

Learning Module 6: Introduction to Risk Management

LOS 6a: define risk management

Risk is generally defined as exposure to uncertainty, such as uncertain environmental variables that cause variation in and unforeseeable outcomes. Risk can also be seen as the probability of loss or unfavorable outcome due to an action, inaction, or external event.

Risk exposure is the level to which the underlying environmental or market risks result in actual risk borne by a business or investor who has assets or liabilities that are sensitive to those risks. Generally speaking, risk exposure is the "vulnerability" to risk resulting from the organization's or investor's decisions on risk-sensitive assets and liabilities.

Risks cannot be avoided in a business or investment environment. However, risks taken ought to be cautiously chosen, understood, and well-managed for a chance to make value out of it.

What is Risk Management?

Risk management is the process by which an organization or individual defines the level of risk to be taken, measures the level of risk being taken, and adjusts the latter toward the former, with the goal of maximizing the company's or portfolio's value or the individual's overall satisfaction, or utility.

In other words, risk management includes the decisions and actions that result in an effective way for an investor or an organization to achieve its goals while being exposed to a tolerable level of risk.

It is important to note that risk management does not mean minimizing risk; it is about understanding and taking risks that best suit investment objectives, with a considerable chance of loss, quantifying the exposure, and continuously monitoring and modifying risk.

Moreover, risk management is not about avoiding or predicting risk. Risk management implies that if an unfavaaourable or favorable event occurs, its effect on an organization or a portfolio will not be a surprise and that it should have been quantified and considered beforehand.

Given the dynamic nature of risks and exposures, risk management needs to be continually revised and reevaluated.

LOS 6b: describe features of a risk management framework

Risk management is the process in which the level of risk to be taken is defined, and the levels of risk are measured with the objective of maximizing the company or portfolio value. Risk management is not about minimizing risk; it is about actively understanding and pursuing those risks which maximize the chance of achieving goals and minimizing the chance of failure.

Designing a Framework

Risk management has to be tailored to the enterprise and requires a custom solution. The risk management framework should address the following areas:

Risk Governance

Governance is the top-level system of structures, rights, and obligations in which an organization is directed and controlled. Risk governance defines the goals, grants authority, and determines the to-level decision-making.

Risk governance is, therefore, the top-down process and guidance that directs the risk management activities to align with and support the overall enterprise. Risk governance involves determining the risk tolerance of an organization and risk oversight.

Risk governance is often determined by regulatory concerns and the fiduciary role of the governing body. For best outcomes, risk governance assumes an enterprise-wide view. Enterprise risk management is an overarching governance approach applied in the whole organization and in alignment with its strategy, guiding the risk-management framework to focus risk activities on the objective, health, and value of the entire organization.

Risk Identification and Measurement

Risk identification and measurement is the quantitative core of the risk management process. It requires ongoing evaluation, both quantitative and qualitative, to analyze the relevant risk

drivers of the risk exposures and to calculate risk metrics under various stress scenarios.

Risk Infrastructure

Infrastructure refers to people and systems that carry out the risk management process. This may include technology solutions capable of capturing, storing, computing, and reporting the necessary data, as well as skilled personnel to run this process.

Policies and Processes

Policies and processes are the extensions of risk governance into the daily operations of an organization. These limits, requirements, constraints, and guidelines should be integrated into the business process. Policies and processes may entail:

- Controlling cash flows in line with risk assessments.
- Conducting due diligence on potential investments.
- Ensuring decisions made include important checklists.
- Ensuring data is updated and protected.

Risk Monitoring, Mitigation, and Management

Actively monitoring and managing risk is a challenging task that requires a continuous and comprehensive evaluation of the risk management process. When it is determined that risk exposure is out of tune with the desired risk tolerance, action needs to be taken to normalize the risk exposure.

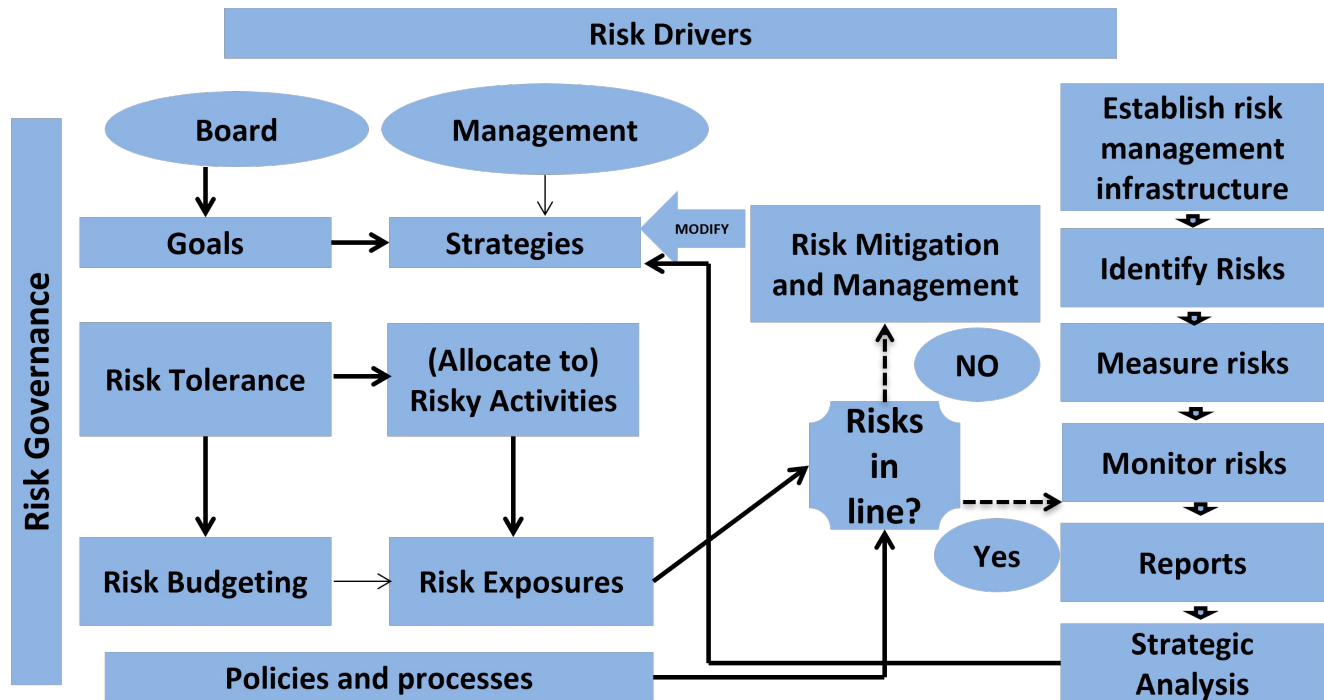
Communication

There must be a communication loop in place to ensure governance parameters can be communicated clearly to managers. The communication loop should also facilitate clear and timely reporting of risk metrics to the governors to enable them update the same and report

back to the organization.

Strategic Analysis or Integration

The risk management framework should provide tools used to separate activities that add value from those that do not. This analysis can improve decision-making and generate better risk-adjusted returns.



Benefits of a Risk Management Framework

When risk management is integrated into all levels of the business, it means there is an effective risk culture. A risk culture generally produces better results than considering risk as an afterthought or ignoring it completely. The benefits include:

- less frequent surprises and a better understanding of the potential effect of a surprise;
- more disciplined approach to decision-making based on the risk-return relationship;
- better response and risk mitigation;

- better efficiency and fewer operational errors;
- a better relationship between the governing body and organization management; and
- a better corporate reputation.

Question

Which of the following is least likely a benefit of a well-implemented risk management framework?

- A. Risks are minimized across the organization to allow for better overall company performance
- B. A relationship of trust is developed between the governing body and the company management
- C. A risk management framework generates feedback loops to allow for more informed and disciplined decision-making

Solution

The correct answer is A.

Risk management does not set out to minimize risks; it is about actively understanding and pursuing those risks which maximize the chance of achieving goals and minimizing the chance of failure.

LOS 6c: define risk governance and describe elements of effective risk governance

Risk governance is the top-down process that directs and aligns risk management to support the goals of an enterprise. The governing body determines the goals and objectives of an organization and its risk appetite or tolerance. Risk tolerance helps in the determination of acceptable risks, risks that should be mitigated, and risks that are unacceptable.

Elements of Effective Risk Governance

Risk governance can be difficult. Effective risk governance, therefore, requires evident commitment from the governing body. It is important for the governing body to openly discuss risk, undertake scenario planning and evaluate the potential negative outcomes of the risk on the organization. This should happen not only after a crisis but also during periods of normalcy.

The risk governance process should focus on the entire enterprise (enterprise risk management) and consider the full spectrum of potential risks, not just quantitative risks.

Since risk management extends into daily operational management, it is good practice to establish a regular forum for the discussion of the risk framework and key issues at the management level.

Moreover, effective risk governance involves a formal appointment of a chief risk officer (CRO) in an executive role, who is responsible for establishing and implementing the risk framework for the enterprise and overseeing its activities

Question

Which of the following *least accurately* describes effective risk governance practices?

- A. Defining risk tolerance and unacceptable risks after a period of crisis
- B. Appointing a CRO to work with the CEO and other executives to build and implement a risk framework
- C. Integrating the risk management framework and process into the management level of the organization

Solution

The correct answer is A.

Effective risk governance requires the governing body to openly discuss risk, undertake scenario planning and evaluate the potential negative outcomes of the risk on the organization during periods of normalcy.

LOS 6d: explain how risk tolerance affects risk management

At the governance level, the risk appetite of the organization must be established. Risk tolerance identifies the extent to which the organization is prepared to experience losses or opportunity costs in the effort to achieve organizational objectives.

Risk Tolerance Determination

The risk tolerance decision requires the integration of an "inside" and an "outside" view. A determination must be made on the internal shortfalls of an organization which may cause failure as well as the external and sometimes, uncertain risk drivers.

Determination of the risk tolerance level is not straitjacket affair. Rather, it depends on a number of factors. The ability to respond dynamically to changing trends, the capacity to withstand losses and remain afloat, the competitive landscape, and the regulatory environment all shape the risk tolerance level of an organization. On the contrary, personal motivations and beliefs, the agenda of board members, short-term pressures, and management compensation are inconsequential to risk tolerance determination.

The appropriate risk tolerance level should be selected and communicated prior to a crisis and should serve as a strategic response template for the management team. Risk-taking and strategic goals should center around the core competencies of the organization.

Once the risk tolerance is determined, the overall risk framework should be tuned to manage, monitor and communicate the risk tolerance.

Question

Which of the following factors should be considered in determining organizational risk tolerance?

- A. Management and employee compensation and bonus schemes
- B. The business-critical cash flow requirements over the medium-term
- C. Delivering strong performance over the subsequent quarter by increasing leverage

Solution

The correct answer is B.

Organizations should not focus on short-term profits or excessive leverage which may actually either lead to long-term failure or work for management compensation. The risk tolerance should focus on the creation of long-term enterprise value.

LOS 6e: describe risk budgeting and its role in risk governance

Risk budgeting focuses on the implementation of the risk tolerance decisions approved by the management at the strategic or governance level. The risk budget will quantify risk by specific metrics and allocate risk across the organization.

Risk Dimensions

A risk budget may be complex and multi-dimensional or make use of simple risk measures. The single-dimensional risk measures most commonly used in portfolio management are:

- standard deviation;
- beta;
- value at risk (VAR); and
- scenario loss.

A multi-dimensional approach consists of layers of the risk budget. For example, factor analysis may be performed to determine the risk premiums to various factors. The factor exposure may then have a strategic overlay, ensuring the overall equity risk, as measured by beta, is within a particular tolerance level.

Benefits of Risk Budgeting

By implementing a risk budget, a risk culture is created in which all decisions are evaluated with a risk-return tradeoff in mind. Management, therefore, focuses on adding value to the overall enterprise when making decisions and simultaneously remaining within the desired risk tolerance level.

Question

Which statement best describes the role of risk budgeting?

- A. The risk budget quantifies risks and allocates risk across the organization based on the risk tolerance level
- B. Management should try and "beat" their risk budget to ensure maximum value creation
- C. The risk budget allows the governing body to determine the level of risk tolerance

Solution

The correct answer is A.

The governing body sets the risk tolerance at the governance or strategic level. This tolerance is implemented through the risk budgeting process which allows management to quantify and allocate risk within the overall risk tolerance.

LOS 6f: identify financial and non-financial sources of risk and describe how they may interact

Financial risks originate from financial markets and might arise from changes in share prices or interest rates. Non-financial risks emanate from outside the financial market environment and could be consequences of environmental or regulatory changes or an issue with customers or suppliers.

Financial Risk

The three primary types of financial risks are:

Market Risk

Market risk arises from movements within the financial market environment. Such movements include shifts in share prices, interest rates, exchange rates, commodity prices, and other economic or industry market factors.

Currency risk is a form of market risk. It affects investors or companies that operate across different countries. Currency risk arises due to a change in the value of one currency relative to another. For instance, a non-US company that imports some of its raw materials from the US will be affected by currency risk, i.e., a change in the dollar relative to the company's domestic currency will affect the quantity of raw materials imported, thereby affecting the company's value.

Credit Risk

Credit risk is the risk of loss due to the failure of one party to pay the other an outstanding obligation. Credit risk may be defined as default risk or counterparty risk. Defaults and bankruptcies have long-term implications for borrowers and may be irrecoverable.

Liquidity Risk

Liquidity risk is the risk of a severe downward price revision when attempting to sell a particular asset. In stressed market conditions, the seller may have to accept a price well below their perception of value. Within financial markets, the typical transaction cost is measured by the bid-ask spread, where the selling price is less than the buying price. When there is uncertainty in the bid-ask spread, for example, if the spread widens significantly during a stressful market period, it means the liquidation price (selling price) is far lower than the seller believes it should be, and this creates a liquidity risk. Liquidity risk does not just pertain to illiquid assets; market liquidity varies over time for particular assets, and the size of the position and the uncertainty associated with its sale or liquidation increases simultaneously.

Non-Financial Risk

There are a number of non-financial risks that an organization may face:

Settlement Risk

Closely related to default risk, it is the risk around the timing of payments between counterparties. For example, while one party may observe the agreement of a currency swap, the other party may not.

Legal Risk

This is the risk of being sued, particularly in litigious environments, or the risk that a counterparty will not uphold a contractual obligation.

Compliance Risk

Compliance risk is made up of regulatory risk, accounting risk, and tax risk. An update of laws and regulations may create the need for financial restatements, back taxes, or other penalties.

Model Risk

This is the risk of valuation error when the valuation of a particular security is based on a misspecified price model.

Tail Risk

The likelihood or probability of a material negative outcome is often understated in financial models, and it is, in most cases, related to model risk. Financial markets do not follow a normal distribution of returns but tend to have "fat tails." In case the internally selected model does not account for this, tail risk is introduced.

Operational Risk

This risk is related to the people and processes of an organization. The employees of an organization can make errors that are financially costly or act fraudulently due to a lack of proper oversight and control. Companies may also be subject to business interruptions attributable to natural calamities or terrorism.

Solvency Risk

A company may not survive if it runs out of cash and becomes insolvent. In times of solvency pressure, a company may be forced to liquidate assets at unfavorable prices simply to raise the necessary cash. Solvency risk can easily be mitigated by making use of less leverage, using more stable sources of funding, and incorporating solvency measures at the governance level of the business.

Interactions Between Risks

There are numerous interactions between risks – both financial and non-financial – and these interactions become more pronounced during times of market stress. The combined risk is often far more than the "sum of the parts" in the sense that risks may exacerbate one another to drive up the total enterprise risk.

An example of risk interactions may be the failure of a key counterparty to settle an obligation on time. Settlement risk creates a solvency risk for the company which was due to receive the proceeds. In turn, it may not be able to pay its suppliers, which occasions legal risk. Or, it may not meet regulatory solvency requirements, which creates compliance risk. It may also need to rapidly sell assets to raise cash hence creating a liquidity risk.

Often, risk models do not adequately account for risk interactions and understate the overall risk. The governance board, company management, and financial analysts should be aware of how consequential a combination of risks can be. This awareness should motivate them to adopt holistic approach to risk management instead of treating each risk in isolation.

Question

Which of the following are examples of financial risks?

- A. Model risk, credit risk, and solvency risk
- B. Tail risk, operational risk, and legal risk
- C. Credit risk, market risk and, liquidity risk

Solution

The correct answer is C.

Credit risk, market risk, and liquidity risk are classified as financial risks.

Model risk, solvency risk, tail risk, operation risk, and legal risk are examples of non-financial risk.

LOS 6g: describe methods for measuring and modifying risk exposures and factors to consider in choosing among the methods

A conversation on risk would be incomplete without a mention of the ability to measure the risk. Organizations need to evaluate the cost-benefit implications of modifying their risk profiles even as they remain within the governing body risk tolerance levels.

Risk Metrics

The most basic quantitative measure or metric associated with risk is probability. Probability is a measure of the relative frequency of a particular outcome. It is incorporated into other measures of risk to provide meaningful information. Commonly used risk metrics are as follows:

Standard Deviation

Standard deviation is a measure of volatility and provides a range of potential outcomes. It has limitations as a measure for financial markets since it presumes a normal distribution of returns. This is inappropriate when we look at empirical data from the last few decades.

Like many of the financial crises before it, the 2007/2008 financial crisis brought to the fore the divergence between the normal distribution and asset return distributions. Due to the wide applicability of the normal distribution and the occurrence of normality in a broad range of phenomena, analysts have tried to fit asset returns to the normal distribution. And while this approach has had some success, it has proved unreliable and grossly inaccurate, particularly in light of the continuous and recurrent nature of financial crises.

Beta

Beta is a measure of the sensitivity of a security's returns to the overall market portfolio. It provides an indication of systematic risk and is particularly appropriate for equity portfolios.

The Greeks

Commonly referred to as the "Greeks", these metrics are appropriate for measuring the risk associated with derivative positions.

Delta

Delta, Δ , is a measure of the degree to which an option is exposed to changes in the price of the underlying asset. It is the ratio of the change in the price of the call option to the change in the price of the underlying asset.

For example, if we have a delta value of 0.5, it means that when the price of the underlying asset moves by a point, the price of the corresponding call option will change by half a point. If delta = 0.5, a \$1 increase in the price of the underlying asset price triggers a \$0.5 increase in the price of the call option.

Theta

Theta, Θ , tells us how sensitive an option is to a decrease in time to expiration. It gives us the change in price of an option prompted by a one-day decrease in its time to expiration.

Options lose value as expiration approaches. Theta estimates the value lost per day if all other factors are held constant. Time value erosion is nonlinear, and this has implications on theta. As a matter of fact, the theta of in-the-money, at-the-money, and slightly out-of-the-money options generally increases as expiration nears. On the other hand, the theta of far out-of-the-money options generally decreases as expiration nears.

Gamma

Gamma, Γ , measures the rate of change in an option's Delta per \$1 change in the price of the underlying stock. It tells us how much the option's delta should change as the price of the underlying stock or index increases or decreases. Options with the highest gamma are the most responsive to changes in the price of the underlying stock.

Vega

Vega measures the rate of change in an option's price per 1% change in the implied volatility of the underlying stock. And while Vega is not a real Greek letter, it tells us how much an option's price moves in response to a change in volatility of the underlying stock.

As an example, a Vega of 6 indicates that for a 1% increase in volatility, the option's price will increase by 0.06. For a given exercise price, risk-free rate, and maturity, the Vega of a call equals the Vega of a put.

Rho

Rho measures the expected change in an option's price per 1% change in interest rates. It tells us how much the price of an option should fall or rise in response to an increase or decrease in the risk-free rate of interest.

As interest rates increase, the value of call options will generally increase. On the other hand, as interest rates increase, the value of put options will usually decrease. Although rho is not a dominant factor in the price of an option, it takes center stage when interest rates are expected to change significantly.

Long-term options are far more sensitive to changes in interest rates than short-term options are. Furthermore, in-the-money calls and puts are more sensitive to interest rate changes compared to out-of-the-money calls and puts.

Duration

Duration is a measure of sensitivity to interest rates used for fixed-income instruments. We will see how to compute duration in the Fixed Income chapter.

Value at Risk (VaR)

VaR can be defined as the minimum amount of loss that can be incurred with a given confidence level (under normal business conditions). It can also be viewed as the worst possible loss under normal conditions over a specified period. Suppose an analyst calculates the monthly VaR as \$100 million at 95% confidence level: what does this imply?

This simply means that under normal conditions, in 95% of the months, we expect the fund to make a profit or loss of no more than \$100 million. Put differently, the probability of losing \$100 million or more in any given month is 5%.

Limitations of VaR

- It does not describe the **worst possible** loss. Indeed, as seen from the example above, we would expect the \$100 million loss mark to be breached 5 times out of a hundred for a 95% confidence level.
- VaR does not describe the losses in the left tail. It indicates the probability of a value occurring but stops short of describing the distribution of losses in the left tail.
- Two arbitrary parameters are used in its calculation – the confidence level and the holding period. The confidence level indicates the probability of obtaining a value greater than or equal to VaR. The holding period is the time span within which we expect the loss to be incurred, say, a week, month, day, or year. VaR increases at an increasing rate as the confidence level increases. VaR also increases with increases in the holding period.
- VaR estimates are subject to both model risk and implementation risk. Model risk arises from incorrect assumptions while implementation risk is the risk of errors from the implementation process.

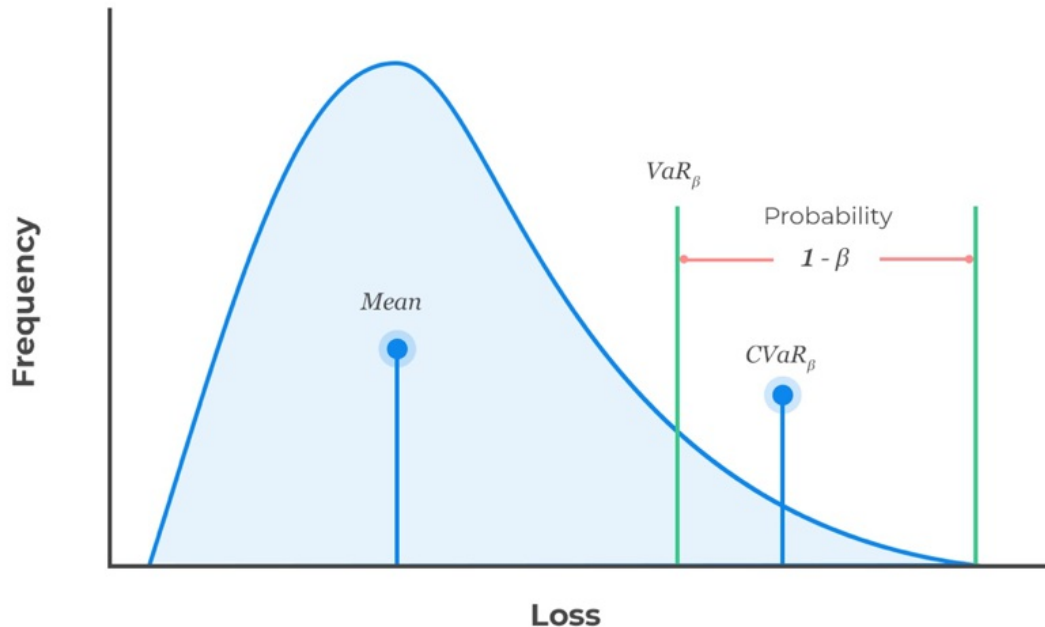
Conditional Value at Risk (CVaR)

The expected shortfall (ES), also known as the conditional VaR (CVAR), is the average of losses defined by the probability. In other words, it is the expected loss given that the portfolio return already lies below the pre-specified worst-case quantile return (e.g. 5th percentile).

Consider this: the 5% VaR for a fund is -25%. Therefore, 5% of the time, the fund earns a return that's less than -25%. The expected shortfall gives as the expected value of all returns falling at or below the 5 percentile return. As such, ES is a larger loss than VaR. However, unlike the VaR, ES satisfies the subadditivity property.



Conditional Value at Risk (CVaR)



The ES is considered a better risk measure than VaR because, unlike VaR, ES gives an estimate of the magnitude of a loss for unfavorable events.

Scenario Analysis and Stress Testing

In order to complement VaR measures, scenario analysis, and stress testing are undertaken to try and understand the expected loss under different market stress conditions. One of the approaches that have been used to incorporate stress tests in VaR models involves trying to assess whether the stress test loss is part of the loss distribution developed in the VaR estimation. This way, a hypothetical/historical stress scenario can be associated with a given probability.

Credit Risk

Credit risk, which pertains to fixed-income securities, relies on a combination of credit ratings

provided by credit rating agencies as well as measures of liquidity, solvency, profitability, and leverage. Credit Default Swaps (CDS) also provide information on the potential risk of default.

Operational Risk

The operational risk stems from internal functions or processes, systems, infrastructural flaws, human factors, and outside events. Operational risks are particularly hard to quantify but can be costly should they occur.

Modifying Risks

Risk modification is not necessarily about risk reduction. It may be about the deflection of risk towards the desired risk target or exposure. There are four main categories of risk modification:

Risk Prevention and Avoidance

It is difficult to completely avoid risk. The decision to avoid a specific risk altogether will be made at a board level. It is here where it will be determined that some business activities are not worth pursuing based on the risk-return tradeoff.

Risk prevention and avoidance are part of the decision on how much risk to accept and it encompasses a trade-off between the cost and the benefit.

Risk Acceptance

In many cases, it makes sense to be exposed to a particular risk. Even then, an individual or organization should do so in an efficient way. Individuals or companies may, for instance, choose to self-insure. This may mean simply bearing the risk or setting aside some provision to cover losses should they occur.

Another form of efficiently accepting risk is through the use of diversification.

Risk Transfer

Risk transfer is the process of passing risk from one party to another and may take the form of an insurance policy. The insurer charges a premium in return for insuring a specific event. The insurer pools risks by selling a large number of diversified insurance contracts with uncorrelated risks.

Risk Shifting

Risk shifting refers to changing the distribution of risk outcomes rather than passing the risk to another party. Risk shifting is often carried out through hedging by using financial market derivatives. Derivatives are either forward commitments or contingent claims.

Forward commitments are agreements that create a future-based transaction obligation between two parties at an agreed price or rate. These include forward contracts, futures contracts, and swaps.

Contingent claims arise in scenarios where both parties are mutually obligated to each other. Options grant the rights but not the obligation to transact. Consequently, the buyer of the option pays a premium at the start of the contract.

Selecting a Modification Method

Choosing the risk mitigation method to use is a critical part of the risk management process. No single option may have an advantage and a cost-benefit tradeoff that may be required. Low-cost precautions against risks with few benefits should always be the first step.

Organizations with strong cash flow may choose to self-insure as it tends to be the cheapest and most flexible option. Such an arrangement must, however, form part of the governance decision-making and risk tolerance process.

Risk transfer through the use of insurance is widely used but may not always be cost-effective. For financial risks, risk shifting through the use of derivatives is common.

Finally, the cost of the modification method must be balanced against the potential benefits while producing an overall risk profile that is consistent with the risk tolerance and objectives of the

organization.

Question

Which risk metrics are often used within a fixed income portfolio?

- A. Beta, delta, and standard deviation
- B. Credit rating, CDS, and duration
- C. VaR, vega, and loss given default

Solution

The correct answer is **B**.

The metrics commonly used to measure risk in fixed income portfolios are credit ratings, CDS pricing, duration as well as solvency, liquidity, profitability, and leverage.