Chapter 1 The Building Blocks of Risk Management

Version 1.0

Introduction

In this chapter, we will look at:

- Definitions of risk
- The traditional risk management process
- The different types of risk
- The tools used to track risk and make decisions.

Definition of Risk

Risk is defined as the uncertainty or volatility around our expected outcomes. For example, an expected outcome can be earning an annual return of 10%. The risk here is that the actual return is not equal to 10%. The volatility around our expected outcome can be both ways - up or down. But we are more concerned about the downside or negative risk, e.g., returns being lower than 10%.

Comparing Risk Management with Risk Taking

In finance, there is a well-known saying that goes, "The higher the risk, the higher the return," implying that there is a natural trade-off between risk and return. Investments with higher risk offer potentially higher returns and those with lower risk offer lower returns. For example, stock prices are more volatile than bond prices (higher risk), but they also offer higher returns.

Risk management focuses on managing risks in order to meet the desired risk appetite of the firm. Risk taking focuses on accepting additional risk in order to obtain additional returns.

1. Typology of Risks and Risk Interactions

The typical risks faced by firms in the financial industry are:

Market Risk

Market risk refers to the risk of losing money while investing in the financial markets. Market prices and interest rates are constantly changing, causing the value of securities and other assets that a firm holds to fluctuate. Market risk can be further classified into the following subtypes:

Interest rate risk: Refers to volatility of fixed income securities due to changes in interest rate levels. For example, when interest rates rise the value of bonds fall.

Equity risk: Refers to the volatility of equity securities. It can be broken down into:

- General market risk: The sensitivity of a stock price to changes in broad market indices. It cannot be diversified away.
- Specific risk: The sensitivity of a stock price to company-specific factors. It can be

reduced by holding a diversified portfolio of several stocks with low correlations with each other.

Foreign exchange risk: Refers to losses that could arise from unhedged foreign currency positions.

Commodity price risk: Refers to the volatility of commodity prices such as gold, crude oil, copper etc.

Credit Risk

Credit risk arises from the failure of one party to fulfil its financial obligations to another party. Credit risk can be further classified into the following subtypes:

Default risk or bankruptcy risk: Refers to situations when a debtor fails to pay interest or principal on a loan.

Downgrade risk: Refers to situations when the creditworthiness of a counterparty decreases and its credit rating is downgraded. It can result in an immediate loss in value of credit-linked securities.

Counterparty or settlement risk: Refers to the risk of losing money when settling transactions. For example, two parties A and B enter into a six month forward contract. At settlement, Party A owes $1 million to Party B. But A is unable to pay this amount because it is facing financial difficulties.

Liquidity Risk

Liquidity risk can be classified into the following subtypes:

Funding liquidity risk: Refers to the risk that a firm is not able to access enough liquid cash and assets to meet its obligations. For example, banks often take in short-term deposits at low interest rates and lend the money out for long term at higher interest rates. If done incorrectly, it can lead to funding liquidity issues. Many of the banks that failed during the 2007-2009 financial crisis had large maturity mismatches.

Market liquidity risk or trading liquidity risk: Refers to the risk of loss in asset values when markets temporarily seize up. This may force the seller to accept a very low price at a loss or take away the seller's ability to convert the asset into cash at any reasonable price. Market liquidity risk can result into funding liquidity risk.

Operational Risk

Operational risk can be defined as the "risk of loss resulting from inadequate or failed internal processes, people, and systems or from external events". This is a broad definition that includes everything from anti-money laundering and cyber risks to terrorist attacks and rogue trading. An example is Barings bank where a rogue trader caused bankruptcy of the bank.

Operational risk includes legal risk – the risk of litigation, but excludes business and strategic risk.

Business and Strategic Risk

Business risk refers to factors that affect the revenues or costs of a company such as consumer demand, pricing decisions, supplier negotiations, competition etc.

Strategic risk involves making large, long-term decisions about the firm's direction. Such decisions often involve major investments of capital, human resources, and management reputation. For example, a large FMCG company plans to launch a consumer product in a new jurisdiction, but despite significant investments, the product fails, resulting in huge losses for the company.

Reputation Risk

Reputation risk is the danger that a firm will suffer a sudden fall in its market standing or brand with economic consequences.

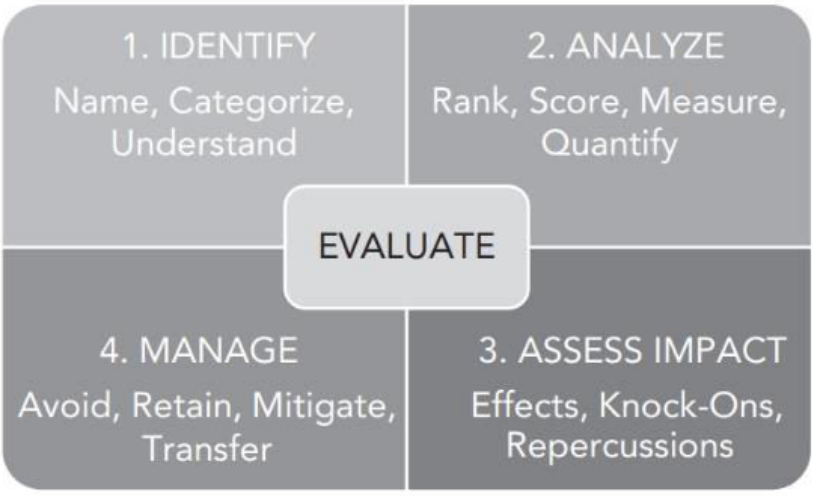
Reputation risk is typically caused by a failure in another area of risk management that undermines trust in the firm's financial stability or reputation for fair dealing. For example, poor credit risk management by a bank could lead to rumors about its failure. This can result in a bank run, in which depositors rush to withdraw their funds, causing liquidity issues for the bank.

2. The Risk Management Process

While taking risks in pursuit of rewards, two key questions must be answered:

- Is the risk proportionate to the reward?
- Can we lower the risk and still get the reward?

A risk management process can help answer these questions. Figure 1.4 from the curriculum illustrates the 'classic risk management process'.



In this process, the risk manager tries to: identify the risk, analyze and measure the risk, assess the effects of any risk event, and finally manage the risk.

Several methods can be used to identify risks such as:

- Brainstorming: Discussions with key representatives from different business divisions to discuss the main challenges their divisions face.
- Industry resources: Industry resources in the form of checklists, professional and regulatory standards, industry surveys and expert opinions may be available.
- Loss data analysis: Internal and external loss records can be analyzed to gauge the frequency and severity of loss events and how they relate to specific risk factors.
- Hypothetical what-if analysis
- Front line observations

There are four options available to manage risks:

- **Avoid risk**: A company may decide to avoid risks by discontinuing a business line or pursuing it using a different strategy. For example, not selling to certain markets, or off-shoring production are methods to avoid risk.
- **Retain risk**: Risks that fall within the firm's risk appetite may be retained. To retain large risks the company may employ mechanisms such as risk capital allocation, self-insurance, and captive insurance.
- **Mitigate risk**: Some risks can be mitigated by reducing exposure, frequency, and severity. For example, taking collateral while lending can mitigate the severity of a potential default.
- **Transfer risk**: Some risks can be transferred to a third party using derivative products, structured products, or by paying a premium. For example, taking a fire insurance coverage.

3. Identifying Risk: Knowns and Unknowns

Figure 1.5 from the curriculum classifies risks into four categories as shown below:

Expected loss: Considers how much an entity expects to lose in the normal course of business. For example, a bank giving out housing loans knows from its experience what percentage of borrowers could default.

Unexpected loss: Considers how much an entity could lose in excess of their average (expected) loss scenarios in stressed market conditions. For example, during a recession.

Known Unknowns: We know the risk, but not the severity of it. For example, no firm could have predicted the severity of the impact of a pandemic like COVID-19. This category is also called 'Knightian uncertainty'.

Unknown Unknowns: This category represents risks that are truly unknown i.e., tail risk events. An example is technology disruption.

Wherever possible, risk managers should try to move poorly understood risks from the periphery of the figure towards the center of the figure.

4. Quantitative Risk Metrics

Expected loss (EL) is the average loss a position taker might expect to incur from a position or portfolio. In general, EL is a function of:

- the probability of the risk event occurring;
- the firm's exposure to the risk event; and
- the severity of the loss if the risk event occurs.

In the banking context, for a loan portfolio, EL can be expressed as a function of the probability of default (PD), the exposure at the time of default (EAD) and the amount of loss given default (LGD).

EL = EAD x PD x LGD

For example, if EAD = $10 million, PD = 1% and LGD = 50%; the expected loss is = $10 million x 0.01 x 0.5 = $50,000.

If EL can be calculated with confidence, it can be treated as a regular cost of business rather than a risk or uncertainty. To compensate for EL, the bank can simply add a price margin that covers the cost of the EL.

Expect the Unexpected

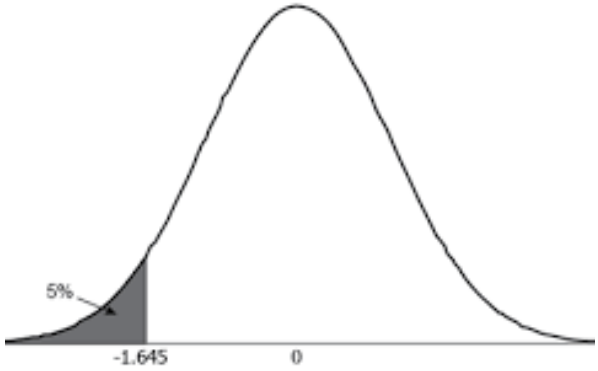
During stressed market conditions, such as a recession, the losses on loan portfolios can exceed the expected level. This is due to the possibility of multiple borrowers defaulting at the same time. The extent to which losses depart from the average is called the unexpected loss level.

Banks set aside significant risk capital to protect themselves against large unexpected losses that could lead to insolvency or default. This risk capital allocation is done in addition to directly pricing EL into the product.

Value-at-Risk

The value-at-risk (VaR) measure helps quantify the risk faced by a firm. It is defined as the worst expected loss over a given horizon under normal market conditions at a given level of confidence. For example, suppose that a bank's trading portfolio has a weekly VaR of $10 million at the 95% confidence level. This means that under normal market conditions, there is a 5% probability that the portfolio will lose more than $10 million over the next week.

VaR measure focuses on the tail of a loss distribution. If the loss distribution is normal, a 95% confidence interval means that we refer to the 5% area in the left tail. This is shown in the diagram below.



Similarly, a 99% confidence interval means that we will refer to a 1% area in the left tail.

Economic capital is the amount of liquid capital that a firm requires based on its understanding of economic risks. The VaR model can be used to calculate economic capital. In the above example, we may term $10 million as economic capital. This capital will be sufficient to cover losses for a week.

Expected Shortfall

VaR tells the minimum loss that can be expected. In contrast, conditional VaR (CVaR, also referred to as expected shortfall) tells the average loss that can be expected if the VaR cut off is exceeded. Instead of considering only the cutoff point in the tail it considers the entire shaded region in the tail.

For a given tail probability, ES is defined as the average of the VaR numbers that exceed the VaR at that tail probability.

5. Risk Factor Breakdown and Interactions between Factors

It is important for risk analysts to break risk down into discrete factors (for e.g. PD, LGD and EAD) and understand how these risk factors may interact over time and under stress to generate losses.

Each primary risk factor can be further broken down into sub factors and examined separately. For example, the PD of a firm may be broken down into key financial indicators (such as D/E ratio, interest coverage ratio), industry sector, management quality etc.

6. Structural Change: From Tail Risk to Systemic Crisis

When the structure underlying a system (e.g. global climate system or financial markets system) changes, risk increases. The frequency and size of large loss events may suddenly increase. Completely new sources of risk may emerge. Historical data may not be useful and 'once-in-100-year' events may occur once a decade until the structural problem is fixed, or proper risk management processes are adopted.

For these reasons, it is important for risk analysts to look out for structural change and model its future effects in their analysis.

7. Human Agency and Conflict of Interest

Employees who understand how risk is generated and managed are sometimes in the best position to game it. To avoid this, many financial institutions employ three lines of defense:

1. First line: Business line that generates, owns and manages risk.
2. Second line: Risk mangers that specialize in risk management and day-to-day oversight
3. Third line: Periodic independent oversight and assurance, such as an internal audit.

However, despite these safeguards, risk management systems always have loopholes that can be exploited. For example, in many rogue trading cases in the banking industry, the trader had first worked in the middle or back office and thus understood the loopholes in the bank's risk management infrastructure.

For these reasons, it is important for risk analysts to understand the role of human agency, self-interest, and conflict of interest.

8. Risk Aggregation

A key challenge faced by risk managers is understanding how risk aggregation can be applied to sum up risks from individual business lines/segments to calculate the total risk at the enterprise level. For example, when trying to aggregate market risk for a stock portfolio and derivates portfolio, different techniques must be applied. Market risk for stock portfolios can be modeled using notional amounts and past volatility. However, derivatives can be highly volatile. Also, many derivatives portfolios are set up such that the individual instruments offset each other's market risk. So, using notional amounts and past volatility to measure market risk for derivatives portfolios makes no sense. Instead, market participant use option Greeks (delta, gamma, theta etc.) to model market risk for derivatives. However, these measures cannot be aggregated at the enterprise level.

VaR is a popular risk aggregation tool. However, it has a few shortcomings. It is not calculated using a set methodology and it relies on many simplifying assumptions. VaR ignores tail risk – it only looks at the largest loss at a given likelihood threshold, and not the size of losses beyond this threshold. These shortcomings of VaR were clearly observed in the financial crisis of 2007-2009.

To overcome these shortcomings of VaR, risk managers started using additional risk measures such as expected shortfall (ES), scenario analysis and reverse stress testing, to complement VaR.

- **Expected shortfall**: It is a statistical measure designed to quantify the mean risk in the tail of the distribution beyond the VaR cutoff.
- **Scenario analysis**: Different scenarios (e.g. best case, worst case) are built and the impact of these scenarios on the firm is analyzed. The focus here is on the severity of the impact rather than the frequency of the event.
- **Reverse stress testing**: This process starts at the end. Models are built to figure out how bad losses could get. We then work backwards to understand how these losses were linked to the firm's exposures and activities. The goal is to devise a strategy for managing the firm's activities in order to avoid the worst-case scenario.

9. Balancing Risk and Reward

The VaR approach helps a firm compare the risk exposures of its different business lines. It also helps understand the expected and unexpected loss levels associated with different activities. To protect itself against these risks, the firm can set aside risk capital (known as economic capital) that is large enough to absorb the unexpected risk.

A useful measure used in this context is RAROC (risk adjusted return on capital). It is calculated as:

RAROC = After-Tax Net Risk-Adjusted Expected Return / Economic Capital.

RAROC measures reward per unit of risk. For an activity to add value to shareholders, RAROC should be higher than the cost of equity.

Four specific practical applications of RAROC are:

- **Business comparison**: We can compare the performance of different business lines that require different amounts of economic capital.
- **Investment analysis**: We can evaluate the likely returns from future investments. For example, a bank could use this measure to decide whether to offer a new type of credit product.
- **Pricing strategies**: We can examine the pricing strategy for different customer segments and products. For example, the firm may have set prices too low to make a risk-adjusted profit.

- **Risk management cost/benefit analysis**: A firm can compare the cost of risk management to the benefits offered. For example, a firm can compare the dollar cost of risk transfer via insurance, to the dollar benefits.

10. Enterprise Risk Management (ERM): More Than Adding Up Risk?

A challenge at many firms is that business divisions manage their risks in a siloed approach, i.e., each division manages their exposure independently without considering the risk exposures of other divisions. To overcome this, firms must adopt enterprise risk management (ERM) approach which establishes processes to manage risk centrally.

Historically, ERM approaches reduced risk to a single number such as VaR or economic capital. However, this is too simplistic and the 2007-2008 financial crisis showed the flaw in this method. Risk managers learned that risk is multi-dimensional and needs to be approached from many angles, using multiple techniques. Effective risk management requires expert judgement combined with application of statistical science.

ERM is more than just aggregating risk at the enterprise level. As illustrated in Figure 1.7 from the curriculum, it is about taking a more holistic approach to the entire risk management process.

Summary

LO: Explain the concept of risk and compare risk management with risk taking.

Risk is defined as the uncertainty or volatility around our expected outcomes.

Risk management focuses on managing risks in order to meet the desired risk appetite of the firm. Risk taking focuses on accepting additional risk in order to obtain additional returns.

A risk management process consists of the following steps: identify the risk, analyze and measure the risk, assess the effects of any risk event, and finally manage the risk.

LO: Evaluate, compare, and apply tools and procedures used to measure and manage risk, including quantitative measures, qualitative risk assessment techniques, and enterprise risk management.

The value-at-risk (VaR) measure helps quantify the risk faced by a firm. It is defined as the worst expected loss over a given horizon under normal market conditions at a given level of confidence.

Additional measures used to complement VaR are: expected shortfall, scenario analysis, and reverse stress testing.

Economic capital is the amount of liquid capital that a firm requires based on its understanding of economic risks. The VaR model can be used to calculate economic capital.

LO: Differentiate between expected loss and unexpected loss and provide examples of each.

Expected loss: Considers how much an entity expects to lose in the normal course of business. For example, a bank giving out housing loans knows from its experience what percentage of borrowers could default.

In a banking context, EL = EAD x PD x LGD

Unexpected loss: Considers how much an entity could lose in excess of their average (expected) loss scenarios in stressed market conditions. For example, during a recession.

LO: Interpret the relationship between risk and reward and explain how conflicts of interest can impact risk management.

There is a natural trade-off between risk and return. Investments with higher risk offer potentially higher returns and those with lower risk offer lower returns.

Employees who understand how risk is generated and managed are sometimes in the best position to game it. For these reasons, it is important for risk analysts to understand the role of human agency, self-interest, and conflict of interest.

LO: 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.

The typical risks faced by firms in the financial industry are:

- Market risk: Further classified into interest rate risk, equity risk, foreign exchange risk, and commodity price risk
- Credit risk: Further classified into default risk or bankruptcy risk, downgrade risk, counterparty or settlement risk
- Liquidity risk: Further classified into funding liquidity risk and trading liquidity risk
- Operational risk
- Business and strategic risk
- Reputation risk

LO: Explain how risk factors can interact with each other and describe challenges in aggregating risk exposures.

A key challenge faced by risk managers is understanding how risk aggregation can be applied to sum up risks from individual business lines/segments to calculate the total risk at the enterprise level.

VaR is a popular risk aggregation tool. However, it has a few shortcomings. It is not calculated using a set methodology and it relies on many simplifying assumptions.

For comparison purposes, firms often calculate RAROC (risk adjusted return on capital). RAROC = After-Tax Net Risk-Adjusted Expected Return / Economic Capital.

