is an important decision. Static strategies are more of a hedge and forget strategies, where a hedge is placed almost exactly to

match the underlying exposure. This hedge remains in place till the exposure ends. Dynamic strategies require more managerial effort and involve a sequence of trades that are used to offset the exposure as nearly as possible. Moreover, dynamic strategies may result in higher transaction costs and require monitoring of positions closely. Proper implementation and communication are the key requirements for the success of any hedging strategy.

The horizon for the hedging position and accounting considerations related to the hedge often has important implications for the way the strategy is planned. Accounting rules require that marked-to-market profit or loss be duly recorded if the position in a derivative and underlying asset are not perfectly matched with regards to dates and quantities. Tax laws vary among countries, and there are differences in tax laws for different derivatives.

## Question

Which of the following best describes the risk capacity?

- A. The amount of risk the firm is willing to accommodate
- B. The total amount of risk that a firm can accommodate without becoming insolvent
- C. The current level of risk to which the firm is exposed
- D. None of the above

## Solution

The correct answer is **B**.

Recall that, risk capacity is the highest level of risk that a firm can handle. This implies that it is the highest amount of risk a firm can handle without running insolvent.

Option A is incorrect because it describes the risk appetite.

Option C is incorrect because it describes the risk profile of a firm.

### **Reading 3: The Governance of Risk Management**

**After completing this reading, you should be able to:**

- Explain changes in regulations and corporate risk governance that occurred as a result of the 2007-2009 financial crisis.
- Describe best practices for the governance of a firm's risk management processes.
- Explain the risk management roles and responsibilities of a firm's board of directors.
- Evaluate the relationship between a firm's risk appetite and its business strategy, including the role of incentives.
- Illustrate the interdependence of functional units within a firm as it relates to risk management.
- Assess the role and responsibilities of a firm's audit committee.

Corporate governance can be defined as the way the firms are run. That is, corporate governance postulates the roles and the responsibilities of a company's shareholders, a board of directors, and senior management. The relationship between corporate governance and risk has become fundamental since the 2007-2009 financial crisis. The critical questions to be answered in the following text are about the relationship between corporate governance practices and risk management practices, the organization of risk management authority through committees, and the transmission of risk limits to lower levels so that they can be observed in daily business decisions.

Lack of transparency, lack of correct and sufficient information about economic risks, and a breakdown in the transmission of relevant information to the board of directors are some of the leading causes of corporate failures in nonfinancial as well as financial sectors in 2001-03 and 2007-09. The subprime crisis was caused by the relegation of risk management activities in the boom years. The risk associated with structured financial products was almost ignored, and this resulted in failed institutions and a global financial crisis.

The post-discussion of corporate governance includes some key issues, especially in the banking industry. These include the composition of the board, the risk appetite, compensation, and

stakeholder priority.

## **Risk Appetite**

The regulators have forced banks to come up with a formal and board-approved risk appetite that reflects the firm's willingness to accommodate risk without the risk of running insolvent. This can be amplified to enterprise risk limits while engaging the board.

The boards have been tasked with the responsibility to cap overcompensation settings. The payment structure should capture the risk-taking adjustment to capture the long-term terms' risks. A good example is where some banks have limited the bonus compensation schemes and also introduce delayed bonus structures.

## **Board Composition**

The financial crisis led to a discussion on the firm's board's independence, engagement, and financial industry skills. However, statistical analysis on the failed banks does not show any correlation between the prowess of a bank and the predominance of either the insiders or outsiders.

## **Stakeholder Priority**

The 2007-2009 financial crisis analysis led to the realization that there was little attention to controlling the tail risks and worst-case scenarios. This has led to discussions on the stakeholders of a bank and their impact on corporate governance.

## **Board Risk Oversight**

After the crisis, the significance of the boards being proactive in risk oversight became a significant issue. Consequently, the boards have been educated on the risks and the direct relationship of the risk management structure, such as delegating CRO's power to report to the board directly.

## **Compensation**

To determine risk behavior, the board takes control over compensation schemes. Boards should

assess the impact of pay structures on risk-taking and also examine whether risk-adjustment mechanisms cater for all key long-term risks. Several banks have already started practicing this for example, by limiting the spread of bonuses in compensation schemes, deferred bonus payments, and clawback provisions.

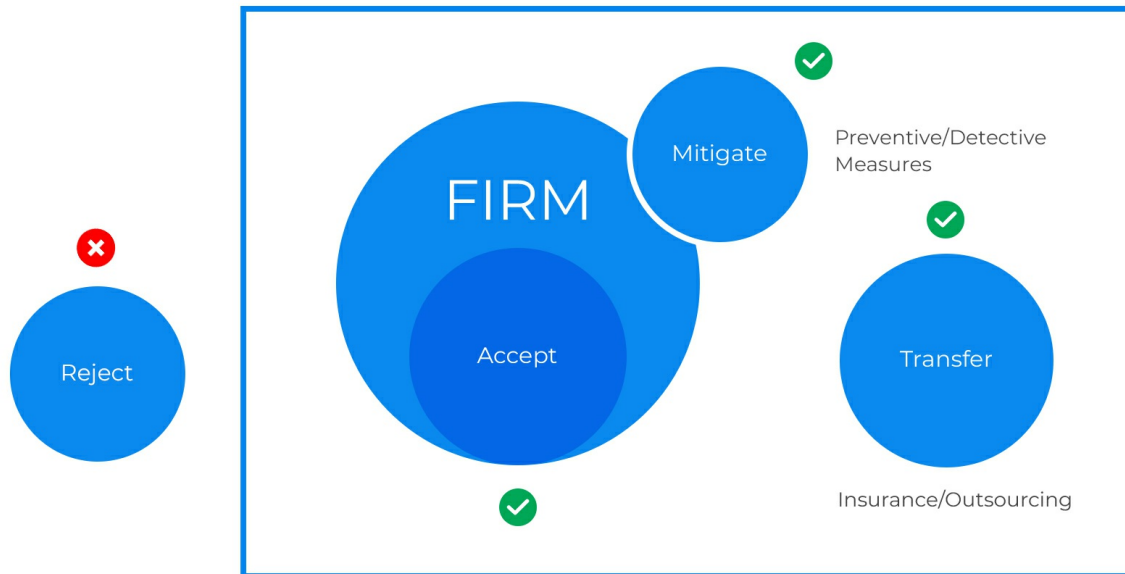
## **The Infrastructure of Risk Governance**

A clear understanding of business strategies and associated risks and returns is necessary for risk governance. The risks associated with business activities should be made transparent to the stakeholders. Appropriate risk appetite should be set for the firm, and the board should oversee the managerial operations and strategy formulation process. Risk management should be involved in business planning, and risks associated with every target should be adequately assessed to see if they fit into the firm's risk appetite. The choices in risk management are as follows:

- Scrapping activities to avoid the risk
- Reducing risk exposure by hedging/buying insurance
- Risk mitigation, for example, reduction of operational risks by control measures
- Accepting risks to generate values for the shareholders.



## Risk Management Strategies



Risk management strategies should be directed to impact economic performance rather than accounting performance. Policies, directives, and infrastructure related to risk management should be appropriately placed in a firm. The seriousness of a firm about its risk management process can be gauged by assessing the career path in the risk management division of the firm, the incentives awarded to the risk managers, the existence of ethics within the firm, and the authority to whom the risk managers report.

## The Board and the Corporate Governance

The primary responsibility of the board of directors is:

- To steer the firm according to the interests of the shareholders. Other stakeholders like the debt holders must also be kept in mind while making strategies at the corporate level. The assumption of particular risks to attain projected returns should be weighed against the sustainability of the profits from such activities. Agency risks, i.e., the conflict of

interests between the management and the stakeholders, should be avoided at all costs. For example, managers may turn to short-term profit-making while assuming long-term risks, to make some bonuses. Corporate governance roles should be independent of the roles of the executive, i.e., the board and the CEO should act independently of each other. Chief risk officers have been put to task in many corporations to integrate corporate governance and risk management activities.

- The board should ensure that staff gets rewarded according to their risk-adjusted performance—this checks fraud related to financial manipulation and stock price boost.
- The board should check the quality and reliability of information about risks, and it should be able to assess and interpret the data. This ensures that all the risk management-related operations are aligned to value creation for shareholders.
- The board should be educated on risk management and should be able to determine the appropriate risk appetite for the firm. There should also be an assessment of risk metrics over a specified time horizon that the board may set. Some technical sophistication is required to build clear strategies and directives concerning crucial risk disciplines. A risk committee of the board should be qualified enough to handle these technicalities. It should also be separated from the audit committee because of the differences in skills and responsibilities.

## **The Transition of Corporate Governance to Best-Practice Risk Management**

As stated earlier, the 2007-2009 financial crisis reflected the weakness in the risk management and oversight of the financial institutions. Consequently, the post-crisis regulatory has emphasized risk governance with an aim to check both the financial risks.

Risk governance is all about coming with an organizational structure to address a precise road map of defining, implementing, and authoritative risk management. Moreover, it touches on the transparency and establishment of channels of communication within which an organization, stakeholders, and regulators engage.



For instance, the board of directors has the responsibility for shaping and authority in risk management. The board of directors to analyze the major risk and rewards in a chosen firm's business strategy.

In other words, the risk governance must ensure that it has put a sound risk management system in place to enable it to expand its strategic objectives within the limits of the risk appetite.

## **The Risk Appetite Statement (RAS)**

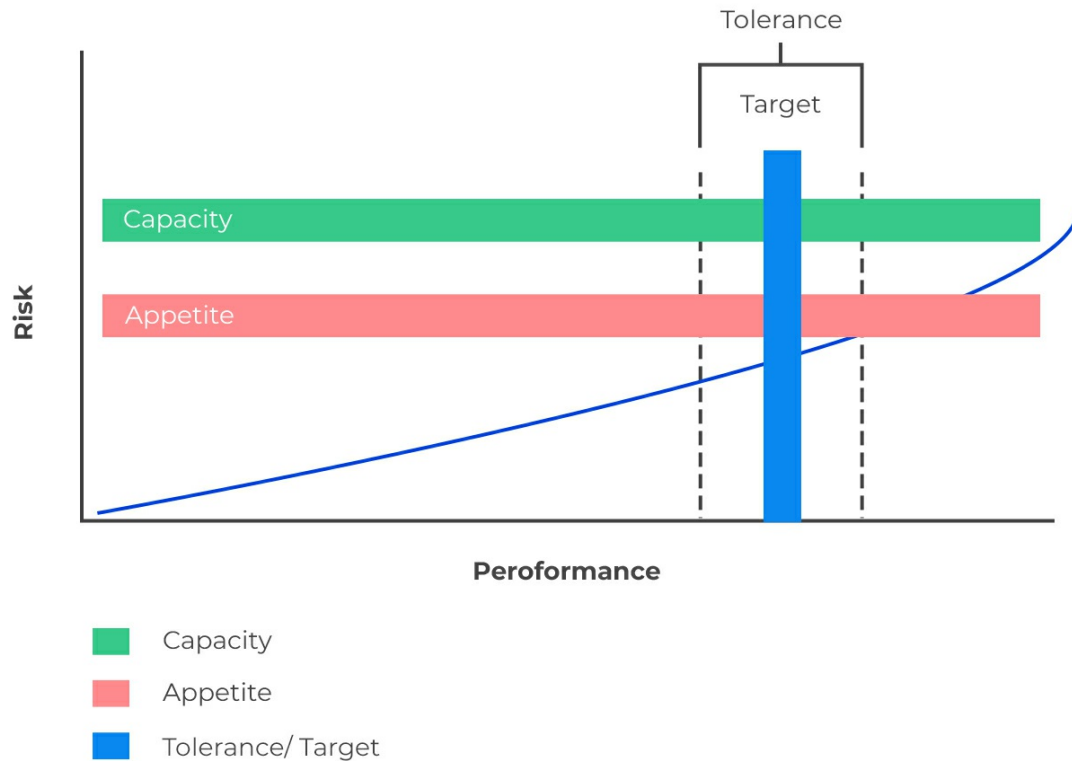
A statement of risk appetite is one of the critical components of corporate governance. RAS contains a precise aggregated amount and types of risks a firm is willing to accommodate or avoid to achieve its business objectives.

Clear articulation of the risk appetite for a firm helps maintain the equilibrium between the risks and return, cultivating a positive attitude towards the tail and even risks, and attaining the desired credit rating.

The RAS should contain the risk appetite, and the risk tolerance measures the maximum amount of risks taken at the business level as well as an enterprise risk. Moreover, it should be the relationship between the risk appetite, the risk capacity, the risk profile, and the risk tolerance.



## Capacity, Appetite, and Tolerance



Risk tolerance is the number of acceptable results relative to business objectives (dotted line on the diagram above). Risk tolerance is a tactical measure of risk, while risk appetite is the aggregate measure of risk. Note that the risk appetite is below the risk capacity of a firm. A firm operating within the risk tolerance can attain the risk-adjusted return objectives relative to the amount of risk.

## Implementation of the Board-Level Risk Governance

In the banking industry, the board of directors charges the committees like risk management committees, among others with ratifying policies and directives for activities related to risk management. The committees frame policies related to division-level risk metrics in relation to the overall risk appetite set by the board. They also look after the effective implementation of these

policies.

## **Role of Audit Committee of the Board**

The audit committee's responsibility is:

- To look into the accuracy of financial and regulatory reporting of the firm and the quality of processes that underlie such activities.
- It also ensures that a bank complies with standards in regulatory, risk management, legal, and compliance activities.
- The audit committee verifies the activities of the firm to see if the reports outline the same.

The members should ideally be nonexecutives to keep the audit committee clear from executive influence. The audit committee should interact with the management productively and should keep all channels of communication open.

## **The Role of the Risk Advisory Director**

There may be a few nonexecutives on the board of directors, who may not have the necessary expertise to understand the technicalities behind the risk management activities of a sophisticated firm. In this case, executives may dominate the nonexecutives, and this may lead to corporate scandals. Training programs and support systems may be put in place to aid such nonexecutives. Another method is to have a specialist in risk management as a risk advisory director on the board. Its functions are:

- The risk advisory director would oversee risk management policies, reports, risks related to the overall business.
- Mitigation of risks like credit risk, market risk, etc. The risk advisory director should be familiar with financial statements and accounting principles.

- The risk advisory director should oversee financial reporting and the dealings between the firm and its associates, including issues like intercompany pricing, transactions, etc.
- The risk advisory director should look into the requirements from regulatory agencies and should lay appropriate directives for the firm to comply with the requirements.
- Participation in audit committee meetings, outlining risk profiles of strategic business segments, sharing insights into corporate governance and risk management policies, and overseeing the conduct of business.

## **The Role of the Risk Management Committee**

The risk management committee in a bank independently reviews different forms of risks like liquidity risk, market risk, etc., and the policies related to them. The responsibility of approving individual credits also usually rests with the risk management committee. It monitors securities portfolios and significant trends in the market as well as breakdowns in the industry, liquidity crunch, etc. It reports to the board about matters related to risk levels, credits, and it also provides opportunities for direct interaction with the external auditor, management committees, etc.

## **The Role of the Compensation Committee**

Its responsibility is to determine the compensation of top executives. Since the CEO could convince the board to pay the executives at the expense of shareholders, compensation committees were put in place to check such occurrences. In the previous decade, compensation based on short-term profits, without much concern about long-term risks, have sealed the fate of many institutions. Since then, compensation based on risk-adjusted performance has gained recognition. Such compensation helps in aligning business activities with long-term economic profitability.

Various caps have also been put in place on the bonuses of executives across the world to prevent a reckless risk-bearing attitude while eying for the upside but bearing no responsibility for the downside of the risky activity. Stock-based compensation may encourage risk-taking as the upsides are not capped while the downsides are. To make employees concerned about the firm's financial health, they may be made the firm's creditors by providing compensations in the form of bonds. For example, UBS has adopted such a strategy.

# **The Risk Appetite and the Business Strategy**

Many firms wish to examine how the regular activities of a firm run within the confines of the set risk appetite and limits defined by the board and executive committees. The process of examining the firm's risk appetite include:

- Risk approval by the board risk committee: The board risk committee approves the risk appetite statement on an annual basis.
- The firm's senior management (such as the CEO and CRO) is tasked by the board with implementing the risk appetite framework.
- With the approval from the board, the senior management comes up with the limiting financial risk parameters (for example, credit risk) and nonfinancial risk (for instance, operational risk) excited by the firm. At this point, the subcommittees can be set up to deal with each risk type independently.
- After setting the risk limit, the senior risk committee then reports the outcome to the board risk committee accompanied by the recommendations on the total risk acceptable, which again subject to the board risk committee's consideration and approval.

## **The Role of the Chief Risk Officer (CRO)**

The CRO is a member of the risk committee whose responsibilities are:

- Designing the risk management program of the firm;
- Risk policies, analysis dimensions, and methodologies;
- Risk management infrastructure and governance in the firm;
- Monitoring the firm's risk limits set by the senior risk management; and
- In many financial institutions such as banks, the CRO is an intermediary between the board and the management. The CRO keeps the board informed on the firm's risk tolerance and condition of the risk management infrastructure and informs the management on the state

of the risk management.

## **The Role of Incentive**

As realized in the global crisis, the executive compensation schemes at many financial institutions motivated short-run risk-taking, leading to management ignoring the long-term risks. That is, the bankers were rewarded based on short-run profits. Consequently, it led to the formation of the compensation committee to cap executive compensation. This prevents a scenario where the CEO can convince the board member to compensate themselves at the expense of other shareholders.

The compensation is part of the risk culture of a firm. Thus, it should be made in accordance with the long-term interest of the shareholders and other stakeholders and the risk-adjusted return on the capital.

For instance, the central bank governors and the finance ministers of the G-20 countries met in September 2009 to discuss the framework for financial stability, one of which is reforms on compensation. The reforms included:

- Scrapping of the multi-annual guaranteed bonuses;
- Controlling the amount of variable compensation given to the employees with respect to total net revenues;
- Promoting transparency through disclosure;
- Recognizing the interdependence of the compensation committee to ensure that they work either with respect to performance and risk; and
- The inclusion of the executive downside exposure by deferring an appropriate compensation, implementing the share-based incentives, and introducing the clawback mechanism where the bonuses are reimbursed if the longer-term losses are incurred after the bonuses are made.

## **The Interdependence of Organizational Units in Risk**

## Governance

Primary responsibility is put on the firm's staff to implement the risk management at all scopes of the firm. The executives and the business line managers should work collaboratively to manage, monitor, and report the various types of risk being undertaken. The figure below illustrates the risk management flows and divided by various management functions.



### Risk Management & Management Functions

#### Senior Management

- Sets business level risk tolerances
- Designs and manages policy
- Evaluates performance

#### Business line

- Takes on and manages exposure to approved risk
- Verifies valuations

#### Risk Management

- Manages risk policy development and implementation
- Monitors limits
- Controls model implementation risks
- Gives senior management independent risk assessments

#### Finance & Operations

- Sets and manages valuations & finance policies
- Oversees official valuations including independent verifications
- Manages and supports analyses required for business planning
- Ensures proper settlement/deal capture/documentations

## The Role of the Audit Function

The audit function is responsible for an independent assessment of the framework and implementation of risk management. It reports to the board about the strategies of business managers and executives, and whether these strategies are in line with the board's expectations.

Regulatory guidelines require audit groups to monitor the adequacy and reliability of documentation, the effectiveness of the risk management process, etc. For example, suppose the market risk is under consideration. In that case, auditors are required to assess the process by which derivative pricing models are examined, changes in measures for quantifying risks, and the scope of risks captured by the models in use. The integrity and independence of position data should also be examined.

There should be an evaluation of the design and conceptual soundness of risk metrics and measures, and stress testing methodologies. The risk management information system, including the process of coding and implementing models, should also be checked and evaluated. The same would include examining controls over market position data capture and that over the process of parameter estimation. The audit function reviews the design of the financial rates database, which is used to generate parameters for VaR models, and things like risk management system upgrade, adequacy of application controls in risk management information system, etc. Documentation related to compliance should be examined, and the audit function should independently assess VaR reliability. The guidelines for the audit function are provided in the International Professional Practices Framework (IPPF). The audit should, essentially, be independent of operational risk management. This ensures that the assessment done by the audit function is reliable.

## **Conclusion**

It is not possible to control the financial health of a firm without an excellent risk management function and appropriate risk metric. Historically, many corporate failures have been associated with the relegation of risks, which would turn fatal later. An important example of this is the subprime crisis in the United States. Therefore, a clear risk management policy should guide the strategies of the firm, and an appropriate risk appetite should limit the exposures of the firm. Such directives make it easy for the executives down the business line to understand their role in the risk management activity.

The risk committees should participate in framing risk management methodologies, and they should have appropriate knowledge of all the risks as well as their metrics so that they can clearly understand the risk reports. A careful delegation of authorities and responsibilities to each risk



management mechanism should ensure that all the gaps are filled, and all the activities are complementary to each other. After taking risk into account, risk measures like VaR, economic capital, etc. can be used to set risk limits, and also be used to determine the profitability of various business lines.

Risk infrastructure can be used as a tool in the analysis and pricing of various deals. It can also be used to formulate incentive compensation schemes so that business decisions and strategies are aligned with risk management decisions.

## Question

Which of the following statements best describes the role of the board in risk management?

- A. Issuing guidelines on how to manage risks
- B. Developing the risk appetite statement and objectives the managers should strive to meet within the risk management framework.
- C. Regularly reviewing decisions made by managers regarding risk exposures
- D. Choosing the risk exposures to hedge, the risks to mitigate, and those to avoid altogether

## Solution

The correct answer is B.

The board sits above the managers in the hierarchy of management in most for-profit organizations. The board assembles and develops a comprehensive risk appetite statement, specifying the risks the company should assume and those to avoid, including the preferred methods of risk mitigation. The managers consult the risk appetite statement when choosing the projects to undertake.

## **Reading 4: Credit Risk Transfer Mechanisms**

**After completing this reading, you should be able to:**

- Compare different types of credit derivatives, explain their application, and describe their advantages.
- Explain different traditional approaches or mechanisms that firms can use to help mitigate credit risk.
- Evaluate the role of credit derivatives in the 2007-2009 financial crisis and explain changes in the credit derivative market that occurred as a result of the crisis.
- Explain the process of securitization, describe a special purpose vehicle (SPV), and assess the risk of different business models that banks can use for securitized products.

## **Overview of Credit Risk Management**

Lending is undoubtedly one of the most profitable investment avenues for banks. Traditionally, banks take short-term deposits and pool them together to provide long-term loans. However, these loans introduce credit risk – the possibility that the funds disbursed may not be recovered following an event of default by the borrower. There are several ways used by banks to deal with credit risk exposure. Banks can

- **Accept** the risk, where the bank simply provides loans and takes no further action
- **Avoid** the risk, which means the bank turns down credit applications
- **Reduce** the risk by taking measures that eliminate at least part of the exposure, for example by adopting a rigorous screening process at the application stage
- **Transfer** the risk to some other entity or person (collectively referred to as the counterparty)

In this chapter, we will extensively look at various methods used by banks to **transfer credit risk**

exposure.

## The Role of Credit Derivatives in the 2007-2009 Financial Crisis

Risk transfer among banks began in earnest towards the end of the 20<sup>th</sup> century. Indeed, one time Federal Reserve Chairman Allan Greenspan is on record admitting that credit derivatives and securitizations represent the main reason the United States banking industry emerged from the 2001-2002 economic slowdown largely unscathed. Some of the instruments that had been in use at the time included credit default swaps, collateralized debt obligations, and collateralized loan obligations.

However, in the aftermath of the 2007/2009 financial crisis, credit derivatives took a significant share of the blame. It has since emerged that the problem was not the instruments themselves but how they were used. While some of these instruments virtually disappeared from the market in the years following the crisis, others continued to thrive. In particular, the CDS and CLO markets remained robust and are still being used widely by banks to manage and transfer credit risk. The very complex instruments, such as collateralized debt obligations squared (CDOs-squared) and single-tranche CDOs, are unlikely to be revived. In recent years, new credit risk transfer mechanisms have also emerged.

## Types of Credit Risk Derivatives

**Credit derivatives** are financial instruments that **transfer the credit risk** of an underlying portfolio of securities from one party to another party without transferring the underlying portfolio. They are usually privately held, negotiable contracts between two parties. A credit derivative allows the creditor to transfer the risk of the debtor's default to a third party.

Credit derivatives are **over-the-counter** instruments. This means that they are non-standardized, and the Securities and Exchange Commission regulations do not bind their trading.

The main types of credit derivatives include:

- Credit default swaps
- Collateralized debt obligations
- Collateralized loan obligations
- Total return swaps
- Credit spread swap options

## **Credit Default Swaps (CDS)**

In a CDS, one party makes payments to the other and receives, in return, the promise of compensation if a third party defaults.

### **Example:**

Assume that Bank A has bought a bond issued by ABC Company. In order to hedge the default of ABC Company, Bank A could buy a credit default swap (CDS) from insurance company X. The bank keeps paying fixed periodic payments (premiums) to the insurance company, in exchange for the default protection.

Debt securities often have longer terms to maturity, sometimes as long as 30 years. Consequently, it is very difficult for a creditor to develop reliable credit risk estimates over such a long investment period. For this reason, credit default swaps have, over the years, become a popular risk management tool. As of June 2018, for example, a report by the office of the U.S. Comptroller of the Currency placed the size of the entire credit derivatives market at \$4.2 trillion, of which credit default swaps accounted for \$3.68 trillion (approx. 88%).

Like other derivatives, the payoff of a CDS is contingent upon the performance of an underlying instrument. The most common underlying instruments include corporate bonds, emerging market bonds, municipal bonds, and mortgage-backed securities.

The value of a CDS rises and falls as opinions change about the likelihood of default. An actual event of default might never occur. It is worth noting that a default event can be difficult to define when dealing with CDSs. Although bankruptcy is widely seen as the “de facto” default, there are companies

that declare bankruptcy and yet proceed to pay up all their debts. Furthermore, events that fall short of default can also cause damage to a creditor. These events include late payments or payments made in a form different from what was agreed upon. Trying to determine the exact extent of damage to creditors when some of these events happen can be difficult. CDSs are, therefore, designed to protect creditors against such events.

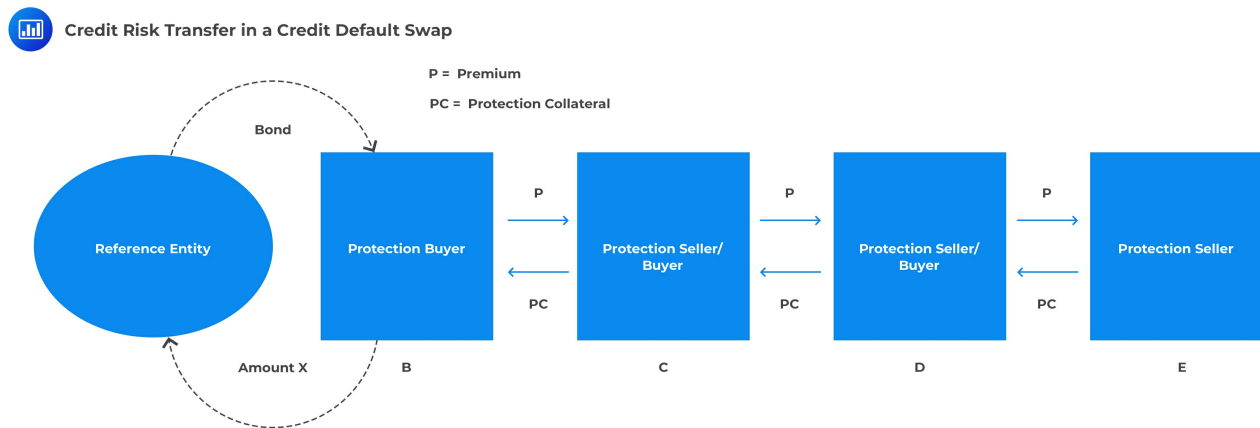
## **Advantages of CDSs**

- CDSs can serve as shock absorbers during a corporate crisis. As happened during the 2001/2002 economic slowdown in the U.S., many creditors from firms such as Worldcom and Enron had transferred risks, and as a result, these corporate scandals did not spread into the banking sector.
- CDS contracts ultimately result in more liquidity (access to capital) since banks have an incentive to lend more at favorable terms.
- The pricing of credit default swaps serves as evidence of the prevailing financial health of a debtor. When used alongside credit ratings, CDSs offer an opportunity to further improve market information about the creditworthiness of a debtor.

## **Disadvantages of CDSs**

- Speculators may increase trading on a CDS, resulting in an increase in the CDS premium concerning a given entity. As a result, such an entity could face increased borrowing rates if it tries to access the financial markets for a loan. For sovereign name CDS contracts (where the borrower is a sovereign country), high premiums may force investors to stay away or switch investments to avoid losses.
- The termination event (i.e., default event) may not be specified, and even if a clear stipulation exists, the credit protection seller may find it difficult to price some events.
- CDS contracts can be abused and manipulated, creating the illusion that the protection buyer is protected when, in fact, they are not.
  - Example: Assume that we have five parties – A, B, C, D, and E. Let us further

assume that party B buys protection from party C for a loan extended to party A, but party C also transfers this risk to party D, and D does the same and buys protection from monoline insurer E. In this scenario, there are three individual agreements made, but economically, only the last buyer (the monoline insurer) bears the ultimate risk. Most importantly, the gross notional amount is inflated **three times more** than the aggregate net exposure.



- The participation of banks in the CDS market can introduce a **moral hazard** in the sense that the CDS (which is an insurance policy against default) may result in laxity in credit monitoring. The case of Enron refers. Several lenders had debt exposure to Enron, and to protect their investments, the banks bought a massive amount of insurance in the form of CDSs. It is estimated that about 800 swaps were bought to insure \$8 billion on Enron's risk. By so doing, the banks neglected their **specialty for monitoring**, despite having the necessary tools and access to Enron's financial system.

## Collateralized Debt Obligations

Collateralized debt obligations (CDOs) are structured products created by banks to offload risk. The first step entails forming diversified portfolios of mortgages, corporate bonds, and various other assets. These portfolios are then sliced into different tranches that are sold to investor groups that have different risk appetites.

The safest tranche is also known as the **senior tranche**. It offers the lowest interest rate, but it is the **first** to receive cash flows from the underlying asset portfolio. The **middle tranche** offers a slightly higher interest rate and ranks just below the senior tranche. Therefore, it takes the **second** spot during cash flow distribution. The most junior tranche, also called the **equity tranche**, offers the highest interest rate but ranks **last** during cash flow distribution. It is also the first tranche to absorb any loss that may be incurred. The amount available for distribution to the equity (junior) tranche is whatever is left from the two other tranches, **less** the **management** fees. These fees can range from 0.5% to 1.5% annually.

Investors in these tranches can protect themselves from default by purchasing credit default swaps. A CDS guarantees a pre-specified compensation if a given tranche defaults. In turn, the investors must make regular payments to the credit protection seller (writer of the CDS).

Each tranche is assigned its credit rating, except the equity tranche. For instance, the senior tranche is constructed to receive an AAA rating. Highly rated tranches are sold to investors, but the junior ranking ones may end up being held by the issuing bank. That way, the bank has an incentive to monitor the underlying loans.

## **Example: Calculating Cash Flows for CDO Tranches**

Let us assume that there is a \$100 million collateral portfolio that is composed of debt at 6%. To pay for this collateral, the CDO is divided into three tranches:

- \$85m of Class A securities, with a credit rating of AAA, senior debt paying 5.0%
- \$10m of Class B securities, with a credit rating of BBB, mezzanine debt paying 9.0%
- \$5m of Class C securities (equity tranche)

In this scenario, the \$85m of Class A would pay out \$4.25m ( $= \$85m \times 5.0\%$ ) in interest each year, Class B pays out \$0.9 ( $\$10m \times 9.0\%$ ). Of the remaining \$0.85m ( $\$6m - \$4.25m - \$0.9m$ ), \$0.2m is used to pay for fees, leaving the equity holders with a return of 13% ( $\$0.65m/\$5m$ ).

## **Advantages of CDOs**



- When used responsibly, CDOs can be excellent financial tools that can increase the **availability and flow of credit** in the economy. By selling CDOs, banks can free up more funds that can be lent to other customers.
- CDOs take the **different levels of risk tolerance** among investors into account. An investor without much risk tolerance could buy the senior tranche of a CDO, which represents the highest-quality loans. On the other hand, an investor with higher risk tolerance could buy the junior tranche that's backed by somewhat riskier loans.
- Collateralized debt obligations allow banks to transform relatively illiquid security (a single bond or loan) into relatively liquid security.

## Disadvantages of CDOs

- CDOs can result in **relaxed lending standards** among banks, as happened in the run-up to the 2007/2009 financial crisis. Most of the CDOs sold at the time were composed of mortgage loans extended to borrowers with **questionable** banks. Such banks were not so keen on establishing accurate and reliable borrower profiles because they would repackage and sell the mortgages to third parties, essentially taking the risk of default off their books.
- Market fears can result in a near standstill in trade, thereby creating a **liquidity problem** and financial loss for an investor. For example, in the run-up to the 2007/2009 financial crisis, the CDOs market grew at an astonishing rate, particularly because there was an overly positive forecast of the mortgage market. It was expected that home prices would continue going up indefinitely. So, when prices stopped going up, defaults skyrocketed, and panic set in. All of a sudden, banks stopped selling CDOs, and the housing market plunged. As CDOs dropped in value, billions were lost by investors, including pension funds and corporations.

## Collateralized Loan Obligations

A collateralized loan obligation is similar to a collateralized debt obligation, except that the underlying

debt is a company loan instead of a mortgage. The investor receives scheduled debt payments from the underlying loans, bearing most of the risk if borrowers default.

As with CDOs, CLOs use a waterfall structure to distribute revenue from the underlying assets. The structure dictates the priority of payments when the underlying loan payments are made. It also indicates the risk associated with the investment since investors who are paid last (equity holders) have a higher risk of default from the underlying loans.

CLOs have the same set of advantages and disadvantages as CDOs.

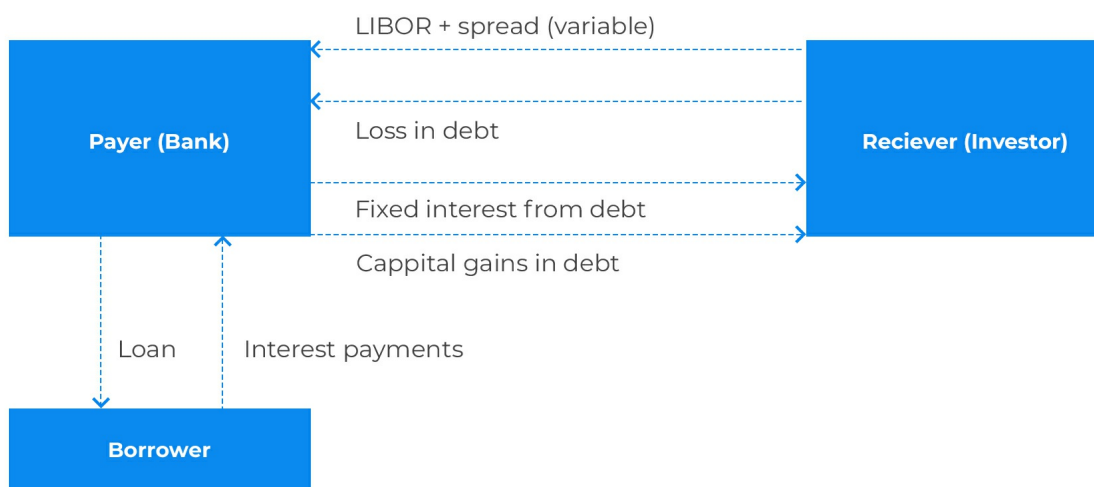
## **Total Return Swap**

A total return swap is a credit derivative that enables two parties to exchange both credit and market risks. In a total return swap, one party, the payer, can confidently remove all the economic exposure of an asset without having to sell it. The receiver of a total return swap, on the other hand, can access the economic exposure of an asset without having to buy it.

For example, consider a bank with significant (but risky) assets in the form of loans in its books. Such a bank may want to reduce its economic exposure concerning some of its loans while still retaining a direct relationship with its customer base. Therefore, the bank can enter a total return swap with a counterparty that desires to gain economic exposure to the loan market. What happens is that the bank (payer) pays the interest income and capital gains coming from its customer base to these investors. In return, the counterparty (receiver) pays a variable interest rate to the bank and also bears any losses incurred in the loan.



## Mechanics of a Total Return Swap



## Advantages of Total Return Swaps

- A TRS allows one party (receiver) to derive the economic benefit of owning an asset without putting that asset on its balance sheet. Besides, it allows the other party (payer), which does retain that asset on its balance sheet, to buy protection against loss in the asset's value. This makes TRSs one of the most preferred forms of financing for hedge funds and special purpose vehicles.

## Disadvantages of Total Return Swaps

- TRSs carry **counterparty risk**. Consider a TRS between a bank (payer) and a hedge fund (receiver) to see how this manifests. Any decline in the value of the underlying loans will reduce returns, but the fund will have to continue making regular payments to the bank. If the decline in the value of assets continues over a significant period, the hedge fund could suffer financial strain, and the bank will be at risk of the fund's default. That hedge funds almost always operate with much secrecy only serves to heighten default risk.
- TRSs are exposed to **interest rate risk**. The payments made by the total return receiver are often equal to LIBOR plus a spread. An increase in LIBOR during the

agreement increases the payment due to the payer, while a decrease in LIBOR decreases the payments to the payer.

## Credit Default Swap Option

A credit default swap option (CDS option), also known as a credit default swaption, is an option on a credit default swap. It gives its holder the right, but not the obligation, to buy or sell protection on a specified reference entity for a specified future period for a certain spread.

CDS options can either be payer swaptions or receiver swaptions.

- A payer swaption gives the holder the right to **buy** protection (pay premiums)
- A receiver swaption gives the option holder the right to **sell** protection (receives premiums)

## Traditional Approaches That Firms Can Use to Help Mitigate Credit Risk.

Banks use several ways to reduce their exposure to credit risk, both individually and on an aggregate basis. Such credit protection techniques include the following:

### Insurance

Credit Risk insurance is a critical risk-mitigation technique that protects lenders against a bad debt or slow payments that are not in line with the initial agreement. If the counterparty cannot pay due to a host of issues such as insolvency, political risk, and interest rate fluctuations, the credit insurer will pay. By the principle of subrogation, the insurer can then pursue the counterparty for payment. When insurance is sought on an **individual obligor** basis, this is termed **guarantee**.

### Netting

Netting is the practice of **offsetting** the value of multiple positions or payments due to be exchanged between two or more parties. Netting entails looking at the difference between the

asset and liability values for each counterparty involved, after which the party that is owed is determined. For netting to work, there must be documentation that allows exposures to be offset against each other.

Netting frequently occurs when companies file for bankruptcy. The entity doing business with the defaulting company offsets any money they owe the defaulting company with money owed. The parties then decide how to settle the amount that cannot be netted through other legal mechanisms.

## **Marking-to-Market/Margining**

This refers to the settlement of gains and losses on a contract daily. It avoids the accumulation of large losses over time, which can lead to a default by one of the parties. As with netting, an agreement has to be in place allowing counterparties to periodically revalue a position and transfer any net value change between them so that the net exposure is minimized.

## **Termination**

Termination describes a situation where parties develop **trigger clauses** in a contract that gives the counterparty the right to unwind the position using some predetermined methodology. Trigger events may include:

- A rating downgrade
- Exceedance of a borrowing/leverage limit
- Performance below a specified threshold

## **The Securitization Process**

Historically, banks used to originate loans and then keep them on their balance until maturity. That was the **originate-to-hold** model. With time, however, banks gradually and increasingly began to distribute loans. By so doing, banks were able to limit the growth of their balance sheet by creating a somewhat autonomous investment vehicle to distribute the loans they originated. This is known as the **originate-to-distribute** business model.

From the perspective of the originator, the OTD model has several benefits:

- It introduces specialization in the lending process. Functions initially designated for a single firm are split among several firms.
- It reduces banks' reliance on the traditional sources of capital, such as deposits and rights issues.
- It introduces flexibility into banks' financial statements and helps them diversify some risks.

To borrowers, the OTD model leads to an expanded range of credit products as well as reduced borrowing costs.

The OTD model, however, has its disadvantages:

- Allowing banks to hive off part of their liabilities can relax lending standards and contribute to riskier lending. This implies that borrowers who previously would be turned - possibly because of poor credit - are granted access to credit.
- By splitting functions among multiple firms, the model can make it difficult for borrowers to renegotiate terms.

A direct result of the shift to the originate-to-distribute model is **securitization**, which involves repackaging loans and other assets into new securities that can then be sold in the securities markets. This removes a substantial amount of risk ( .e., liquidity, interest rate, and credit risk) from the originating bank's balance sheet when compared to the traditional originate-to-hold strategy. Apart from loans, various other assets, such as residential mortgages and credit card debt obligations, are often securitized.

To reduce the risk of holding a potentially undiversified portfolio of mortgage loans, several originators (financial institutions) work together to pool residential mortgage loans. The loans pooled together have similar characteristics. The pool is then sold to a separate entity, called a special purpose vehicle (SPV), in exchange for cash. An issuer will purchase those mortgage assets in the SPV and then use the SPV to issue mortgage-backed securities to investors. MBSs are backed by

loans as collateral.

The simplest MBS structure, a **mortgage pass-through**, involves cash (interest, principal, and prepayments) flowing from borrowers to investors with some short processing delay. Usually, the issuer of MBSs may enlist the services of a **mortgage servicer** whose main mandate is to manage the flow of cash from borrowers to investors in exchange for a fee. MBSs may also feature **mortgage guarantors** who charge a fee and, in return, guarantee investors the payment of interest and principal against borrower default.

## Question

What are the contractual specifications for the protection seller of a credit default swap?

- A. The protection buyer pays a premium to the protection seller at regular intervals, until a credit event occurs, in which case the protection seller compensates the protection buyer for the credit event.
- B. If a credit event occurs, the protection seller is obliged to exchange contractually specified assets for government bonds.
- C. The protection seller pays a premium to the protection buyer at regular intervals until a credit event occurs, in which case the protection buyer compensates the protection seller for the credit event.
- D. If the underlying of the credit default swap is a bond issued by a specific corporation, only that corporation can act as a protection seller.

**The correct answer is: A)**

In a CDS, one party makes payments to the other and in return, receives the promise of compensation if a third party defaults.

Example: Assume that Bank A has bought a bond issued by ABC Company. In order to hedge the default of ABC Company, Bank A could buy a credit default swap (CDS) from insurance company X. The bank keeps making fixed periodic payments (premiums) to the insurance company, in exchange for the default protection. In the event of default, the bank would receive compensation from the insurance company, usually equal to the bond's face value.

**D is incorrect.** The issuer of a bond cannot double up as the protection seller of the security issued.



## **Reading 5: Modern Portfolio Theory (MPT) and the Capital Asset Pricing Model (CAPM)**

**After completing this reading, you should be able to:**

- Explain modern portfolio theory and interpret the Markowitz efficient frontier.
- Understand the derivation and components of the CAPM.
- Describe the assumptions underlying the CAPM.
- Interpret and compare the capital market line and the security market line.
- Apply the CAPM in calculating the expected return on an asset.
- Interpret beta and calculate the beta of a single asset or portfolio.
- Calculate, compare, and interpret the following performance measures: the Sharpe performance index, the Treynor performance index, the Jensen performance index, the tracking error, information ratio, and the Sortino ratio.

***Exam tip: Be sure to understand the calculations behind the CAPM because there is a strong likelihood you will be getting mathematical questions on this in your FRM part 1 exam.***

### **Modern Portfolio Theory**

Modern portfolio theory is attributed to Harry Markowitz, who postulated that a rational investor should evaluate the potential portfolio allocations based on means and variances of the expected return distributions.

### **Assumptions of the Modern Portfolio Theory**

I. The capital markets are perfect. Perfect market implies that:

- There are no transaction costs and taxes.
- All market participants can access available information without any cost.
- There is perfect competition in the market.

II. The returns from the portfolios are normally distributed. This allows the characteristics of the returns to be stated in terms of the mean and the variance.

Markowitz suggested that the size of investment made by an institution should be based on the contribution of the assets to the entire portfolio's return (in terms of mean and return). The assets' performance is not evaluated independently but rather with the performance of other assets.

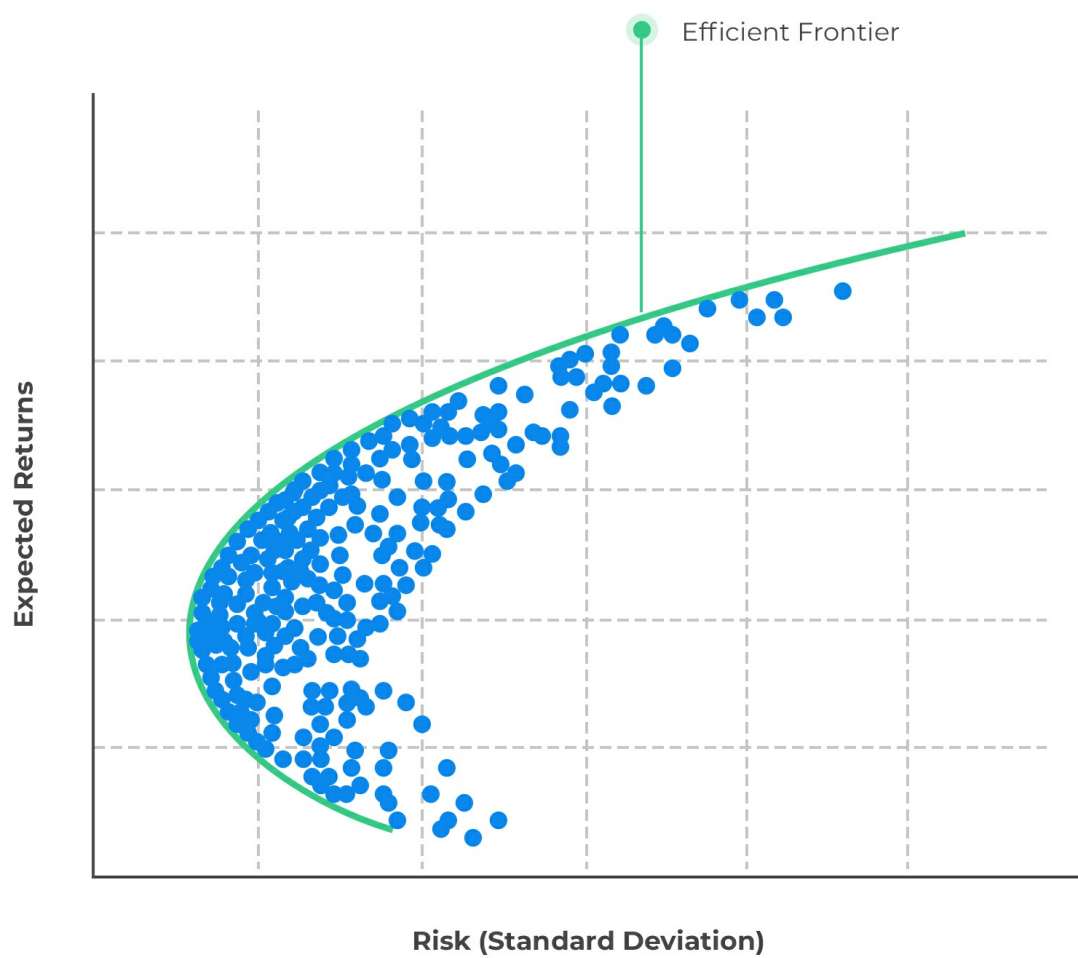
Portfolio diversification is one method of decreasing the risk exposure to each asset. Thus, investors must be compensated for accepting the risk in each asset. Diversification enables the maximization of the level of returns at any provided level of risk.

## **Markowitz Efficient Frontier**

The Markowitz Efficient Frontier (or only efficient frontier) is a curved solid curve with a plot of the optimal returns for each level of risk. Each point on the curve represents the maximum level of portfolio return for a given level of risk.



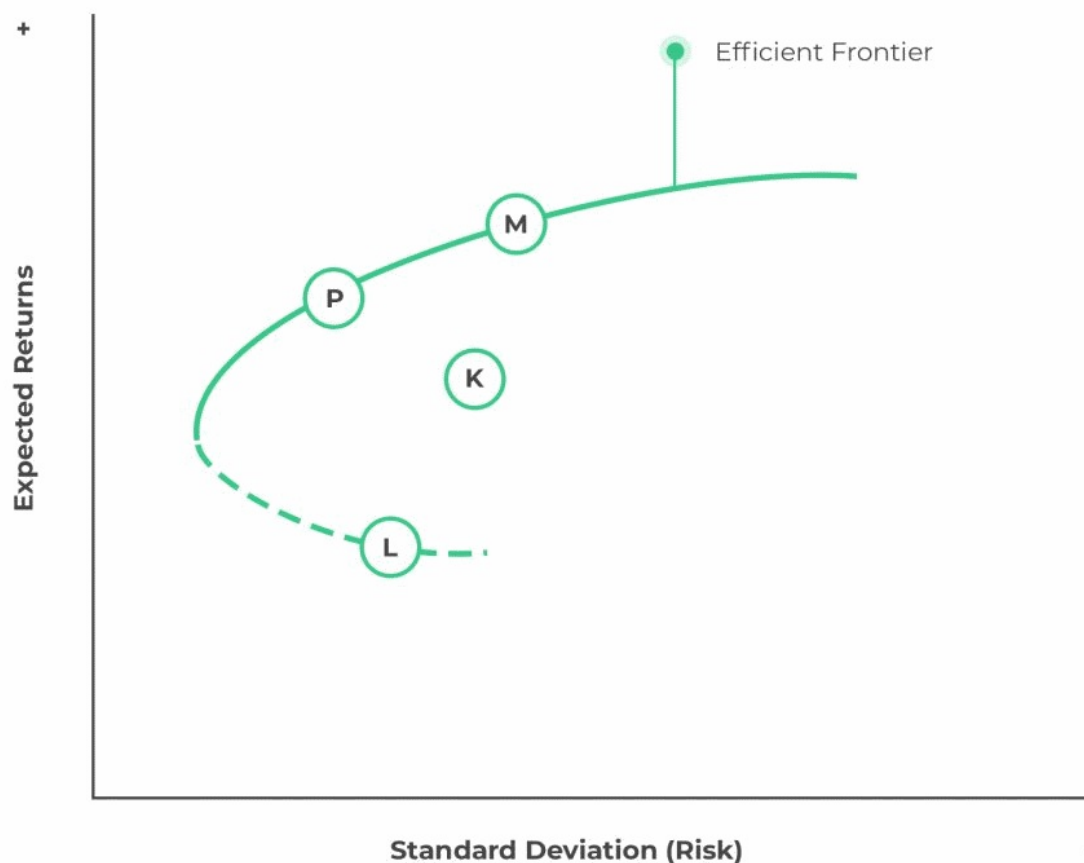
## Markowitz Efficient Frontier



Now, consider the following efficient frontier.



## Optimal and Suboptimal Portfolios



Portfolio P gives the best return for the same level of risk. On the other hand, portfolio K is termed as suboptimal since there are other portfolios (located on the vertical distance between the portfolio K and the efficient frontiers) that can offer better returns for the same level of risk, namely portfolio M.

Portfolio M is referred to as the market portfolio. The market portfolio assumes that the market attains the equilibrium and appropriately includes all the risky assets in the economy weighted by their respective market values.

Portfolio P is also an efficient portfolio, but representing a lower level of risk than portfolio M.

From the efficient frontier, it is easy to see that the expected return is increased by increasing the portfolio's risk level and vice versa. The dotted line represents the most inefficient portfolios; in this case, portfolio L. Inefficient portfolios imply that the investor achieves the lowest level of return given any level of risk.

## **The Capital Asset Pricing Model (CAPM)**

The Capital Asset Pricing Model, derived by Sharpe, Lintner, and Mossin, stipulates assumptions regarding the market and how investors behave to enable the creation of an equilibrium model of prices in the whole market. CAPM explains that the market equilibrium is attained when all investors hold portfolios whose constituents are a combination of riskless assets and the market portfolio.

### **Assumptions Underlying the CAPM**

Assumptions of the CAPM model include:

- There are no transaction costs
- There are no taxes
- Assets are infinitely divisible
- Unlimited short-selling is permissible
- All assets are marketable/liquid
- Investors are price takers whose individual buy and sell transactions do not affect the price
- Investors' utility functions are based solely on expected portfolio return and risk
- The only concern among investors are risk and return over a single period, and the single period is the same for all investors.

Under these assumptions, the expected rate of return over a given holding time is given by:

$$E(R_i) = R_f + \beta_i (R_m - R_f)$$

Where

$E(R_i)$ : the expected return of asset  $i$  over the holding period

$R_f$ : rate of return on the risk-free asset

$R_m$ : Expected market return over the holding period

$\beta_i$ : the Beta factor of the asset  $i$

Note that  $(R_m - R_f)$  is the expected return per unit risk (beta) and  $\beta_i (R_m - R_f)$  is the expected return above the risk-free rate of return.

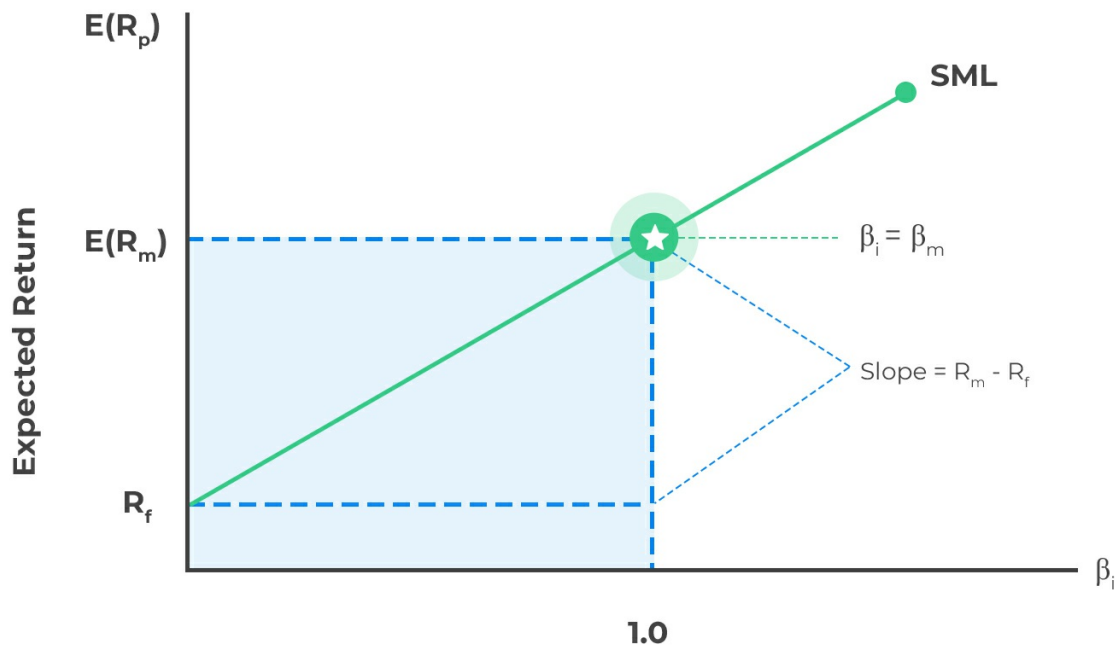
## Interpreting Beta

**Beta** is a measure of the systematic risk associated with a particular stock, asset, or portfolio.

**Systematic risk** is the portion of risk that cannot be eliminated by any amount of diversification.



## Beta Slope (Systematic Risk)



A value of beta above 1 indicates a stock/asset/portfolio that has, historically, amplified the return of the whole market (positive or negative). A beta close to zero would indicate a stock/asset/portfolio that provides a more stable return than the market as a whole. A negative beta would signify a stock/asset/portfolio whose performance is counter-cyclical, i.e., offsets the overall market experience.

For company i:

$$\beta_i = \frac{\text{Cov}(i, m)}{\sigma_m^2} = \frac{\sigma_{im}}{\sigma_m^2}$$

Where  $\sigma_m$  is the variance of the market index and  $\sigma_{im}$  the covariance between the individual stock's/asset's return and that of the market.

Alternatively, by using the fact that:

$$\text{Corr}(i, m) = \rho_{im} = \frac{\text{Cov}(i, m)}{\sigma_i \sigma_m} = \frac{\sigma_{im}}{\sigma_i \sigma_m}$$

$$\Rightarrow \sigma_{im} = \rho_{im} \cdot \sigma_i \sigma_m$$

We can write:

$$\beta_i = \rho_{im} \frac{\sigma_i}{\sigma_m}$$

Where

$\rho_{im}$ : correlation coefficient between returns of asset i and that of the market portfolio.

$\sigma_i$ : standard deviation of asset i

$\sigma_m$ : standard deviation of the market portfolio

Therefore, we can write:

$$E(R_i) = R_f + \sigma_i \rho_{im} \left( \frac{R_m - R_f}{\sigma_m} \right)$$

This is the equation of the security market line (SML). The equation implies that the expected return on any asset is equivalent to a risk-free rate of return plus the premium. The SML implies that the expected return on any asset can be expressed as the linear function of assets covariance with the whole market.

## Derivation of CAPM

The derivation of CAPM involves three major steps:

1. Recognize that investors are only compensated for bearing systematic risk, not specific risks that can easily be diversified away. Note that, beta is an appropriate measure of systematic risk.
2. Suppose we recognize that portfolio expected return is a weighted average of individual expected returns and portfolio beta is a weighted average of the individual betas. In that case, we can show that portfolio return is a linear function of portfolio beta. And because arbitrage prevents mispricing of assets relative to systematic risk, then an individual asset's expected return is a linear function of its beta.



3. We can then use the risk-free asset and the market portfolio to solve for the intercept and slope of the CAPM.

$$E(R_i) = R_f + \beta (R_m - R_f)$$

## The Capital Market Line

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

$$E(R_C) = R_f + \left[ \frac{E(R_m) - R_f}{\sigma_m} \right] \sigma_C$$

Where

$E(R_C)$  is the expected return of any portfolio on the efficient frontier

$\sigma_C$  is the standard deviation of the return on portfolio C

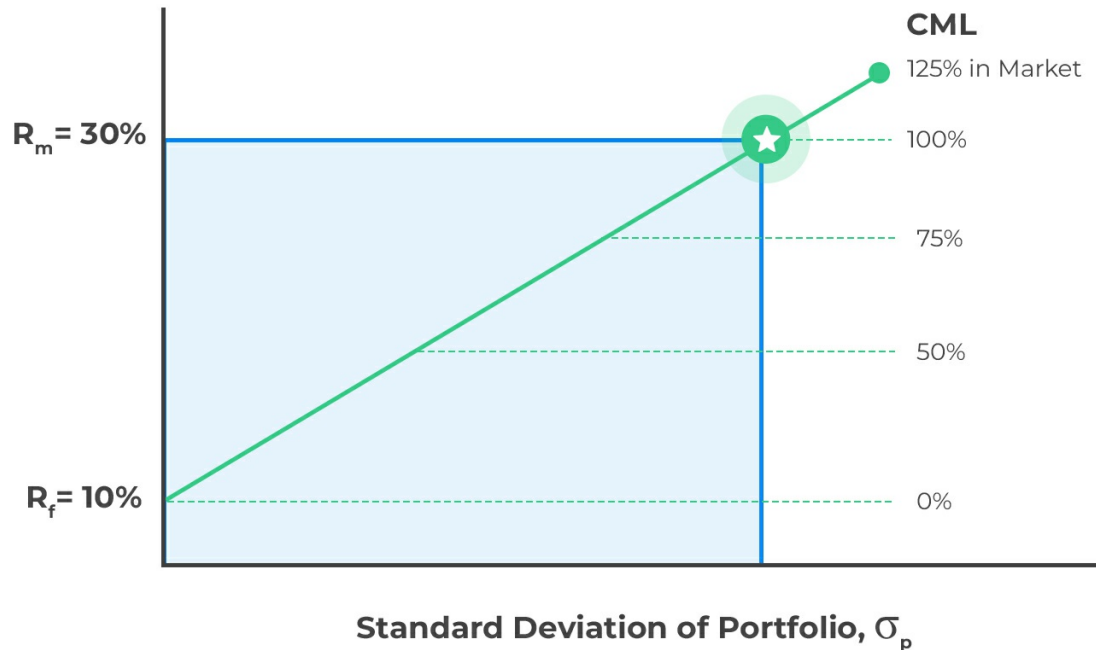
$E(R_m)$  is the expected return on the market portfolio

$\sigma_m$  is the standard deviation of the return on the market portfolio

$R_f$  is the risk-free rate of return.



## The Capital Market Line



The capital market return implies that the return on any portfolio is a linear function of its standard deviation. The variable  $\left[ \frac{E(R_m) - R_f}{\sigma_m} \right]$  is termed as the *market price of risk* or *the risk premium*.

## Single-Index Performance Measurement Indicators

### The Sharpe Performance Index (SPI)

The Sharpe ratio is equal to the risk premium divided by the standard deviation:

$$SPI = \frac{E(R_p) - R_f}{\sigma(R_p)}$$

Where:

$E(R_p)$  = portfolio's expected return

$R_f$  = risk-free rate

$\sigma (R_P)$  = standard deviation of returns of the portfolio

The Sharpe ratio, or reward-to-variability ratio, is the slope of the capital allocation line (CAL). The greater the slope (higher number), the better the asset. Note that the risk being used is the total risk of the portfolio, not its systematic risk, which is a limitation of the measure. The portfolio with the highest Sharpe ratio has the best performance, but the Sharpe ratio by itself is not informative. In order to rank portfolios, the Sharpe ratio for each portfolio must be computed.

A further limitation occurs when the numerators are negative. In this instance, the Sharpe ratio will be less negative for a riskier portfolio resulting in incorrect rankings.

## **The Treynor Performance Index (TPI)**

The Treynor measure (1965) of a portfolio is explained by the expression below.

$$TPI = \frac{E(R_p) - R_f}{\beta_p}$$

Where:

$E(R_p)$  = portfolio's expected return

$R_f$  = risk-free rate

$\beta_p$  = beta of the portfolio

Treynor measures the risk premium per unit risk (Beta). As with the Sharpe ratio, the Treynor ratio requires positive numerators to give meaningful comparative results and, the Treynor ratio does not work for negative beta assets. Also, while both the Sharpe and Treynor ratios can rank portfolios, they do not provide information on whether the portfolios are better than the market portfolio or information about the degree of superiority of a higher ratio portfolio over a lower ratio portfolio.

## **The Jensen Performance Index (JPI)**

Jensen's alpha (Jensen, 1968) is described as an asset's excess return over and above the return predicted by CAPM.

$$\text{Jensen's measure of a portfolio} = \alpha_p = E(R_p) - [R_f + \beta_p (E(R_m) - R_f)]$$

Jensen's alpha is based on systematic risk. The daily returns of the portfolio are regressed against the daily market returns to compute a measure of this systematic risk in the same manner as the CAPM. The difference between the actual return of the portfolio and the calculated or modeled risk-adjusted return is a measure of performance relative to the market.

If  $\alpha_p$  is positive, the portfolio has outperformed the market, whereas a negative value indicates underperformance. The values of alpha can be used to rank portfolios or the managers of those portfolios, with the alpha being a representation of the maximum an investor should pay for the active management of that portfolio.

## Relationships Between Treynor and Jensen Performance Indices

Denote the JPI by  $\alpha_p$  which is the y-intercept of the regression equation:

$$E(R_p) - R_f = \alpha_p + \beta_p (E(R_m) - R_f)$$

Divide the equation above by  $\beta_p$  to get:

$$\frac{E(R_p) - R_f}{\beta_p} = \frac{\alpha_p}{\beta_p} + (E(R_m) - R_f)$$

The left-hand side of the equation above is just TPI. So,

$$\text{Treynor Performance Index} = \text{TPI} = \frac{\alpha_p}{\beta_p} + (E(R_m) - R_f)$$

For a greater performance,  $\text{TPI} > E(R_m) - R_f$  and thus  $\frac{\alpha_p}{\beta_p} > 0$ . Also,  $\beta_p > 0$  for almost all assets and thus it must be true that  $\alpha_p > 0$ . From these results is evident to say that if a superior performance is demonstrated by TPI, then is also the case for JPI and vice versa.

## The Tracking-Error (TE)

Tracking error measures the difference between a portfolio's return and that of a benchmark level, which was meant to be surpassed by the tracking error. We need to calculate the quantity:

$$TE = (R_P - R_B)$$

Where

$R_P$ : the return of the portfolio is considered

$R_B$ : Return on the benchmark portfolio

Another way of calculating the TE is to calculate the standard deviation of the difference in the portfolio and the benchmark return:

$$TE = \sqrt{\frac{\sum (R_P - R_B)^2}{N - 1}}$$

Where N is the number of periods under consideration.

## The Information Ratio (IR)

The information ratio is similar to SPI only that it is the active return relative to the benchmark portfolio divided by the standard deviation of the active return ( $R_P - R_B$ ):

$$IR = \frac{E(R_P - R_B)}{\sqrt{\text{Var}(R_P - R_B)}}$$

Where:

$R_P$ =portfolio return and

$R_B$ =benchmark return

IR can be used in place of TE

## The Sortino Ratio (SR)

The Sortino ratio is much like the Sharpe ratio, but there are two glaring differences:

- The risk-free rate is replaced with a minimum acceptable return, denoted as  $R_{\min}$
- The standard deviation is replaced by a semi-standard deviation, which measures the variability of only those returns that fall below the minimum acceptable performance.

The measure of risk is the square root of the mean squared deviation from  $T$  of those observations in period  $t$  where  $T > R_{P_t}$ , else zero.

$$SR = \frac{(E(R_P) - T)}{\sqrt{\frac{1}{N} \sum_{t=1}^N \min(0, R_{P_t} - T)^2}}$$

Where  $T$  is the target or required rate of return (which can be a risk-free rate or any other rate) for an investment decision. It is also termed as the minimum acceptable rate of return (MAR).

## Question 1

Given the following information for a security:

- $R_f = 5\%$
- Std. dev. of security = 40%
- Security correlation with market = 0.80
- Std. dev. of market = 20%
- $R_m = 10\%$

What is the expected return for the security?

- A. 16%
- B. 13%
- C. 21%
- D. 24%

The correct answer is **B**.

First, find Beta;

- $\text{Beta} = (0.80 \times 0.40) / 0.20 = 1.6$

Next, use the CAPM model to find the expected return;

$$E(R_i) = R_f + \beta_i(R_m - R_f)$$

- $E(R_i) = 5\% + 1.6(10\% - 5\%) = 13\%$

## Question 2

Given the following information:

- Risk-free asset:  $R_f = 3\%$
- Market portfolio:  $E(R_p) = 10\%$
- Standard deviation:  $\sigma = 26\%$

What is the expected return from a portfolio which has 130% weight invested in the risky asset?

- A. 14.8%
- B. 8.4%
- C. 12.1%
- D. 13%

The correct answer is **C**.

Here, we're borrowing 30% in the risk-free asset and investing the proceeds plus the whole portfolio in the market portfolio.

Return with -30% in the risk-free asset and 130% in the risky asset:

- $E(R_i) = -0.3 \times 3\% + 1.3 \times 10\% = 12.1\%$

### Question 3

A portfolio has an expected return of 18% and a volatility of 10%. If the risk-free rate of interest is 4%, then what is the Sharpe ratio of the portfolio?

- A. 0.14
- B. 0.18
- C. 1.8



D. 1.4

The correct answer is **D**.

$$S_P = \frac{E(R_P) - R_f}{\sigma(R_P)}$$

Sharpe Ratio of the portfolio =  $(0.18 - 0.04) / 0.10 = 1.4$

## Question 4

Your portfolio had a value of EUR 1,000,000 at the start and EUR 1,150,000 at the end of the year. Over the same period, the benchmark index has had a return of 4%. If the tracking error is 11%, then what is the information ratio?

A. 1

B. 0.11

C. 0.733

D. 1.36

The correct answer is **A**.

The return of the portfolio is  $(1,150,000 - 1,000,000) / 1,000,000 = 0.15$  or 15%

$$IR = \frac{E(R_P) - E(R_B)}{\text{Tracking error}}$$

$= (15\% - 4\%) / 11\% = 1$

## **Reading 6: The Arbitrage Pricing Theory and Multifactor Models of Risk and Return**

After completing this reading, you should be able to:

- Explain the arbitrage pricing theory (APT), describe its assumptions, and compare the APT to the CAPM.
- Describe the inputs (including factor betas) to a multifactor model and explain the challenges of using multifactor models in hedging.
- Calculate the expected return of an asset using a single-factor and a multifactor model.
- Explain how to construct a portfolio to hedge exposure to multiple factors.
- Describe and apply the Fama-French three-factor model in estimating asset returns.

In the previous reading, we discussed the Capital Asset Pricing Model (CAPM). CAPM is a single-factor model that gives the expected return of a portfolio as a linear function of the markets' risk premium above the risk-free rate, where beta is the gradient of the line.

On the other hand, the Arbitrage Pricing Model (APT) uses the same analogy as CAPM, but it includes multiple economic factors.

### **The Arbitrage Pricing Theory**

According to APT, multiple factors (such as indices on stocks and bonds) can explain the expected return rate on a risky asset. APT has three common assumptions.

### **Assumptions of the APT Model:**

1. The returns from the assets can be explained using systemic factors.
2. No arbitrage opportunities exist in a well-diversified portfolio. (**Arbitrage** refers to the action of buying an asset in the cheaper market and simultaneously selling that asset in the

more expensive market to make a risk-free profit.)

3. By using diversification, the specific risks can be eliminated from the portfolios by the investors.

According to APT, return on given security  $i$  is given by:

$$R_i = E(R_i) + \beta_{i1} [I_1 - E(I_1)] + \cdots + \beta_{iK} [I_K - E(I_K)] + e_i$$

Where

$R_i$ : rate of return on security  $i$  ( $i = 1, 2, \dots, N$ )

$E(R_i)$ : the expected return of security  $i$ .

$I_K - E(I_K)$ : Surprise factor (the difference between the observed and expected values in factor  $k$ )

$\beta_{iK}$ : measure the effect of changes in a factor  $I_k$  on the rate of return of security  $i$

$e_i$ : noise factor also called idiosyncratic factor

The APT was put to trial by Roll and Ross (1980) and Chen, Roll, and Ross (1986) while determining the factors that explained the average returns on traded stocks on New York Securities Exchange (NYSE).

According to Roll, a well-diversified portfolio are volatile, and that the volatility of a long portfolio is equivalent to half of the average volatility of its constituent assets. Therefore, he concluded that systematic risk drivers limit the impact of diversification within the asset groups.

According to Ross (1976), assuming that there is no arbitrage opportunity, the expected return on a well-diversified is given by:

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

where

$E(R_P)$ : Expected return on a well-diversified portfolio

$\beta_{PK}$ : Factor loading for portfolio relative of factor  $k$

$E(R_Z)$ : Expected rate of return on a portfolio with zero betas (such as risk-free rate of return)

$E(I_K) - E(R_Z)$ : Risk premium relative to factor  $k$

Moreover, Roll realized that a portfolio that has been adequately diversified possesses a high correlation when drawn from a similar asset class and less correlated when diversification occurs across multiple asset groups.

### **Example: Calculating Expected Return Under APT**

The following data exists for asset A:

- Risk-free rate = 3%,
- GDP factor beta = 0.40,
- Consumer sentiment factor beta = 0.20,
- GDP risk premium = 2%,
- Consumer sentiment risk premium = 1%

Calculate the expected return for Asset A using a 2-factor APT model.

$$E(R_A) = 0.03 + 0.4(0.02) + 0.2(0.01) = 0.04 = 4\%$$

Note: Both CAPM and APT describe equilibrium expected returns for assets. CAPM can be considered a special case of the APT in which there is only one risk factor – the market factor.

Many investors prefer APT to CAPM since APT is an improved version of CAPM. This is because CAPM is a one-factor model (only the market index is used to calculate the expected return of any security). At the same time, the APT is a multifactor model where numerous indices are used to explain the variation of the expected rate of return of any security.

## **Multifactor Models**

A multifactor model is a financial model that **employs multiple factors** in its calculations to explain asset prices. These models introduce uncertainty stemming from **multiple sources**. CAPM, on the other hand, limits risk to one source – covariance with the market portfolio. Multifactor models can be used to calculate the required rate of return for portfolios as well as individual stocks.

**CAPM uses just one factor** to determine the required return – the **market factor**. However, the market factor can be **split** up even further into different macroeconomic factors. These may include inflation, interest rates, business cycle uncertainty, etc.

A **factor** can be defined as a variable that explains the expected return of an asset.

A **factor-beta** is a measure of the sensitivity of a given asset to a specific factor. The bigger the factor, the more sensitive the asset is to that factor.

A multifactor appears as follows:

$$R_i = E(R_i) + \beta_{i1}F_1 + \beta_{i2}F_2 + \dots + \beta_{ik}F_k + e_i$$

Where:

$R_i$ =rate of return on stock i

$E(R_i)$ =expected return on stock i

$\beta_{ik}$ =sensitivity of the stock's return to a one-unit change in factor k

$F_k$ =Macroeconomic factor k

$e_i$ =the firm-specific return/portion of the stock's return unexplained by macro factors

The expected value of the firm-specific return is **always zero**.

## **The Expected Return of an Asset Using the Single-Factor Model**

The single-factor model assumes there's just one macroeconomic factor, and appears as follows:

$$R_i = E(R_i) + \beta_i F + e_i$$

$E(R_i)$  is the expected return on stock  $i$ . In case the macroeconomic factor has a value of zero in any particular period, then the return on the security will equal its initially expected return  $E(R_i)$  plus the effects of firm-specific events.

## Example of a Single-Factor Model

Assume the common stock of Blue Ray Limited (BRL) is examined with a single-factor model, using unexpected percent changes in GDP as the single factor. Assume the following data is provided:

- Expected return for BRL = 10%
- GDP factor-beta = 1.50
- Expected GDP growth = 4%

Compute the required rate of return on BRL stock, assuming there is no new information regarding firm-specific events.

## Solution

We know that:

$$\begin{aligned} R_i &= E(R_i) + \beta_i F + e_i \\ &= 10\% + 1.5 \times 4\% \\ &= 16\% \end{aligned}$$

## The Expected Return of an Asset Using the Multi-Factor Model

### Example of a Multi-Factor Model

Assume the common stock of BRL is examined using a multifactor model, based on two factors: unexpected percent change in GDP and unexpected percent change in interest rates. Assume the

following data is provided:

- Expected return for BRL = 10%
- GDP factor beta = 1.50
- Interest rate factor beta = 2.0
- Expected growth in GDP = 2%
- Expected growth in interest rates = 1%

Compute the required rate of return on BRL stock, assuming there is no new information regarding firm-specific events.

$$\begin{aligned} R_i &= E(R_i) + \beta_{i1}F_1 + \beta_{i2}F_2 \\ &= 10\% + 1.5 \times 2\% + 2.0 \times 1\% \\ &= 15\% \end{aligned}$$

## Hedging Exposures to Multiple Factors

The specific risks (idiosyncratic risks) can be removed by diversification, but the factor betas (systematic risk) can only be removed by hedging strategy. Each factor can be regarded as fundamental security and can be utilized to hedge the same factor relative to given security.

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

- GDP beta = 0.4
- Consumer sentiment beta = 0.20

### Case 1:

Assume the investor wishes to hedge away GDP factor risk, yet maintain the 0.20 exposure to consumer sentiment. How would they achieve this?

The investor should combine the original portfolio with a 40% short position in the GDP factor

portfolio. The GDP factor-beta on the 40% short position in the GDP factor portfolio equals -0.40, which perfectly offsets the 0.40 GDP factor-beta on the original portfolio.

## **Case 2:**

Assume the investor might want to hedge away consumer sentiment (CS) factor risk, yet maintain the 0.40 exposure to GDP. How would they achieve this?

The investor should combine the original portfolio with a 20% short position in the consumer sentiment factor portfolio. The CS factor-beta on the 20% short position in the GDP factor portfolio equals -0.20, which perfectly offsets the 0.20 GDP factor-beta on the original portfolio.

## **Case 3:**

Assume the investor wants to hedge away both factor risks. How would they achieve this?

The investor would have to form a portfolio that's 40% invested in the GDP factor portfolio, 20% in the CS factor portfolio, and 40% in the risk-free asset (note that total = 100%). Let us refer to this portfolio as portfolio H.

Portfolio H can be used to hedge away all the risk factors of the original portfolio. That would involve combining the original portfolio with a short position in portfolio H. The original portfolio betas (0.4 and 0.2) would be perfectly offset by the short position in portfolio H, the hedge portfolio.

## **Challenges of Using Multifactor Models in Hedging**

The main challenge of using multi-factor models in hedging is determining the frequency of adjusting the hedge. It is worth noting that there exists a tradeoff between the cost of hedging and the need to keep the portfolio and the hedge aligned. Tracking errors are most likely to occur if the hedging is not adjusted frequently. However, if the hedging is adjusted more frequently, the costs of trading will be higher and this will likely lower overall performance.

Model risk is another challenge faced while hedging using multi-factor models. Model risk comprises model errors and the potential for errors in implementing the hedging strategy. Factor model errors occur when a model contains mathematical errors or is based on biased assumptions. A hedging



strategy based on linear factor models that do not put into consideration nonlinear relationships among factors will be biased.

Another challenge is assuming stationarity in the underlying asset distribution, forgetting that such distributions can change as time goes by. Furthermore, some assumptions may fail to hold in certain conditions, e.g., in stressed market conditions.

## The Fama-French Three-Factor Model

One widely used multifactor model that has been developed in recent times is the Fama and French three-factor model. A major weakness of the APT model is that it is silent on the relevant risk factors for use. The FF three-factor model puts three factors forward:

- Size of firms
- Book-to-market values
- Excess return on the market

The firm size factor, also known as SMB (small minus big) is equal to the difference in returns between portfolios of small and big firms ( $R_s - R_b$ ).

The book-to-market value factor, also known as HML (high minus low) is equal to the difference in returns between portfolios of high and low book-to-market firms ( $R_H - R_L$ ).

Note: book-to-market value is book value per share divided by the stock price.

Fama and French put forth the argument that returns are higher on small versus big firms as well as on high versus low book-to-market firms. This argument has indeed been validated through historical analysis. Fama and French contend that small firms are inherently riskier than big firms, and high book-to-market firms are inherently riskier than low book-to-market firms.

The equation for the Fama-French three-factor model is:

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

Where,

$E(R_P)$ : is the expected return on portfolio P

$r$ : risk-free interest rate;

$E(R_M - r)$ ,  $E(\text{SMB})$  and  $E(\text{HML})$ : expected premiums;

$\beta_{PM}, \beta_{P,\text{SMB}}, \beta_{P,\text{HML}}$ : the coefficients for the time-series regression:

$$R_P - r = \alpha_P + \beta_{PM}(R_M - r) + \beta_{P,\text{SMB}}\text{SMB} + \beta_{P,\text{HML}}\text{HML} + \epsilon_P$$

The intercept term,  $\alpha_P$ , equals the abnormal performance of the asset after controlling for its exposure to the market, firm size, and book-to-market factors. As long as the market is in equilibrium, the intercept should be equal to zero, assuming the three factors adequately capture all systematic risks.  $\epsilon_i$  represents random error.

**Exam tip:** SMB is a hedging strategy – long small firms, short big firms. HML is also a hedging strategy – long high book-to-market firms, short, low book-to-market firms.

Fama and French expanded their model in 2015 by proposing two factors:

- Robust Minus Weak (RMW). RMW is the difference between the return of firms with high (robust) and weak (low) operating profitability.
- Conservative Minus Aggressive (CMA): the difference between the returns of the firms that conservatively invest and those with aggressive kinds of investment.

### Example: Calculating the Expected Return of a Portfolio Based on the Fama-French Three-Factor Model

A Firm's financial analyst believes the Fama-French dependencies are given in the table below.

	Value
Beta	0.3
SMB	1.25
HML	-0.7

### Solution

The firm earns an extra 4% yearly due to its competitive advantage. Moreover, the firm earns a 15% return on equities, an SMB of 2.5%, an HML of 0%, and a risk-free rate of 2%. What is the expected return of the firm?

According to the Fama-French Three-Factor Model the expected return is given by:

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

$$R_P - 2\% = 4\% + 0.30(15\% - 2\%) + 2.5\% \times 1.25 - 0.70 \times 0\% = 13.03\%$$

## Question

Suzy Ye is a junior equity research analyst at a research firm based in South Korea. For the first time, she is using the multifactor model to compute the return of Wong Kong Corp (WK). She has compiled the following data for the computation of the return:

- Wong Kong's expected return: 7%
- Expected GDP growth: 4.5%
- Expected Inflation: 2.5%
- GDP factor-beta: 1.5
- Inflation factor-beta: 2
- Risk-free rate: 2%

Suppose the actual GDP growth and actual inflation of South Korea are 3% and 2.9%, respectively, then which of the following is an accurate estimate of the return?

- A. 7.55%
- B. 10.05%
- C. 5.55%
- D. 18.75%

The correct answer is **C**.

A multifactor model (2-factor model in the given question) only includes the expected return of the stock, macroeconomic factor and the factor-beta, and firm-specific risk, which in this case is zero.

$$\begin{aligned} R_{WK} &= E(R_{WK}) + \beta_{GDP}F_{GDP} + \beta_I F_I \\ &= 0.07 + 1.5(0.03 - 0.045) + 2(0.029 - 0.025) \end{aligned}$$

$$= 0.07 - 0.0225 + 0.008 = 5.55\%$$

## **Reading 7: Risk Data Aggregation and Reporting Principles**

**After completing this reading, you should be able to:**

- Explain the potential benefits of having effective risk data aggregation and reporting.
- Explain challenges to the implementation of a strong risk data aggregation and reporting process and the potential impacts of using poor-quality data.
- Describe key governance principles related to risk data aggregation and risk reporting.
- Describe characteristics of effective data architecture, IT infrastructure, and risk-reporting practices.

### **Risk Data Aggregation and Reporting**

One lesson learned from the 2007-2009 Global Financial Crisis was that banks' information technology (IT) and data architectures were inadequate to support the broad management of financial risks. Some financial institutions could not aggregate risk exposures and identify concentrations across business lines. Others were unable to manage their risks properly because of weak risk data aggregation capabilities and risk reporting practices.

This weakened the financial system's stability. In response, the Basel Committee issued supplemental Pillar 2 (supervisory review process) guidance to enhance banks' ability to identify and manage bank-wide risks.

### **Benefits of Effective Risk Data Aggregation and Reporting**

The Basel Committee defines **risk data aggregation** as "defining, gathering, and processing risk data according to a bank's risk reporting requirements to enable the bank to measure its performance against its risk tolerance/appetite."

Some of the activities carried out during risk data aggregation include sorting, merging, and breaking down sets of data.

However, how exactly do effective risk data aggregation and reporting benefit a bank? The benefits include:

- An **increased ability to anticipate problems**. Aggregated data gives managers a holistic view of risk exposure and enables them to foresee problems.
- An **increased ability to find routes back to financial health** in times of financial stress. For example, a bank may negotiate better credit deals or identify a suitable merger partner.
- **Improved resolvability**. For global systemically important banks (G-SIBs) in particular, resolution authorities must have access to aggregate risk data that is compliant with FSB's Key Attributes of Effective Resolution Regimes for Financial Institutions.
- Improved capability of the risk function to make judgments that can bring about **increased efficiency and profitability**.

## **Key Governance Principles Related to Risk Data Aggregation and Risk Reporting**

One of the issues widely blamed for the quick escalation of the 2007/09 financial crisis was the inability of banks to identify concentrations of risk across business lines as well as at the bank group level. Furthermore, the main reason why the banks were unable to identify such concentrations has much to do with the absence of aggregate risk data and bank-wide risk analysis.

In response, the Basel committee has since pushed for higher corporate governance and issued supplementary Pillar 2 guidance regarding bank capital models and risk management models (e.g., VaR). The following principles have specifically been set out:

## **Principle 1-Governance**

Quoting the Basel committee,

"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."

This principle suggests that risk data aggregation should be a central part of risk management. Senior management should make sure the risk management framework incorporates data aggregation before approving it for implementation.

A bank's risk data aggregation capabilities and risk reporting practices should be:

- Fully documented.
- Validated and independently reviewed by individuals well versed in IT, data, and risk reporting functions.
- Unaffected by the bank's group structure.
- Senior management should go to great lengths to ensure risk data aggregation is part and parcel of the risk management function.
- Considered part of any new initiatives, including acquisitions and divestitures, IT change initiatives and new product development.

## **Data Architecture and IT Infrastructure Features That Can Contribute to Effective Risk Data Aggregation and Risk Reporting Practices**

The importance of having a robust IT system cannot be underestimated, but building one for purposes of risk aggregation and reporting can be quite expensive. The benefits of such a system are realized in the long term. The Basel Committee believes that in the long-term, IT benefits outweigh the costs.



## **Principle 2-Data Architecture and Infrastructure**

Quoting the committee,

"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."

Principle 2 goes ahead to implore banks to:

- Make risk data aggregation and reporting practices a crucial part of the bank's planning processes.
- Establish integrated data classifications and architecture across the banking group.
- Appoint individuals tasked with various data management responsibilities. For example, risk managers, business managers, and IT specialists should be tasked with ensuring that data is relevant, entered correctly, and aligned to data taxonomies.

## **Characteristics of a Strong Risk Data Aggregation Capability**

Firms should monitor their data continuously to ensure the accuracy and integrity of data. Risk data should be complete and consistent with sources and include all material risk disclosures at a granular level. To ease reporting to the executive management, data should be categorized and classified accordingly. Note, however, that when the classifications of the data are too broad, information can be lost.

Banks are required to produce aggregate risk information in a timely manner. However, the timeliness is often compromised in an attempt to extract and map data from different trading systems into other systems.

Effective risk data aggregation involves certification of data elements, data quality documentation, data quality assurance mechanisms, and assessment of data quality per risk type.

On the other hand, ineffective risk data aggregation capabilities may involve a lack of well-established

data quality rules such as minimum standards for data quality reporting thresholds; absence of a designated authority; lack of an effective escalation model; and weaknesses in quality control and overreliance on manual processes without proper documentation; lack of consistency for some key reports; inability to promptly source risk data from foreign subsidiaries and lack of standardized reference data.

## **Principle 3-Accuracy and Integrity**

Quoting the committee,

"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 to minimize the probability of errors."

According to Principle 3:

- Data aggregation and reporting should be reliable.
- Controls surrounding risk data should be as robust as those applicable to accounting data.
- A bank should strive to have a single authoritative source of risk data for each type of risk.
- A bank's risk management personnel should be granted access to risk data to ensure they can aggregate, validate, and properly reconcile data.
- A bank must strike a balance between automated and manual systems. Where professional judgment is paramount, human intervention can be quite necessary.
- Banks should have policies designed to keep the accuracy of risk data in check and correct poor data quality.
- All manual, as well as automated risk data aggregation systems, should be well documented. Besides, they should explain manual workarounds and propose actions that could minimize the impact of manual workarounds.
- When a bank is relying on manual processes and desktop applications such as spreadsheets, there should be effective controls that safeguard the quality of data.

- Data should be defined consistently across a bank.
- Data should always be reconciled with other bank data, including accounting data, to ensure its accuracy.

## **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."

Principle 4 requires that:

- Both on- and off-balance sheet risks should be aggregated.
- Banks should ensure that risk data is always complete. If the data is not complete, the banks should explain the reasons to bank supervisors.
- It is not necessary to express all forms of risk in a common metric or basis, but risk data aggregation capabilities should be the same regardless of the choice of risk aggregation systems implemented.

## **Principal 5-Timeliness**

"A bank should be able to generate aggregate and up-to-date risk data promptly while also meeting the principles relating to accuracy and integrity, completeness, and adaptability. The precise timing depends on the nature and the volatility of the risk being measured as well as its criticality to the overall risk profile of the bank. The precise timing will also depend on the bank-specific frequency requirements for risk management reporting, under both normal and stress/crises, set based on the characteristics and overall risk profile of the bank."

Banks need to build their risk systems to produce aggregated risk data rapidly during times of stress or crisis for all critical risks. Critical risks include:

- Counterparty credit risk exposures (derivatives);
- Trading exposures;
- Operational risk indicators;
- Aggregated credit exposure to a large corporate borrower, among others.

## **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 or crises, requests due to changing internal needs, and requests to meet supervisory queries."

A bank's risk data aggregation capabilities should be flexible:

- To assess emerging risks;
- To incorporate changes in the regulatory framework;
- To produce quick summary reports, etc.

## **Characteristics of Effective Risk Reporting Practices**

### **Principle 7-Accuracy**

"Risk management reports should accurately and precisely convey aggregated risk data and accurately reflect risk. In addition, reports should be reconciled and validated."

Risk management reports should be accurate and precise to ensure a bank's board and senior management can rely with confidence on the aggregated information to make critical risk-related decisions.

Approximations are an integral part of risk reporting and risk management (scenario analyses, and stress testing, among others.) Therefore, banks should follow the reporting principles in this document and establish expectations for the reliability of approximations (accuracy, timeliness, etc.)

## **Principle 8-Comprehensiveness**

"Risk management reports should cover all material risk areas within an organization. The depth and scope of these reports should be consistent with the size and complexity of a bank's operations and risk profile, as well as the requirements of the recipients."

Risk management reports should include exposure and position information for:

- Significant risk areas (e.g., credit risk, market risk, liquidity risk, operational risk)
- Significant components of those risk areas (e.g., single name, country, and industry sector for credit risk).
- Risk-related measures (e.g., regulatory and economic capital).
- Emerging risk concentrations through forward-looking forecasts and stress tests.

## **Principle 9-Clarity and Usefulness**

"Risk management reports should communicate information clearly and concisely. Reports should be easy to understand yet comprehensive enough to facilitate informed decision-making. In addition, reports should include meaningful information tailored to the needs of the target audience,"

Risk reports should ensure that information is meaningful and tailored to the needs of the target audience, in particular, the board and senior management. The board is responsible for determining its risk reporting requirements and complying with its obligations to shareholders and other relevant stakeholders.

Moreover, the right balance of qualitative and quantitative information is important. Therefore, the board should alert senior management when risk reports do not meet its requirements.

## **Principle 10-Frequency**

"The board and senior management (or other recipients as appropriate) should set the frequency of risk management report production and distribution. Frequency requirements should reflect the needs of the recipients, the nature of the risk reported, and the speed at which the risk can change,

as well as the importance of reports in contributing to sound risk management and effective and efficient decision-making across a bank. The frequency of reports should be increased during times of stress/crisis."

A bank should routinely test its ability to produce accurate reports within established timeframes, particularly in times of stress/crises. Some exposure information may be needed intraday to allow for timely reactions.

## **Principle 11-Distribution**

"Risk management reports should be distributed to the relevant parties while ensuring confidentiality is maintained."

Banks should strike a balance between the need to ensure confidentiality and the timely dissemination of reports to all appropriate recipients.

## **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."

"Supervisors should have the ability to use a range of tools, including Pillar 2."

### **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."

## **Reading 8: Enterprise Risk Management and Future Trends**

**After completing this reading, you should be able to:**

- Describe Enterprise Risk Management (ERM) and compare an ERM program with a traditional silo-based risk management program.
- Describe the motivations for a firm to adopt an ERM initiative.
- Explain best practices for the governance and implementation of an ERM program.
- Describe risk culture, explain characteristics of strong corporate risk culture, and describe challenges to the establishment of a strong risk culture at a firm.
- Explain the role of scenario analysis in the implementation of an ERM program and describe its advantages and disadvantages.
- Explain the use of scenario analysis in stress testing programs and in capital planning.

A company must analyze risks with each risk type to define and measure the risk, aggregate the risk within diverse business lines, and develop hedging strategies.

However, companies should address each of their significant risks and the interdependence of risks. Since risks are highly dynamic and correlated, an integrated approach is required to manage them. Suboptimal performance may result from a fragmented approach towards risk management in which case, risk is managed in organizational silos. If the interdependence of risks such as credit risk, market risk, operational risk, etc. is not considered in the risk management activities, attempts to address risks are bound to remain inefficient and faulty.

### **Enterprise Risk Management (ERM)**

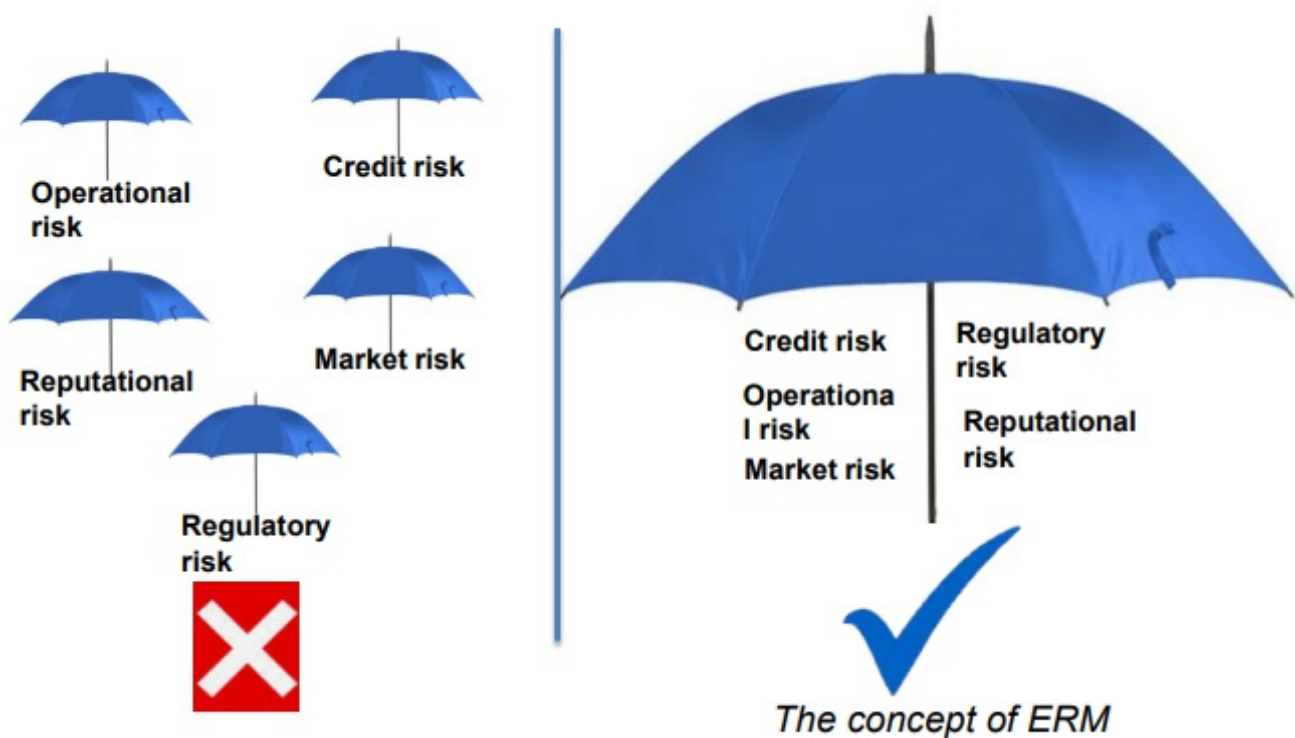
Enterprise risk management (ERM) is responsible for organizing and coordinating an integrated risk management framework for a firm. It establishes policies and directives for managing risks across business units and provides the senior management with overall control and monitoring of an organization's exposure to significant risks and incorporates them into strategic decisions. ERM,



therefore, goes beyond silo-based risk management by providing a broader and consistent enterprise view of risk. Therefore, it pinpoints the significant threats facing a firm's life and its core operations.

## Motivations for a Firm to Adopt an ERM Initiative

- Risks between and among different silos are highly dynamic and correlated.
- Suboptimal performance may result from a fragmented approach towards risk management in which risk is managed in organizational silos.
- If the interdependence of various risks such as credit risk and market risk is not captured in risk metrics, such metrics are faulty, misleading, and unhelpful.



Since ERM integrates risks of business units, it most often requires a centralized risk management unit so as to provide the Board of Directors and the CEO with an organization-level risk report.

Due to an integration of risk management functions and strategies to deal with risks and their transfer, the ERM approach diversifies risks within an organization across business units. This approach departs from the tendency of the silo technique of risk management to use financial instruments separately for business units and take a portfolio view accounting for all the units together. As such, this approach optimizes the use of derivatives, insurances, etc. to hedge and transfer risks.

By integrating risk management activities with business processes, ERM improves the functioning of business units and influences business decisions.

ERM changes the outlook of risk management from a defensive approach to a strategic offensive tool for making an organization more profitable.

## Comparison of ERM Program with Traditional Silo-Based Risk Management Program

Enterprise Risk Management	Traditional Silo-Based Risk Management
Risk management is executed as an integrated unit using global risk management and chief risk officer (CRO).	Risk management is executed in isolated parts firm.
Risks are viewed across business lines by looking at the diversification and the concentration of the risk.	Risks are viewed at business lines, type of risk and functional silos.
Rational risk management is based on cross-universal metrics such as VaR and scenario Analysis to aggregate risk.	Various risk metrics are used, which cannot be compared.
It is easy to measure and track enterprise risk since the risk is aggregated across multiple risk-types.	Seeing the bigger picture of risks is not possible, if at all, the risks are aggregated.
It is possible to reduce the costs of risk transfer and integrating instruments.	Risks are managed differently using diverse instruments, making it costly.
Each risk management approach is viewed as one component of a total cost of risk, measured in a single currency with the inclusion of risk/reward and cost/benefit optimization using the same currency.	Each risk management approach is often treated separately without optimizing the strategy.
It is possible to integrate risk management with balance sheet management, capital management, and financing strategies.	It is impossible to integrate the management and transfer of risk with balance sheet management and financing strategies.

# The Risk Culture

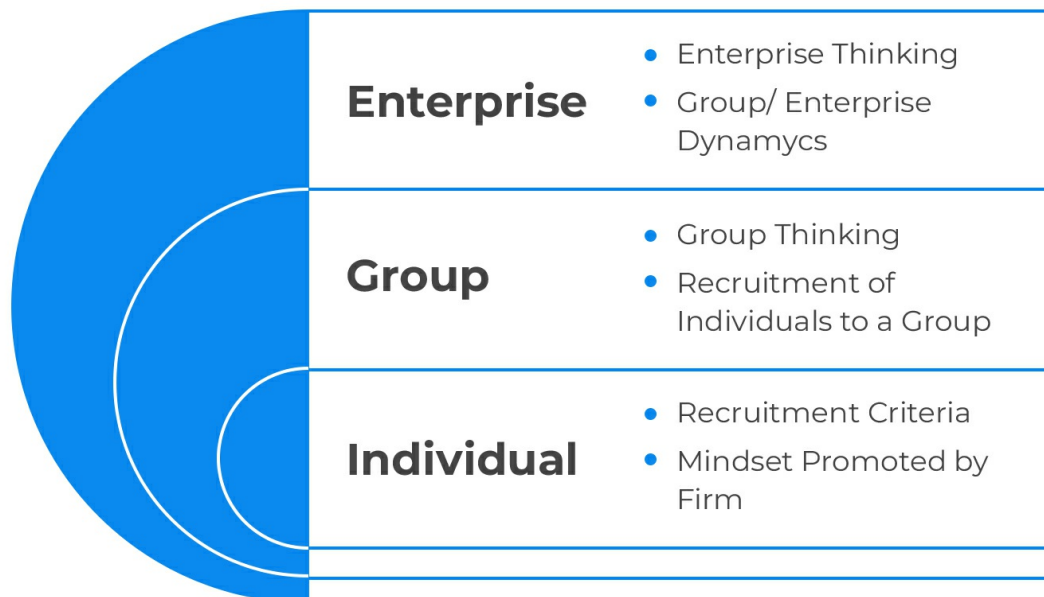
Risk culture refers to defined norms and traditions of how an individual or a group of individuals within a firm can identify, understand, and discuss the risks that confront a firm and the firm's risk appetite. Strong risk culture in a firm makes ERM most effective.

Post-financial crisis reports of 2007-2009 emphasized that lack of risk culture led to risk management failure in large financial institutions. Other signs of lack of risk culture include money laundering and embargo breaches. Absence of risk culture leads to dire consequences, emphasizing the need by firms to establish and maintain a risk culture.

Creating a risk culture can be challenging because it involves different stakeholders: individuals, the whole enterprise, and individual groups.



## Risk Culture with Different Stakeholders



The risk perspective of each layer can overlap, creating a gap between the stated goals of an enterprise and the employees. Moreover, risk culture is not easily reared in the way of investigating

enterprise progress.

Forming a view of risk culture in an institution assists in taking note of the risk appetite of the institution. One of the approaches in viewing risk culture is using the critical risk culture indicators.

## **The Risk Culture Indicators**

The Financial Stability Board (FSB) has indicated four key risk culture indicators which include:

### **1. Incentives**

This can be seen in terms of risk-related compensations, which should support a firm's risk appetite and desired risk culture.

### **2. The Tone from the Top**

The leadership tone of a firm should be able to go in line with the firm's core value and communicate and assess business strategies relative to risk appetite.

### **3. Accountability**

There should be a clear expectation of monitoring and accountability of risks for significant risks in a firm.

### **4. Effective Communication and Challenge**

There should be clear communication among individuals. Divergence of views should be tolerated and risk management approached with open discussions among a firm's stakeholders.

The indicators set by FSB are just broad internal culture indicators.

The firm should also consider the environmental (external) culture indicators, which include:

1. Regulatory standards
2. Professional Standards

3. Risk or Corruption indices in a country
4. Economic cycles such as the credit cycle

Modern firms have started addressing the issue of risk using the stated internal indicators or by conducting surveys to know the level of risk culture in their respective firms.

## **Characteristics of a Strong Risk Culture**

Risk culture is a key element of an organization's enterprise risk management framework, which encompasses the general awareness, attitudes, and behavior of an organization's employees toward risk and how risk is managed within an organization. It is a key indicator of how widely an organization's risk management policies and practices have been adopted.

### **Risk-Related Behavior**

Strong risk culture has generally been associated with more desirable risk-related behavior (e.g., speaking up) and less undesirable behavior.

### **Personal Characteristics**

Personal characteristics are important when it comes to strong risk culture. Long-tenured and less risk-tolerant employees and employees with a positive attitude towards risk management are more likely to display desirable risk-related behavior. Those with high personal risk tolerance are more likely to display undesirable risk-related behavior.

### **Risk Structures**

Good risk structures such as policies, controls, IT infrastructure, training, and remuneration systems, etc. appear to support a strong culture and ultimately a less undesirable risk behavior. Good risk structures do not necessarily guarantee good behavior. There have been suggestions that structures such as remuneration are interpreted through the lens of culture.

### **Staff Ranking**

Senior staffs tend to have a significantly more favorable perception of culture than junior staff. This highlights the importance of anonymous and independent risk culture assessments where staff feel safe enough to reveal their true beliefs.

## **Challenges Facing the Establishment of a Strong Risk Culture in a Firm**

Some challenges stand in the way of developing sound risk management. These are:

### **1. Conflict Between Risk Indicator and Risk Level**

The industry wishes to identify indicators, which show the level of their risk culture. However, sometimes these indicators can be used as levers of behavior change comprising the purpose of the indicators and hence the risk culture.

### **2. Lack of Enough Education**

To develop a robust risk culture, the firm should employ simple language in the definition of risk management terms, key concepts, and the role of ERM stakeholders.

### **3. Time and Space**

The risk culture might not have developed in all parts of a firm. Moreover, an enterprise can fail to detect early signs of risk due to lack of proper identification mechanism when multiple signals occur.

### **4. Cursive Data**

Lack of adequate data undermines the development of risk culture to analyze the level of risk culture in an enterprise. However, in the coming years, technological processes such as machine learning have enabled the gathering of enormous data for analyzing signs of risk.

### **5. Culture cycle**

The true nature of an organization's risk culture is perhaps visible only during times of stress. A risk culture that seems strong today may not survive a crisis in the future. In an effort to withstand buffeting like this, regulators want risk managers to bear real weight within firms; however, as memories of the last crisis fade, this weight diminishes.

## **Scenario Analysis**

Scenario analysis involves visualizing a framework, developing a coherent explanation of why variables do change and assessing its impact on a firm's risk portfolios.

A scenario analysis should be distinguished from sensitivity testing, which involves varying one parameter or variable in a risk model to determine how sensitive the model is to the variation. Scenario analysis and Sensitivity testing are the primary identification tools of the ERM, which come in handy since the probabilistic risk metrics such as VaR proved to be weak.

Scenario analysis might be qualitative, but many firms have come up with excellent ways of building quantitative models to assess the effect of each scenario on their portfolios and businesses.

Scenario analyses assist firms to determine the impact of unfavorable events and events that do not have historical data.

### **Advantages of Scenario Analysis**

1. There is no need to consider risk frequency beyond its soundness
2. Scenarios can take the form of transparent and intuitive explanations.
3. It challenges a firm to imagine the worst and control the effects.
4. It enables the firms to identify warning signals and build contingency plans for the risk.
5. Scenario analysis does not depend on historical data. Instead, it can be based on either past events or forward-looking hypotheses
6. Firms have the freedom to make scenario analysis as complicated or straightforward as they want, without the regulator's interference.

### **Disadvantages of Scenario Analysis**

1. In scenario analysis, it is difficult to determine the probability of events because it does not lead to risk quantification.
2. The future scenarios can become complicated with many choices in place.
3. The extent of firms' imagination is limited. For example, scenarios might underestimate the effect of an extreme loss occurrence or remove significant risk exposures.
4. The number of appropriate situations that can be developed is limited.
5. The last central crisis often motivates the scenarios chosen; imaginative future scenarios may be dismissed as inappropriate.
6. Scenario analyses are different in terms of quality and sophistication, and so their credibility and assumptions can be challenging to analyze.
7. The applicability of scenario analysis depends on the accuracy, comprehensiveness, and predictive qualities of the firm's stress test program.

Scenario analysis had been one of the risk management tools even before the global financial crisis. For instance, banks used the short-run selection of historical and hypothetical occurrences from listed events. They compared them with their portfolios to determine which variable applied to the current portfolios and tried to offer an explanation.

After the global financial crisis, banks realized that they had been ignoring the integrated risks along the business lines, the interaction of risks, and behavioral change of market participants in times of stress. Moreover, evidence showed that scenario analysis of that time was not thorough.

Therefore, regulators have reiterated the need for financial institutions to demonstrate their capability to withstand adverse scenarios after the financial crisis. For instance, US regulators insist that big banks should use macroeconomic stress scenarios such as reduction of GDP and employment across their enterprise exposures.

Scenario analysis is applied to stress testing. For instance, if a bank can prove that it can maintain minimum levels of capital ratios and raise capital in a time of stress, then it must revise the business plans of its various departments while lowering its level of risk appetite.

The US stress tests mushroomed when the Supervisory Capital Assessment (SCAP) was conducted in 2009 (after the crisis), whose outcomes assured banks of their stability. From 2011 going forward, the Dodd-Frank Act catalyzed the US Federal Reserve to conduct two annual stress tests using



scenario analysis. These tests include:

1. Dodd-Frank Act stress test (DFAST) which is executed in mid-year for the banks with assets above \$ 10 billion.
2. Comprehensive Capital Analysis and Reviews (CCAR) which is conducted at the end of each year for the banks with assets above USD 50 billion.

Both of the above methods require banks to develop their scenarios and supervisory situations. However, DFAST is less demanding and applies fewer capital assumptions as compared to CCAR.

The Federal Reserve comes up with three critical supervisory macroeconomic scenarios which are:

1. Baseline scenario represents the consensus arrived at by the bank economist.
2. The adverse scenario is a moderately falling economy.
3. The severely adverse scenario is considered severe with a broad global recession and a decline in demand.

CCAR requires banks to anticipate how these scenarios will impact their income statements and balance sheets over nine quarters. In addition to this, they must also:

1. Give a detailed assessment of capital sourcing and utilization over the planning period.
2. Submit the descriptions of the firm's procedures and ways of controlling the capital adequacy of the firm
3. Submit a detailed copy of the capital policy
4. Descriptions of the expected changes in business loans that might affect the capital adequacy of the firm.

In each of the stated scenarios, each bank must prove its capacity to maintain minimum levels of capital ratios and raise capital in a time of stress. They also need to predict the behavior of all risk factors impacting their portfolios.

In Europe, stress testing using scenario analysis has developed. A good example is the European Banking Authority (EAB). Even then, it is not as improved as it is in the US. EAB is more static, less complicated, and more flexible in altering risk and business strategies as compared to CCAR because it includes a large number of banks.

## **ERM and Strategic Formulations**

Enterprise risk managers must take part in strategy formulation. One of the latest industries to encourage the application of ERM is corporate planning and strategy. ERM builds a secure link between risk and reward.

Stochastic stress testing is the latest stress testing technique. It provides the practicality of the strategy that ERM applies. Moreover, technology development has made positive scenario simulation easy. This has facilitated macroeconomic stress testing as a part of planning activities such as growth plans and strategic risk management.

## Question

Which one of the following is one of the external risk culture indicators?

- A. Regulatory standards
- B. Country's corruption indices
- C. Professional Standards
- D. All of the above

## Solution

**The correct answer is D**

The environmental (external) indicators which include: Regulatory standards, Professional Standards, Risk or Corruption indices in a country and Economic cycles such as credit cycle.

## **Reading 9: Learning From Financial Disasters**

### **After completing this reading, you should be able to:**

Analyze the key factors that led to and derive the lessons learned from case studies involving the following risk factors:

- Interest rate risk, including the 1980s savings and loan crisis in the US
- Funding liquidity risk, including Lehman Brothers, Continental Illinois, and Northern Rock
- Implementing hedging strategies, including the Metallgesellschaft case
- Model risk, including the Niederhoffer case, Long Term Capital Management, and the London Whale case
- Rogue trading and misleading reporting, including the Barings case
- Financial engineering and complex derivatives, including Bankers Trust, the Orange County case, and Sachsen Landesbank
- Reputational risk, including the Volkswagen case
- Corporate governance, including the Enron case
- Cyber risk, including the SWIFT case

In this chapter, we look at famous financial disasters that have been witnessed over the years. Although each case study has its distinctive elements, they all have something in common: Certain risk factors were ignored, resulting in major financial loss. We are going to look at how each of these disasters came up, identify the warning signs that were ignored, and attempt to draw relevant lessons that can help avert similar disasters in the future.

### **Interest Rate Risk**

***Interest rate risk*** is the danger that a change in interest rates will cause the value of assets to

decline and that of liabilities to increase. Over the last century, thousands of firms have failed as a result of interest rate risk. Between 1986 and 1995, for example, nearly a third of the 3,234 savings and loan associations in the United States failed.

## **The Savings and Loan Crisis**

In the 1980s, the savings and loans industry in the United States suffered through a period of distress.

Savings and Loans (S&Ls) associations were founded in the 18<sup>th</sup> century with the sole purpose of funding homeownership. At the time, banks did not lend money for residential mortgages. S&L members would pool their savings and lend the money to a few members to finance their home purchases. After repaying the funds, other members would also get a chance to borrow.

Notably, S&Ls were governed by the so-called "Regulation Q," which set their minimum capital requirements and capital adequacy standards. Under regulation Q, S&Ls were required to pay depositors a rate of interest that was significantly lower than that offered elsewhere. Furthermore, S&Ls were not allowed to offer commercial loans to avoid risky lending. The overriding goal among policymakers and the government was to make thrifts focus solely on promoting housing and homeownership.

For a long period, these regulations worked well for S&Ls as it meant they could pay low rates on short-term deposits, pool the funds, and then provide mortgage loans at a higher interest rate. To their advantage, the demand for homes continued to rise, especially in the first half of the 19<sup>th</sup> century.

In the 1970s, however, there was a dramatic increase in both interest rates and inflation. This had two main implications:

- Depositors trooped into S&Ls to withdraw their money, eying higher rates elsewhere. This meant that the amount available for lending reduced significantly.
- Funding costs for S&Ls increased significantly, wiping out the interest rate spread they depended on to make a profit. In other words, short-term deposits became costlier, and therefore the margin between the cost of funds and profit from long-term fixed-rate

mortgages decreased.

A high rate of inflation also meant that the number of mortgage applications reduced, further reducing revenue for S&Ls. The low demand for mortgages combined with higher interest rates elsewhere resulted in an unprecedented loss in the value of outstanding mortgages. As a result, the net worth of most S&Ls was essentially wiped out. And because the existing regulations severely restricted alternative profit-making investments, S&Ls had to stick with a dwindling portfolio of low-interest mortgages as their only income source. While all this was happening, alternative investments were increasingly gaining popularity, especially money market funds, which offered higher returns.

In an attempt to stem the tide and restore some financial stability among S&Ls, the US government relaxed the regulations that had been in place for decades.

Several changes were introduced to allow S&Ls to "grow" out of their problems. For the first time, the government was explicitly seeking to influence S&L profits as opposed to promoting housing and homeownership. For instance, interest rate caps were removed, and S&Ls were allowed to offer commercial loans. What's more, S&Ls could choose to be under either a state or a Federal charter. Federally-chartered thrifts took full advantage of the deregulation and rushed to become federally chartered, because of the advantages associated with a federal charter. Deposit insurance was also increased from \$40,000 to \$100,000 in an attempt to restore some confidence among depositors.

These regulatory changes did not quite generate the intended effect. For instance, the availability of deposit insurance led to a moral hazard. S&Ls engaged in even riskier lending activities. Ultimately, it is estimated that S&Ls suffered a combined loss of more than \$160 billion. To bail them out, taxpayers paid \$132 billion. The Federal Savings and Loan Insurance Corporation paid \$20 billion to depositors of failed S&Ls before it went bankrupt. The S&Ls paid the remaining amount.

## **Lessons Learned**

### **1. Regulation is good, but overregulation can be dangerous!**

One of the root causes of the S&L industry's woes was overregulation. Federal regulation had some very strict and precise conditions under which all S&Ls operated. Initially, for example, S&Ls were

barred from offering commercial loans; they were only allowed to offer mortgages to facilitate homeownership. That prevented them from experimenting with different ways to adapt to changing market conditions. Regulators charged with defining "acceptable assets" in insurance and banking should take heed.

## 2. Deposit insurance can result in increased market indiscipline

The introduction of federal insurance guarantees can inadvertently trigger greater risk-taking among banks and insurance firms. It may create a situation where both lenders and depositors feel they have nothing to lose.

- To mitigate interest rate risk, there's a need for banks to have assets that are highly correlated with liabilities. That can be achieved by having a diversified portfolio of assets and making use of interest rates derivative products such as caps, floors, and swaps.

## Funding Liquidity Risk

**Funding liquidity risk** refers to the possibility that a bank could find itself unable to settle obligations with immediacy. It has much to do with:

- The **risk that** bank will be unable to pay its debts when they fall due
- The **risk that the** bank cannot meet the demand of customers wishing to withdraw their deposits
- The risk that a bank will be unable to roll over short-term credit, e.g., commercial paper.

There are two main sources of funding liquidity risk:

1. External market conditions, such as changes in supply and demand.
2. Structural balance sheet risks (Balance sheet risk is uncertainty about future values of balance sheet items not directly related to business or financing activities. Examples are interest rate risk and liquidity risk).

Let's look at a few case studies where funding liquidity risk played a starring role:

## Lehman Brothers

The collapse of Lehman Brothers presents the most spectacular and perhaps the most documented event during the 2007/2009 financial crisis. Here's how the crisis unfolded.

One Henry Lehman founded Lehman Brothers in 1884 as a general and dry goods store. Soon afterward, Mr. Henry was joined by his brothers Emanuel and Mayer, and that's how the name "*Lehman Brothers*" came about. For many years, the company conducted business as a private institution until the year 1994 when it opened its ownership to the public through an IPO that generated well over \$3.3 billion. At this point, the company ventured into commercial and investment banking activities.

Lehman Brothers' entry into the commercial and investment banking market coincided with the change from the **originate-to-keep** business model to the **originate-to-distribute** model. Most banks were increasingly offering securitized assets built upon mortgages sold to residential customers. Lehman Brothers became one of the pioneers of securitization, and its fortunes greatly improved. Between 2003 and 2004, for example, the company acquired five mortgage lenders in an attempt to consolidate its grip on the securitization market further. For a while, Lehman Brothers recorded fast growth fueled by the house price bubble. In early 2007, the firm surpassed Bear Stearns and became the largest underwriter for mortgage-backed securities.

It wasn't until the second half of 2007 when cracks started to appear in the originate-to-distribute business model. It became evident that the US housing bubble had burst and that the subprime mortgage market was in deep trouble. As a result, investor confidence began to erode, and firms heavily invested in subprime securities all of a sudden found themselves unable to borrow at similar terms as before. In July of that year, the conditions were so bad that Bear Stearns (Lehman's Brothers' top competitor) had to support two of its hedge funds following steep losses caused by their subprime mortgage exposure.

Banks are naturally leveraged institutions that prefer debt to equity, and Lehman Brothers followed the script. In the run-up to the crisis, however, Lehman pursued leverage to levels not seen before. To put things in perspective, the bank had an assets-to-equity ratio of approximately 31:1 by mid-



2007. Critically, the bank turned to short-term debt to fund its day-to-day operations, particularly the repo market.

As it turned out, the bank's overreliance on the repo market exposed it to serious funding problems because it had to keep investors (counterparties) happy at a time when the industry was witnessing dwindling fortunes. That meant the bank had to offer guarantees continually and sometimes above-market returns to stay in business. The fact that the borrowed funds were used to fund relatively illiquid long-term real estate assets made the situation even worse.

All hell broke loose in 2008. First to go down was Bear Stearns after its repo lenders and bank counterparties lost confidence in the firm's ability to repay its debts. As a sign of just how low Bear Stearns had sunk, J.P. Morgan bought the collapsed firm at just 10% of its prior market value. After this, the focus shifted to Lehman Brothers, who had so far avoided large-scale eye-catching losses through a combination of short-term borrowing and corporate restructuring strategies aimed at cutting costs. Lehman's share price declined sharply by more than 48% following the collapse of Bear Stearns.

For a while, Lehman was able to restore some consumer confidence by announcing better than expected profits. Lehman also watered-down concerns that it was too leveraged by announcing that \$4 billion in preferred stock had been raised, and the whole amount could be converted to common stock at a 32% premium to its current value.

The upturn turned out to be short-lived because soon after, news broke alleging that the firm had overvalued its real estate-based assets. At this point, Lehman could no longer cling to market confidence, so critical to the firm's funding strategy (and therefore its liquidity). As the crisis mounted, many of Lehman's major counterparties began to demand even more collateral to fund its operations. Others began reducing their exposure, and some institutions flatly refused to do business with the firm. Attempts were made to merge the firm or to sell it to another large bank, but none of them materialized.

In the early hours of 15th September 2008, Lehman was forced to file for bankruptcy, triggering a global financial crisis that saw a virtual meltdown of financial markets.

## **Lessons Learned**

Firms (and investors), in general, should never resort to **extreme leverage** that far surpasses the capacity to repay. Lehman Brothers took on huge amounts of short-term debt to fund long-term assets, exposing itself to serious liquidity problems. Too much debt means that a firm cannot absorb a major loss.

Lehman's failure has also highlighted the need to have tougher regulations in the securitization market, particularly because mortgage-backed securities and related instruments such as credit default swaps result in a highly interconnected financial market that is highly vulnerable to a total collapse in case one or two "big names" fail.

## **Continental Illinois National Bank and Trust Company**

The failure of Continental Illinois National Bank and Trust Company in 1984 presents the biggest US liquidity debacle in the banking sector before the 2007/2009 financial crisis. Its subsequent rescue gave rise to the term "too big to fail."

At its prime, the Chicago-based lender was the seventh-largest bank in the US, with an asset pool of approximately \$40 billion. Its roots go back in time to 1910 through a merger, but what especially stood out was the management's aggressive growth strategy. At the time, banks were not allowed to open branches across state lines. Any bank intending to lend outside its state of origin could only purchase loans from other banks. In line with its fast growth strategy, Continental Illinois took up the task head-on.

The bank developed a network of contacts across the country and positioned itself as a willing buyer of some of the most complex and riskiest loans. Initially, the bank's strategy seemed to bear fruit, and this served as further evidence for the management that the plan was working. In the 5 years before 1981, the bank's commercial and industrial lending jumped from USD 5 billion to over USD 14 billion. During that time, the bank's total assets grew from USD 21.5 billion to USD 45 billion. What the management didn't know was that things would soon head south.

Continental Illinois had developed an informal business partnership with Oklahoma-based Penn Square Bank. This smaller bank had issued loans to oil and natural gas companies in Oklahoma during the boom of the late 1970s. If a loan was too large for it to service, PennSquare Bank would pass it over to Continental Illinois. Through this arrangement, Continental Illinois purchased \$1 billion in

speculative energy-related loans. In July 1982, Penn Square Bank collapsed after a large number of borrowers failed to honor their contracts following an unprecedented decline in the price of oil. This put Continental Illinois firmly in the spotlight.

Over the next few months, defaults continued to mount. At the same time, Continental found itself increasingly unable to fund its operations from the US markets. As a result, it began to raise money at much higher rates in foreign wholesale money markets (e.g., Japan).

In the first quarter of 1984, the bank announced that its nonperforming loans had suddenly increased by \$400 million to a total of \$2.3 billion. This heightened anxiety among investors and the general public; most analysts and industry experts were of the view that it was just a matter of time before Continental Illinois suffered the same fate as Penn Square Bank. By 10th May 1984, the rumors about the bank's insolvency had spread far and wide, sparking a crippling run. Before the trouble, the bank held \$28.3 billion in deposits. Out of fear, depositors trooped into the bank to withdraw their funds, most of them wiping their accounts clean. Foreign investors also turned their back on the bank. In the end, a total of \$10.8 billion was withdrawn in the space of a few days.

In the second half of May 1984, Continental Illinois attempted to project stability by maintaining its operations. At the same time, the bank borrowed from the Federal Reserve Bank of Chicago as well as several other big banks across the country in an attempt to cope with the ongoing run. However, the run did not subside, and regulators realized they were now staring at a full-blown liquidity crisis that would spill over to other banks. It is estimated that nearly 2,300 banks had some exposure to Continental Illinois, with a majority holding at least \$100,000.

Regulatory authorities eventually stepped in to prevent a domino effect on other banks.

## **Lessons Learned**

- Classifying institutions as "too big to fail" may lead to greater risk-taking. Banks that expect government support may take greater risks, safe in the knowledge that if the going gets tough, neither the bank nor its depositors will absorb most of the loss. The US congress later attempted to limit rescues of "too big to fail" institutions by passing the Federal Deposit Insurance Corporation Improvement Act (1991).

- Reliance on the so-called hot money (short-term loans from the money market) is perilous. A large number of depositors at Continental Illinois were local and international institutional investors. A run on these deposits led to Continental Illinois's failure.
- Rumors alone can bring down even the biggest of banks. Although there was significant mismanagement and financial strain at Continental Illinois, the end was not nigh, and post-crisis analysis suggests the bank would have carried on despite the losses arising from its relationship with Penn Square Bank. Unfounded rumors that the bank was on the verge of bankruptcy proved to be the stroke that broke the camel's back.

## **Northern Rock**

The 2007 failure of mortgage bank Northern Rock in the UK presents a more recent illustration of liquidity risk arising from structural weaknesses in a bank's business model. The bank's failure can be traced down to two key things: (I) excessive funding of long-term assets using short-term finance and (II) a sudden loss of market confidence. It was the first run on a UK bank in 140 years.

Northern Rock was a fast-growing lender based in the North East of the United Kingdom. The bank had forged a success story enviable by any other bank within and outside the UK. For example, assets had been growing at around 20% per year for several years thanks to specialization in residential mortgages. The bank continued to expand aggressively in the marketplace into the first quarter of 2007. Things were going so well that the bank had reached a multimillion sponsorship deal with Newcastle United, one of the biggest and most successful football clubs in the country.

The bank's growth was strongly anchored in the originate-to-distribute business model, where it raised money through securitizing mortgages and selling covered bonds. Unlike many of its peers, the bank did not rely on customer deposits for funding. Instead, it borrowed heavily in the international money markets, particularly within the interbank market.

To mitigate possible weaknesses in its funding strategy, Northern Rock tapped markets across the globe – Europe, the Americas, as well as in the United Kingdom. In early 2007, concerns about mortgage-related assets began to surface among investors. Of significance was the rising number of defaults in the US subprime mortgage market, which eventually spread globally.

When the interbank funding market froze in early August 2007, all of Northern Rock's global funding channels dried up simultaneously. Interestingly, the bank had announced increased interim dividends just a few weeks prior, after UK regulators approved a Basel II waiver that allowed the bank to adopt so-called "advanced approaches" for calculating credit risk that looked likely to reduce its minimum required regulatory capital.

After getting wind of Northern Rock's inability to fund itself through the interbank market, UK authorities started exploring discussed a range of rescue alternatives. But these plans leaked, immediately setting in motion a run on deposits between 14th September and 17th September. Calm only (slowly) returned after UK authorities came out publicly to reassure everyone that deposits would be repaid. Eventually, Northern Rock accepted emergency capital injection from the government and then public ownership.

## **Funding Liquidity Risk: General Lessons**

Following the 2007/2009 financial crisis, guidelines by the US Federal Reserve require large banks to put in place **liquidity testing programs**. These programs aim to ensure that banks have liquidity and funding strategies that will survive system-wide stress scenarios. To manage funding liquidity risk, a bank should optimize its borrowing sources and their composition.

Trade-offs drive decisions regarding the composition of assets and liabilities as discussed below:

### **1. The trade-off between funding liquidity and interest rate risk**

When funding liabilities have a shorter duration than loan assets, the bank is exposed to less interest rate risk and more funding liquidity risk. But when funding liabilities have a longer duration than loan assets, the bank is exposed to more interest rate risk and less funding liquidity risk.

### **2. The trade-off between cost and risk mitigation**

To mitigate funding liquidity risk in a positively sloped yield curve environment, institutions can increase the maturity of their funding liabilities to push them farther away into the future. However, this will cost more than cheaper shorter-duration funding.

To a limited extent, banks can also mitigate funding liquidity risk by **reducing the maturity of their assets**. However, this is usually not possible because asset maturity is driven by borrower demand, and reducing the term to maturity may force the bank to settle for a smaller risk premium.

It is also important to have a **standby emergency liquidity cushion** to ensure that the bank can meet unforeseen commitments. The larger and better quality of the cushion, the lower the risk. However, such a cushion may require the bank to invest in short-term highly liquid assets that will often earn lower returns compared to less longer-term, less liquid assets.

## Constructing and Implementing Hedging Strategies

For both financial and non-financial institutions, the development and implementation of effective hedging strategies come with benefits as well as challenges. Nonetheless, certain constants must be present in any strategy that an institution comes up with:

- The function or individual(s) responsible for developing hedging strategies should have access to relevant information and tools, including market data, corporate information, and advanced statistical tools. This will help them to choose the appropriate models to use for both pricing and hedging.
- The firm must decide whether to use static hedging or dynamic hedging

A **static hedge** is one that does not need constant re-balancing as the price and other characteristics (such as volatility) of the securities it **hedges** change. A static hedge usually involves the purchase of a hedging instrument that very closely **matches** the position to be hedged. The hedging instrument is typically held for as long as the underlying position is kept.

A **dynamic hedge**, on the other hand, involves **adjusting** the hedge through a series of ongoing trades to continuously (or frequently) calibrate the hedge position to the (changing) underlying exposure. As expected, this strategy demands greater managerial input and may come with higher transaction costs.

- The firm must decide on the **time horizon** over which a hedging strategy will be

implemented. Horizons can be fixed (e.g., quarter-end or year-end) or rolling. No matter the choice of the horizon, performance evaluations, and investment horizons should be aligned.

- **Accounting issues and potential tax implications** need to be considered when devising a hedging strategy. For example, derivatives come with complex accounting requirements that may be subject to change. A derivative and the corresponding position it is intended to hedge must be perfectly matched (e.g., in terms of dates and quantities) for them to be reported together in operational profit without the need to report an accounting profit or loss.

Tax can have implications on the cash flows of a firm, and therefore getting competent professional guidance on tax matters is critical when developing and implementing a hedging strategy.

Finally, the success of any hedging strategy depends on how effective the **implementation** process is. This is especially true because markets are in constant movement, and prices keep on changing. As such, what appears to be an attractive hedging opportunity can suddenly become unattractive.

## **Metallgesellschaft: A Case of Dynamic Hedging Gone Wrong**

Metallgesellschaft Refining and Marketing (MGRM) was an American subsidiary of Metallgesellschaft (MG), an international conglomerate with interests in trading, engineering, and chemicals. In 1991, MGRM designed a marketing strategy to insulate from the volatility associated with the price of petroleum.

MGRM committed to selling, at prices fixed in 1992, certain amounts of petroleum every month for up to 10 years. The contracts initially proved to be masterstrokes since they guaranteed a price over the current spot. The profit margin was between \$3 and \$5. By Sept 1992, MGRM had sold forward contracts amounting to the equivalent of around 160 million barrels. The contracts were attractive, particularly because they gave customers the option to exit if the spot price rose above the fixed price in the contract.

If a customer chose to exit a contract, MGRM would pay in cash one-half of the difference between

the futures price and the fixed price times the total volume remaining to be delivered on the contract. A customer had the choice to exercise this option if they did not need the product or in the face of financial difficulties.

In effect, the contracts gave MGRM a short position in long-term forward contracts. To hedge these positions, MGRM turned to long positions in near-term futures using a stack-and-roll hedging strategy. A **stack-and-roll hedge** involves purchasing futures contracts for a nearby delivery date and, on that date, rolling the position forward by purchasing a fewer number of contracts. The process continues for future delivery dates until the exposure at each maturity date is hedged.

MGRM used short-term futures to hedge because of a lack of alternatives. Besides, the long-term futures contracts available were highly illiquid. As it turned out, MGRM's open interest in unleaded gasoline contracts was 55 million barrels in the fall of 1993, compared to an average trading volume of 15-30 million barrels per day.

MGRM encountered problems in the timing of cash flows required to maintain the hedge. Over the entire life of the hedge, these cash flows would have canceled out. MG's problem was a lack of necessary funds needed to maintain its position. The fundamental problem manifested in the form of inadequate funds to mark positions to market and meet margin requirements. In December 1993, MGRM was forced to cash out its positions, incurring a loss of \$1.5 billion in the process.

## Model Risk

**Model risk** is the risk of loss resulting from the use of **insufficiently accurate** models to make decisions when valuing financial securities. Model risk can stem from using an incorrect model, incorrectly specifying a model, and using insufficient data and incorrect estimators.

A major pitfall when using a model to value security is the use of **flawed assumptions**. For example, a stock pricing model might assume an upward sloping yield curve when it is, in fact, downward sloping or even flat. This type of risk is both common and dangerous and can be among the most difficult risks to detect.

We now look at well-known cases where model risk plays a prominent role:



## **Wrong Assumptions—The Niederhoffer Put Options**

Victor Niederhoffer was a trading guru who had set up a very successful hedge fund in the 1990s. The fund had come up with a strategy it considered low risk: writing uncovered, deep out-of-the-money put options on the S&P 500 index. In other words, the fund sold a very large number of options on the S. & P. index, taking millions of dollars from other traders (in the form of premiums). In exchange, the fund was promising to buy a basket of stocks from them at current prices, if the market ever fell. And because these options were deep OTM, the premium received was relatively smaller than that of at-the-money options sold at the time.

In essence, therefore, Mr. Niederhoffer was betting in favor of a large probability of making a small amount of money, and betting against the small probability of losing a large amount of money. The overriding assumption underlying this strategy was that a one-day market decline of more than 5% would be extremely rare. If market returns were normally distributed, a fall of this magnitude was next to impossible. As it turned out, this assumption was wrong.

On 27th October 1997, the market plummeted 7%. The sharp drop in US equity prices was a spillover effect following a large overnight plummeting of the Hang Seng Index in Asia. Immediately after this, the holders of the many put options Mr. Niederhoffer had written came calling all at once, intent on exercising their right to sell their stocks to the fund at the pre-crash prices. The fund struggled to meet the demands of all option holders, forcing Mr. Niederhoffer to wipe out all his cash reserves, including his savings.

Besides the put options, the fund had several outstanding derivatives. Ultimately, the fund was unable to meet over USD 50 million in margin calls. The fund's brokers had no choice but to liquidate Niederhoffer's positions for pennies on the dollar, a move that effectively wiped out the fund's equity.

What lesson do we learn from Mr. Niederhoffer's failed strategy?

The lesson here is that there is nothing like a sure bet in today's competitive financial markets. A strategy designed to make small profits while betting against a large market move can unravel literally in the blink of an eye, however small the probability of loss is.

## **Long Term Capital Management and Model Risk: When "Normal" Relationships Breakdown**

Long Term Capital Management (LTCM) was a multi-billion hedge fund founded by John Meriwether, a Salomon Brothers trader. The principal shareholders were Nobel-prize-winning economists Myron Scholes and Robert Merton. All the three were experts in derivatives and had carved out a reputation for unrivaled market analysis.

To join the fund, investors were required to part with a whopping \$10 million each. Despite this huge outlay, LTCM gave away very little in terms of the nature of its investments. What's more, investors were not allowed to liquidate their positions during the first three years of their investment. This allowed the fund to lock in the funds in long-term investments. The founders and major shareholders went as far as investing a large portion of their net worth in the fund, which demonstrates just how convinced they were that the fund would succeed.

At first, the fund recorded a stellar performance unheard of before. LTCM boasted annual returns of 42.8 percent in 1995 and 40.8 percent in 1996. This was even after the management set aside about 27% of the proceeds for their compensation and other fees. In 1997, LTCM successfully hedged most of the risk from the Asian currency crisis. That year, the fund earned a return of 17.1% for investors. By 1998, however, the fund was on the brink of bankruptcy as a result of its trading strategies.

Like many hedge funds at the time, LTCM adopted a hedging strategy hinged upon a predictable range of volatility in foreign currencies and bonds. The management believed that the probability of market moves larger than the fund's hedges was very small. To estimate future volatility, LTCM's models relied heavily on historical data. However, all historical models are only reliable in the absence of large economic shocks, especially the ones that haven't been experienced in history. External shocks make correlations that are historically low to increase sharply. And so, it proved to be.

In mid-1998, Russia declared its intention to devalue its currency and followed that up by defaulting on its bonds. That event was beyond the normal range of volatility predicted by LTCM's models, which means the existing hedges proved insufficient. The US stock market dropped by 20 percent, while European markets fell by 35 percent. Most investors turned to Treasury bonds for refuge, triggering a significant drop in long-term interest rates.

LTCM's highly leveraged positions took a strong hit and started to crumble. A multitude of banks and pension funds had heavily invested in LTCM. So, when trouble rocked LTCM, the solvency of all these institutions was at stake. In September, Bear Stearns landed the knock-out punch. The bank managed all of LTCM's bond and derivatives settlements. Bear Stearns called in half a billion dollars payment, out of fear of losing all its considerable investments.

To save the US banking system, the Federal Reserve Bank of New York convinced 15 banks to save LTCM by pumping in some \$3.5 billion.

In summary, LTCM's crisis could be attributed to the following:

- Overreliance on historical models that did not simulate the occurrence of large economic shocks.
- LTCM's models further assumed that low-frequency/high-severity events were uncorrelated over time. As it turned out, one economic shock triggered another, such that extremely low probability events were occurring several times per week.
- All of LTCM's trading strategies were hinged on the assumption that risk premiums and market volatility would ultimately decline. As a result, the firm had failed to diversify its investments wide enough.

Several suggestions have been put forth to avoid a recurrence of a similar crisis:

- There's a need for large-scale stress testing using not just historical data but also simulated stress scenarios, even if such scenarios haven't yet played out on the market.
- The initial margin in derivative contracts should always be enforced. In many cases, LTCM had to mark its positions to market, but the initial margin was waived.
- There's a need to incorporate potential liquidation costs into prices to recognize the possibility of adverse market movements.

## **The VaR of Hedge Funds**

LTCM made heavy use of a Value-at-Risk (VaR) model as part of its risk control. VaR is a measure of

the worst-case loss for investment or set of investments, given normal market conditions, over a specific time horizon, and at a given confidence level. It is the maximum expected loss given certain assumptions (to do with volatility) and a level of confidence.

The management at LTCM felt that it had structured the fund's portfolio such that there was an extremely small chance of the fund's risk exceeding that of the S&P 500. But the problems encountered, later on, show that hedge funds are not necessarily subject to the same set of assumptions as other firms when calculating regulatory VaR. In particular,

- A 10-day horizon is too short to determine a hedge fund's VaR. The time horizon for economic capital should be the time it takes to raise new capital, liquidate positions without duress, or the period over which a crisis scenario will unfold.
- Traditional VaR models **fail to capture liquidity** risk. These models incorrectly assume that liquidity will remain fairly constant throughout all market conditions.
- It is nearly impossible to capture correlation and volatility risks (i.e., the risk that the realized correlations and volatilities significantly deviate from expectations) without stress testing.

## **Model Risk and Governance—The London Whale**

In 2012, J.P. Morgan Chase lost more than 6.2 billion dollars from exposure to a massive credit derivatives portfolio in its London office. The main culprit in the whole saga was one Bruno Iksil, a synthetic credit portfolio trader. Bruno Iksil was given the title of the "London Whale" by media outlets in the aftermath of the scandal.

Here's a summary of the London whale debacle:

JPM set up the Chief Investment Office (CIO) with the sole purpose of investing the excess cash (deposits) of the bank. Initially, most of the money was channeled into high-quality securities such as loans, mortgage-backed securities, corporate and sovereign securities. At the height of the 2007/2009 financial crisis, the bank constructed a synthetic credit portfolio (SCP) motivated by the need to protect the bank against adverse credit scenarios such as widening credit spreads. The bank cited the need to make financial bets that would offset risks the bank took elsewhere, such as by

loaning money to homeowners or trade engagements with other banks that could fail. This begs the question: what exactly was a synthetic credit portfolio?

The bank's synthetic credit portfolio (SCP) was essentially a basket of credit default swaps featured in standardized credit default swap indices. The bank took both buyer and seller positions in these swaps. As a protection buyer (short risk position holder), the bank would pay premiums and, in turn, receive the promise of compensation in the event of default. As a protection seller (long risk position holder), the bank would receive premiums and, in turn, promise to compensate the buyer in the event of default.

In the first few years, the SCP performed well. In 2009, for example, the SCP netted the CIO about \$1 billion. At that point, the notional size of the SCP was \$4 billion. By 2011, the notional size of the SCP had risen to about \$51 billion – a more than tenfold increase. For a while, the SCP continued to perform well, with 2011 trading (bets) producing a gain of \$400 million.

In December 2011, the management at JPM directed the CIO to reduce the exposure of the SCP and its risk-weighted assets following a more positive outlook of the economy. By so doing, the bank wanted to reduce its regulatory requirements. To achieve this, the CIO would have had to unwind SCP positions by selling them off. In the CIO's estimates, such a move would have led to an estimated loss of \$500 million – in the form of loss of premiums and trade execution costs. The CIO decided not to take that route and instead came up with a different strategy – one that would prove "fatal" in financial terms.

The CIO launched a trading strategy that focused on purchasing additional long credit derivatives to offset its short derivatives positions and lower the CIO's RWA. That strategy ended up increasing the portfolio's size, risk, and RWA. Besides, the strategy took the portfolio into a net long position, thereby eliminating the hedging protections the SCP was originally supposed to provide. Notably, the strategy's assumptions about the market environment and correlation between positions did not play out as expected. What followed were trading losses that continued accumulating with each passing trading day.

As losses mounted, CIO traders tried to defend their existing positions by further growing their portfolios with huge trades to support market prices. But the markets proved rather illiquid, and CIO traders became significant market movers in these securities. That reduced their ability to exit the

markets without suffering losses in the process.

## **Operational Risk**

In the first three months of 2012, the number of days reporting losses exceeded the number of days reporting profits. In an attempt to conceal these losses, the CIO came up with a new valuation system. The CIO had hitherto valued credit derivatives by marking them at or near the midpoint price in the daily range of prices (bid-ask spread) offered in the market. By using midpoint values, the resulting prices were considered to be the "most representative of fair value."

The new valuation system set marks that were at significant variance to the midpoints of dealer quotes in the market. The end goal was to paint a rosier picture of the outstanding derivative positions and, therefore, a better than the actual marking-to-market picture on the books. In particular, the new system resulted in smaller losses being reported in the daily profit/loss reports. Despite the new valuation system, the CIO continued to make losses. As of 16th March 2012, the SCP had reported year-to-date losses of \$161 million. If the old system making use of midpoint prices had been used, those losses would have been \$593 million – a whopping \$432 million more.

## **Absence of Regulatory and Corporate Oversight**

The London whale case exposed a culture of poor regulatory oversight in which risk limits were repeatedly breached, risk metrics disregarded, and risk models manipulated without any concrete steps being taken by the management to correct these anomalies. Since the CIO wasn't a client-facing unit of the bank, it was not subject to the same regulatory scrutiny as other portfolios.

Besides, SCP traders did not have to prepare daily reports for senior management. What's more, risk committee meetings were rare, and in the few instances the committee happened to meet, there appeared to be no specific charter, and only CIO personnel would attend.

In the absence of oversight, CIO traders were able to engage in speculative and risky trades that were not in line with the CIO's traditional investment strategy, which had hitherto prioritized long-term investments, limiting the use of credit derivatives to hedging purposes only.

## **Fudged VaR Models**

CIO traders, risk personnel, and quantitative analysts frequently attacked the accuracy of the risk metrics used, including the VaR. The riskiness of credit derivatives was downplayed, and new risk measurement and models were proposed to lower risk results for the SCP.

Traders argued that the existing models were too conservative and therefore overstated risk, resulting in limit breaches. Senior management approved the migration to a new VaR model that had been researched and built by CIO traders themselves. Crucially, the bank did not obtain approval from the Office of the Comptroller of Currency. That means there had been little room for checks and balances in the process of developing the model.

The updated VaR model resulted in risk numbers that were 50% lower than prior numbers, paving the way for even more speculative trading and high-risk strategies. Months later, the bank's model Risk and Development Office determined that the model had mathematical and operational flaws. Some of the issues that came to light include:

- EXCEL spreadsheets used required manual updates
- There were coding errors in the calculation of hazard rates and correlation estimates
- Unrealistically low volatility was attached to illiquid securities, built upon the assumption that prices for days on which trades did not occur would be the same as the price when last traded.
- Instead of using the Gaussian Copula model in the built-in analytics suite as required under Basel 2.5, the model used a Uniform Rate option.

On 10th May, the bank backtracked, revoking the new VaR model due to the above inaccuracies, and the prior model was immediately reinstated.

## **Rogue Trading and Misleading Reporting at Barings Bank**

The Barings case revolves around Nick Leeson, a British trader. Barings PLC of London was the oldest merchant bank in England. After making a reputation for hard work and a unique understanding of the market while serving in other posts outside Barings bank, Leeson was appointed the general manager and head trader of Barings Futures Singapore. In his new post, Nick Leeson quickly became

a renowned operator of the derivative product's market on the SIMEX (Singapore International Monetary Exchange).

As a reward from his bosses, Leeson was given some "discretion" in his trades: He could place orders on his own (speculative or "proprietary" trading). He was also in charge of accounting and settlements, and there was no direct oversight over his trading book. This allowed him to create a dummy account - 88888 - where he'd dump all losing trades. As far as the London office was concerned, Leeson was reporting profits after profits on his trades. His seniors never questioned his constant requests for Margin calls

Leeson took on huge positions as the market seemed to "go his way." He also sold options, taking-on huge market risk, which stems from unexpected major events that, while not directly related to markets, can adversely affect markets. He would also record trades that were never executed on SIMEX.

On 16<sup>th</sup> January 1995, Leeson placed a short straddle on the Singapore Stock Exchange and Nikkei Stock Exchange. That means he simultaneously sold put options (conferring a right to sell) and call options (a right to buy) on Nikkei-225 futures. Such a strategy is aimed at making profits in the form of premiums received and works only if the market proves less volatile than the option prices predicted.

Mr. Leeson is said to have sold up to 40,000 such option contracts and earned the bank an estimated \$150m. His underlying conviction was that the Nikkei would stay in the 18,500-19,500 range, and even in the worst-case scenario, it would not drop below 19 000 points. In an astonishing turn of events soon afterward, a huge earthquake hit Japan, sending its financial markets tumbling. In the space of a week, the Nikkei had lost more than 7%.

Nick Leeson took a futures position valued at \$7 billion in Japanese equities and interest rates linked to the variation of Nikkei. He was "long" on Nikkei. In the three days following the earthquake, he bought more than 20 000 futures, each worth \$180 000.

Unfortunately, the Nikkei never recovered. By the time his dealings came to light, Barings had lost approx. \$1.25 billion. The bank could not withstand this loss and ultimately filed for bankruptcy. In summary, Leeson's phony transactions went unchecked for long periods because of the following



reasons:

- There was little management oversight of the settlement process. Of note, Leeson reported to multiple managers. There wasn't a clear demarcation of roles and responsibilities.
- Apart from being Baring's Floor manager, Leeson was in charge of settlement operations. This allowed him to influence back-office employees to hide his trading losses from the London office.

To a smaller extent, some blame can be apportioned to the Singapore Stock Exchange and the Nikkei Stock Exchange. The two exchanges failed to flag the unusually large positions racked up by Barings bank. It has been reported that the exchanges did ask for information, but their concerns were watered down, with the bank forwarding a few fictitious client names. The exchanges could also have sensed danger if there had been an information-sharing mechanism between them.

## **Lessons Learned**

- Reporting and monitoring of positions and risks (i.e., back-office operations) must be separated from trading (i.e., front-office operations)
- Outsized or strangely consistent profits should be independently investigated and rigorously monitored to verify that they are real, generated following the firm's policies and procedures, and not the result of nefarious or unacceptably risky activities.
- It is the responsibility of risk managers to analyze reported business profits and determine if they seem logical in light of the positions held.

It is, however, important to note that Barings' downfall could have been averted under regulations that were implemented by the Basel Committee just a few years later. For starters, the committee set capital adequacy requirements and set limits on concentration risk. Under the 1996 amendment, banks must report risks that exceed 10% of their capital and cannot take positions that exceed 25% of their capital. Had these rules been in effect in 1994, Barings would have been prohibited from racking up such large positions.

## Financial Engineering

Financial engineering is all about the creation of complex financial structures that meet the needs of the investor. It involves the use of derivatives such as forwards, swaps, and options. Derivatives allow investors and institutions to break apart (i.e., segment) risks. Conversely, derivatives can be used to manage risks on a joint basis.

For illustration, consider a UK fund manager holding a bond denominated in US dollars. The manager is exposed to interest rate risk in the US fixed income market and the currency risk from changes in the euro/dollar exchange rate. In these circumstances, there are two options for the manager:

- Use a currency swap which effectively hedges both risks
- Hedge the foreign exchange rate exposure separately through a currency forward or option, and then hedge the interest rate risk through a quanto swap. Under the quanto swap, they would receive the coupon in euros at a pre-arranged rate and pay the UK LIBOR floating rate.

In practice, financial engineering is often exploited by investors in speculative ways in an attempt to earn immediate portfolio returns. However, such speculative tendencies require the taking of more risk in some form or the other. This risk may come in the form of an unlikely but potentially very severe future loss. Too often, the embedded risk is not fully understood by firms entering into complex derivatives.

### The Risk of Complex Derivatives at Bankers Trust (BT)

Procter & Gamble (P&G) and Gibson Greetings sought the assistance of Bankers Trust (BT) in an attempt to reduce funding costs. BT used derivatives trades which promised P&G and GG a high probability, a small reduction in funding costs in exchange for a low probability, large loss. As it turned out, derivative trades only churned out significant losses for both P&G and GG.

BT's derivatives were designed to be intentionally complex to stop P&G and GG from understanding their risks and overall implications. The trades were quite differentiated in form and structure, making them incomparable to derivative trades of other companies. BT duped P&G and GG into

thinking that the trades were tailored to meet their individual needs. In the end, P&G and GG came to the painful realization that they had been misled after taking in huge losses. The two sued BT.

During the suit, BT's taped conversations between its marketers and customers played a key role. The tapes exposed just the tools BT staff used to fool customers, particularly through the use of complex terminology and pricing structures. In some tapes, BT staff could be heard openly bragging about their unethical behavior.

The scandal dealt a huge blow to BT's reputation and forced senior managers to resign, including the CEO. Eventually, BT was acquired by Deutsche Bank and dismantled.

## **Excess Leverage and Complex Financial Instruments at Orange County**

The Orange County case illustrates how complex financial products characterized by large amounts of leverage can create significant losses. In December 1994, the use of complex structured products by Orange County treasurer, Robert Citron, resulted in a loss of \$1.5 billion. This was the largest loss ever recorded by a local government investment pool. At the root cause of the downfall was Robert Citron's decision to borrow heavily in the repo market.

Repos allow investors to finance a significant portion of their investments with borrowed money (i.e., leverage). But the use of leverage has a multiplicative effect on the profit or loss on any position; even a small change in market prices can have a significant impact on the investor.

Robert Citron had been entrusted with a \$7.5 billion portfolio belonging to county schools, cities, districts, and the county itself. To many investors, Citron was a financial management guru who had, for a long time, managed to deliver consistently higher returns. Indeed, his returns were about 2% higher than the comparable State pool.

The fund had only USD 7.7 billion in equity, but Citron managed to borrow USD 12.9 billion through the repo market, creating a USD 20.6 billion portfolio. Citron used the funds to purchase complex inverse floating-rate notes. But here's the interesting bit; the coupon payments of inverse floating-rate notes decline when interest rates rise as opposed to conventional floaters, whose payments increase in such a situation. In effect, therefore, Mr. Citron was betting in favor of interest rates falling or generally staying low.

For a while, interest rates went down, and his bet seemed to be paying off. It was in these circumstances when Citron was able to record higher than average returns. However, throughout 1994, the Federal Reserve announced a hike in interest rates by 250-basis points. As expected in this scenario, the increase in interest rates reduced the value of Citron's portfolio substantially, generating a loss of USD 1.5 billion by December 1994. At the same time, Citron struggled to roll over maturing repo agreements, with most lenders tabling stringent demands, including the provision of more collateral before giving a single coin. Ultimately, Orange County was forced to file for bankruptcy. Citron later admitted he understood neither the position he took nor the risk exposure of the fund.

In summary, therefore, this debacle was caused by two key things:

- Excessive use of leverage
- A highly risky interest rate bet that did not take into account the Federal Reserve's possible changes in monetary policy.

## **Lessons Learned**

- Every firm needs to have more than a basic understanding of the risks that are inherent in their business models. Senior management then needs to take these risks into account when coming up with a risk management framework.
- Senior management needs to stick to the portfolio strategy communicated to stakeholders at the onset. Robust policies and risk measures should be adopted as specified in the risk appetite statement and the risk management framework.
- Management, and boards, should endeavor to establish areas of the business where risks may hide and also seek to establish the circumstances which can result in a loss.

## **The Case of Investing in AAA Tranches of Subprime CDOs: Sachsen**

Subprime securities were some of the most popular assets in the run-up to the 2007–2009 financial crisis. But while subprime securities offered an attractive risk premium, they also required

understanding and pricing expertise. European banks were some of the biggest buyers of US subprime securities. Among these institutions were publicly-owned banks in Germany called the Landesbanken.

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The Landesbanken traditionally specialized in lending to regional small- and medium-sized companies. However, in the run-up to the crisis, a thriving industry pushed some of the banks to open overseas branches and develop investment banking businesses. One of the most notorious examples was the Landesbank Girozentrale Sachsen –a Leipzig-based bank.

Sachsen opened a network of units (called conduits), which is used to raise money through the sale of short-term debt.

The money would subsequently be invested in the subprime securities market. Sachsen opened a branch in Dublin tasked with setting up the units to hold large volumes of highly rated US mortgage-backed securities. While these units were technically off the parent bank's balance sheet, they benefited from the guarantee of Sachsen itself. That means Sachsen would promise to lend the units extra money if they ever needed it.

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In the run-up to the crisis, the size of Sachsen's off-the-balance-sheet operation was simply too large compared to Sachsen's balance sheet.

When the subprime crisis struck in 2007, Sachsen's attempts to rescue the units it had set up ended

up wiping out the bank's capital. Eventually, the bank had to be sold to Landesbank Baden-Württemberg (LBBW).

## **Reputation Risk**

Two key things determine a firm's reputation:

- The ability and willingness to fulfill its promises to counterparties and creditors
- The ability to deal fairly and follow ethical practices

In recent years, however, firms have become increasingly concerned about their reputation due to the rapid growth of public and social networks. A rumor can spread like a bushfire and cause untold reputational damage in just a few hours. As a result, companies are under growing pressure to demonstrate their commitment to environmental, social, and governance-related best practices. The reputational damage caused by unethical conduct, whether rumored or real, can be very severe.

## **Volkswagen Emission Cheating Scandal**

The Volkswagen emissions scandal, also known as Dieselgate or Emissionsgate, burst onto the public scene in September 2015, but its origin can be traced back to 2009.

In model years 2009 through 2015, the carmaker had been installing in its diesel engines software that had been intentionally programmed to reduce emissions during testing. This meant that the cars would pass emission tests with "flying colors" only to emit up to 40 times more Nitrogen Oxide during real-world driving. This software had been installed in over ten million cars, most of which had already been shipped to various dealers and direct consumers around the world.

In 2014, engineers in the United States carried out live road tests, and that's when the whole scheme was unearthed. Reached out for comment, Volkswagen executives in Germany and the United States formally acknowledged the deception on a conference call with officials from the United States Environmental Protection Agency (EPA). As soon as irrefutable evidence had been gathered, the EPA made the information public.

What followed was untold damage to the Volkswagen brand. The company's share price fell by over a third, and the firm faced billions of dollars in potential fines and penalties. Multiple parties filed lawsuits, most of them emphasizing the health hazards faced by consumers. Volkswagen's reputation took a severe hit around the world, with most of the damage happening in the US. The impact was so great that the German government expressed fears that the scandal would diminish the value of the imprimatur "Made in Germany."

## **Corporate Governance: Enron**

Enron was formed in 1985 following a merger of InterNorth and Houston Natural Gas. The firm was originally involved in the regulated transportation of natural gas. But following the deregulation of energy markets, the firm lost the exclusive rights to its pipelines. As a result, the management was forced back to the drawing board to devise new ways to remain in business. The management came up with an innovative business strategy that involved buying gas from various suppliers and selling it to a network of consumers at guaranteed amounts and prices. In return for assuming the associated risks, Enron charged fees for these transactions. As part of this process, Enron created a market for energy derivatives where one had not previously existed.

The new strategy turned out to be a huge success; so much so that up until late 2001, nearly all observers — including Wall Street professionals — spoke highly of this new strategy and considered it a business masterstroke. And true to their assessment, Enron's financial position changed dramatically. The firm's reported annual revenues grew from under \$10 billion in the early 1990s to \$139 billion in 2001, a transformation that firmly placed the firm among the top five Fortune 500 companies. Enron's shares peaked at USD 90.56 in August 2000. That year, the firm had more than 20,000 employees on its payroll and revenues of nearly USD 101 billion.

Interestingly, Enron became a major proponent of the deregulation of the energy market. In the firm's assessment, deregulation would come with greater flexibility to pursue its business model. Top managers at the firm took actions that prioritized profit over consumer welfare. For example, the firm was a prominent player in the 2000-2001 California electricity crisis. Enron created artificial power shortages enabling it to raise power prices by up to 2,000%. The crisis ultimately forced the state's Democratic governor, Gray Davis, out of office with Arnold Schwarzenegger eventually coming in as his replacement. Meanwhile, the shortages helped Enron to make USD 1.6

billion.

Despite these shady deals, Enron still went down in December 2001, but why?

Thanks to its large-scale involvement in energy markets, Enron traded large amounts of oil futures contracts. However, the contracts didn't involve any stake in oil price movements. Instead, Enron was collecting cash by selling oil for future delivery, promising to buy back the delivered oil at a fixed price.

As a result, no oil was delivered. This was a strategy of a loan where Enron paid cash at a later date to receive cash at the beginning of the contract. This way, the company did not have to reveal these transactions as loans in financial statements. The result was ill financial health disguised in impressive financial statements that didn't portray the real financial situation.

JPMorgan Chase and Citigroup were the main counterparties in Enron's trades. When the scandal blew open, the two had to pay \$126 million in fines for assisting and abetting fraud against Enron shareholders.

## Key Points

- Many in Enron's senior management went against the key tenets underlying the principal-agent relationship. Most managers acted in their self-interest at the expense of shareholders. After the scandal came to light, for example, Enron chairman and CEO Ken Lay was charged with "falsifying Enron's publicly reported financial results and making false and misleading public representations about Enron's business performance and financial condition."
- Enron's board failed to fulfill its fiduciary duties to shareholders. For example, the board allowed the chief financial officer to be the sole manager of a private equity fund that did business with Enron. Private equity lacked economic substance
- Enron outsourced its audit function to Arthur Andersen, formerly one of the Big Five accounting firms. Andersen either failed to catch or explicitly approved many of the fraudulent accounting practices that led to Enron's collapse. After the scandal came to light, the Securities and Exchange Commission (SEC) was forced Andersen to surrender its



accounting licenses. This was effectively a death sentence for the firm.

## **Cyber Risk**

The rapid rise of the internet as the preferred method to transact and share information has exposed individuals and institutions to cyber risk. There are cases where bank systems have been hacked, and ATMs breached, leading to not just loss of cash but also exposure and theft of client information. Such information can be used to inflict serious damage to clients and institutions.

As a result, financial institutions have had to spend billions of dollars every year to boost the security of their systems. The goal is to rebuff both external attacks as well as internal attacks perpetrated by individuals within the institution. Threats to the banking system from cyber-attacks are also a major concern to international regulatory bodies, such as the Bank for International Settlements (BIS) and the International Monetary Fund (IMF), as well as to local regulators.

### **The SWIFT Case**

The Society for Worldwide Interbank Financial Telecommunication, also known as SWIFT, is a secure electronic platform used to transfer funds among more than 11,000 financial institutions worldwide. Thanks to SWIFT, transactions that would take days are completed in a matter of seconds. For the longest time, SWIFT was considered a super-secure system nearly impossible to hack. But that notion changed in April 2016.

An article published in the New York Times revealed that hackers had used the

SWIFT network to steal USD 81 million from Bangladesh Bank (the central bank

of Bangladesh). The money was transferred through the SWIFT network to accounts in the Philippines controlled by hackers.

The hackers unleashed malware that sent unauthorized messages instructing the transfer of funds to the account. The attack had been planned so meticulously that details of the transfers were immediately erased from the system. Confirmatory messages sent to designated individuals were not sent.

Though the SWIFT network was itself not compromised, the management moved with speed to reassure clients that weaknesses in the system would no longer be tolerated. A Customer Security Program (CSP) was also set up, consisting of mandatory security controls, information-sharing mechanisms, and sophisticated security features. As of December 2018, 94% of clients complied with CSP requirements.

## **Reading 10: Anatomy of the Great Financial Crisis of 2007-2009**

After completing this reading, you should be able to:

- Describe the historical background and provide an overview of the 2007-2009 financial crisis.
- Describe the build-up to the financial crisis and the factors that played an important role.
- Explain the role of subprime mortgages and collateralized debt obligations (CDOs) in the crisis.
- Compare the roles of different types of institutions in the financial crisis, including banks, financial intermediaries, mortgage brokers and lenders, and rating agencies.
- Describe trends in the short-term wholesale funding markets that contributed to the financial crisis, including their impact on systemic risk.
- Describe responses made by central banks in response to the crisis.

## **Historical Background of the Great Financial Crisis**

A financial crisis is a **disruption of the capital markets** typically associated with falling asset prices and insolvency of debtors and intermediaries, which disrupts the ability of the market to allocate capital. Financial crises are often characterized by panic and bank runs during which investors sell assets or withdraw funds from savings accounts due to fears that the value of their assets will decrease if they continue to be held in financial institutions. An economic crisis may also be caused by the burst of a **speculative bubble**, the **crash of stock markets**, **sovereign default**, or a **currency crisis** - a situation where there's a steep decline in the value of a nation's currency. A financial crisis can be confined to a single economy, but it can also spread to an entire economy or even multiple economies around the world. There have been many crises in the last century, including the Great Depression in 1932, the Suez Crisis in 1956, the International Debt Crisis in 1982, the Russian Economic Crisis (1992-97), and the Latin American Debt Crisis in 1994-2002. However, none of these crises left as big a scar on the world's economic footing as the great

financial crisis of 2007-2009, also referred to as the 2007/2009 financial crisis.

The 2007/2009 financial crisis was a period of general economic breakdown that affected not just the United States, where it began, but just about every country around the world. According to the International Monetary Fund (IMF), it was the worst crisis since the Great Depression in the 1930s. It is widely attributed to the collapse of the United States real estate market, particularly after the emergence of the subprime mortgage market.

## **Overview of the Great Financial Crisis**

The Great Financial Crisis of 2007-2009 (GFC) began in December 2007 and lasted for 19 months until June 2009. Let's look at some notable events that preceded the crisis.

### **U.S. Housing Policy**

Although conventional wisdom holds that the 2008 financial crisis was brought about by insufficient government monitoring of risk management in the private sector, there appears to be compelling evidence the true cause was the U.S. government's housing policy. The government had passed legislation aimed at increasing home ownership by providing favorable mortgage terms to middle and lower-income earners. The government actively encouraged banks to extend mortgages to a broader borrower base in an attempt to bridge the gap between the poor and the middle class.

This ambitious policy was implemented primarily through the government-sponsored enterprises (GSEs) Fannie Mae and Freddie Mac and the U.S. Department of Housing and Urban Development (HUD). Ultimately, the legislation forcefully relaxed traditional mortgage underwriting standards to make mortgage credit more readily available to lower-income borrowers. However, loosened standards spread across the wider market and contributed to an enormous house price bubble between 1997 and 2007. By 2008, most mortgages in the U.S. were subprime or weak and were failing at an unprecedented rate. The high default rate systematically weakened the financial markets, culminating in the failure of Lehman Brothers - one of the biggest investors in mortgage-backed securities.

### **U.S. Housing Bubble**

A housing bubble is a **temporary** period of months or years during which housing prices are inflated beyond **fundamentals** due to high demand and low supply.

In the years leading up to the GFC, the U.S. economy was driven by a housing bubble. Home prices had consistently been increasing in the preceding years (2000 to 2007), although there were a few (insignificant) declines in between. The key reason behind this was the relative lax lending standards that rendered most Americans eligible for mortgages even when their creditworthiness wasn't particularly impressive. When the bubble burst, financial institutions were left with trillions of dollars in subprime mortgage investments that were nearly worthless. In addition, housing construction fell by more than 4%, the national GDP tumbled, and consumption slowed.

## **The Shadow Banking System**

The shadow banking system refers to the collection of **non-bank financial intermediaries** (NBFIs) providing services **similar** to those of traditional commercial banks but **outside the normal regulatory framework** for banks. In the years leading up to the GFC, the shadow banking system has recorded steady growth. Important NBFIs included securitization vehicles (SPVs), investment banks, money market funds, and mortgage companies. Due to inadequate regulation, the shadow banking system was marked by irrational exuberance and poor risk management. NBFIs were known to take higher liquidity and credit risk levels than traditional banks. The vast majority of NBFIs originated subprime mortgages, packaged them in mortgage-backed securities, and distributed them throughout the financial system. When it became clear the securitization market was headed for ruin, creditors ran from the shadow banking system, triggering a run that disrupted the flow of credit to consumers.

Because of the shadow banking system's sheer size, interconnectedness with mainstream financial institutions, the complexity of operations and assets, and dependence on short-term funds, its failure had an enormous effect on the global financial system.

## **Debt Accumulation**

In the decades leading up to the GFC, households had been accumulating debt. When housing prices started falling, individuals and corporates concentrated on paying off debt while reducing

consumption and investment. This gradually slowed down the economy.

## **Build-Up To the Financial Crisis and the Factors That Played an Important Role**

The first prominent signs of problems arrived in early 2007 when Freddie Mac announced its decision to stop purchasing high-risk mortgages. Around the same time, New Century Financial, a leading mortgage lender to below-average-risk borrowers, filed for bankruptcy. Credit rating agencies also began to downgrade structured financial instruments.

Another sign that all was not well came when the ABX index – used as a benchmark for measuring the overall performance of the subprime mortgage market – began to reflect higher expectations of default. After these initial warnings, runs occurred in the short-term market (shadow banking system) – a market previously considered safe. Large-scale withdrawals from short-term funds were made. Issuers of asset-backed commercial papers started having difficulties rolling over their outstanding debt. What followed was a series of bankruptcy declarations and takeovers.

### **Notable Events**

#### **Failure of Countrywide Financial Corp.**

Countrywide Financial Corp. was a major U.S. mortgage lending company. The corporation was founded in the 1960s by Angelo R. Mozilo, a butcher's son from the Bronx, and David Loeb, a founder of a mortgage banking firm in New York. Subprime lending provided Countrywide with a lot of benefits during the early 2000s. In 2001, mortgages accounted for 28 percent of Countrywide's net income, with subprime loans raking in \$280 million. By comparison, subprime loans had earned the corporation just \$86.9 million in the previous year. In 2002, a significant and rapid increase occurred in Countrywide's loan portfolios to minorities and low- to moderate-income households.

In 2007, Countrywide's annual report took a somber tone after years of fast growth and optimistic projections. Countrywide had already begun to feel the effects of the financial crisis. The report focused a great deal on the accounting details of its mortgage portfolio and default rates. The report revealed that in just a year, Countrywide had depreciated over \$20 billion and absorbed over \$1

billion in losses. By 2008 there was approximately \$8 billion worth of subprime loans in Countrywide's books, and to make matters worse, the delinquency rate stood at 7% against an industry average of 4.67%. In the same year, foreclosures doubled, and the firm tried to cope with the situation by laying off around 20 percent of its employees (20,000 people). In 2008, the company was acquired by Bank of America after nearly failing due to a lack of funding. A substantial discount was applied to the price tag compared to what the company was actually worth. Shares had been valued at \$20/share earlier in the year, but Bank of America paid just \$8/share.

## **Failure of Bear Stearns**

Bear Stearns was a global investment bank and financial company founded in 1923 in New York. It collapsed during the 2008 financial crisis.

Ahead of the collapse, Bear Stearns was heavily involved in securitization and issued large amounts of asset-backed securities. Even as investor losses mounted in those markets in 2006 and 2007, the company's management felt it was a good time to increase exposure. To avert a sudden collapse, the Federal Reserve Bank of New York provided an emergency loan in March 2008. Sadly, that wasn't enough to save Bear Stearns. Unable to roll over its short-term funding, the bank was bought by JPMorgan Chase at a big discount. To put that into perspective, Bear Stearn's pre-crisis stock price stood at more than \$130 a share, but JPMorgan was able to negotiate a price of just \$10 a share.

## **The Collapse of Lehman Brothers**

In the mid-2000s, Lehman Brothers had massive exposure to mortgage-backed securities (MBS). The housing boom had led to the creation of an unprecedented amount of MBSs and collateral debt obligations (CDOs). By 2007, Lehman Brothers was the largest holder of MBSs. But on September 15, 2008, Lehman Brothers filed for bankruptcy, marking the peak of the subprime mortgage crisis. But what exactly happened?

In the first two quarters of 2008, the bank reported losses running into billions of dollars due to the high default rate in the subprime mortgage business. Upon learning that Lehman had been downgraded due to these losses and heavy exposure to the mortgage industry, the Federal Reserve called Lehman to negotiate financing for its reorganization. After these discussions failed, Lehman

filed a Chapter 11 petition. It remains the largest bankruptcy in American history. One day after the bankruptcy filing, the Dow Jones Industrial Average dropped 4.5%, its biggest decline since September 11, 2001. This signaled the government's limits in managing the crisis and caused a general panic.

Lehman's bankruptcy filing was a seismic event that shook the global financial system to the core. In the month following its collapse, equity markets lost more than **\$10 trillion** in market capitalization.

## **The Collapse of the Reserve Primary Fund**

The Reserve Primary Fund (RPF) was the first money market fund ever created in the U.S. During its peak, it held assets worth more than \$60 billion. Amid the financial crisis of 2007-2008, RPF lost dollar value or "broke the buck." "**Breaking the buck**" refers to a situation where a money market fund's investment income does not cover its operating expenses or investment losses. Eventually, RPF was liquidated. But the failure of Lehman Brothers had a very strong hand in the collapse of RPF.

RPF began to invest in commercial paper in 2006, an asset class the fund's founder Bruce Bent had dismissed in 2001. By early 2008, 56% of the fund's portfolio was comprised of asset-backed and financial-sector commercial paper. Lehman Brothers' bankruptcy on September 15, 2008, raised concerns about RPF's holdings of Lehman-issued paper, which then accounted for 1.2% of its portfolio. Among money market funds, RPF was especially vulnerable because it did not have a parent company that could guarantee its share price. Withdrawals from the fund topped 25% by the afternoon of September 15 and more than half the following day, as clients sought to exit the fund before the price of its Lehman assets could impact RPF's share price. Without a buyer, the fund declared the assets worthless and announced a \$0.97 share price. The fund was liquidated at the end of September.

## **The Role of Subprime Mortgages and Collateralized Debt Obligations (CDOs) in the Crisis**



Subprime mortgages are mortgages given to individuals whose credit histories are **poor**, **incomplete**, or **nonexistent**. Subprime borrowers often have poor credit ratings, large loan-to-values (low up-front deposits), and high loan-to-income ratios. A typical subprime mortgage comes with a low "teaser" rate in the first couple of years which then reverts to a higher rate for the remaining term to maturity. In the years leading up to the GFC, subprime mortgages had several notable features:

- **NINJA loans:** Some subprime mortgage varieties were extended to borrowers with no income, no job, and no Assets.
- **100% loan-to-value ratio:** A 100 percent loan-to-value loan allows you to borrow 100 percent of the value of your property (There's no up-front payment required).
- **Interest-only mortgage:** Initially requires only payment of interest, typically in the first five or ten years.
- **Liar Mortgage:** A type of mortgage whose approval requires little or no documentation to prove the income of the borrower.

Many subprime borrowers, some of whom were property speculators, were optimistic that at the end of their teaser period, they would be able to refinance to a similar or even better product or sell the home at a profit. But when house prices declined, many of these borrowers found themselves in negative equity positions (the value of their mortgages exceeded the value of their homes). Many chose to default on their obligations, resulting in more foreclosures and a supply glut, further pushing house prices down.

The other notable practice in the lead-up to the financial crisis was the selling of loans to third parties under the OTD (originate-to-distribute) model. Under the model, lenders would issue mortgages to borrowers and then package them into secondary assets that could be sold to third-party investors. Prior to the sale, lenders would cease holding the mortgages as assets on their balance sheets. Instead, these loans would be moved into bankruptcy-remote structured investment vehicles (SIVs). Investors used to do business directly with the SIVs. In securitization, certain types of assets are bundled so that they can be repackaged into interest-bearing securities. Upon purchasing the securities, the purchasers receive interest and principal payments from the assets.

**Collateralized debt obligations** (CDOs) provide an example of such a structure, where the pool of securities is divided into multiple tranches (e.g., senior, junior, and equity). Cash flows and losses are shared according to a waterfall structure, where senior tranches receive cash flows first but absorb losses last. Despite the fact that the underlying mortgages consisted of NINJA and liar loans, the senior tranches were deemed very safe and had an AAA rating. At the same time, many of the junior tranches of multiple structures of CDOs were bundled together and resold as CDO-squared (CDOs whose cash flows are backed by other CDO tranches rather than mortgages). In the end, some of the products developed from these structures were too complex and opaque to be valued, even during normal times and even for sophisticated investors.

The fact that CDOs created from NINJA loans and other substandard facilities were given an AAA rating demonstrates that rating agencies did very little to realistically and reliably assess the credit quality of the CDOs. Notably, rating agencies relied on data provided by issuers while conducting their credit analysis. In addition, rating agencies were usually paid by the issuer. In these circumstances, there was a clear conflict of interest because the arrangement gave rating agencies an incentive to issue favorable ratings. In other words, rating agencies were ready to turn a blind eye to possible underlying risks in exchange for huge "assessment fees" from issuers.

## **The Roles of Different Types of Institutions in the Financial Crisis, Including Banks, Financial Intermediaries, Mortgage Brokers and Lenders, and Rating Agencies**

### **Banks (Lenders) and Financial Intermediaries**

Banks were mainly originators of mortgage-backed securities. After successfully selling mortgages to consumers, banks securitize these mortgages (assets on the balance sheet) by creating structured investment vehicles (financial intermediaries) via which the pooled assets would be sold to investors. SIVs are usually designed to be bankruptcy-remote, meaning they have their own legal status. As a result, an SIV's obligations are secure even if the parent company goes bankrupt. In the same breath, the operations of the S.P. are restricted to purchasing and financing specific assets or projects. These characteristics enabled banks to remove securitized assets from the balance sheet, a move that in part contributed to relaxed lending and know-your-customer (KYC) standards. As a result, the

number of subprime mortgages would steadily increase as more and more assets got securitized.

## **Mortgage Brokers**

Mortgage brokers serve as an intermediary, bringing together mortgage borrowers and lenders, but they do not use their own funds to originate the loans.

Due to lax lending standards and weak internal controls, some brokers and borrowers submitted false documentation that allowed borrowers to obtain funding under fraudulent terms. The problem was exacerbated by the compensation structure for most mortgage brokers, which rewarded increasing the volume of loans originated while paying "lip service" to long-term performance. Brokers generally incurred few (if any) consequences if an originated loan eventually defaulted. As a result, brokers had little incentive to perform proper due diligence.

## **Rating Agencies**

During the Global Financial Crisis of 2008, credit agencies came under fire for giving high credit ratings to debts that later turned out to be high-risk investments. Specifically, they failed to identify (or overlooked) risks that might have warned investors against investing in certain instruments, such as mortgage-backed securities.

A potential conflict of interest between rating agencies and securities issuers was also highlighted. Rating agencies are paid by issuers of securities to provide rating services. As a result, they might be reluctant to assign very low ratings to the issuer's securities.

A third point to be noted is that subprime mortgages were too new to provide reliable, proven data that could be used to draw long-term risk predictions. Thus, many of the initial ratings assigned to these securitizations (most often the senior tranches with AAA ratings) were likely flawed from the start.

## **Trends In the Short-Term Wholesale Funding Markets That Contributed to The Financial Crisis**

Short-term wholesale debt comprises two instruments: repurchase agreements (R.A.s) and commercial paper (C.P.).

## Repurchase Agreements (Repos)

Generally, a repurchase agreement ("repo") is an agreement that involves the sale and subsequent repurchase of the same security at a higher price at a later date. It is a transaction in which a security is exchanged for cash. The security serves as collateral to the buyer until the seller can pay them back, and in addition, the buyer earns interest. Since the security seller receives cash at the beginning of the repo, the seller has the status of a **borrower** in a collateralized loan transaction (with the security as collateral). The security buyer, who provides cash at the beginning of the repo but receives a higher sum at the end of it, can be considered a **lender** (as the higher sum is equivalent to principal plus interest).

Repo transactions can use a variety of securities as collateral, from government bonds, highly rated corporate bonds, to securitized tranches. There is a direct relationship between the quality of collateral and the size of the haircut (that is, the difference between the initial market value of an asset and the purchase price paid for that asset at the start of a repo), with higher (lower) quality collateral having smaller (larger) haircuts. A haircut of 10% means that for every USD 100 pledged as collateral, a borrower can get USD 90. A haircut aims to protect the lender from having to sell collateral at a loss following a default and recovering less than the full amount of the loan. The bankruptcy process does not apply to repos. Consequently, if one counterparty fails, the other may unilaterally terminate the transaction and sell the collateral.

## Commercial Paper

Unsecured CP financing involves issuing short-term debt that is not backed by any assets. Due to the absence of specific collateral that a lender can seize in the event of bankruptcy, unsecured commercial paper issuers typically have very high credit quality. Normally, if C.P. issuers' credit quality deteriorates, for example, by way of a rating downgrade, an orderly exit will occur through margin calls.

However, there are special commercial papers that are backed by specific collateral. The collateral

could be credit card loans, mortgages, or other securitizations. Such a commercial paper is known as an asset-backed commercial paper (ABCP).

## **How Exactly Did These Short-term Funding Instruments contribute to the Crisis?**

SIVs holding mortgages were predominantly funded through ABCPs and repurchase agreements, so they had to roll over obligations at maturity to maintain liquidity. SIVs were thus exposed to significant funding liquidity risk in the event of a crisis. As housing and mortgage-backed security prices declined, lenders began questioning the quality of the assets contained within SIV structures and began extending fewer short-term loans. By August 2007, ABCP and repo markets had been shut down entirely. SIVs' sponsors were also hurt since they often extended backstop lines of credit to these entities. The negative effect spread even further. For example, ABCPs had been popular investments for money market funds. When ABCP prices started tumbling, large investors triggered financial hemorrhage among the leading money market funds by rushing to withdraw their stakes. This further exacerbated the liquidity crisis.

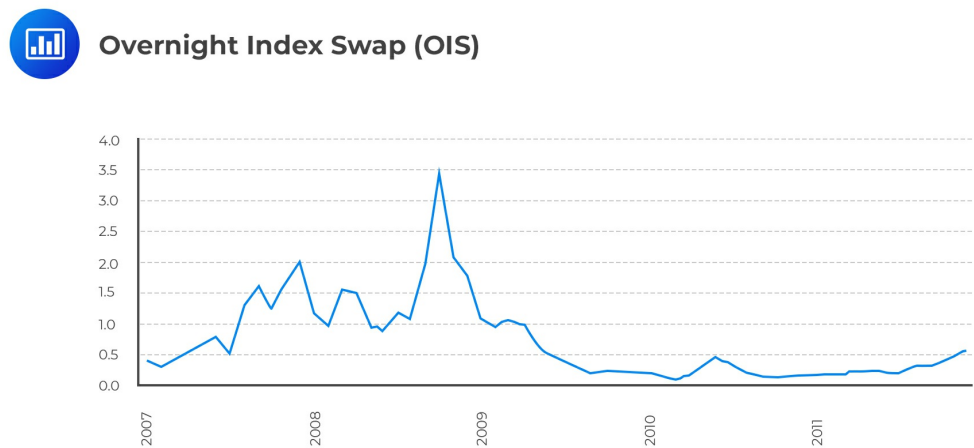
## **Systemic Risk**

Systemic risk refers to the possibility that a company- or industrial-level event could cause severe instability or even the collapse of the entire industry or economy.

During the GFC, what began as a subprime mortgage crisis quickly escalated into a **full-blown financial meltdown** whose effects were felt across the financial markets. Once market participants started to grow wary and weary of doing business with financial institutions with a direct or indirect stake in the mortgage industry, various actions were taken that ended up throwing the financial markets further into turmoil. For example, haircuts on short-term funding increased from 0% before the crisis to nearly 25% in November 2008, shortly after the collapse of Lehman Brothers. The LIBOR-overnight index swap (OIS) spread, one of the most trusted indicators of the overall health of the financial system, shot up from nearly 0% pre-crisis to over 3.6% at the peak of the crisis. The sharp increase pointed to dwindling confidence among participants in the interbank lending market. At the same time, some institutions that could not borrow in the short-term market

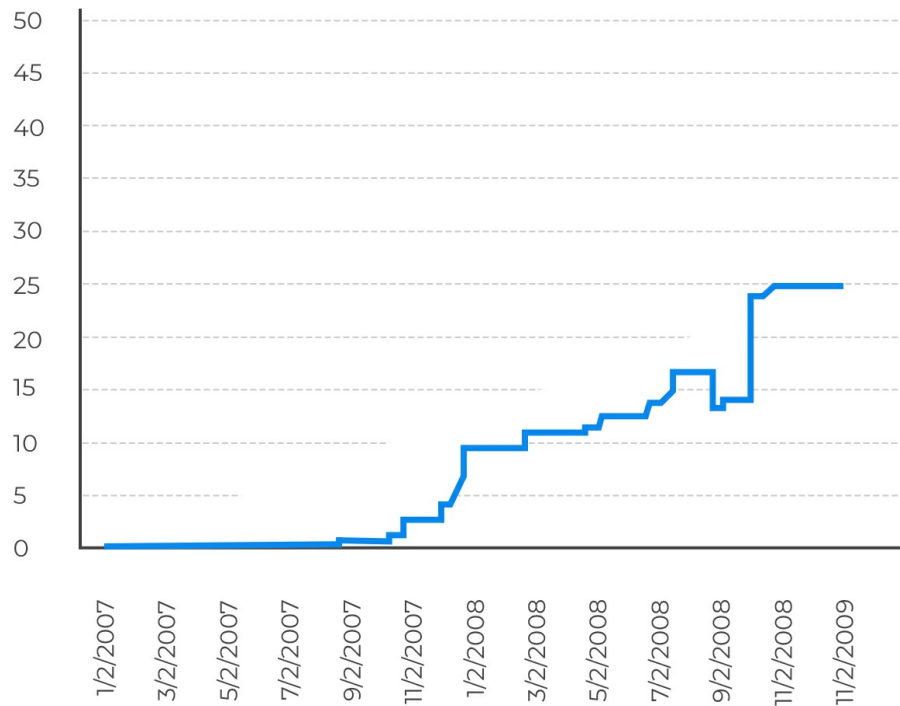
were left with no choice but to sell some of their assets in distress. This further pushed market prices down and left these institutions with "bare bone" equity levels that couldn't support long-term/strategic objectives. Some filed for bankruptcy, while a few lucky ones were bailed out by the government or absorbed by other relatively stable institutions.

**Figure 1 - Historical Preview of the Overnight Index Swap**





## Average Repo Haircut on Structured Debt



## Responses Made by Central Banks in Response to the Crisis

To combat the crisis, the Federal Reserve and other central banks from around the world devised innovative liquidity injection facilities. The Federal Reserve created backstop facilities to support most asset classes that experienced stress during the crisis. These actions included:

- Establishing long-term lending facilities against high-quality collateral;
- Granting investment banks and securities firms access to the discount window (a lending facility that helps financial institutions manage short-term liquidity needs);
- Offering credit against illiquid asset-backed securities of high quality;
- Providing financing for the purchase of unsecured C.P.s and ABCPs;

- Providing liquidity to money market funds; and
- Buying assets from Fannie Mae and Freddie Mac.

These actions were aimed at improving liquidity. This led to the central banks' balance sheets becoming significantly larger.

U.S. government interventions during the crisis were as follows:

- The Term Auction Facility (TAF), a program implemented in December 2007 to provide funds to depository institutions through the auctioning of funds against a broad range of collateral;
- The Primary Dealer Credit Facility (PDCF), which allowed the Fed to lend funds, via repos, to primary dealers;
- The Economic Stimulus Act of February 2008 which provided temporary tax incentives for businesses; and
- The Troubled Asset Relief Program (TARP) to purchase toxic assets and equity from financial institutions

Question



Where did the Great Financial Crisis of 2007-2009 start?

- A. The collapse of Fannie and Mae
- B. The failure of the Lehman Brothers
- C. The central bank intervention
- D. The Subprime Mortgage Market.

**Solution**

The correct answer is D

The events that led to the Great Financial Crisis started with a downturn in the US subprime mortgage market in 2007.

## **Reading 11: GARP Code of Conduct**

**After completing this reading, you should be able to:**

- Describe the responsibility of each GARP Member concerning professional integrity, ethical conduct, conflicts of interest, the confidentiality of information, and adherence to generally accepted practices in risk management.
- Describe the potential consequences of violating the GARP Code of Conduct.

*The excerpt is the GARP Code of Conduct by GARP.*

### **Introductory Statement**

The GARP Code of Conduct ("Code") sets forth principles of professional conduct for Global Association of Risk Professionals ("GARP"), Financial Risk Management (FRM®FRM®) and Energy Risk Professional (ERP®ERP®) certifications and other GARP certification and diploma holders and candidates, GARP's Board of Trustees, its Regional Directors, GARP Committee Members and GARP's staff (hereinafter collectively referred to as "GARP Members") in support of the advancement of the financial risk management profession. These principles promote the highest ethical conduct and disclosure levels and provide direction and support for both the individual practitioner and the risk management profession.

The pursuit of high ethical standards goes beyond following the letter of applicable rules and regulations and behaving in accordance with the intentions of those laws and regulations, it is about pursuing a universal ethical culture.

All individuals, firms, and associations have an ethical character. Some of the biggest risks faced by firms today do not involve legal or compliance violations but rest on decisions involving ethical considerations and the application of appropriate standards of conduct to business decision-making.

There is no single prescriptive ethical standard that can be globally applied. We can only expect that GARP Members will continuously consider ethical issues and adjust their conduct accordingly as they engage in their daily activities. This document makes references to professional standards and

generally accepted risk management practices. Risk practitioners should understand these as concepts that reflect an evolving shared body of professional standards and practices. In considering the issues this raises, ethical behavior must weigh the circumstances and the culture of the applicable global community in which the practitioner resides.

## **Code of Conduct**

The Code is comprised of the following Principles, Professional Standards, and Rules of Conduct, which GARP Members agree to uphold and implement.

### **1. Principles**

#### **1.1 Professional Integrity and Ethical Conduct**

GARP Members shall act with honesty, integrity, and competence to fulfill the risk professional's responsibilities and to uphold the reputation of the risk management profession. GARP Members must avoid disguised contrivances in assessments, measurements, and processes that are intended to provide a business advantage at the expense of honesty and truthfulness.

#### **1.2 Conflicts of Interest**

GARP Members have a responsibility to promote the interests of all relevant constituencies and will not knowingly perform risk management services directly or indirectly involving an actual or potential conflict of interest unless full disclosure has been provided to all affected parties of any actual or apparent conflict of interest. Where conflicts are unavoidable, GARP Members commit to their full disclosure and management.

#### **1.3 Confidentiality**

GARP Members will take all reasonable precautionary measures to prevent intentional and unintentional disclosure of confidential information.

## **2. Professional Standards**

### **2.1 Fundamental Responsibilities**

- GARP Members must endeavor, and encourage others, to operate at the highest level of professional skill.
- GARP Members should always continue to perfect their expertise.
- GARP Members have a personal ethical responsibility and cannot out-source or delegate that responsibility to others.

### **2.2 Best Practices**

- GARP Members will promote and adhere to applicable “best practice standards,” and will ensure that risk management activities performed under his/her direct supervision or management satisfies these applicable standards.
- GARP Members recognize that risk management does not exist in a vacuum.
- GARP Members commit to considering the wider impact of their assessments and actions on their colleagues and the wider community and environment in which they work.

### **2.3 Communication and Disclosure**

GARP Members issuing any communications on behalf of their firm will ensure that the communications are clear, appropriate to the circumstances and their intended audience, and satisfy applicable standards of conduct.

## **Rules of Conduct**

### **1. Professional Integrity and Ethical Conduct**

**GARP Members:**

**1.1** Shall act professionally, ethically, and with integrity in all dealings with employers, existing or potential clients, the public, and other practitioners in the financial services industry.

**1.2** Shall exercise reasonable judgment in the provision of risk services while maintaining the independence of thought and direction. GARP Members must not offer, solicit, or accept any gift, benefit, compensation, or consideration that could be reasonably expected to compromise their own or another's independence and objectivity.

**1.3** Must take reasonable precautions to ensure that the Member's services are not used for improper, fraudulent, or illegal purposes.

**1.4** Shall not knowingly misrepresent details relating to analysis, recommendations, actions, or other professional activities.

**1.5** Shall not engage in any professional conduct involving dishonesty or deception or engage in any act that reflects negatively on their integrity, character, trustworthiness, or professional ability or on the risk management profession.

**1.6** Shall not engage in any conduct or commit any act that compromises the integrity of GARP, the (Financial Risk Manager) FRM designation or the integrity or validity of the examinations leading to the award of the right to use the FRM designation or any other credentials that may be offered by GARP.

**1.7** 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. If there appears to be a conflict or overlap of standards, the GARP member should always seek to apply the higher standard.

## **2. Conflict of Interest**

### **GARP Members:**

**2.1** Shall act fairly in all situations and must fully disclose any actual or potential conflict to all affected parties.

**2.2** Shall make full and fair disclosure of all matters that could reasonably be expected to impair their

independence and objectivity or interfere with their respective duties to their employer, clients, and prospective clients.

### **3. Confidentiality**

#### **GARP Members:**

**3.1** Shall not make use of confidential information for inappropriate purposes, and unless having received prior consent shall maintain the confidentiality of their work, their employer or client.

**3.2** Must not use confidential information to benefit personally.

### **4. Fundamental Responsibilities**

#### **GARP Members:**

**4.1** Shall comply with all applicable laws, rules, and regulations (including this Code) governing the GARP Members' professional activities and shall not knowingly participate or assist in any violation of such laws, rules, or regulations.

**4.2** Shall have ethical responsibilities and cannot out-source or delegate those responsibilities to others.

**4.3** Shall understand the needs and complexity of their employer or client and should provide appropriate and suitable risk management services and advice.

**4.4** Shall be diligent about not overstating the accuracy or certainty of results or conclusions.

**4.5** Shall clearly disclose the relevant limits of their specific knowledge and expertise concerning risk assessment, industry practices, and applicable laws and regulations.

### **5. General Accepted Practices**

#### **GARP Members:**

**5.1** Shall execute all services with diligence and perform all work in a manner that is independent of

interested parties. GARP Members should collect, analyze and distribute risk information with the highest level of professional objectivity.

**5.2** Shall be familiar with current generally accepted risk management practices and shall clearly indicate any departure from their use.

**5.3** Shall ensure that communications include factual data and do not contain false information.

**5.4** Shall make a distinction between fact and opinion in the presentation of analysis and recommendations.

## **Applicability and Enforcement**

Every GARP Member should know and abide by this Code. Local laws and regulations may also impose obligations on GARP Members. Where local requirements conflict with the Code, such requirements will have precedence.

Violation(s) of this Code may result in, among other things, the temporary suspension or permanent removal of the GARP Member from GARP's Membership roles, and may also include temporarily or permanently removing from the violator the right to use or refer to having earned the FRM designation or any other GARP granted designation, following a formal determination that such a violation has occurred.

## Practice Question

Romney Muriuki, FRM, works as an analyst for an African Insurance firm that has 8 branches in Central Africa. In a recent report, Muriuki makes the following statements:

"Based on the fact that the firm has recorded steady growth in customer numbers over the last decade, and that the insurance penetration currently stands at 3%, I expect the trend to continue for the next 10 years. I also expect that the company will be able to translate the continually increasing revenue into significant profits."

The report goes on to describe in detail the risks facing the firm, particularly geopolitical risks associated with African countries. Muriuki's report:

- A. Violated the Code by failing to distinguish factual details from his opinion
- B. Did not violate the Code
- C. Violated the code by giving a shallow professional assessment of the insurance market in Africa
- D. Violated the Code by failing to properly identify all the risks related to operations in African countries

The correct answer is **B**.

Historical growth can be presented as a fact since it actually happened. Muriuki states that the firm should expect further growth in revenue and profits, which is an opinion. He does not claim that these are facts. Therefore, he does not violate the standard regarding the separation of facts from opinions.