Book 1

Foundations of Risk Management

FRM Part I Notes

Nov 2023 Edition

FALCON EDUFIN Learning Made Simple

Falcon Edufin
falconedufin.com

Shashank Wandhe,
FRM, BCA
Trainer: FRM, CFA, CA Final(SFM)

Table of Contents

Reading 01 The Building Blocks Of Risk Management

LEARNING OBJECTIVES

- **EXPLAIN THE CONCEPT OF RISK AND COMPARE RISK MANAGEMENT WITH RISK-TAKING.**
- **DESCRIBE ELEMENTS, OR BUILDING BLOCKS, OF THE RISK MANAGEMENT PROCESS AND IDENTIFY PROBLEMS AND CHALLENGES THAT CAN ARISE IN THE RISK MANAGEMENT PROCESS.**
- **EVALUATE AND APPLY TOOLS AND PROCEDURES USED TO MEASURE AND MANAGE RISK, INCLUDING QUANTITATIVE MEASURES, QUALITATIVE ASSESSMENT, 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.**

Note: There are two approaches to study this topic (also applicable for all the other theory topics of this book).

- *Approach 01: Start FRM preparation with this topic (or this book). This approach is recommended only for students who are well versed with finance and risk management industry. If you are new to this industry, I would recommend you to use approach 2 to avoid all the pain of studying this topic.*
- *Approach 02: First finish preparation of Book 2, 3, 4 and CAPM APT topics from Book 01 and then study Book 01 theory topics. Because most of the terms required to understand this reading (and other theory readings of Book 01) are discussed in detail in other books which will reduce friction in preparation of this topic.*

Please read note given on the previous page before reading this topic.

INTRODUCTION

Risk is essentially the likelihood that undesirable things may occur. The first autonomous financial risk transfer mechanism was created in northern Italy in the thirteenth century when the insurance contract separated from the loan contract. Risk mathematics began to be studied more methodically in the seventeenth century. This was followed by the development of exchange-based risk transfer in the form of agricultural futures contracts in the eighteenth and nineteenth centuries.

TYPES OF RISKS

Market Risk

Market prices and interest rates fluctuate, causing the value of securities and other assets to rise and fall. Because price volatility is the source of market risk, these swings create the possibility of loss. Market risk can manifest itself in a variety of ways depending on the underlying asset. From the standpoint of a financial institution, the most important types are stock risk, interest rate risk, currency risk, and commodity price risk.

Market risk is driven by the following.

- *General market risk:* This is the risk that an *asset class will fall* in value, leading to a fall in the value of an individual asset or portfolio.
- *Specific market risk:* This is the risk that an *individual asset will fall* in value *more than* the *general asset class*.

The correlations between positions can be used to manage market risk. A large equities portfolio's diversification benefits, for example, form the foundation of investment risk management.

However, market risk occurs as a result of these interrelationships. For example, an equity portfolio meant to mirror the performance of an equity market benchmark may underperform it—a type of market risk. Similarly, a position designed to balance off, or hedge, another position or market price behaviour may do so in an imperfect way—a type of market risk known as basis risk.

This mismatch of price fluctuations is frequently a bigger challenge for risk managers than any single market risk exposure. A commodities risk manager, for example, may be using crude oil futures to hedge jet fuel, only to discover that the regular price differential between the two has expanded.

Credit Risk

Credit risk emerges when one party fails to fulfil its financial obligations to another. Some examples of credit risk are as follows:

- A debtor fails to repay loan (bankruptcy risk);
- An obligor or counterparty is credit rating is downgraded (downgrade risk)
- A counterparty to a market trade fails to perform (counterparty risk), including settlement or Herstatt risk.

The possibility of default of the obligor or counterparty, the exposure amount at default, and the amount recoverable at default indicate credit risk (EL = PD X LGD X EAD, ref Book 4 credit risk). A firm's risk management approach can influence these levers, including the quality of its borrowers, the credit instrument's form (e.g., whether it is heavily collateralized) and exposure controls.

Most loans have a clear level of exposure, while some transactions can be uncertain. Derivatives, for example, have no immediate market value and thus no credit risk. The position can develop a major counterparty credit exposure if markets move.

Risk variables are identified and evaluated to determine the likelihood of an obligor defaulting. Some financial indicators and industry sectors are used in corporate credit risk analysis. However, obligor concentration and the combination of risk factors define the risk in total credit risk portfolios. The portfolio will be significantly riskier if:

- It has a small number of large loans rather than many smaller loans;
- The returns or default probabilities of the loans are positively correlated (e.g., borrowers are in the same industry or region);
- The exposure amount, probability of default, and loss given default amounts are positively correlated (e.g., when defaults rise, recovery amounts fall).

Risk managers utilise sophisticated credit portfolio models to identify risk posed by various risk factor combinations.

Liquidity Risk

Liquidity risk is used to describe two quite separate kinds of risk funding liquidity risk and market liquidity risk.

Funding liquidity risk

Is the risk that a corporation will not have enough liquid cash or assets to pay its obligations. All businesses face funding liquidity risk. For example, many small and developing businesses struggle to pay their payments quickly enough while still investing for the future.

Banks face a unique type of funding liquidity risk due to their business model. For example, banks strive to take in short-term deposits and lend them out longer-term at a higher interest rate. To reduce risk, good asset/liability management (ALM) is essential in the banking industry. ALM uses techniques like gap and duration studies.

Market liquidity risk

Trading liquidity risk is the risk of asset value loss when markets abruptly seize up. As a result, a seller may be forced to accept an abnormally low price, or lose the power to convert an asset into cash and finance at any price. Market liquidity risk can quickly become financing liquidity risk if banks rely on volatile wholesale markets to raise cash.

Market liquidity risk is difficult to quantify. In a regular market, liquidity is measured by the number of transactions and the bid-ask spread. However, these are not always reliable indications of market liquidity in a crisis.

Operational Risk

Insufficient or failing internal procedures, people, and systems, or external events, constitute operational risk. **It excludes business, risk, and reputation risk.**

From anti-money laundering and cyber hazards to terrorist attacks and rogue trading, that's a broad definition. During the 1990s, rogue trading helped regulators integrate operational risk in bank capital calculations.

Beyond the banking business, many company tragedies might be classified as operational risk. These include physical operational failures and corporate governance issues, as the 2001 Enron debacle. Many risk managers outside the financial industry focus on operational risk management, frequently through insurance solutions.

However, defining and measuring operational risk remains difficult, particularly in the financial sector.

Business and Strategic Risk

Business risks include client demand, pricing decisions, supplier agreements, and managing product innovation. **Business risk is not strategic risk**. Major strategic decisions generally involve significant cash, human risk, and management reputation investments.

Business and strategic risks occupy most of management's attention in non-financial organisations, as they definitely do in financial firms. But it's not clear how they link to other hazards or how they fit into each firm's risk management system.

For exam please note: Business risk is the risk in ongoing business (in current state) however, strategic risk involves risk in expansion plans, new prototype development etc.

Reputation risk

Most reputation risk occurs when another area of risk management fails, causing loss of faith in the firm's financial stability or reputation for fairness.

For example, a big credit risk management failure might lead to financial concerns. Rumours can be deadly. Investors and depositors may start withdrawing support in anticipation of others. Banks must prepare plans to reassure markets and restore their reputations. Fairness is also important. There are certain expectations for big businesses. Erroneous product risk disclosure might cost a company valuable clients.

Regulators' reputation is crucial to financial organisations. Regulators possess significant informal and formal power. If a regulator loses trust in a bank, its actions may be criticised or limited.

RISK MANAGEMENT PROCESS

We take risks for reward, be it food, shelter, or bitcoin. But the real questions are: is the reward worth the risk, and can we reduce the risk and still achieve the return? To answer these questions, we need our first building block: the risk management method.

Risk management process:

- **Identify the risk:** Identify the risk to which firm is exposed.
- **Analyse Risk:** Understand the risks nature.
- **Assess impact of risk:** Quantify the risk and asses the impact on the firm.
- **Manage Risk:** Take the steps to manage the risk(discussed in the next point).

Choices in risk management process:

- *Avoid* Risk: There are *dangers that can be avoided* by closing the business or changing the strategy. Exporting to specific markets or outsourcing production may be avoided to reduce political or currency concerns.
- *Retain* Risk: Some risks are *within* the firm's *risk appetite*. Captive insurance and risk capital allocation can maintain large risks.
- *Mitigate* Risk: *Exposure*, *frequency*, and *severity can* all *be reduced* (e.g., improved operational infrastructure can mitigate the frequency of some kinds of operational risk, hedging unwanted foreign currency exposure can mitigate market risk, and receiving collateral against a credit exposure can mitigate the severity of a potential default).
- *Transfer* Risk: *With derivatives*, *structured products*, or *paying* a *premium*, certain risks can be transferred (e.g., to an insurer or derivatives provider).

In order to explore additional value-creating possibilities for its stakeholders, the risk taker must strengthen its risk management strategy. Risk management investment allows farmers to grow more food, metal companies to create more metal, and banks to lend more money. Firms can excel with risk management.

In modern economies, risk management is about more than just survival. It's vital to specialisation, scale, efficiency, and wealth development.

That's why risk never goes away. Success in risk management paves the way for more. The risk manager must constantly discover, evaluate, and manage risks to avoid exposing the organisation to unnecessary risk. Identifying and analysing risk in a rapidly changing world remains difficult.

KNOWN VS UNKNOWN RISKS

One of the most common errors is to focus on known and measurable hazards while neglecting unknown or undefined threats.

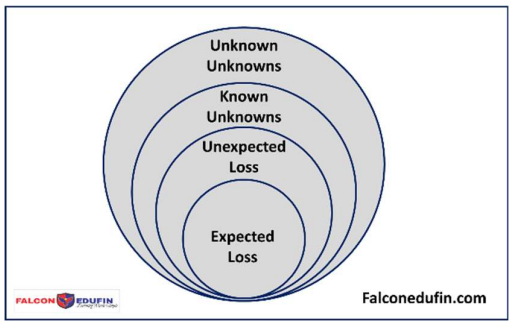


Figure 1.5 depicts a basic classification of known versus unknown risk. Individuals tend to focus on recognised risks and neglect new or poorly understood risks. But the hazards must be handled.

Knightian uncertainty (known unknown) is tremendous. The likelihood of nuclear war is uncertain but impact is huge. Risk management can help avoid or manage Knightian uncertainty. To take bold measures, everyone must acknowledge the Knightian uncertainty (if unquantifiable in terms of frequency).

Uncertainty and quantified risk are distinct concepts. Risk of non-measurable risks is the duty of risk managers. They must constantly look for "unknown unknowns," including hidden risks. They can't overlook Knightian doubts. They must sometimes ensure their firms avoid or transfer them. Risk managers shift poorly understood hazards closer to the centre of Figure 1.5. Knightian doubts can be more severe and widespread than we think. Risk managers must never approach unknown threats as if they are known. Uncertainty and ambiguity exist in greater levels for some risky

activities than others. Our faith in a risk metric influences how it should be used in decision-making.

RISK MEASUREMENT

Risk can be measured as quantitative and qualitative risk measures. This you don't need to separately focus on this section because it is discussed in detail across the FRM curriculum in different sections (mainly different chapters from Book 4).

Quantitative **Risk measurement Tools**

- Value at risk
- Expected loss measure
- Unexpected loss measure

Qualitative **Risk Measurement Tools**

- Stress Test
- Scenario Analysis

RISK AND REWARD RELATIONSHIP

A VaR technique can assist the organisation to compare the risk exposures of different business lines. Firms learn to expect and avoid losses associated with certain activities. The firm can also protect itself by ensuring that its risk capital (also known as economic capital) is sufficient to absorb any unforeseen risk.

Economic capital, often known as risk capital, is the amount of capital a bank needs to manage its economic risks. Regulatory capital is estimated according to regulatory rules and techniques. Economic and regulatory capital typically overlap, although the amounts are often quite different. Economic capital allows the corporation to conceptually balance risk and profit. Firms can compare their revenue and profit to the quantity of economic capital necessary to sustain each activity.

These risk capital costs can subsequently be factored into product pricing and business line performance comparisons. There are evident causes. For example, Business A may incur high annual EL expenditures but little unforeseen losses. Contrarily, Business B may receive minimal EL but suffers huge losses at the conclusion of every business cycle.

It's difficult to evaluate Business A and B's profitability without comprehensive risk-adjusted research. During the benign cycle, Business B is likely to be quite appealing. The firm may opt to lower product prices to increase sales. When the cycle turns, this typically results in losses. Global banking businesses have tended to behave in this way, compounding the tendency for economies to boom and crash.

To factor in the cost of risk of both expected and unexpected losses, the bank can apply a classic formula for risk-adjusted return on capital (or RAROC):

RAROC = Reward/Risk

Where reward is described as After-Tax Risk-Adjusted Expected Return and risk as economic capital.

After-Tax Net Risk-Adjusted Expected Return also needs to be adjusted for Expected Losses:

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

To provide value to shareholders (and the stock price), RAROC must exceed the cost of equity capital (i.e., the hurdle rate or minimum return on equity capital required by the shareholders to be fairly compensated for risk).

The RAROC formula has several applications in various sectors and institutions. Though sophisticated, they all serve the same purpose: adjusting performance for risk. Four everyday uses stand out.

- **Business comparison:** RAROC allows organisations to compare the performance of different business lines.
- **Investment analysis:** A firm often utilises the RAROC method to assess prospective investment returns (e.g., the decision to offer a new type of credit product). RAROC findings can also be used to examine if a business line is delivering a return above a hurdle rate set by the firm's equity investors.
- **Changing pricing strategy** for different customer categories and products. For example, it may have set prices excessively low to achieve a risk-adjusted profit in one business sector while increasing market share in another (and overall profitability).
- **Risk management** RAROC assessments can assist a corporation compare the cost of risk management (e.g., risk transfer via insurance, to the benefit of the firm).

Applying RAROC is problematic due to its reliance on the underlying risk estimations. Business lines frequently contest the veracity of RAROC statistics. Like other risk measures, decision-makers should always comprehend the number's meaning and context.

Reading 02 How Do Firms Manage Risk

Learning objectives

- 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.

RISK MANAGEMENT ROAD MAP

Given the prior reading, it may seem evident that corporations should manage financial risk. But it's not that easy in business. A company must answer various questions.

- Does managing risk make sense from the perspective of the firm's owners?
- What is the precise purpose of a risk management strategy?
- How much risk should the firm retain? What risks should be managed?
- What instruments and strategies should be applied?

The wrong answers can turn risk management itself into a major threat to the firm.

The list given below serves as a road map for these difficulties. While this chapter follows a set path, risk management is an iterative process. For example, if a firm learns the costs and complexities of risk management, it may reconsider engaging in risky commercial activities.

1. Identify risk appetite.
   - Identify key corporate goals and risks.
   - Should we manage risk?
   - Which risks should we manage?
   - Create a risk appetite statement (broad terms).
2. Map risks, make choices.
   - Map risks.
   - Assess or measure risk/impact.
   - Perform risk/reward analysis of risk management strategy (RAROC etc.)
   - Prepare comparative cost/benefit of risk management tactics.
   - Choose basic strategy/tactics.
   - Create a risk appetite statement (detailed terms).
3. Operationalize risk appetite.
   - Express risk appetite in operational terms.
   - Assess risk policies.
   - Set risk limit framework.
   - *Rightsize* risk management team.
   - Resources, expertise, infrastructure
   - Incentives and independence
4. Implement.
   - Choose tactics/instruments.
   - Make day-to-day decisions.
   - Establish oversight.
5. Re-evaluate regularly to capture changes in:
   - Risk appetite/risk understandings/stakeholder viewpoints,
   - Business activity and risk environment (remapping), and New tools, tactics, cost-benefit analyses.

RISK APPETITE

Risk appetite explains how much and what kind of risk a company is ready to take. Contrast this with risk capacity, which specifies how much risk a corporation can take.

Companies are increasingly using board-approved risk appetite to guide management and (possibly) investors. But, in practise, what is a risk appetite? It's two.

- A statement indicating the company's willingness to take risks in order to achieve its objectives. Typically, the thorough risk appetite statement is an internal document that **must be approved by the board of directors (and not CRO)**. Attenuated versions, on the other hand, may appear in some yearly business reports.
- The total of the systems that connect this top-level statement to the firm's daily risk management operations. The firm's detailed risk policy, business-specific risk declarations, and a framework of restrictions for key risk areas are examples of these processes.

The board must also approve the operational manifestation of the risk appetite statement, which must be consistent with a broader set of risk-related signals that the company provides to its employees (e.g., incentive compensation schemes).

The **risk appetite is set substantially below the firm's total risk carrying capability** and well above the existing level of risk exposure. These are intended to alert the board if risk taking appears to be unusually low or if there is a risk of exceeding the agreed-upon risk appetite.

Another important problem is risk appetite consistency across risk kinds. In general, businesses see themselves as "conservative" or "entrepreneurial" in their approach to risk. This classification, however, should logically be based on the type of risk and the firm's risk management capabilities.

Risk appetite is therefore part of a firm's wider identity and capabilities. Firms must ask, "Who are we?" and "Who do our stakeholders think we are?" well before they get to the point of trying to operationalize a risk appetite.

RISK MANAGEMENT STRATEGY

After a risk manager has mapped the firm's significant hazards and understands its risk appetite, he or she can decide how to best address each risk. Risk managers must first identify the most critical risk exposures and make some basic prioritising decisions. Which threats are the most serious and urgent? Second, the company must weigh the advantages and disadvantages of various risk management solutions.

- *Retain:* Some risks will be accepted in their totality, while others will be accepted in part of a loss distribution. It's important to remember that retained dangers aren't always little. A gold mining corporation, for example, may choose to keep gold price risk because its investors want it. An input price risk that manifests as predicted loss, on the other hand, can be kept and priced into the product. Making well studied decisions to retain risk is an important aspect of risk management.
- *Avoid:* Companies *may desire to avoid taking risks that are "unnatural" to their industry*. Some risks can only be averted if a commercial activity is halted. Certain types of risk or dangerous behaviour are sometimes referred to as "zero tolerance" by businesses. However, unless appropriate precautions are in place, this emotion may be more optimistic than descriptive.

- *Mitigate:* Other dangers can be reduced in a variety of ways. An airline investing in more efficient aircraft to offset its exposure to jet fuel price risk is an example of a company requesting additional collateral to mitigate a credit risk.
- *Transfer:* A portion of a company's *risk might be transferred to a third party*. *Insurance contracts* and financial *derivatives*, for example, can be used to transfer risks (at a financial cost).

Role of senior management

The *selection of risk management strategies for greater hazards will be the* responsibility *of senior management and the board*. The *risk manager,* on the other hand, must assist them in deciding which of the different possibilities to pursue. Which strategy enables the company to stay within its risk appetite the most effectively? The costs of any technique are rarely fully disclosed. For example, the cost of transferring risk should include the cost of hiring a risk manager as well as the cost of managing any remaining risks (e.g., basis risks).

Meanwhile, a company that hedges the price of a commodity may find that any drop in the spot price gives its competitors a short-term advantage. Is it possible to put a figure on that prospective competitive disadvantage? While numbers are important, so is business judgement. Finally, this type of research may be required for risks that are more difficult to quantify than market risk, such as new insurable risks.

Firms may, for example, need to estimate the extent of a cyber risk loss using worst-case analysis and expert judgement (e.g., a 5% projected possibility of a USD 100 million data loss event), and then compare that against the mitigation afforded by a costly data system upgrade. This should be weighed against the costs and benefits of offloading some of the risk to the rapidly expanding cyber insurance market.

RISK MANAGEMENT STRATEGIES THEIR LIMITS AND EXAMPLES

Read this table once.

Limit	Nature	Example Weakness
Stop Loss Limits	Loss threshold and associated action (e.g., close out, escalation)	Will not prevent future exposure, only limit realized losses
Notional Limits	Notional size of exposure	Notional amount may not be strongly related to economic risk of derivative instruments, especially options.
Risk Specific Limits	Limits referencing some special feature of risk in question (e.g., liquidity ratios for liquidity risk)	These limits are difficult to aggregate; may require specialized knowledge to interpret.
Maturity/Gap Limits	Limit amount of transactions that mature or reset/ reprice in each time period	These limits reduce the risk that a large volume of transactions will need to be dealt with in a given time frame, with all the operational and liquidity risks this can bring. But they do not speak directly to price risk.
Concentration Limits	Limits of concentrations of various kinds (e.g., to individual counterparties, or product type)	These limits must be set with the understanding of correlation risks. They may not capture correlation risks in stressed markets.
Greek Limits	Option positions need to be limited in terms of their unique risk characteristics (e.g., delta, gamma, vega risk)	These limits suffer from all the classic model risks and calculation may be compromised at trading desk level without the right controls and independence.
Value-at-Risk (VaR)	Aggregate statistical number	VaR suffers from all the classic model risks and may be misinterpreted by senior management. Specifically, VaR does not indicate how bad a loss might get in an unusually stressed market.
Stress, Sensitivity, and Scenario Analysis	These limits are based on exploring how bad things could get in a plausible worst-case scenario. Stress tests look at specific stresses. Sensitivity tests look at the sensitivity of a position or portfolio to changes in key variables. Scenario modeling looks at given real-world scenarios (hypothetical or historical).	Varies in sophistication. Dependent on deep knowledge of the firm's exposures and market behavior. Difficult to be sure that all the bases are covered (e.g., there are endless possible scenarios).

Figure 2.5 **Limits—Example Types.**

RISK TRANSFER MECHANISM

In many cases, the risk manager will decide to transfer a portion of a financial risk to the risk management markets. The range of instruments available for hedging risk is can be categorized (broadly) into swaps, futures, forwards, and options. These instruments have different capabilities like the different tools.

The use of these instruments requires firms to make key decisions based on their specific needs. For example, firms must decide how much they are willing to pay to preserve flexibility. Note that a forward contract provides price stability, but not much flexibility (because it requires the transaction to occur at the specified time and price). A call option provides both price stability and flexibility, but it comes with its own added cost (i.e., the option premium). Another key difference cuts across instrument types: trading mechanics. Is the instrument offered through one of the large exchanges, or is it a private bilateral O TC agreement between two parties? O TC and exchange-based derivatives have different strengths and weaknesses, particularly relating to liquidity and counterparty credit risk. Exchange-based derivatives are designed to attract trading liquidity. Not all succeed, but most can be traded easily at a relatively low transaction cost. The downside of this approach is like that of buying an off-the-rack suit: it is difficult for the risk manager to find a perfect fit. For example, a commodity risk manager may find the available futures contract does not cover the exact risk type, has a timing mismatch, or captures the price in the wrong location. These mismatches create basis risk. More positively, exchange-based derivatives minimize counterparty credit exposure through margin requirements and netting arrangements. Counterparty credit risk in the O TC markets often looks rather low until a financial crisis occurs. At that point, banks and other counterparties suddenly look fragile. Clearing houses have begun to play a bigger role in the O TC market, so the distinction between exchange-based and O TC instruments in terms of counterparty risk is no longer as clear cut. Risk managers can mix and match the various OTC and exchange-based instruments to form a huge variety of strategies. The next few sections look at strategy formulation in three key markets: agricultural products, energy, and interest rate/ foreign exchange.

Read this table

Instrument Type	Defining Features
Forward	It is a tailored agreement to exchange an agreed upon quantity of an asset at a pre-agreed price at some future settlement date. The asset may be delivered physically, or the contract may stipulate a cash settlement (i.e., the difference between the agreed upon price and some specified spot or current price).
Future	It is an exchange-listed forward with standardized terms, subject to margining.
Swap	It is an over-the-counter (OTC) agreement to swap the cash flows (or value) associated with two different economic positions until (or at) the maturity of the contract. For example, one side to an interest rate swap might agree to pay a fixed interest rate on an agreed upon notional amount for an agreed upon period, while the other agrees to pay the variable rate. Swaps take different forms depending on the underlying market.
Call Option	The purchaser of a call option has the right, but not the obligation, to *buy* the underlying asset at an agreed upon strike price, either at the maturity date (European option) or at any point during an agreed upon period (American option).
Put Option	The purchaser of a put option has the right, but not the obligation, to *sell* the underlying asset at the agreed upon strike price at the maturity date (European option) or at any point during an agreed upon period (American option).
Exotic Option	There are many different options beyond the standard or plain vanilla puts and calls. These include Asian (or average price) options and basket options (based on a basket of prices).
Swaption	It is the right, but not the obligation, to enter a swap at some future date at pre-agreed terms.

Figure 2.6 The risk management toolbox.

INTEREST RATE RISK MANAGEMENT

For many firms, interest rate risk is a major concern. Their fundamental task is to avoid taking on too much debt at high interest rates and avoid overexposure to variable rates of interest. This balancing act is determined by:

- Each firm's financial risk appetite, which may set out the levels of debt the board is happy with, and
- The proportion of fixed interest to variable interest, (perhaps across several time horizons).

A firm's financial risk appetite needs to be congruent with its target credit rating and any covenants it has made to banks and other financing providers. Even if the firm's risk appetite remains stable, the rest of its risk management environment is constantly changing.

These changes will come as the debt portfolio matures, business financing needs evolve, as well as when regulations and taxes change. More urgently, interest rates change and so do the relationships between rates across a range of maturities (i.e., yield curve risk).

Changes in interest rates are linked to the broader economy and consumer demand. They may affect the fundamental health of a business, including its ability to meet debt obligations. On the upside, the falling cost of servicing variable rate debt can offer an important natural hedge in a deteriorating business environment.

Treasures meet this complex challenge by using a variety of instruments, such as O TC interest rate swaps and currency swaps. When formulating specific strategies, the risk manager should return repeatedly to the firm's risk appetite and their directive. Often, that directive is to create a more stable version of the future around which the firm can plan.

PROBLEMS IN CORPORATE HEDGING STRATEGY

A firm can misunderstand the type of risk to which it is exposed, map or measure the risk incorrectly, fail to notice changes in the market structure, or suffer from a rogue trader on its team. Some simple tips that might have prevented many corporate risk management disasters are

Tips

- Set out clear goals.
- Keep instruments and strategies simple.
- Disclose the strategy and explain ramifications.
- Set resources and limits suitable for the strategy.
- Stress test and set up early warning indicators.
- Watch for counterparty and break clause risk.
- Consider the ramifications of many different market scenarios, for example, margin calls.

One cause of a mishap is to create a "risk management" program that is not really intended to manage risk. For example, it may seem legitimate for the firm to use risk management instruments to lower the amount of interest that it pays. Swaps and other derivatives can be used to attempt to reduce the amount of interest paid, but in

exchange the hedger may be forced take on much more downside risk, or to alter the structure of the interest paid to minimize payments in the short-term in exchange for ballooning payments in the future.

This kind of program is often more about artificially enhancing returns to meet analyst forecasts, or covering up fundamental business problems, than it is about true risk management. At worst, the program might be characterized by unnecessarily complex derivative structures, leverage, or strategies that turn sour after some superficially unlikely but entirely plausible event (such as an unexpected shift in interest rates or a rise in basis risk). This is not really a failure of risk management, but of corporate governance.

A purer cause of failure is poor communication about the risk management strategy and its potential consequences. The classic example of this is perhaps the implosion of the MGRM (MG Refining and Marketing) hedging program in 1993.

Reading 03 Corporate Governance

After completing this reading you should be able to:

- Explain changes in corporate risk governance that occurred as a result of the 2007-2009 financial crisis.
- Compare and contrast best practices in corporate governance with those of risk management.
- Assess the role and responsibilities of the board of directors in risk governance.
- 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.

INTRODUCTION

Corporate governance is the way in which companies are run. It describes the roles and responsibilities of a firm's shareholders, board of directors, and senior management. Corporate governance, along with its relationship to risk, has become a major issue in the banking industry. This reading traces the development of risk governance (i.e., how firms undertake and oversee risk management) over the past two decades. It describes how risk governance morphed from a vague principle into a well-defined set of best practices and became a central tenet of modern banking regulation.

POST 2007 CRISIS CORPORATE GOVERANACNE

Stakeholder Priority	Enquiries into the 2007-2009 financial crisis found that often little attention was paid to controlling tail risks and considering truly worst-case outcomes. This has led to a debate about the uniquely complicated set of stakeholders in banking and the potential impact on corporate governance. In addition to equity, banks have large amounts of deposits, debt, and implicit government guarantees. Depositors, debtholders, and taxpayers have a much stronger interest in minimizing the risk of bank failure than do most shareholders, who often seem to press for short-term results. Shareholder empowerment, the usual remedy to corporate governance ills, may therefore be an inadequate solution for the banking industry's woes.
Board Composition	The crisis reignited a longstanding debate as to how to ensure bank boards can achieve the appropriate balance of independence, engagement, and financial industry expertise. Analyses of failed banks do not show any clear correlation between success and a predominance of either insiders or outsiders. One can note, however, that failed bank Northern Rock had several banking experts on its board.
Board Risk Oversight	The importance of boards being proactive in risk oversight became increasingly recognized following the crisis. This has led to a focus on educating boards about risk and making sure they maintain a direct link to the risk management infrastructure (e.g., by giving CROs direct reporting responsibilities to the board).
Risk Appetite	Regulators have pushed banks to articulate a formal, board-approved risk appetite that defines a firm's willingness to undertake risk and tolerate threats to solvency. This can be translated into an enterprise-wide setting of risk limits. Engaging the board in the limit-setting process helps to make sure it thinks clearly about risk-taking and its implications for day-to-day decision-making.
Compensation	One of a board's key levers in determining risk behavior is its control over compensation schemes. Boards have a duty to examine how pay structures might affect risk-taking and whether risk-adjustment mechanisms capture all key long-term risks. Some banks have started instituting reforms, such as limiting the scope of bonuses in compensation packages, as well as introducing deferred bonus payments and clawback provisions.

Post crisis regulatory response

The risk-based capital requirements adopted in Basel II have been expanded to better address risks emanating from capital markets activities. These risks include exposure to central counterparties, margins on non-centrally cleared derivatives, exposure to counterparty credit risks, and securitization.
Basel III has also designed a macroprudential overlay intended to reduce systemic risk and lessen procyclicality. The macroprudential overlay consists of five elements:

1. A leverage ratio of 3%,
2. A countercyclical capital buffer,
3. Total loss-absorbing capital (TLAC) standards that apply to global systemically important banks (G-SIBs),
4. Systemically important markets and infrastructures (SIMIs); in the case of OTC derivatives, the Basel Committee is pushing the market to move as many trades as possible through centralized clearing and trade reporting, and
5. Capturing systemic risk and tail events in risk modeling and stress testing.

The framework for handling market risk was revised in 2016 with the Fundamental Review of the Trading Book (FRTB). Specifically, disclosure requirements were enhanced to reflect a more comprehensive approach to describing and calculating risk, as well as to facilitate comparative risk analysis.

The BCBS also confronted governance issues exposed by the crisis. In October 2010, it issued several principles designed to improve corporate governance in the banking industry. These principles addressed the duties of the board and the qualification of board members, as well as the importance of an independent risk management function. These principles were revised in 2015 with an eye towards reinforcing the board's active role in collective oversight and risk governance. The revised guidance report defines roles of the board and the board risk committees, senior management, CROs, and internal auditors.

Corporate governance in banking has been strongly impacted by the post-crisis regulatory response. This includes Basel III, but also the U.S. Dodd-Frank Act and the European Supervisory Review and Evaluation Process (SREP).

CORPORATE GOVERNANCE PRINCIPLES FOR BANKS

Table 3.2 Corporate Governance Principles for Banks

1.	**Board's Overall Responsibilities**	The board has overall responsibility for the bank, including approving and overseeing management's implementation of the bank's strategic objectives, governance framework and corporate culture.
2.	**Board Qualifications and Composition**	Board members should be and remain qualified, individually and collectively, for their positions. They should understand their oversight and corporate governance role and be able to exercise sound, objective judgment about the affairs of the bank.
3.	**Board's Own Structure and Practices**	The board should define appropriate governance structures and practices for its own work and put in place the means for such practices to be followed and periodically reviewed for ongoing effectiveness.
4.	**Senior Management**	Under the direction and oversight of the board, senior management should carry out and manage the bank's activities in a manner consistent with the business strategy, risk appetite, remuneration, and other policies approved by the board.
5.	**Governance of Group Structures**	In a group structure, the board of the parent firm has the overall responsibility for the group and for ensuring the establishment and operation of a clear governance framework appropriate to the structure, business, and risks of the group and its entities. The board and senior management should know and understand the bank group's organizational structure and the risks that it poses.
6.	**Risk Management Function**	Banks should have an effective independent risk management function, under the direction of a chief risk officer (CRO), with sufficient stature, independence, resources, and access to the board.
7.	**Risk Identification, Monitoring, and Controlling**	Risks should be identified, monitored, and controlled on an ongoing bank-wide and individual entity basis. The sophistication of the bank's risk management and internal control infrastructure should keep pace with changes to the bank's risk profile, the external risk landscape, and to industry practice.
8.	**Risk Communication**	An effective risk governance framework requires robust communication within the bank about risk, both across the organization and through reporting to the board and senior management.
9.	**Compliance**	The bank's board of directors is responsible for overseeing the management of the bank's compliance risk. The board should establish a compliance function and approve the bank's policies and processes for identifying, assessing, monitoring, reporting, and advising on compliance risk.
10.	**Internal Audit**	The internal audit function should provide independent assurance to the board and should support the board and senior management in promoting an effective governance process and the long-term soundness of the bank.
11.	**Compensation**	The bank's remuneration structure should support sound corporate governance and risk management.
12.	**Disclosure and Transparency**	The governance of the bank should be adequately transparent to its shareholders, depositors, other relevant stakeholders, and market participants.
13.	**Role of Supervisors**	Supervisors should provide guidance for and supervise corporate governance at banks, including through comprehensive evaluations and regular interaction with boards and senior management; should require improvement and remedial action as necessary; and should share information on corporate governance with other supervisors.

BOARD AND CORPORATE GOVERNANCE

One of the key duties of a corporate board of directors is to protect the interests of shareholders. Traditionally, the board has been cast as the gatekeeper for all shareholders. A growing number of analysts, however, argue that the responsibility of the board extends beyond shareholders to include all corporate stakeholders (e.g., debtholders and employees). Given the divergent interests of the various stakeholders, managing this responsibility is not always an easy task. Debtholders, for example, are primarily interested in the extreme downside risk.

This is because their stake in the firm is most at risk during times of distress (i.e., when corporate solvency is on the line). The board is also charged with overseeing executive management. Analyzing the risks and returns from corporate activity is one of the

board's fundamental duties. If management assumes a given risk, the board must understand the type and magnitude of the threat posed should that risk come to fruition.

Addressing conflicts of interest between management and shareholders lies at the heart of corporate board oversight. Such conflicts are referred to in the financial literature as agency problems, and they are often manifested as the unwarranted assumption of risk to pursue short-term profits or to enhance apparent performance. These activities put the interests of management squarely against those of longer-term stakeholders.

Conflicts of interest are easily created, rendering agency risk a perennial governance challenge. For example, giving executives stock options (which take on value only if the firm's shares exceed a certain price) can incentivize senior management to take actions designed to temporarily boost the firm's share price, even if these actions hurt the firm in the long term.

Even the best-designed executive compensation systems cannot fully prevent executives from being tempted to pursue short term results to the detriment of long-term objectives. For this reason, the scope and structure of executive compensation has become a major concern and measures to strengthen executive accountability are gaining traction.

Ongoing tensions between the interests of CEOs and the interests of longer-term stakeholders have become a prominent feature of corporate management. Agency risks arising from these tensions provide an important rationale for the board's independence from executive management. They also explain the recommended best practice of separating the position of CEO from that of board chairperson.

The bankruptcy of brokerage firm MF Global in 2011 illustrates the perils of agency risk, particularly when the board's independence from executive management is questionable. In 2010, MF Global appointed Jon Corzine17 18 as chairperson of the board and CEO. At the time, the firm was already experiencing liquidity and compliance problems. Under Corzine's leadership, A Q and despite repeated warnings by the firm's CRO at the time, MF Global made huge proprietary investments in European sovereign debt. These investments soured in 2011, exacerbating the firm's liquidity problems. This led to a loss of shareholder and client confidence, and ultimately to the firm's collapse.

During this time, the firm allegedly misappropriated client funds in an attempt to keep the firm solvent. This prompted the U.S. Commodity Futures Trading Commission (CFTC) to act against Corzine and the firm's assistant treasurer.

BEST PRACTICE RISK MANAGEMENT

The experience of the past two decades illustrates how the objectives of corporate governance and risk management have converged. The 2007-2009 crisis exposed extreme deficiencies in risk management and oversight among financial institutions. As a result, post-crisis regulation has raised the bar for risk governance with the aim of reining in both financial and agency risks.

Risk governance involves setting up an organizational infrastructure to articulate formal procedures for defining, implementing, and overseeing risk management. It is

also about transparency and establishing channels of communication within the organization as well as with external stakeholders and regulators.

The mix of the measures adopted, and the degree to which they are enshrined in law, varies between jurisdictions. In 2012, the World Bank articulated a set of standards for risk governance aimed at improving the effectiveness of risk management and control, enhancing risk management standards, and promoting the competitiveness and sustainability of financial institutions.

The board of directors plays a central role in both the shaping and oversight of risk management. Its primary responsibility in risk governance is to assess the fundamental risks and rewards engendered in the firm's business strategy. This assessment must be based on a clear understanding of the institution's direction and goals. The board must proactively participate in strategic planning as well as outline the appropriate risk appetite (as discussed in Chapter 2).

Risk appetite is intimately related to business strategy and capital planning. Certain activities may be categorically inappropriate for an enterprise given the type of risk involved. The appropriateness of other activities may be a function of their scope relative to the firm's total asset value. Business planning must take risk management into consideration from the outset, and the matching of strategic objectives to risk appetite must be incorporated into the planning process. Equally important is a clear communication of risk appetite and risk position throughout the firm. This allows the firm to set appropriate limits on its various risk-bearing activities.

The board is also responsible for oversight and risk transparency. It must ascertain whether any major transaction undertaken by the firm is consistent with the authorized risk and associated business strategies. Similarly, it must ensure that the disclosure to managers and relevant stakeholders is both adequate and compliant with internal corporate rules and external regulations.

Given the board's accountability to stakeholders, the board is ultimately responsible when risk policy is ignored or violated. To fulfill its role in risk governance, the board must assess whether the firm has put an effective risk management system in place that enables it to further its strategic objectives within the confines of its risk appetite. The board must also make sure that procedures for identifying, assessing, and handling the various types of risk (e.g., business, operational, reputational, market, liquidity, compliance, and credit) are in place. While a willful assumption of excessive risk lies at the heart of many corporate failures, just as many can be attributed to an inability to identify risk or assess it properly in a timely manner.

The risk management process may seem complex and confounding and boards may find this task difficult to take on. However, the strategic principles underlying risk governance are simple. Ultimately, only four basic choices need to be made in the management of corporate risk:

1. The choice to undertake or not to undertake certain activities;
2. The choice to transfer or not transfer either all or part of a given risk to a third party (or third parties); such transfers can be accomplished via the purchase of insurance policies, hedging activities, and so on;
3. The choice to preemptively mitigate risk through early detection and prevention; and

4. The choice to assume or not assume risk, fully cognizant of both the upside and downside implications.

Risk management must be implemented across the entire enterprise under a set of unified policies and methodologies. (This is called enterprise risk management and is discussed in Chapter 8.) The infrastructure of risk management, which includes both physical resources and clearly defined operational processes, must be up to the task of an enterprise-wide scope. The task of assessing the fitness of a risk management system is daunting, but doable nonetheless. One way to measure the seriousness of a risk management process is to examine the human capital employed and the risk managers' standing within the corporate hierarchy.

- Is the risk manager considered to be a member of the executive staff and can this position lead to other career opportunities?
- How independent is the risk manager? What authority does he or she hold? To whom does he or she report?
- Are risk managers paid well relative to other employees who are rewarded for performance (e.g., traders)?
- To what extent can one characterize the enterprise's ethical culture as being strong and resilient against the actions of bad actors? Has the firm set clear-cut ethical standards and are these standards actively enforced?

The board must also evaluate the firm's performance metrics and compensation strategy. It has the critical responsibility of making sure executives are compensated based on their riskadjusted performance and that the incentives inherent in such compensation do not clash with shareholder interests.

Within the framework of risk governance oversight, the board should ensure the information it obtains concerning the implementation of risk management is accurate and reliable. Information should be gathered from multiple sources, including the CEO, other senior executives, and both internal and external auditors. Board members must also arm themselves with additional knowledge, because they are required not only to ask tough questions but also understand the answers they are told.

The board's scope in risk governance is comprehensive. However, its responsibility to take a proactive approach does not suggest a day-to-day involvement. Rather, its role is to ensure that the processes and procedures around the delegation and implementation of risk management decisions are performing as planned. As discussed previously, the 2007-2009 financial crisis highlighted the need to strengthen the role of the board and its commitment to risk management.

Board members need to be trained on risk issues and on how to evaluate and define the firm's risk appetite. They need to be able to assess the firm's capacity for risk over a specified time horizon while considering the firm's mix of business activities, earnings goals, strategic objectives, and competitive position. This will allow the board to understand the firm's risk profile and monitor its performance relative to the risk appetite.

The board should also have a risk committee whose members have enough analytic sophistication and business experience to properly analyze key risks. The board risk and audit committees should be two separate entities, given that each requires different skills to meet its respective responsibilities.

RISK APPETITE STATEMENT

Publishing a risk appetite statement (RAS) is an important component of corporate governance. The Financial Stability Board (FSB) describes an RAS as "a written articulation of the aggregate level and types of risk that a firm will accept or avoid in order to achieve its business objectives." The RAS includes both qualitative and quantitative statements.

The objectives of an RAS should be clearly articulated.

The FSB states that:

> an effective risk appetite statement should:
>
> > Include key background information and the assumptions that informed the financial institution's strategic and business plans at the time they were approved
>
> Be linked to the institution's short- and long-term strategic, capital, and financial plans, as well as compensation programs . . . "

An RAS should contain risk appetite and risk tolerance measures that limit the amount of risk taken at the business unit level as well as the organizational level. The RAS should also make transparent the relationship between risk appetite, risk capacity, risk tolerance, and the current risk profile.

Risk tolerance refers to the range of acceptable outcomes related to achieving a business objective. **Risk tolerance is a tactical measure, whereas risk appetite is a broader aggregate measure of the amount at risk.** Risk appetite is set at a level sufficiently below the risk capacity to ensure that the actual risk stays well below the risk capacity of the firm. The goal here is to keep the actual risk profile within the established risk tolerance bands. Operating within the risk tolerance bands provides management with comfort that the firm can achieve the desired risk-adjusted return objectives subject to limiting the amount at risk.

BOARD LEVEL RISK GOVERNANCE

The previous sections have outlined the rationale and some of the objectives of risk governance. This section examines the mechanisms used by financial institutions (as well as other risk-taking corporations) to implement risk governance best practices.

At most firms, the key risk management policies and procedures are approved by the board audit and risk management committees. These committees also review the implementation of these policies and examine their efficacy. They interpret the board-approved risk appetite and break it down into a set of practical restrictions and limitations. These new rules are then disseminated throughout the organization by the executive staff and department heads.

THE BOARD AUDIT COMMITTEE

An effective audit committee is essential to the directors' oversight of the firm. In addition to being accountable for the accuracy and completeness of a firm's financial and regulatory disclosures, the audit committee is responsible for ensuring the firm's

compliance with best-practice standards in non-financial matters as well. Regulatory, legal, compliance, and risk management activities all fall under the purview of the audit committee.

An audit provides the board with independent verification of whether the firm is doing what it claims to be doing. This critical verification function sets the audit committee's work apart from the work of other risk committees.

At the same time, however, the audit committee's duties extend beyond the search for discrepancies and infringements. The committee must assess not only the veracity, but also the quality of the firm's financial reporting, compliance, internal control, and risk management processes. For example, in its review of financial statements, the audit committee must not only confirm the accuracy of the financial statements, but that the firm sufficiently addresses the risk of possible material misstatements in its reporting as well. The financial crisis revealed the failure of many firms' audit committees to uncover the excess risk undertaken in proprietary trading, or to alert their boards to the risk of holding disproportionately large positions in structured credit products.

To successfully execute their duties, audit committee members must be knowledgeable, capable of independent judgment, financially literate, and have the utmost integrity. Members cannot be afraid to challenge management and ask hard questions when needed. In most banks, a director who is not a member of the executive staff chairs the audit committee, and most of its members are independent as well. Although the audit committee's relationship with management can be adversarial at times, the two groups need to foster an amicable and productive relationship in which all lines of communication are always kept open.

ROLE OF RISK ADVISORY DIRECTOR

It is unreasonable to expect the entire board to possess the skills necessary to analyze the financial condition of complex risk-taking corporations (which financial institutions are by definition). This is particularly true if the appointed independent directors include individuals who originate from other industries beyond the financial services sector and who have no connections to the enterprise. This practice can be problematic, because (historically) it has been a simple matter for executives to befuddle non-executives who lack the skills and/or confidence to challenge them. Director training programs, as well as outside professional support, can be helpful in this regard.

One approach is for the board to include a risk specialist. This is typically an independent member of the board (not necessarily a voting member) who specializes in risk analysis and management. This person's job is usually to enhance the efficacy of the executive risk committee and the audit committee. This involves examining risk governance in terms of the risk policies approved by the board, as well as the methodologies and infrastructure used to execute and oversee them.

These risk advisory directors can also keep board members apprised as to the best practices in corporate governance and risk management. They can also give their professional opinion on risks associated with the firm's core business model and the areas of activity in which the firm operates or seeks to pursue.

ROLE OF BOARD RISK MANAGEMENT COMMITTEE

A board risk management committee is responsible for setting the firm's risk appetite and independently reviewing the governance of all material risks. The committee's review includes an analysis of policy guidelines, methodologies, and risk management infrastructure. By maintaining direct contact with external and internal auditors, a board risk management committee can allow for better communication between the board and management.

In addition, the **board of directors typically delegates the responsibility for approving and reviewing the risk levels to the board risk management committee**. Its role, as well as the terms of its oversight, are usually formally approved and documented by the board. The board risk management committee also monitors financial, operational, business, reputational, and strategic risks. It reports to the board on various issues (e.g., the extension of special credit should the firm exceed the risk limits set by the board).

ROLE OF INCENTIVES

This section illustrates how structure meets process to ensure that a firm's regular activities are appropriate given its risk appetite and the limits defined by the various board and executive committees.

The process can be summarized as follows.

- The board risk committee approves the firm's risk appetite on an annual basis. This risk appetite is based on a set of broad, yet clearly defined, risk metrics (e.g., the total interest rate risk assumed by the bank).
- The firm's senior risk committee (which is led directly by the CEO and typically includes the CRO, the CFO, the treasurer, chief compliance officer, and the executives in charge of the various business units) is empowered by the board to implement and oversee the risk appetite framework.
- Under the board's authority, the senior risk committee determines the limiting parameters for financial (e.g., credit and market) and nonfinancial risk (e.g., business risk and operational risk) undertaken by the firm. Sub-committees may be established to handle each type of risk independently. For example, the firm's credit risk committee would set limits on the magnitude and type of credit risk undertaken, as well as oversee credit risk reporting.
- After setting risk ceilings, the senior risk committee then reports back to the board risk committee with recommendations regarding the total risk deemed prudent (which are subject to the latter's consideration and approval).

ROLE OF CRO

The senior risk committee also bears responsibility for the establishment, documentation, and enforcement of any corporate policies concerning risk. It also sets risk limits for specific business activities, which are then delivered to the CRO. The CRO is usually a member of the risk committee and is responsible for the design of the firm's risk management program (in addition to other responsibilities). The CRO is also responsible for risk policies, analysis approaches, and methodologies, as well as the risk management infrastructure and governance inside the organization.

The bank's senior risk committee delegates the power to make day-to-day decisions to the CRO. This includes the ability to approve risks exceeding preset limits imposed on the various business activities, provided these exceptions remain within the bounds of the overall board-approved limits.

For example, each business unit may be given authorization to assume a certain maximum level of risk up to a certain ceiling. The firm's senior risk committee reviews and approves each business unit's mandate periodically, and the CRO is responsible for monitoring these limits. In larger financial institutions, the best practice is for such processes (e.g., the development and approval/renewing of such risk-taking allowances) is clearly defined. Usually, any such approval is valid for one year following approval by the senior risk committee. However, the CRO may approve an extension of the mandate to accommodate the committee's schedule.

Although CROs are typically part of the management team, it is critical for them to be granted both the authority and independence to effectively discharge their duties. The global financial crisis, along with the problems exemplified by the MF Global bankruptcy, underscore the need to fortify CRO independence and authority. CROs should be proactively involved in setting risk strategy as well as in the implementation and managerial oversight of risk management. They should also report directly to the CEO, maintain a seat on the board risk committee, and have a voice in approving new financial instruments and lines of business. Most importantly in this regard, the CRO should have a clear mandate to bring any situation that potentially compromises the bank's risk appetite guidelines or its risk policy to the attention of management at all levels and to the board.

At many banks, CROs act as a liaison between the board and management. They keep the former apprised as to the enterprise's risk tolerance and the efficacy of its risk management program, alerting it to deficiencies in the system. At the same time, the CRO communicates the board's views to management and distributes this information throughout the entire organization.

All organizations must strike a balance between ensuring they can achieve their objectives and maintaining risk standards. The CRO is responsible for independently monitoring these standards on an ongoing basis. He or she may order specific units to cut back or entirely close positions in the wake of concerns regarding exposures to market, credit, operational, or business risks.

Corporations may also appoint business risk committees for each major line of business. A business risk committee typically comprises both business and risk personnel. Its goal is to align business unit decisions with the organization's desired risk/reward tradeoff and ensure proper risk management at the business line level. The business risk committee can be responsible for articulating how a given risk will be handled in accordance with how risk management for a specific business relates to the overall risk function. Additionally, the authority to approve policies related to more business-specific risk and to conduct detailed reviews of business-level risk limits can also be entrusted to the business risk committee.

LIMITS POLICIES

Optimal risk governance requires the ability to link risk appetite and limits to specific business practices. Accordingly, appropriate limits need to be developed for each business as well as for the specific risks associated with the business (as well as for the entire portfolio of the enterprise).

Market risk limits are designed to constrain exposure to risk derived from price and rate changes. Credit risk limits are intended to cap a firm's exposure to defaults or an erosion in the quality of credit exposures (e.g., those originating from the lending portfolio or through derivative transactions). Banks also tend to place exposure to other types of risk (e.g., asset/ liability management, liquidity, or even catastrophe risk) on their policy agenda as well. The nature of any given limit will vary and is driven by the nature of the risk in question, the competitive positioning of the firm, and the span of its activities. Best practice dictates that the processes involved in setting risk limits, reviewing exposures, approving exceptions to risk limit policy, and analyzing methodologies be documented.

Best practice in risk management often employs analytical methodologies to measure risk. When analyzing credit risk, a bank's potential exposure can be analyzed by risk grade. Risk-sensitive methodologies (e.g., VaR) are useful in the assessment of risk for most typical portfolios under an assumption of relatively normal market conditions. However, they are less applicable in stressed circumstances or for more specialized portfolios. Accordingly, best practices call for scenario analysis and stress testing to be included in the risk analysis toolbox and incorporated within the limit framework in order to validate survivability under worstcase conditions.

Most institutions set two types of limits.

- Tier 1 limits are specific and often include an overall limit by asset class, an overall stress-test limit, and a maximum drawdown limit.
- Tier 2 limits are more generalized and relate to areas of business activity as well as aggregated exposures categorized by credit rating, industry, maturity, region, and so on.

Standards for the metrics employed by risk limits are proposed by the CRO and approved by the internal risk committee. Practically speaking, these limits should be designed such that the probability of exceeding them during the normal course of business is low. Limit determination needs to take the business unit's historical behavior into account and to aim for a figure that gives the business unit a margin for error. For example, a bank may decide to design their Tier 1 limits on market risk such that, during the normal course of business and under normal market conditions, the unit's exposures range from 40% to 60% of the set limit and perhaps the peak limit utilization (again, under normal market conditions) should hit 75% to 85% of this ceiling.

A consistently designed limit structure helps banks to consolidate their risk management across diverse businesses. When limits are calculated in a unified manner and expressed in terms of economic capital, or a similar unified term, it is then possible to apply Tier 2 limits across business lines.

MONITORING RISK

The setting of meaningful risk limits marks the beginning, rather than end, of the risk management process. Once set, these limits must be closely monitored to verify compliance. Of all the types of risks discussed in the previous section, market risk is the most time-sensitive and thus requires continual monitoring.

To monitor market risk limits effectively, the daily valuation of asset positions is imperative. Profit and loss statements should be prepared outside of the bank's trading department and submitted to (non-trading) executive management. In addition, all assumptions used in the valuation models should be independently verified. Similarly, the trading team's adherence to risk policy and market risk limits, as well as the bank's escalation plan for dealing with exceptions, should be documented on a timely basis. Procedures covering the treatment of acceptable limit exceptions and unacceptable violations should be articulated in writing and made clear to managers and traders alike.

The assessment of portfolio valuation methods constitutes an integral part of risk limit monitoring. The variance between a portfolio's actual volatility and that predicted under the bank's risk measurement methodology should be evaluated on a regular basis. Stress tests should be done to ascertain the impact of material changes to market and credit risk on the bank's earnings.

Where time is of the essence, the most appropriate source of information may well be the front office. For example, risk measures relating to the monitoring of intra-day trading exposures may need to be extracted directly from the day's accumulated client orders. Data used in the monitoring of market limits, on the other hand, should be obtained from consolidated market data feeds not connected to front office systems.

To ensure integrity, this data must be reconciled with entries in the bank's official books and their format must facilitate risk measurement, such as with VaR methodologies for calculating market or credit risk.

In the implementation of both Tier 1 and Tier 2 limits, business units must adhere to strict protocols regarding prior disclosure of anticipated limit violations to the risk management function.

The CRO must be notified well in advance of potential limit deviations. If risk management is alerted to a planned excess, the probability that this excess will be approved is higher. For example, business unit heads may be compelled to issue an alert when an exposure reaches a certain threshold (e.g., 85% of the limit). The CRO, jointly with the unit head, could then petition the bank's business risk committee for a temporary limit increase.

Upon approval, the business risk committee would then submit the request for final approval by the senior risk committee. Should the limit be breached, the risk management function should immediately record all excesses on a daily limit exception report that distinguishes between Tier 1 and Tier 2 limit exceptions. This report specifies the circumstances and rationale for the exceedances and outlines how the bank plans to handle them.

- Tier 1 limit exceedances must be cleared or corrected immediately.

- Tier 2 exceedances are less urgent and can be cleared within a few days or a week. The CRO should then list all Tier 1 and Tier 2 limit exceedances on an enterprise exception report, which captures all exceptional risk activity at the enterprise level.

This report is then submitted for discussion at the daily risk meeting. **No manager, including the CEO, should be authorized to exclude risk limit exceedances from the daily exception report.** There is an opportunity cost inherent in effective risk limit management. Because the bank prevents the pre emptive assumption of additional risk, it may have to forfeit opportunities for additional profits. As a given limit is neared, a bank should conduct a cost-benefit-risk analysis to decide if an exception should be made.

INCENTIVE AND RISK TAKING

One lesson from the global financial crisis is that the prevailing executive compensation schemes at many financial institutions encouraged short-term risk-taking, causing management to often underestimate and at times entirely ignore long-term risks. The trend to reward bankers and traders with bonuses tied to short-term profits, or to the volume of business activity, had grown in the two decades preceding the crisis. This incentivized these individuals to front load income and push off risk.

Compensation schemes were structured like call options in that they had unlimited upside but were capped on the downside. Executives collected bonuses when the bank posted profits, but there was no real penalty attached to poor performance or losses. Aided by excessive leverage, bank personnel were literally able to "bet the bank" on astonishingly reckless investment strategies.

In many jurisdictions, regulations now require public firms to establish a dedicated board compensation committee to set executive compensation. Such regulation is driven by concerns over the ability of CEOs to persuade board members to compensate themselves and other executives at the expense of shareholders, who have virtually no say in such decisions.

It is now widely recognized that compensation is part of a sound risk culture. Specifically, it should be aligned with the long-term interests of shareholders and other stakeholders, as well as with risk-adjusted return on capital. It should incentivize employees to take calculated, rather than reckless, risks. Banks must address any potential distortions arising from the way they structure compensation. The incorporation of risk management considerations into the setting of performance milestones is on the rise and is already considered a leading practice. Compensation planning is increasingly considered a key facet of enterprisewide risk management.

That said, one must recognize that firms will always be tempted to offer attractive compensation packages to so-called "rainmakers" who exhibit an unusual talent for generating revenues. Absent international cooperation, the market for human capital may be subject to regulatory arbitrage as banking enterprises cherry pick the jurisdictions in which they operate.

In September 2009, the G-20 countries called on their respective central bank governors and finance ministers to establish an international framework to promote financial stability, including a reform of compensation practices. In an endorsement of the

FSB's implementation standards, the G-20 recommendations included:

- The elimination of multi-annual guaranteed bonuses;
- The incorporation of executive downside exposure through the deferral of certain compensation, the adoption of sharebased remuneration to incentivize long-term value creation, and the introduction of clawback provisions that require reimbursement of bonuses should longer-term losses be incurred after bonuses are paid;
- Limitations on the amount of variable compensation granted to employees relative to total net revenues;
- Disclosure requirements to enhance transparency; and
- Affirming the independence of the committees responsible for executive compensation oversight to ensure their alignment with performance and risk.

In 2014, the FSB reported that implementation of these standards was essentially complete in almost all FSB jurisdictions. In some jurisdictions (e.g., the European Union), regulators went beyond the recommended standards and adopted bonus caps equal to 100% of an executive's salary or, if approved by two thirds of shareholders, 200% of their salary.

Share-based compensation aims to align the respective interests of executives and shareholders. Theoretically, occupying the same boat as other shareholders should curb excessive executive risk-taking. Flowever, this is not necessarily the case. Prior to the collapse of Lehman Brothers, for example, employees held approximately one third of the firm's shares. One must also bear in mind that share ownership can also encourage risk-taking because while potential shareholder gains are infinite, losses are limited to their investment.

One remedy for this dilemma could be to turn employees into the bank's creditors by introducing restricted notes or bonds tied to compensation schemes. Swiss bank UBS adopted such a solution in 2013. It paid its most highly compensated employees in part with bonus bonds that are forfeited if the bank's regulatory capital ratio falls below 7.5%.

THE INTERDEPENDENCE OF ORGANIZATIONAL UNITS IN RISK GOVERNANCE

The implementation of risk management at virtually all levels of the enterprise is primarily the responsibility of the bank's staff, rather than the board committees. Executives and line business managers need to work together to manage, monitor, and report the various types of risk being undertaken. Business managers also play an important part in the verification of timely, accurate, and complete deal capture and their affirmation of official profit and loss (P&L) statements.

A bank's operations function not only shares in the implementation of risk management but plays a critical role in risk oversight as well. In investment banks, for example, its role is to independently execute, record, and settle trades; reconcile front and back-office positions; and chronicle all transactions. The operations staff also prepares earnings reports as well as independent valuations of the bank's positions (e.g., mark-to-market).

The finance group, on the other hand, is responsible for developing valuation and finance policies, ensuring the accuracy and completeness of reported earnings, and

reviewing independent valuation methodologies and processes. Finance also manages business planning and is called upon to support the financial needs of the various business lines.

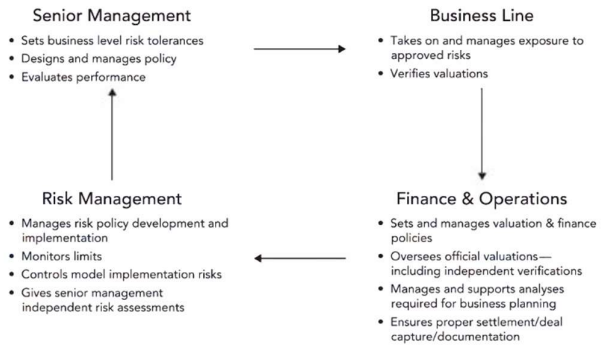


Figure 3.2 Interdependence in risk management.

ROLE OF AUDIT FUNCTION

The previous sections outlined a risk management process that conforms to risk governance. Adherence to this process can prevent the assumption of unbridled excessive risk. However, the risk governance function alone cannot ascertain compliance to the policies established by the board and external regulations.

This is where the audit function comes in. It is incumbent upon the internal audit function to ensure the set-up, implementation, and efficacy of risk management/governance. To this point, regulators typically require the internal audit function to review all processes, policies, and procedures related to risk management. A comprehensive review includes, among other things, assessing the organization of the risk control unit and documentation along with analyzing the integrity of risk governance and the efficacy of the risk management process.

This analysis includes the integration of risk measures into daily business management. Internal auditors are responsible for:

- Reviewing monitoring procedures,
- Tracking the progress of risk management system upgrades, assessing the adequacy of application controls in generating and securing data, and
- Affirming the efficacy of vetting processes.

Best practices also call for the internal audit function to review documentation relating to compliance and to compare this with the standards stipulated in the regulatory guidelines. It should also offer its opinion on the reliability of any VaR reporting framework. Taking market risk as an example, bank auditors are called upon to review the vetting process pertaining to the derivative valuation models used by both the front office and the back office.

They must sign off on any significant changes to the risk quantification process as well as validate the range of risks analyzed by the various risk measurement models. Internal auditors are also required to inspect the reliability of information systems as well as the validity and completeness of the data on which market risk metrics are computed.

Regulatory requirements notwithstanding, a key task undertaken by the audit function should be the evaluation of the design and conceptual soundness of risk measurement. Internal auditors should validate market risk models by back testing investment strategies. Additionally, they should evaluate the soundness of risk management information systems (also called risk MIS) used in the quantification of risk throughout the enterprise. These can include coding processes, internal model applications, and controls over position data capture. Similarly, auditors should analyze assumptions pertaining to volatility, correlations, and other parameter estimates. An auditor's responsibilities often include ensuring the veracity of the market databases used to generate VaR parameters.

A risk management function can be rated. This rating may be used internally or by third parties (e.g., rating agencies) that undertake comparative analyses of multiple enterprises. There is no one formula for excellence in risk management. Despite this, the rating of risk management practices would be instrumental in facilitating comparisons across an organization so that both the internal and external parties can benefit from such objective critiques.

The Institute of Internal Auditors (I I A) has devised a set of standards relating to internal controls, governance, and risk management. The organization's International Professional Practices Framework (IPPF) articulates standards, some of which are mandatory and others that are strongly recommended. The mandatory standards and ethical code define the requirements for professional practice. The recommended guidance outlines how these standards should be applied and implemented in practice.

Within the industry, there has been an active debate as to whether the audit function should have effective oversight of the firm's operational risk management. Note that the audit has a natural interest in the quality of internal controls. While subject to auditor review, however, the implementation of risk management must remain separate from the auditing function.

As a basic principle, auditor independence from the underlying activity is essential to ensure confidence in any assurances or opinions rendered by the auditors to the board, and this applies equally to the risk management function and its associated processes. Unless this independence is maintained, conflicts of interest could compromise the quality of both risk management and audit activity and seriously jeopardize risk governance.

Reading 04 Credit Risk Transfer Mechanism

Learning Objectives

- Compare different types of credit derivatives, explain how each one transfers credit risk, and describe their advantages and disadvantages.
- 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.

INTRODUCTION

The core risk exposure for banks is credit risk. Traditionally, banks have taken short-term liquid deposits and provided longterm, illiquid loans. Before the new millennium, banks had only a limited capacity for managing credit risk exposure. That all changed by the end of the twentieth century.

In 2002, then-Federal Reserve Chairman Alan Greenspan spoke of a "new paradigm of active credit management." He argued that the United States banking system had withstood the 2001-2002 economic slowdown in part because it had transferred and dispersed credit exposures using novel credit derivatives and securitizations. These included credit default swaps (CDSs), collateralized debt obligations (CDOs), and collateralized loan obligations (CLOs). *(We will learn about these terms in more detail in FRM Part II)*

This praise may seem misguided, given the role of credit transfer instruments in the build-up of systemic risk that preceded the 2007-2009 global financial crisis. However, the blame initially assigned to credit derivatives should in fact be laid at the feet of those who used and abused them.

The CDS and CLO markets remained robust, in certain respects, during and following the crisis. As a result, they fulfilled their purpose of helping to manage and transfer credit risk. Although there were major systemic deficiencies (e.g., conflicts of interest and transparency issues) that needed to be addressed, the mechanisms themselves were not the real culprit in precipitating the crisis.

Many commentators have come to the view that the role of these mechanisms in causing the crisis may have had more to do with failings of the pre-crisis securitization process than with the underlying principle of credit risk transfer. Note that the performance of credit derivative markets was, and remains, highly varied. Some parts of the securitization industry remained viable through much of the crisis and beyond. This is perhaps because their risks remained relatively transparent to investors.

While some credit transfer markets and instruments met their demise following the financial crisis, some are now reappearing (though not as they were in the past). Some of these instruments may take off again as the economy improves and if interest rates rise high enough to support costly securitization processes. Still others were relatively unaffected by the crisis. Some of the more robust instruments that survived the crisis include CDS and asset-backed securities (ABS), which can be backed by assets such as auto loans, credit cards receivables, equipment leases, and student loans. In addition, asset-backed commercial paper (ABCP) and mortgage backed securities (MBS) are expected to survive and draw renewed interest. While the CLO market was dormant for a few years following the crisis, new CLO issuance has grown significantly since 2011, surpassing pre-crisis volumes.

Collateralized debt obligations squared (CDOs-squared), as well as other forms of overly complex securitized instruments (e.g., single-tranche CDOs and complex ABCP) are unlikely to be revived. Their complexity was not meant to make these instruments better at hedging risk. Rather, it was meant to make them easier to market.

Meanwhile, new credit risk transfer strategies are emerging. One example can be seen in the growing number of insurance companies buying bank loans with the aim of

building asset portfolios that match their long-term liabilities. The high capital costs associated with post-crisis reforms suggest the "buy-andhold" banking model will remain a relatively inefficient way for banks to manage risks generated by lending and other banking activities. Regulators, as well as industry practitioners, are interested in securitization market reforms aimed at helping banks obtain funding, optimizing risk management, and encouraging liquidity and economic growth. In the longer term, the 2007-2009 crisis may end up being viewed more as a constructive test of the credit transfer market than its undoing.

ADVANTAGES OF CREDIT RISK TRANSFER MECHANISM

Banks have long had several ways to reduce their exposure to credit risk—both on an individual name and an aggregate basis. Such credit protection techniques include the following.

- Purchasing insurance from a third-party guarantor/underwriter: When done on an individual obligor basis, this is termed a guarantee. This is often seen in the U.S. municipal bond market.
- Netting of exposures to counterparties: This is done by looking at the difference between the asset and liability values for each counterparty and having in place documentation saying that these exposures can be netted against each other. Otherwise, if a counterparty goes bankrupt, the value of the obligation that counterparty has to the bank vanishes while the bank itself remains liable for any funds due to the counterparty.
- Marking-to-market/margining: This entails having an agreement in place among counterparties to periodically revalue a position and transfer any net value change between the counterparties so that the net exposure is minimized. This requires relatively sophisticated systems and has historically been seen in the market for exchange-traded derivatives.
- Requiring collateral be posted: Collateral can offset credit losses in the event of default. Note that there are instances when the circumstances precipitating the default could negatively impact the value of the collateral. For example, with an oil company offering barrels of crude as collateral, the probability of the company defaulting increases as the price of oil falls (this is known as wrong way risk).
- Termination/Put option: At inception, the counterparties agree to a set of trigger events that, if realized, would require the unwinding of the position using a pre-determined methodology (often the mid-market valuation). Such triggers could be downgrades, metrics based on balance sheet/ income statement items, and so on. In the case of a put option, the lender has the right to force early termination at a pre-determined price.
- Reassignment of a credit exposure to another party in the event of some predefined trigger (e.g., a ratings downgrade).

The strategies discussed above are effective but require specific agreements between the counterparties to enact. For this and other reasons, they may not easily fit the needs/goals of the counterparties. Critically, they are limited in that they do not isolate credit risk from the underlying positions for redistribution to a broader class of investors. Nor do they effectively "slice and dice" risk to enable the fine tuning of positions or credit portfolios.

Credit derivatives (e.g., CDSs) were formulated precisely to enable this fine tuning. Credit derivatives are off-balance sheet instruments that facilitate the transfer of credit risk between two counterparties (the beneficiary who sells the risk and the guarantor who buys the risk) without having to sell the given position. Credit derivatives permit the isolation of credit risk (e.g., in a loan or a bond) and transfers that risk without incurring any funding or client management issues. They are to credit what interest rate and foreign exchange derivatives were to market risk (because these innovations isolated market risk from funding and liquidity risk concerns).

Credit derivatives come with their own set of challenges. Each of the counterparties is obliged to understand the full nature of the risk transfer: how much risk is transferred, the nature of that risk, how the trigger events are defined, any periodic payment obligations, the obligations and rights for each counterparty in trigger scenarios, and so on. They also need to understand when the contract is enforceable and when (if ever) it is not. There are also issues of systemic concentration risk—even prior to the 2007-2009 financial crisis, regulators were concerned about the relatively small number of liquidity providers in the credit derivatives markets. They feared this nascent market could face disruption if any of the major participants were to experience distress (in isolation or in concert). It is interesting to note, however, that the single-name and index CDS markets operated relatively smoothly at the height of the credit crisis under the leadership of the International Swaps and Derivatives Association (ISDA).

Risk transfer and securitization enables institutions to effectively tailor pools of credit-risk exposures by facilitating the sale and repackaging of risk. Securitization is also a key source for funding consumer and corporate lending. According to the International Monetary Fund (IMF), the issuance of securitized loans soared from nearly nothing in the early 1990s to almost USD 5 trillion in 2006. Trading volumes collapsed following the subprime crisis, however, especially for mortgage-backed CDOs and CLOs. Only credit card receivables, auto loans, and lease backed securities remained relatively unaffected.

With the huge expansion in the issuance of corporate bonds since 2012, there has been a revival in the market for securitized corporate loans. This is because their CLO structure is transparent for investors and the collateral is reasonably easy to value.

The Securities and Exchange Commission, in conjunction with U.S. federal banking regulators, finalized Section 15G of the Securities and Exchange Act in 2014. This imposed risk retention provisions on asset-back securities, including CLOs. Specifically, the rules require securitizers to retain, without recourse to risk transfer or mitigation, at least 5% of the credit risk.3 These provisions were designed to align securitizers' interests with those of investors, requiring the former to "have skin in the game."

When properly executed in a robust, liquid, and transparent market, credit derivatives contribute to the process of credit price discovery (i.e., they clarify and quantify the market value for a given type of credit risk). In addition to putting a number to the default risk incurred by many large corporations, CDS prices also offer a means to monitor default risks in real time (as opposed to periodic credit rating assessments). The hope is that improvements in price discovery will eventually lead to enhanced liquidity, along with a more efficient market pricing of credit spreads for the full spectrum of instruments with credit risk exposure.

Historically, it has been true that corporate bond markets perform price discovery. However, bonds blend interest rate and credit risk (and sometimes liquidity risk) together. Moreover, the corporate bond market is only useful to understand the credit risk for those companies that issue bonds—which is generally limited to the largest public companies. On the other hand, credit derivatives can potentially help in pricing the credit risk embedded in privately traded high-yield loans and loan portfolios.

Credit risk in a mature credit market goes beyond default risk to include risks arising from credit spread fluctuations. These risks affect the valuation of all associated instruments subject to credit risk (e.g., bonds, derivatives, and loans). Accordingly, the traditional "credit risk" evolves to the "market risk of credit risk" (for certain liquid assets).

Of course, pricing credit risk and regarding it as a variable with a non-stationary value is incorporated (at least to an extent) in traditional bond analysis. Consider a corporate bond duration-hedged by a treasury bond: The resulting interest rate spread will tend to increase as the obligor's credit quality declines. New technologies, innovations, and markets are increasing the transparency of credit pricing across the full range of the spectrum and thus this concept is becoming increasingly critical to risk management.

SECURITIZATION CONCEPT

Securitization involves the repackaging of loans and other assets into new securities that can then be sold in the securities markets. This eliminates a substantial amount of risk (i.e., liquidity, interest rate, and credit risk) from the originating bank's balance sheet when compared to the traditional buy-and-hold strategy.

The securitization process begins with the creation of a corporation called a special purpose vehicle (SPV). The SPV then purchases loan portfolios from several banks to create investments products (e.g., CLOs). SPVs are mainly funded by several classes of bonds, arranged by seniority and/or credit rating, along with a relatively small equity tranche. This equity tranche, which is the most junior tranche, will usually provide less than 10% of an SPV's total funding.

The trend toward securitization began in 1968 with the birth of the Government National Mortgage Association (GNMA, also known as Ginnie Mae). Consumer ABSs in the United States and residential mortgage-backed securities (RMBS) in the U.K. emerged in the 1980s. The 1990s saw the development of commercial mortgage-backed securities (CMBS) in the United States Between 2000 and 2007, there was a surge in the issuance of very complex, risky, and opaque CDOs in the U.S. private label securitization market.

Buy and hold to originate to Distribute

Starting in the 1980s, certain banking activities shifted from the traditional buy-and-hold strategy to a new originate-to-distribute (OTD) business model. Credit risk that would have once been retained by banks on their balance sheets was sold, along with the associated cash flows, to investors in the form of ABSs and similar investment products. In part, the banking industry's enthusiasm for the OTD model was driven by the Basel capital adequacy requirements. Specifically, banks sought to optimize their use of capital by moving capital consuming loans off their books. Accounting and regulatory

standards also tended to encourage banks to focus on generating the upfront commissions associated with the securitization process.

The shift toward the OTD business model seemed to offer the financial services industry many benefits.

- Originators benefited from greater capital efficiency and enhanced funding opportunities, as well as lower earnings volatility (at least in the short term), because the OTD model seemingly dispersed credit risk and interest rate risk across many market players.
- Investors benefited from a wider array of investments, allowing them to diversify their portfolios and better sync their risk/return profiles with their goals and preferences.
- Borrowers benefited from the expansion of available credit and product options, as well as from the lower borrowing costs resulting from these benefits.

However, benefits of the OTD model progressively eroded as risks accumulated in the years leading up to the financial crisis. And while there is widespread disagreement regarding the OTD model's relative contribution to the crisis, there is a consensus that it created moral hazard by lowering the incentives for lenders to monitor the creditworthiness of borrowers. There is also agreement that too few safeguards were in place to offset this moral hazard.

Nevertheless, leading up to the financial crisis, banks deviated from, rather than followed, the OTD business model. Instead of acting solely as intermediaries (i.e., transferring risk from mortgage lenders to capital market investors), many banks took on the role of the investor. In the mortgage market, for example, relatively little credit risk was transferred. Instead, many banks retained or even acquired a considerable amount of securitized mortgage credit risk.

Risks that should have been broadly dispersed under the OTD model were instead concentrated in entities primarily established to skirt mandatory capital requirements. Banks and other financial institutions achieved this by establishing highly levered off-balance sheet ABCP conduits and structured investment vehicles (SIVs).

Banks misjudged the risks (e.g., reputation risk) contained in the commitments made to SIV investors. They also (falsely) assumed that there would be a substantial ongoing access to liquidity funding and that markets in these assets would be sufficiently liquid to support securitization.

Firms that were selling their credit exposures found themselves retaining a growing pipeline of credit risk. Furthermore, they did not adequately measure and manage the risks that would materialize if assets could not be sold. Some levered SIVs suffered from significant liquidity and maturity mismatches, making them vulnerable to a classic bank run (or rather a shadow bank run).

These problems shed light on the need to strengthen the foundations of the OTD model. The factors that exacerbated these weaknesses included bank leverage, faulty origination practices, and the fact that many financial firms chose to retain (rather than fully transfer) the credit risk embedded in the securities they originated. Among the issues that needed to be addressed were the following.

- There were misaligned incentives along the securitization chain, driven by the pursuit of short-term profits. This was the case among many originators, organizers, managers, and distributors. Investor oversight was weakened by complacency, as market growth beckoned many to "let the good times roll." The complexity of these instruments and a lack of understanding among investors also served as barriers to market discipline and oversight.
- The risks embedded in securitized products were not transparent. Investors had difficulty assessing the quality of the underlying assets and the potential correlations between them.
- There was poor securitization risk management, particularly regarding the identification, assessment, handling and stress testing of market, liquidity, concentration, and pipeline risks.
- There was an overreliance on the accuracy and transparency of credit ratings. This was problematic because rating agencies failed to adequately review the granular data underlying securitized transactions and underestimated the risks of subprime CDO structuring.12

Figure 4.3 The self-reinforcing securitization chain.[11]

Figure 4.3 summarizes this self-reinforcing securitization chain that amplified systemic risk during the crisis by allowing massive leverage and risk concentration in the financial sector.

While operating at a fraction of its pre-crisis size, the securitization market is on the rebound. MBSs, particularly those issued by U.S. government agencies, continue to dominate the landscape in terms of the volume of outstanding securities, new issuances, and trading. The markets for other asset-backed securities, such as those related to consumer lending, have held their ground since the crisis and have grown in recent years. As for CDSs, while the notional amount outstanding has fallen from a peak of USD 61.2 trillion in the first half of 2008 to only USD 8.1 trillion in the second half of 2018.13 However, the volume of contracts cleared by central counterparties (CCP) has risen and in the second half of 2018 accounted for 55% of all contracts.

The dust has not entirely settled on the regulatory environment. Some measures are still being drafted, some are in various stages of implementation, and others are facing the possibility of repeal. This regulatory uncertainty serves as an obstacle to securitization's comeback. It remains to be seen if, once implemented, these new measures will be enough to prevent the formation of a similar constellation of

incentives, actors, and circumstances that plagued the securitization process before the crisis.

While it is important to be cognizant of the potential risks posed by credit derivatives, the case favouring a thriving market in these financial instruments is compelling. The paradigm of active credit management has not been replaced by a new paradigm. The demand for instruments that efficiently transfer credit risk and improve the effectiveness of risk management continues to prevail, and the OTD model of banking based on the transfer and dispersion of credit risk continues to carry the promise of furthering systemic financial stability.

Reading 05 Modern Portfolio Theory and Capital Asset Pricing Model

Learning Objectives

- 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 the capital 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 Sortino ratio.

INTRODUCTION

In this reading we will cover some important topics of finance industry which laid down the foundation for modern tools of asset pricing(mainly stocks). When students try to read whole text of Modern portfolio theory (MPT) and Capital asset pricing model (CAPM) in crude form it leads to lots of confusion and misunderstanding. This happens because of the contradiction between some theories. The best approach to simply this reading is knowing the history of evolution of asset pricing tools which we will discuss below. While writing content for this topic my goal is to prepare you for exam and hence either I will drop unnecessary discussions or tone down the technical language in order to simplify this discussion.

Evolution of Asset Pricing

In this section we will discuss evolution of asset pricing and relevance of that evolution for you as FRM student.

Don't put all the eggs in one basket – Meaning of diversification before 1958: We all know the concept of diversification of investment in order to reduce the risk. If you invest in 10 stocks instead of 1, the risk is reduced. In the book Intelligent Investor, Benjamin explained the importance of diversification which later became a quote "don't put all the eggs in one basket". This is the time when the concept of diversification was limited to instead of investing in only one asset, prefer investing in different assets or asset categories. Example: If you have $100000 then you should invest $10,000 in 10 stocks instead of investing all the funds in one stock. The method or tools used to select valuable stocks are still the same. Investors focused on EPS, market cap, dividend payout, board of directors' composition etc which relevant even today. Please note currently investors were not much focused on risk of investment. This is mainly because unlike return, no tools were available to quantifying risk of investment and hence risk management was only limited to basic diversification. There is one more problem, There was no formal method to tell, what proportion of funds one should invest to optimize returns and reduce risk in the process of diversification?

How many eggs to put in each basket? – Diversification quantified 1952.

This is the first-time statistics enters finance industry. Harry Markowitz the father of Modern Portfolio Theory (MPT) published paper in Journal of Finance 1952, which provides the statistical toolsets (mean variance framework) to measure risk/return the first time. This theory provides the quantification of risk and diversification, which was mission before. In 1952 paper, there was no discussion of risk-free asset. In 1958 Tobin further developed this theory by introducing risk free security which results into Capital Market Line. The modern portfolio theory was much appreciated by academia but heavily criticized by investors/ industry for being too mathematical for investment purpose. Obviously because unlike today, nerds were busy in physics research and rocket launching and the financial market was handled by the rest. The modern portfolio theory gave the framework which is known as mean-variance framework.

This theory provided (relevant topics for our exam)

- Calculation of risk (and return) for single asset using standard deviation.
- Calculation of risk and return for portfolio.
- Benefits of diversification with the help of correlation between assets.

- Concept of efficient frontier and investors portfolio selection.
- Capital Market Line (further development in MPT by tobin)

Problems in MPT apart from assumptions

- No separation of systematic risk and unsystematic risk.
- Not useful for asset pricing

MPT was recognized by Industry – because of CAPM 1962 to 1966.

CAPM was developed by Treynor (1962), Sharpe (1964) and Lintern (1965), independently which is based on MPT. Each of them gets recognition for CAPM because of the different approaches they used to arrive at the same conclusion CAPM. The CAPM gives a simple equation to price assets and hence was considered very useful by industry. One can not use CAPM without first applying MPT, hence MPT got its recognition. Importance of CAPM over MPT

- Use in expected return of investor and asset pricing.
- Use of risk free security.
- Separation of systematic risk from total risk.
- Security Market line.

Measuring the performance – Outcome of CAPM

Further or simultaneous developments in CAPM resulted into ratios which we can use to measure the performance of securities or portfolio managers. In this reading we will discuss following concepts which are build over CAPM/MPT

- Sharpe ratio
- Treynor ratio
- Jensens Measure
- Tracking error
- Information ratio
- Sortino Ratio

Note: To understand the concepts discussed below, you should be well versed with the concepts discussed in quants (Probability till regression analysis).

MODERN PORTFOLIO THEORY

The assumptions of modern portfolio theory

- Returns are normally distributed: The assumption is important and allows investor utility choice to be stated in terms of mean and standard deviation (variance). Investors do not care about the skewness and kurtosis of the distribution of return.
- Investors are rational and risk averse: Investors evaluate portfolio allocation based on the mean and variance of the expected return distribution. Investors seek to maximize the utility
- Markets are perfect: This means there are no taxes or transaction costs, investors have free access to information, perfect competition exists among all the market participants.

Because the returns are not perfectly correlated, investors can invest in diversified portfolio in order to minimize risk while keeping the expected return. Please note, in theory investing in multiple non correlated asset reduces the risk but returns are unaffected. This is because return and risk of portfolio (assuming two assets to simplify discussion) is calculated as

Assume return r1 and r2, standard deviation Sd1 and Sd2 and weight of investment W1 and W2 of asset A1 and A2 respectively.

Return of two asset portfolios is calculated as:

$$R_p = r_1 w_1 + r_2 w_2$$

Standard Deviation of two asset portfolios:

$$SD_P = \sqrt{(Sd_1 w_1)^2 + (Sd_2 w_2)^2 + 2Sd_1 Sd_2 w_1 w_2 \rho_{12}}$$

Whereρ_{12} *is the correlation between asset A*1 *and A*2.

Note: Calculation of SD, correlation and beta (will use later in this reading) are already discussed in book 2 basic statistics reading, hence not discussed here.

The formula used for SD of portfolio uses correlation between two assets which impacts the result. Here, correlation is the source of diversification benefits. Summary of correlation impact –

- If correlation is +1 i.e. perfect positive correlation: No diversification benefit in adding two assets in portfolio because standard deviation of portfolio is simply weighted average of SD of each asset.
- If correlation is -1 i.e. perfect negative correlation: Highest diversification benefit in adding two assets in portfolio.
- If correlation is less than +1(including negative): Diversification benefit in adding two assets in portfolio because SD of portfolio is less than weighted average of SD of individual assets.

The conclusion is as the correlation decreases, diversification benefit increases.

Efficient Frontier

Portfolio diversification enables (at least in theory) the zero-cost reduction of risk exposures to individual assets. Therefore, investors should receive no compensation for taking on the specific risk (also known as the idiosyncratic risk) of any asset.

Logically, a reduction in risk should result in lower expected returns. If the asset weights are appropriately selected, however, the resulting diversification can enable the optimization (i.e., maximization) of returns for any given level of risk. Plotting the optimal returns for each level of risk results in the efficient frontier, which is represented by the curved solid line in following diagram. Each point on this curve represents the portfolio of assets that is expected to offer the highest return for the given level of risk.

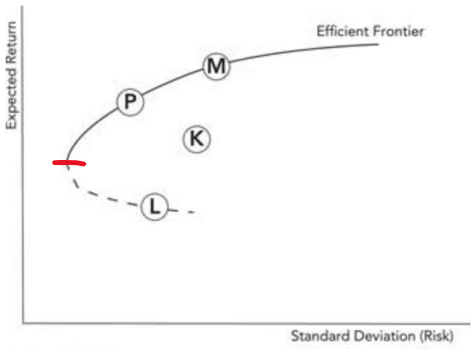


Figure 5.1 The efficient frontier of Markowitz.

In simple language, if we create various combination of portfolios by using different weights and assets, and plot all the portfolios as per risk and return, we will get the graph like above. All the portfolios will lie on or under the curve. A rational investor will always choose portfolio which offers best return between portfolios which offers same standard deviation and portfolio which offers the lowest standard deviation between portfolios which offers same return. The result of this behavios is efficient frontier (dark black line). Any investor will always choose portfolio on the efficient fronter and will never choose the portfolio which is on the dotted line (L) or portfolio under the curve (K).

The lowest point on the efficient frontier is known as global minimum variance portfolio (red). The portfolio is known as global minimum variance portfolio because it offers lowest variance. Hence the investor who wish to invest in the lowest risk portfolio will invest in global minimum variance portfolio.

Please note, all the portfolios are created using combination of assets with are risky. If investor adds the risk free security in this combination, it will result in the portfolio which will lie outside the curve (discussed in next section).

Capital market line

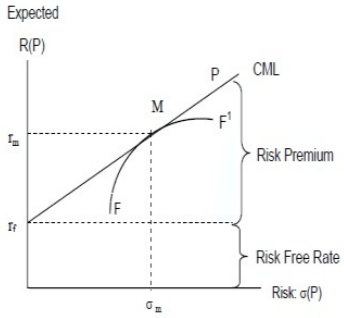
If we introduce risk free asset(T bill) in above setup we get the straight line known as capital market line. This is the comnbination of portfolio on efficient frontier and risk free asset. Assuming the homogeneous expectations of investors i.e. investors have same expectation relating to risk, return and correlation, they will select only one portfolio on efficient frontier which offers best return for risk taken. This portfolio is known as market portfolio (combination of all risky assets). In theory, because investors are not buying any portfolio combinaitons other than the market portfolio, other portfolio will cease to exist.

Measure of optimal return for given risk

$$= \frac{E(R_M) - R_f}{\sigma_M} = \frac{Expected\ return\ of\ market - risk\ free\ return}{Standard\ deviation\ of\ market}$$

This is formula of shapre measure which will discuss later in this reading.

In this diagram, M is the market portfolio. If M is combined with risk free asset with return Rf in various combination, we get straight line known as CML.



The tangency point of the line and efficient frontier is the market portfolio M. When investor invests in M and risk free security, it resulting portfolio will line on CML but below tangency point. All the portfolios which lie below M are known as lending portfolio. If investor allocates all the funds in Rf only, the point we get is Rf, where return is equal to rf and risk is 0.

Borrowing portfolio is the combination of borrowing at Rf and investing amount into M. The combination will lie on CML but above M. Assume investor have $1000 to invest. If he invests all the funds in M then the risk and return of the portfolio is on point M. However, if investor borrows $1000 and invest $1000 from his own pocket, resulting portfolio can produce returns more than return possible on efficient frontier but this will increase risk.

Equation of CML

$$E(R_p) = R_p + \frac{E(R_M) - R_f}{\sigma_M} X\ \sigma_p$$

Where slope of CML line is Sharpe ratio.

CAPITAL ASSET PRICING MODEL

CAPM uses assumptions similar to MPT. Assumptions are

1. Access to information for all market participants, meaning that all information is freely available and instantly absorbed;
2. No transaction costs, taxes, or other frictions;
3. Allocations can be made in an investment of any partial amount (i.e., security is perfect divisibility);
4. All participants can borrow and lend at a common risk-free rate; and
5. Any individual investor's allocation decision cannot change the market prices.

First two assumptions are same as MPT.

CAPM Model:

$$E(R_p) = Rf + (Rm - Rf)X\ \beta$$

Where Beta β is beta of stock to market calculated as,

$$\beta = \frac{Cov\ (x, m)}{\sigma_M^2} = \rho_{xm} \frac{\sigma_x}{\sigma_M}$$

Rf is risk free rate,

Rm is Expected market return

E(Rp) is expected return of asset

Cov(xm) = covariance of return of stock and market

σ_m is variance of market.

$(Rm - Rf) = marekt\ risk\ premium$ (Please note the difference between market return and market risk premium for exam purpose)

Illustration 1:

Assume the expected return of market is 10% and risk free return is 5%. Assuming the beta of stock A is 0.5, to calculate the expected return of investor,

E(Rp) = 5 + (10-5) x 0.5 = 7.5%

However if beta of stock is 1 then using the same formula, answer will be 10%

And assuming the beta of 0, the answer is 5%.

Why so?

Beta is the relationship of stock with market. If the beta is 1 this means the stock is equally risky as market, then investor should seek the return equal to market 10% and not less or more. If the beta is 0, then stock has zero risk compared to market, which is equivalent to investing in risk free security and investor should seek return equal to Rf 5%. And when investor invests in security which is less risky compared to market, investors expected return should be less than market return but more than risk free rate.

CAPM equation shows that the investor seeks the compensation known as risk premium in expected return of security in comparison to market. Riskier the security compared to market, higher the risk premium.

Illustration 2:

In above illustration, we assumed beta value, but we can also calculate beta if the required information is given. Assume the standard deviation of stock and market is 25% and 20% respectively. The correlation between the stock and market is 0.65. Calculate the beta and expected return using same information from above illustration(except beta).

$Beta\ = \frac{0.25}{0.20}\ X\ 0.90 =\ 1.125$

Using this beta in above equation, we get expected return of 10.625%. Because investor is investing in security which is riskier than market, investors required return is higher than market return.

Beta can also be estimated using OLS method of linear regression. We are finding slope coefficient in this case.

Beta As the measure of systematic risk

In the first section of this reading we used standard deviation as the measure of risk. However, in this part we are using beta as the measure of risk. The reason for this change is very simple. Stock prices mainly moves for two reasons, first is market movement and second is own stock specific problems. Like internal fraud, issues with management. This is firm specific risk and known as idiosyncratic risk or unsystematic

risk. Standard deviation measures the total risk of the stock because it captures all movements(from historical data). When we are dealing with only one security total risk is important. However, when the we have well diversified portfolio, the firm specific risk is not important. In well diversified portfolio, if the market goes down, irrespective of the level of diversification portfolio will go down. Hence, in case of well diversified portfolio, investor will only ask for the compensation/ risk premium for risk related market.

Overvalued vs undervalued security

In the above section we discussed the calculation of expected return of asset using CAPM. However, investor can also calculate the expected return using analysis valuation. Assume analyst projects the value of stock after 1 year equal to $110 which is currently trading at $100. In this case the expected return using analyst valuation is 10%. However, expected return using CAPM might be completely different say 12%. Using both the returns investor can decide if the security is undervalued or overvalued.

The confusion:

The return calculated using CAPM is called as required return and return of analyst valuation is called as expected return. However, some authors use just reverse of this, i.e. CAPM return as expected return and analyst return as required return. If you get question which requires the you to decide undervalued/overvalued security based on comparison of expected and required return, there is no way to know which return is which. Fortunately, if we analyse the past exams we can say, GARP is aware of this problem, and in exam irrespective of term used, GARP will specify the CAPM or analyst return. For example, expected return (using CAPM) is 10%.

Overvalued or undervalued security (Please watch video for reasoning).

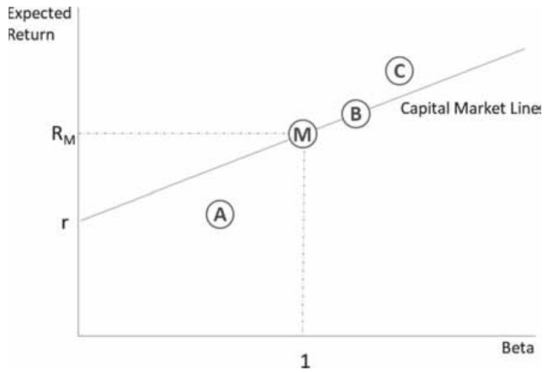
If CAPM return (required return) > Analyst return (expected return),

- Stock is overvalued.
- Overvalued security would plot below security market line.
- Investor should short this stock

If CAPM return (required return) < Analyst return (expected return),

- Stock is undervalued.
- Overvalued security would plot above security market line.
- Investor should purchase this stock

Security market line is given by CAPM equation by plotting beta on x axis and E(R) on Y axis. M is the market portfolio when the beta is equal to 1 and return is equal to Rm. When the beta is zero SML touches Y axis at Rf indicating the return of Rf and zero beta for risk free security.



PERFORMANCE MEASURES

Portfolio managers need to measure the performance of their investment/portfolio. If manager focuses only on the return produced by asset, this might lead to wrong conclusions because performance should be measured in risk and return both. Following table provides the information of three portfolios A, B and C.

	Portfolio A	Portfolio B	Portfolio C
Expected Return	10%	15%	20%
Standard Deviation	8%	20%	22%
Beta wrt market	1.2	0.5	0.2

If we analyse these three options just by using returns, then we might conclude portfolio C is best investment options. But this is not the right choice because for higher returns of C one need to take higher risk of 20% compared to Portfolio A (SD of 8%) which is substantially lower risk. It is difficult to compare these portfolios using these parameter values directly. Hence economist like Sharpe, Traynor and Jenson designed measures which combine the risk and return which is referred as risk adjusted return measures.

We will use four performance measures which measures the performance of portfolio –

- Sharpe Ratio
  Treynor Ratio
- Jensons Alpha
- Sortino Ratio

For all the ratios, the rule is the higher the better. If ratio of one portfolio is higher than other portfolio then it performed better compared to other portfolio.

Sharpe Measure

Formula

$$sharpe\ ratio = \frac{E(R_p) - R_f}{\sigma_p} = \frac{Expected\ return\ of\ portfolio - risk\ free\ rate}{standard\ deviation\ of\ portfolio}$$

When to use sharpe ratio?

Sharpe ratio should be used for the undiversified portfolio or single assets. This is because we are considering total sight in the form of standard deviation in formula.

Also note that the sharpe ratio is the slope of the capital market line which we discussed in the previous section.

Treynor Measure

Formula

$$Treynor\ ratio = \frac{E(R_p) - R_f}{\beta_p} = \frac{Expected\ return\ of\ portfolio - risk\ free\ rate}{Beta\ of\ portfolio}$$

When to use Treynor ratio?

Treynor measure is similar to Sharpe but in denominator, it considers beta of portfolio which is the measure of systematic risk. Hence Traynor is useful when the portfolio is well diversified.

Treynor measure as slope of SML (Security market line)

If we adjust this measure by calculating Treynor measure for market, then the modified formula is the slope of SML / CAPM equation.

$$Treynor\ ratio\ of\ market = \frac{E(R_m) - R_f}{\beta_m} = E(R_m) - R_f, where\ \beta\ of\ market\ is\ 1$$

In CAPM equation,

$$E(R_p) = Rf + (Rm - Rf)X\ \beta$$

Treynor measure can be considered as slope of CAPM or SML line.

Jenson's Alpha

Formula

$$Jensons\ alpha = E(R_p) - CAPM\ return = E(R_p) - [Rf + (Rm - Rf)\ \beta$$

When to use?

Because of the use of beta in formula, Jenson's alpha is suitable for the performance measurement of well diversified portfolio.

Illustration (Sharpe, Treynor and Jenson's)

We will use the same information given in above table

	Portfolio A	Portfolio B	Portfolio C
Expected Return	10%	15%	20%
Standard Deviation	8%	20%	22%
Beta wrt market	1.2	0.5	0.2

Assuming the risk free rate of 5% and market return of 8%, find the Sharpe ratio, Treynor ratio and Jenson's alpha.

Ratios	Portfolio A	Portfolio B	Portfolio C
Sharpe ratio	0.10 – 0.05 / 0.08 **= 0.625**	0.15 – 0.05/ 0.20 = **0.5**	0.20 – 0.05 / 0.22 **= 0.6818**
Treynor ratio	0.10 – 0.05 / 1.2 = **0.04166**	0.15 – 0.05/ 0.5 =2	0.20 – 0.05 / 0.2 0.75
Jensen's alpha	0.10 – (0.05 + (0.08 – 0.05)1.2) = **0.014**	0.15 – (0.05 + (0.08 – 0.05)0.5) = **0.085**	0.20 – (0.05 + (0.08 – 0.05)0.2) = **0.144**

Analysis:

Performance order using

- Share Ratio: Portfolio C > Portfolio A > Portfolio B
- Treynor Ratio: Portfolio B > Portfolio C > Portfolio A
- Jenson's Alpha: Portfolio C > Portfolio B > Portfolio A

Sortino Ratio

Sortino is modified version of Sharpe ratio, where instead of risk free rate we use minimum acceptable return and instead of standard deviation we use downside deviation. We know standard deviation captures the shocks of upside and downside both. Meaning if the stock is moving up, standard deviation considers this as risk however, upside risk is good risk which increases risk. Hence, considering downside risk is more suitable. The downside risk is calculated by downside deviation, which is different from standard deviation because in calculation we only take values when return goes below mean and ignore values when returns are above mean in mean deviation calculation.

Formula

$$Sortino = \frac{R_p - R_{min}}{Downside\ deivaiton}$$

Illustration:

Assume the return of portfolio is 10%, downside deviation is 5% and minimum acceptable return (like benchmark return) is 4%.

Sortino ratio $= \frac{0.10-0.04}{0.05} = 1.2$

Note: Downside deviation will be mostly provided in exam question, because it is too lengthy to calculate in exam setting.

TRACKING ERROR AND INFORMATION RATIO

In previous section we discussed the performance measure of portfolios. In this section we will discuss the performance measure of portfolio managers. For information ratio calculation we use the past track record of portfolio manager, by taking return produced by portfolios he managed. Higher deviation in return of portfolios managed by a manger is indicative of lower skills of portfolio management of a manager. The deviation is measured by tracking error or TE. If the portfolio manager's TE is low, this is indication of better skills of portfolio management.

$$Information\ ratio = \frac{E(R_p - R_B)}{TE}$$

Where, Rb is the return of benchamark (like S&P index) and TE is tracking error. The calculation of TE can be done using formula (not important for exam).

$$Tracking\ error = \sqrt{\frac{\sum(R_p - R_B)^2}{n-1}}$$

This formula is similar to standard deviation, where average return is replaced by return of benchmark. For exam purpose just remember that we use benchmark instead of return average in formu. GARP mgith ask this in theory.

Reading 06 The Arbitrage Pricing Theory and Multifactor Models of Risk and Return

Learning objective

- 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.
- Calculate the expected return of an asset using a single-factor and a multifactor model.
- Explain models that account for correlations between asset returns in a multi-asset portfolio.
- 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.

INTRODUCITON

The CAPM model which we discussed in previous topic is defined by linear regression model which is one variable linear regression model. The CAPM model is one factor model which considers the impact of only one risk factor which is beta. After CAPM, Economist devised more developed model which considers the impact of more than one risk factors which impact the asset prices.

One of such model developed by Ross known as arbitrage pricing theory (APT). This is multifactor model that measures the linear relationship between asset prices and risk factors. The risk factors such as indices, bond index and some macroeconomic factors.

APT assumes there is no arbitrage is possible and if it exists, it is immediately absorbed by market participants. As per APT, the expected return for security I can be modelled as

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

E(Ri) = Expected return of stock

Beta = Sensitivity for risk factor

F = Risk factor

ei = random error

Assumption of APT

- Market participants are seeking to maximize utility (profits)
- Frictionless markets.
- There are no arbitrage opportunities

The issue with APT model is that it does not specify the specific factors which impacts the return.

APPLICATION OF MULTIFACTOR MODEL

In their famous paper, Fama and French (1996) present a threefactor model that captures these factors.7 Their model extends CAPM by adding two additional factors:

- Small Minus Big (SMB) (i.e., the difference between returns from small stocks and those from large stocks); and
- High Minus Low (HML) (i.e., the difference between the returns on stocks with high book-to-market values and those of stocks that have low book-to-market values).

The three-factor model proposed by Fama and French is then:

$$E(R_p) - r = \beta_i[E(Rm) - r] + \beta_{SMB}E(SMB) + \beta_{HML}E(HML)$$

Illustration:

Assume the following market forecast

- 12.5% return on equities over the next year
- SMB of 3.5%, SMB beta factor 1.25
- HML of 0.0% and , HML beta factor -0.75
- Risk free rate of 1.5%
- Alpha = 3.0%
- Beta of market = 0.25

E(Rc) – 1.5% = 3.0% + 0.25 (12.5 -1.5) + 1.25*3.5 – 0.75 * 0.0

E(Rc) = 11.63%

Expected return is equal to 11.63%.

Reading 07 Principles for Effective Data Aggregation and Risk Reporting

Learning Objectives

- Explain the potential benefits of having effective risk data aggregation and reporting.
- Describe the impact of data quality on model risk and the model development process.
- Describe key governance principles related to risk data aggregation and risk reporting practices.
- Identify the governance framework, risk data architecture and IT infrastructure features that can contribute to effective risk data aggregation and risk reporting practices.
- Describe characteristics of a strong risk data aggregation capability and demonstrate how these characteristics interact with one another.
- Describe characteristics of effective risk reporting practices.
- Describe the role that supervisors play in the monitoring and implementation of the risk data aggregation and reporting practices.

INTRODUCTION

Effective risk analysis requires sufficient and high-quality data. This makes data a major asset in today's world, and it should be treated as such.

Risk analysis can be done using:

- **Internal data** of an organization (e.g., transaction data within a financial institution or the specific costs of raw materials for a manufacturing company). Statistical techniques for analysing this data are wide-ranging and can include tools such as machine learning and artificial intelligence (Al).
- **External Data:** (e.g., data on the economy or on a specific industry). Financial institutions need data on past inflation rates, changes in money supply, major interest rates, exchange rates, and so on. Some external data can be collected from public sources, whereas other types of data may have to be purchased from vendors.

A special committee of the Basel Committee on Banking Supervision (BCBS) examined bank data collection, data storage, and data analysis practices. That committee uncovered many problems within the industry and subsequently published a special report on risk data management. It concluded that data quality in the banking industry was inadequate to aggregate and report risk exposures across business lines, legal entities, and at the bank group level.

To address these inadequacies, the BCBS published a set of 14 principles to guide banks as they overhauled their risk data aggregation and reporting capabilities (BCBS 239). The BCBS defines risk data aggregation as the "process of defining, gathering, and processing risk data according to [a firm's] risk reporting requirements to enable the bank to measure its performance against its risk tolerance/appetite.

Data in model risk

Data acquisition plays an important role in model risk. Financial institutions rely on models to guide their day to day operations and to analyze their risk exposures. As a result, even the smallest of model errors can have dire consequences.

Model risk can be decomposed into four components:

- Input risk
- Estimation risk
- Valuation risk
- Hedging risk.

Note that data acquisition is especially pertinent when considering input risk. Models depend on the quality of data because it is used to create statistical estimators of their parameters. As the adage goes: "garbage-in, garbage-out".

BENEFITS OF EFFECTIVE RISK DATA AGGREGATION AND REPORTING

If a firm fully adheres to the BCBS principles, its risk managers will have less uncertainty regarding the accuracy, integrity, completeness, timeliness, and adaptability of the data they use. Simply put, risk management benefits from having high-quality risk data at all levels of the organization.

Designing and implementing an effective risk data aggregation and reporting capability enhances tactical and strategic decision-making processes. This reduces the chance of losses and improves risk-adjusted returns.

Banks need to leverage the relevant risk information and carefully consider what data can be obtained (and at what cost). It can be challenging for risk managers to process and refine fast moving big data into usable risk information. It is essential that decision-makers have confidence in the quality of the underlying data. If the information is inaccurate or incomplete, management may not be able to make sound risk decisions.

Advances in data analytics (e.g., machine learning) are being used to collect, analyse, and convert large volumes of unstructured data into usable information. This makes it easier for organizations to avoid information overload and enables them to turn vast amounts of data into a strong competitive advantage.

Rigorous model validation also plays a critical role in risk management. In the United States, model developers must comply with regulatory guidance on model vetting. The Federal Reserve provides comprehensive guidance for banks on effective model risk management. This guidance calls for a "rigorous assessment of data quality as well as the proper documentation." Model developers need to demonstrate that the data behind the model and the chosen methodology.

BCBS 239 was a major driver in the rise of the chief data officer (CDO) function. The CDO is typically responsible for standardizing a firm's approach to data management. Note that data standardization efforts have grown well beyond reference data to include financial products data and accounting data. If independent departmental applications and methodologies are based on consistent standards, the data that flows up through an organization's structure will provide a reliable, accurate, and manageable view of the institution's total risk profile.

If this is not the case, however, important connections among different dimensions of an organization's business will not be transparent. An example of such data risk is the case where customers with credit products in different business lines (e.g., a mortgage and a credit card) are not recognized as the same customer due to the absence of standardized customer identification codes.

An operational process that allows flawed data to enter the system may eventually cause failures in the aggregate. An example of such a failure can be seen in the role of erroneous/fraudulent mortgage application data in precipitating the 2007-2008 collapse of the U.S. housing market. Note that this flawed data, which concerned loan suitability, was submitted by individuals one application at a time yet at an unusually high frequency.

KEY GOVERNANCE PRINCIPLES

If firms follow BCBS principles, the risk management will have less uncertainty regarding the data quality they use. Effective risk data aggregation and reporting capability reduces the chances of losses and improves risk adjusted returns.

Principle 01: Governance

Governance—A firm'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.

Summary of commentary on Principle 01

A strong governance framework combined with well-designed data and IT infrastructure is necessary to ensure BCBS 239 compliance. Also, independent validation is required to ensure risk data aggregation and risk reporting (RDARR) capabilities are functioning as intended and are appropriate for the firms risk profile.

A bank with a limited ability to integrate data will have difficulties in satisfying the Basel Principles. Risk data (internal and external) is procured from various sources and technologies, hence collecting data and feeding it to analytics system is key challenge.

Effective risk data governance is achieved by implementing policies that set out a clear delineation of roles, incentive schemes and responsibilities for risk data management. In addition to revieing and approving a bank's RDARR, the board has an important governance role related to RDARR. RDARR policies should be reviewed and revised if necessary after major acquisition or changes in strategy.

Principle 02: Data architecture and infrastructure

***Data architecture and IT infrastructure**—A bank should design, build, and maintain data architecture and IT infrastructure which fully supports its risk data aggregation capabilities and risk reporting practices not only in normal times but also during times of stress or crisis, while still meeting the other Principles.*

Summary of commentary on Principle 02

Firms should establish integrated risk data architectures. Roles should be clearly specified, including the responsibilities for ensuring "adequate controls throughout the lifecycle of the data and for all aspects of the technology infrastructure." There is no uniform blueprint in place for a BCBS 239-compliant infrastructure and solutions are specific to each institution. The optimal approach ensures that all people and systems within the banking group are working with the same data, the same models, and the same assumptions.

Firms should create information on data characteristics. This could be in the form of various data models. The four primary types of data models include:

Semantic data models address the agreed-upon meaning of elements in the model. **Conceptual models** confirm human understanding of the system and its objectives. **Physical data** models translate the data requirements and properties expressed in the **logical model** into a specific implementation on an IT hardware/software vendor system platform.

CHARACTERISTICS OF A STRONG RISK DATA AGGREGATION CAPABILITIES

Principle 3 Accuracy and Integrity

A bank should be able to generate accurate and reliable risk data to meet normal and stress/crisis reporting accuracy requirements. Data should be aggregated on a largely automated basis to minimize the probability of errors.

Principle 4 Completeness

A bank should be able to capture and aggregate all material risk data across the banking group. Data should be available by business line, legal entity, asset type, industry, region, and other groupings, as relevant for the risk in question, that permit identifying and reporting risk exposures, concentrations, and emerging risks.

Principle 5: Timeliness

A bank should be able to generate aggregated and up-to-date risk data in a timely manner while also meeting the principles relating to accuracy and integrity, completeness, and adaptability. The precise timing will depend upon the nature and potential volatility of the risk being measured as well as how critical it is 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/crisis situations, set based on the characteristics and overall risk profile of the bank.

Principle 6: Adaptability

A bank should be able to generate aggregate risk data to meet a broad range of on-demand, ad hoc risk management reporting requests, including requests during stress/crisis situations, requests due to changing internal needs, and requests to meet supervisory queries.

Summary of commentary on Principle 03 to 06

The degree of timeliness required depends on the risk area being monitored (information requirement on trading floor is more time sensitive compared to loan portfolio). Compromise in timeliness are often made due to the need to extract and map data from different trading system into other system that can integrate, summarize and report on the consolidated data.

Adaptability would include the ability to stress test the parts of portfolio to produce an aggregated enterprise risk measure, also include the capability to incorporate changes in an upcoming regulatory framework and ability to combine that with historical data to produce an overall risk measures.

CHARACTERISTICS OF EFFECTIVE RISK REPORTING PRACTICES

Principle 7: Accuracy

Risk management reports should accurately and precisely convey aggregated risk data and reflect risk in an exact manner. Reports should be reconciled and validated.

Principle 8: Comprehensiveness

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

Principle 9: Clarity and usefulness

Risk management reports should communicate information in a clear and concise manner. Reports should be easy to understand yet comprehensive enough to facilitate informed decision-making. Reports should include meaningful information tailored to the needs of the recipients.

Principle 10: Frequency

The board and senior management (or other recipients as appropriate) should set the frequency of risk management report production and distribution. 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 the bank. The frequency of reports should be increased during times of stress/crisis.

Principle 11: Distribution

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

Summary of commentary on Principle 07 to 11

The BCBS notes that risk management report 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 decision about risk.

SUPERVISORY MEASURES

Although principles in previous sections are focused on internal risk reporting, some supervisors have indicated regulatory and stress-testing results would also help to inform the process when assessing bank compliance. More recently, the European Central Bank has stated that financial and regulatory reporting is part of BCBS 239 compliance. Though many banks have asked, regulators have not come forward with clearer guidelines for compliance. The regulators continue to emphasize that ascertaining compliance with BCBS 239 is a subjective exercise and that the standards for each bank are accordingly bespoke.

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.

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 08 Enterprise Risk Management and Future Trends

Learning objectives

- **Describe** Enterprise Risk Management (ERM) and **compare** an ERM program with a **traditional** silo-based risk management program.
- Compare the **benefits and costs** of ERM and describe the **motivations** for a firm to adopt an ERM initiative.
- Explain **best practices** for the governance and implementation of an ERM program.
- Describe **important dimensions** of an ERM program and relate ERM to strategic planning.
- 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.

INTRODUCTION

Earlier chapters of this book have focused on specific risk types (e.g., credit risk, market risk, or operational risk). This approach has also been adopted by banking regulators, who require banks to hold minimum capital against credit, market, and operational risk (e.g., Pillar I of Basel III). Looking at risk within risk types and specific business portfolios makes it easier to:

- Define and measure risk (e.g., most financial models deal with specific risks),
- Aggregate risk within business lines, and
- Hedge risk using derivative instruments, which tend to be risk specific.

However, it is also important to compare exposures to one another. Doing so allows firms to prioritize risk management and understand how risk-type and business line exposures add up to their total exposure. At the enterprise level, risks may negate each other (e.g., through netting and diversification) or exacerbate each other (e.g., through risk concentrations, contagion, and cross-over risks).

Enterprise risk management (ERM) applies the perspective and resources at the top of the enterprise to manage the entire portfolio of risks and account for them in strategic decisions. ERM improves upon silo-based risk management by giving executives an integrated, enterprise-level view of risk. This feature makes ERM an important supplement to the more limited perspective available from specific business lines or risk-type functions. It also focuses attention on the largest threats to a firm's survival and core functionality.

Another important feature of ERM is that it supports a consistent approach to enterprise risks throughout a firm, from the boardroom to the business line. This consistency can be achieved through a robust risk culture and an adherence to enterprise risk appetites and governance. Firms that lack this consistency may see one business unit reject an opportunity due to its risk, while similar opportunity is embraced by another unit.

Benefits of ERM

- Helps firms define and adhere to enterprise risk appetites
- Focuses oversight on most threatening risks. Identifies enterprise-scale risks generated at business line level
- Manages risk concentrations across the enterprise. Manages emerging enterprise risks (e.g., cyber risk, AML (anti-money laundering) risk, reputation risk)
- Supports regulatory compliance and stakeholder reassurance
- Helps firms to understand risk-type correlations and cross-over risks
- Optimizes risk transfer expenses in line with risk scale and total cost
- Incorporates stress scenario capital costs into pricing and business decisions
- Incorporates risk into business model selection and strategic decisions

ERM VS TRADITIONAL SILO BASED APPROACH.

Traditional Risk Management	ERM View
Risk viewed in the business line, risk-type, and functional silos	Risk viewed across business lines, functions, and risk types, looking at diversification and concentration
Risk managers work in isolation	Risk team integrated using global risk management committee and chief risk officer
Many different risk metrics that cannot be compared	Development of rational risk management frameworks and cross-risk universal metrics (e.g., VaR and scenario analysis) to integrate risk view (i.e., apples to apples)
Risk aggregated, if at all, within business lines and risk types. Difficulty seeing the aggregate risk picture	Tools and integrated frameworks make it possible to more accurately measure and track enterprise risk. Potentially, risk is aggregated across multiple risk types.
Each risk type managed using risk-specific transfer instruments	Possibility of cutting risk transfer costs firm-wide and integrated (e.g., multi-trigger) instruments
Each risk management approach (e.g., avoid/retain/mitigate/ transfer) often treated separately, with strategy rarely being optimized.	Each risk management approach is viewed as one component of a total cost of risk, ideally measured in a single currency. Component choice is optimized as far as possible in risk/reward and cost/benefit terms expressed in that currency.
Impossible to integrate the management and transfer of risk with balance sheet management and financing strategies	Risk management is increasingly integrated with balance sheet management, capital management, and financing strategies.

KEY ERM DIMENSIONS

ERM in practice can be thought in as five dimensional process. Following are the five dimensions and their examples

Dimension	Description	Example
Target	These include the enterprise's risk appetite and how it relates to its strategic goals (discussed in Chapter 2). Risk appetite is linked to operational mechanisms, such as global limit frameworks and incentive compensation schemes. One goal of ERM is to set the right targets and make sure they are not in conflict with other strategic goals.	Enterprise goals: Enterprise risk appetite, enterprise limit frameworks, risk-sensitive business goals and strategy formulation
Structure	The organizational structure of an ERM program includes the role of the board, the global risk committee and other risk committees, the CRO, and the corporate governance framework described in Chapter 3. The goal of ERM is to make each structure sensitive to the	How we organize ERM: Board risk oversight, global risk committee Risk Officer; ERM subcommittee; reporting lines for ERM; reporting structures

	enterprise scale risks faced by the firm, including indirect losses.	
Metrics and Identification	No amount of thoughtful target setting or ERM reorganization will help if a firm cannot identify enterprise-scale risks and measure their severity, impact, and (ideally) frequency. This chapter discusses key ERM metrics such as enterprise-level scenario analysis and stress testing. Other metrics include aggregate risk measures such as VaR, total-cost-of-risk methodologies, risk-specific metrics, and whole-of-firm risk mapping and flagging mechanisms. Here, the goal of ERM is to make sure the firm has the right family of metrics to capture enterprise risks.	How we measure enterprise risk: Enterprise-level risk metrics, enterprise stress testing, aggregate risk measures (Value-at-Risk, Cash-Flow-at-Risk, Earnings-at-Risk, etc.), "total cost of risk" approaches, enterprise level risk mapping and flagging, choice of enterprise-level risk limit metrics
ERM strategies	Firms also need to articulate specific strategies for managing enterprise-scale risks at either the enterprise level or through the business lines. This includes the fundamental decisions to avoid, mitigate, or transfer risks, along with the choice of enterprise risk transfer instruments.	How we manage ERM: Enterprise level risk transfer strategies, enterprise risk transfer instruments, enterprise monitoring of business line management of enterprise-scale risks
Culture	If targets, structure, and metrics are the bones of the ERM strategy, then culture is the flesh and blood. In short, a strong risk culture is built from a pervasive sense of common goals, practices, and behaviours.	How we do things: "tone at the top", accountability for key enterprise risks, openness and effective challenge, risk aligned compensation, staff risk literacy, whistle-blowing mechanisms

The success of ERM is governed by the how these five dimensions interact with each other.

ENTERPRISE LEVEL RISK DEMAND

A risk that looks small at the business line level can develop into a threat to the whole enterprise. Conversely, a risk that looks threatening at a business line level might look trivial in the context of the diversified enterprise risk portfolio. Following are four key reasons for focusing on enterprise level risk.

Top to Bottom – Vertical Vision

Large risks often begin their life a long way from the board room. As an example, consider the case of a car manufacturer. Suppose that a poor design or sourcing decision is made, and a potentially dangerous car part is installed. The risk is engineered into countless cars and therefore threatens the enterprise, its suppliers, and their insurers through recall and compensation costs, lost sales, and reputational harm.

We can see something similar happening in the "product factories" of financial institutions. For example, misconduct issues have plagued large financial firms in recent years. In these firms, selling a poor investment product may not seem like a

critical threat at the business line level when the business is young. As the business grows, however, that threat can rise dramatically over time.

For both financial and non-financial firms, the remedy might be something simple (e.g., tweaking the design or spending marginal amounts on better components) or something painful (e.g., closing a product line and firing the line manager). It might also mean recognizing that the risk is being driven by poor target setting by senior management.

ERM is the process of:

- Recognizing the potential threat to the whole enterprise arising from the risky design/production decision, and
- Picking up on early signs that things are going wrong to reduce the leveraging effect of time.

ERM brings risk decisions, across time and space, in line with the enterprise's stated risk appetite.

Are there potentially Dangerous concentrations of risk within the firm?

Line managers look after specific business lines and therefore it can be difficult for them to spot risk concentrations across the enterprise. Credit concentrations, for example, are the big red lever of the credit portfolio. If a bank loans too much to one person (i.e., name concentration), the bank risks a big hit. If too many borrowers belong to the same industry, a sector downturn could wreak havoc.

Hidden concentrations often build up across many different businesses because line managers cannot see the connections. In banking, for example, an institution may lend to one firm in its corporate loan division and then create a counterparty exposure with the same firm in its derivatives division. Many kinds of concentration risk can creep across enterprises. Examples include the following.

- Geographical and industry concentrations. Examples include where a manufacturer's production facilities or a bank's core IT is located within a given region, or where a financial firm is over-exposed to default risk in a local economy or type of industry.
- Product concentrations. For example, a derivative or retail product might be mispriced in multiple divisions.
- Supplier concentrations. An example would be a firm that has too great of a dependency on a link in its global supply chain or, in the case of financial institutions, on technology suppliers or data/risk analysis providers.

During the global financial crisis of 2007-2009, many firms found themselves with concentrations of mortgage risk in both specific geographies and risky product types (e.g., negative amortizing mortgages).

Firms cannot always avoid concentrations. For example, insurers and bankers have been wary of concentrating their key systems, infrastructure, and data with cloud computing providers. However, large security investments made by cloud providers mean that going to the cloud could offer one way to manage cyber risk and strategic technology risk. Firms must manage such risk trade-offs.

Ultimately, ERM includes the recognition and management of concentration risks according to a firm's risk appetite.

Think Beyond Silos

Conversely, there are major diversification benefits that can only be understood at the enterprise level, particularly in terms of risk type.

Acknowledging risk-type diversification reduces the aggregate risk capital a firm needs to hold. It also helps to transform "badly behaved" risk portfolios, including many kinds of operational risk, into loss distributions closer to a normal bell-shaped curve.

At the same time, thinking beyond silo-based risk management helps firms to understand how risk types can interact to worsen enterprise threats. For example, enhanced consumer protection in the United States since the global financial crisis has created significant cross-over risks between credit risk, legal risk, and reputational risk. As a result, banks are under growing pressure to make sure they are not deceiving customers or engaging in abusive acts.

Likewise, ERM can help firms understand how risk can cross over between risk types during times of stress.

Don't Insure the Kettle

Consumers are nearly always right to turn down offers of insurance for inexpensive goods. For example, if a kettle catches fire, it is the home insurance they need to worry about and not the replacement cost of the kettle.

Firms have been applying the same logic at the enterprise level since the 1960s by using mechanisms such as self-insurance and captive insurance to retain portions of property, liability, and other risks. Note that around 20% of firms with between USD 1 billion and USD 5 billion in revenue have a captive insurance unit; that percentage rises to over 50% for firms with at least USD 10 billion in revenue. Risk retention decisions are best made at the enterprise level, where the aggregate level of risk exposure can be understood.

The process of understanding an enterprise risk and then managing a portion of it in-house is happening again today with cyber risk. So far, only around 12% of firms using captives employ them to provide cyber coverage. However, 23% of them plan to do so by 2020. This growth will be driven by firms improving their understanding of cyber risk, such as through enterprise risk assessments of cyber dependencies and vulnerabilities, and then applying quantitative metrics to assess the financial impact of cyber events.

This demonstrates a general truth: firms that understand enterprise risk can translate this understanding into dollar savings. The process is most obvious in the case of insurable risks, but it is true for financial risks as well. As firms understand their true exposures (i.e., considering enterprise netting and diversification effects) they can retain the right level of exposure and target resources towards the real, enterprise threatening risks.

RISK CULTURE

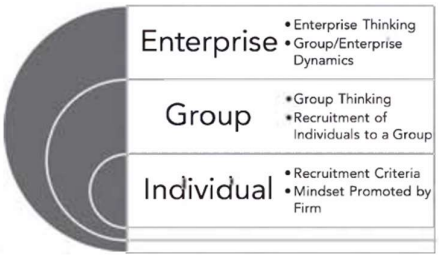
Risk culture can be thought of as the set of goals, values, beliefs, procedures, customs, and conventions that influence how staff create, identify, manage, and think about risk within an enterprise, including implicit and explicit beliefs. Another well-known definition is that "risk culture can be defined as the norms and traditions of behavior of

individuals and of groups within an organization that determine the way in which they identify, understand, discuss, and act on the risks the organization confronts and the risks it takes."

Risk culture sounds intangible, but a strong risk culture is a firm's surest handle on ERM in the same way that a strong safety climate minimizes accidents in physical industries. In the aftermath of the global financial crisis of 2007-2009, supervisory reports focused on risk culture as a driver of risk management failure in large financial institutions. Other culture-driven scandals emerged in the post-crisis years, including the misselling of consumer financial products (e.g., the UK payment protection insurance scandal), the manipulation of financial markets (e.g., Libor rate manipulation), money laundering, and embargo breaches. The banks involved in these scandals paid massive penalties and suffered discounting on their share prices while litigation continued. It is therefore not surprising that around 70% of surveyed financial institutions say that establishing and embedding risk culture across the organization is a high priority.

Risk culture is a difficult to address because it is multi-layered. Individuals arrive at an enterprise with their own risk mindsets that are driven by their personalities, demographics, professional standards, personal experiences, and so on. They then absorb many of the risk-related behaviors and practices of their local group (e.g., business line sales targets) and make risk decisions as part of that local social environment.

In turn, this can lead to a gap between the stated targets of the organization (e.g., risk appetite and values) and behavior by its employees. This behavior may be driven by short-term or selfcentered goals, with rules being broken or side-stepped. Furthermore, it is not easy to improve risk culture across the whole enterprise if a firm has no way to assess its progress.



Risk culture indicators

Financial firms are increasingly expected to be able to form a view of risk culture within their institutions and of the degree to which their risk culture helps them adhere to their risk appetites. One approach is to identify what are called key risk culture indicators.

In an effort to reduce the risk posed by systemically important financial institutions, the Financial Stability Board (FSB) has specified four key risk culture indicators:

1. **Accountability:** Are there clear expectations on monitoring and accountability for key risks? Are escalation processes used?
2. **Effective communication and challenge:** Is there evidence that opposing views from individuals are valued? Are there regular assessments of "openness to dissent"? Is risk management given stature?
3. **Incentives:** Are compensation and performance metrics supportive of the firm's risk appetite and desired culture?

4. **Tone from the top** Does board and executive compensation support the firm's core values? Do management's actions support or undermine the risk message? Can the board be shown to monitor and communicate how business strategy fits with risk appetite?

Other factors *for strong risk culture*

Risk Appetite Knowledge: Do key staff members know the firm's enterprise risk appetite? Can they answer straightforward questions about its application to business decisions?

Risk Literacy/Common Language: Do staff use a common language to describe risk and its effects? Are training programs available and attended?

Risk Information Flows: Can the firm see information flowing up and across the firm in a way that captures and highlights enterprise-scale risks? And is there a clear link to specific discussions and decisions?

Risk/Reward Decisions: Has the firm tested whether senior executives respond to benchmark risk/reward questions consistently with each other and with the firm's risk appetite?

Risk Stature: Do the key ERM staff have the right stature and direct communication with the Board? Who hires and fires them?

Escalation and Whistle Blowing: Do key staff members understand when and how they can escalate a suspected enterprise risk? When were escalation procedures last used? Is there a whistle-blowing mechanism and is it used?

Board Risk Priorities: Can the board name the top ten enterprise risks faced by the firm? Can it name the key industry disasters associated with these risks?

Action Against Risk Offenders: Has the firm disciplined employees who have acted against its risk appetite and ethical stance? Does the staff believe action will be taken even if a risk violation leads to a profit rather than a loss?

Risk Incident and Near Miss Responses Can the firm show how it has identified culture issues in risk incidents and the measures taken in response?

CHALLENGES IN ESTABLISHING STRONG RISK CULTURE

There are several problems standing in the way of a robust risk culture.

1. Risk indicator or risk lever? The industry desperately wants to identify risk indicators that can be used to prove it is steadily improving risk culture. But if **indicators** are **used as levers** to **change behavior** (e.g., if survey results affect the performance assessments of senior managers), **could** the indicators **themselves become compromised**? It's a lot easier to manage (or manipulate) an indicator than it is to manage risk culture.

2. Education for everyone? Firms can and should create common enterprise languages of risk by defining risk management terms, concepts, and common procedures as well as key ERM roles (e.g., the Board, CRO, and business line leaders). One large

financial institution went so far as to create a fictional character in a web-based game to bring risk taking decisions to life and improve risk communication (which apparently provoked "mixed responses"). But so-called education for everyone includes the board. At the end of the day, can the board list the top ten enterprise risks and explain how these relate to the firm's risk appetite?

3. Time and space: Do the same cultural attitudes exist in all parts of the firm and how do they change over time?

- Empirical evidence suggests risk culture is mainly formed in the local business lines, rather than at enterprise level. It's easy for business lines to develop distinct risk cultures under the example of local team leaders.
- Conversely, if signs emerge from multiple business lines that something is wrong, (e.g., similar "near misses" in terms of conduct issues), does the firm have mechanisms to pick up these signals? Or are they all dealt with individually?

4. Culture cycle: Arguably, it is only during times of stress that the enterprise's real risk culture becomes visible. As a result, risk cultures that look robust today may not survive real-life crises. While regulators want risk managers to carry real weight within firms to withstand this kind of buffeting, history suggests this weight lessens as memories of the last crisis fade into the past.

5. Curse of data: In the years ahead, firms will be able to gather massive amounts of data about risk culture from survey focus group evidence, risk culture indicator scores, and human resources data (e.g., the number of sick days taken). They can then combine this data with a wider set of risk data to spot patterns. However, managers may need to deploy machine learning technologies to hunt down insights and warning signs in such large data sets.

SCENARIO ANALYSIS

Sensitivity testing involves changing one parameter or variable in a risk model to see how sensitive the model result is to the alteration (and thereby identifying key variables). On the other hand, stress testing includes changing one or more key variables to explore risk model results under stressful conditions.

Scenario analysis involves imagining a whole scenario, developing a coherent narrative that explains why the variables change, and assessing the effects of this on the firm's risk portfolios.

While scenario analysis may be entirely qualitative, firms are building increasingly sophisticated quantitative models to assess the impact of each scenario on their portfolios and businesses.

Scenario analysis, along with stress and sensitivity testing, have risen to become the preeminent risk identification tools for many ERM programs. This is a result of the weaknesses in probabilistic risk metrics (e.g., VaR) that were revealed by the global financial crisis of 2007-2008. When markets begin to behave abnormally, risk factor relationships break down to produce market movements and loss levels that seem inconceivable based on VaR calculations. For example, amid market turmoil in August 2007, Goldman Sachs' chief financial officer David Viniar said that his firm was "seeing things that were 25-standard deviation moves, several days in a row."

This is where scenario analysis comes in. It helps firms think through the enterprise impact of abnormal events and events for which there is no historical data. But it also has its own set of advantages and disadvantages.

Table 8.5 Scenario Analysis: Advantages and Disadvantages

Advantages	Disadvantages
No need to consider risk frequency beyond "plausibility"	Difficult to gauge probability of events; does not lead to the quantification of risk
Scenarios can take the form of transparent and intuitive narratives.	Unfolding scenarios can become complex with many choices.
Challenges firms to imagine the worst and gauge the effects	Firms may not stretch their imaginations (e.g., scenarios might underestimate the impact of an extreme loss event or omit important risk exposures).
Can allow firms to focus on their key exposures, key risk types, and the ways in which risk develops over time	Only a limited number of scenarios can be fully developed—are they the right ones?
Allows firms to identify warning signals and build contingency plans	Are they the right warnings and plans, given the scenario selection challenge?
Does not depend on historical data; can be based around either historical events or forward-looking hypothetical events	The scenarios chosen are often prompted by the last major crisis; imaginative future scenarios may be dismissed as improbable.
Firms can make scenario analysis as sophisticated or straightforward as they like, outside regulator defined programs.	Scenario analyses vary in terms of quality and sophistication. Their credibility and assumptions can be difficult to assess.
Stress test results can influence risk appetite, risk limits, and capital adequacy.	Usefulness depends on accuracy, comprehensiveness, and the forward-looking qualities of the firm's stress test program.

Image source: GARP

USE OF SCENARIO ANALYSIS IN STRESS TESTING PROGRAM AND IN CAPITAL PLANNING

The US stress tests began with an initial Supervisory Capital Assessment Program (SCAP), which was conducted in May 2009 as part of the healing process toward the end of the global financial crisis. The results from SCAP helped reassure markets about the stability of the banking system. From 2011 onward, as part of the Dodd-Frank Act, the Federal Reserve began conducting two separate annual stress test exercises:

- Dodd-Frank Act stress tests (DFAST), which are conducted in the middle of the year for all banks with assets above USD 10 billion; and
1. Comprehensive Capital Analysis and Reviews (CCAR), which are conducted at the end of the year for banks with assets above USD 50 billion.

DFAST and CCAR apply the same supervisor-devised scenarios. However, DFAST is more prescriptive, applies more limited capital action assumptions, and is less demanding in terms of reporting. Both DFAST and CCAR also oblige banks to generate their own scenarios to complement the supervisory scenarios.

The Federal Reserve generates three supervisor-devised macroeconomic scenarios, that are differentiated by what they are designed to mimic:

- Baseline: Corresponds to the consensus forecast among major bank economists,
- Adverse: A moderately declining economy, and
- Severely Adverse: Severe, broad global recession/depression and an associated decline in demand for long-term fixed income investment.

CCAR obliges banks to project how these scenarios drive their income statements and balance sheets over a nine-quarter horizon. This complex process requires the dynamic

projection of revenues, provisions, credit losses related to defaults and downgrades, management rules for new loan issuances, regulatory ratios, and so on. CCAR firms must also submit detailed capital plans that include:

- Assessments of expected sourcing and use of capital over the planning horizon,
- Descriptions of the firm's process and methodology to gauge capital adequacy,
- Capital policy, and
- Discussions of any expected business plan changes that are likely to materially impact capital adequacy/liquidity.

For each scenario, banks must show that they maintain minimum capital ratios, how they will raise capital if necessary, and their intentions in terms of dividend distribution, share buybacks, and so forth. For example, one way to hedge potential capital shortages over the planning horizon is to issue contingent convertible bonds (CoCos),

Minimum capital ratios

- Common equity Tier 1 capital ratio: 4.5%
- Tier 1 risk-based capital ratio: 6%
- Total risk-based capital ratio: 8%
- Tier 1 leverage ratio: 4%

If a bank cannot show it satisfies minimum capital ratios under stressed conditions, it must review the business plans of its various units and lower its risk appetite.

Five key improvements driven by CCAR

2. CCAR macroeconomic scenarios unfold over several quarters (rather than being simply point-in-time shocks).
3. The scenarios drive a series of interlinked factors covering a variety of risks (e.g., credit risk, market risk, and operational risk).
4. The risk variables are not held static. Therefore, all sorts of underlying risk factors (e.g., probability of default and loss given default) and market impacts (e.g., credit spreads and margining) need to be adjusted as the scenario unfolds.
5. In turn, banks can allow for their capital planning as the scenario unfolds.
6. Importantly, imposing a standard set of scenarios on the largest banks allows regulators to see systemic effects and compare bank risk exposures.

Stress Testing in Europe Futures

The European Banking Authority (EBA), has experienced less rapid success than the American regulators. The EBA's testing procedure is less sophisticated, less dynamic, and gives less room for changing risk and business strategies as scenarios play out than the CCAR does. This is so because the EBA stresses more banks than the CCAR does.

It's possible that new approaches to bank supervision under the European Central Bank's Supervisory Review and Evaluation Process will drive significant advances in European stress testing rather than the EBA's supervisor-led stress tests (SREP). Using industry best practises as a guide, these new techniques will look at how banks investigate the viability of their business models under stress, including capital and liquidity adequacy. Scenario analysis and stress testing will be important tools in this process.

Banks are anticipated to go from a small number of very deterministic scenario testing to a much more dynamic-stochastic approach in the next years. This strategy will use simulation tools to investigate numerous potential future events, such as macroeconomic and geopolitical shocks.

There are numerous ways to define the relationship between the situation and the risk elements. As an illustration, the association between a shock to oil prices (a component of the scenario) and GDP growth rate (a risk factor) may be based on managerial judgement or statistical analysis of prior data.

Each bank will be able to create a comprehensive distribution of results for key performance indicators (KPIs) like expected earnings, regulatory capital, RWAs, and credit losses by creating thousands of scenarios. A bank may choose to focus on the average result of the simulations for some purposes (perhaps taken to be the base case scenario). While others may concentrate on the worst or extremely worst outcomes (i.e., adverse and severely adverse scenarios).

In addition, banks can use these simulation data to do reverse stress tests. In terms of bank KPIs, they can specifically identify the entire range of worst outcomes (i.e., the tail of the distribution). After that, they can examine the events that led to these worst-case tail risks and how the shocks resulted in losses. The business lines and portfolios that contribute to a worst-case loss are highlighted, and the most important risk factors are brought to light through this approach.

The worst business conditions for particular business lines can also be identified by a company, and it can examine how sensitive different KPIs (like loan losses) are to the family of risk factors. Globally, many banks still see stress testing as primarily a regulatory compliance task. The outcomes are not included into their routine planning procedures. A new generation of stress testing technology, however, gives institutions benefits above and beyond compliance. They can utilise the outcomes in particular to:

- Specify their risk appetites and limit frameworks,
- Perform a "reasonableness check" on business and capital planning,
- Develop early warning signals, and
- Put in place contingencies to manage credit, funding, and liquidity shocks.

ERM AND STRATEGIC DECISION MAKING

The development of strategies must involve ERM. The banking sector can give numerous examples of how business strategies—such as boosting lending volume by lowering standards or achieving quick expansion through a series of acquisitions—did not take ERM into account.

The most recent thinking in the business community pushes companies to use ERM to create a tighter connection between risk and reward in company planning and strategy. The most recent stochastic stress testing methods provide a useful tool for considering the ERM consequences of a strategy. For instance, a bank can investigate the risk implications of increasing its loans to a certain industry sector. The bank might discover that the strategy reduces its risk and can withstand shocks. As an alternative, the plan can raise risk concentrations or reliance on a significant macroeconomic factor.

Meanwhile, positive scenarios can be explored much more easily thanks to scenario simulation technologies. For instance, a bank may discover that it would profit from a drop in oil prices if it had earlier cut back on lending to oil producers in favour of businesses that would profit from lower input costs, such as manufacturers.

Macroeconomic stress test results will thus be incorporated into regular business planning processes (e.g., growth plans, strategic risk management, and balance sheet and capital management). But could novel ERM strategies influence other types of strategic choices?

The causes of strategic risk are not merely macroeconomic ones. Banks and all other types of businesses must evaluate the strategic risks brought on by shifting social norms, technological advancements, and competitive dynamics. Strategic risks of this nature are extremely difficult since, by definition, they lack historical precedent (as opposed to something like a fall in GDP).

New methods for creating scenarios, nevertheless, might be beneficial. For instance, they can provide businesses with a mechanism to simulate how strategic shocks would affect the corporate balance sheet and improved ways to include expert opinions into a strict scenario selection process.

It is crucial to strengthen a larger range of business strategy decisions. Strategic errors were the main culprit a remarkable 81 percent of the time, according to a study looking at enterprise value loss in public corporations in the United States between 2002 and 2012. Strategic errors significantly outranked traditional risk management issues (such as significant operational disasters, fraud, corporate governance failures), as well as external shocks, as destructors of shareholder value (e.g., natural catastrophes and political and regulatory upheavals).

RISK MANAGEMENT AND FUTURE

The field of risk management is a recent development. In the first chapter, we learned that the global financial crisis of 2007-2009 prompted risk managers to focus more on the interconnectedness of different forms of risk and the necessity of combining statistical analysis with professional judgement. These three ideas also provide insight into the future of risk management.

01 Risk is multidimensional and requires holistic thinking

Risk managers are now aware of the necessity to use a variety of risk indicators to capture the various risk aspects. The main development to date has been the creation of novel scenario analysis and stress testing techniques to complement summary statistics (e.g., VaR).

But scenario analysis has flaws of its own. Future research will place more attention on improving simulation technology and stricter scenario selection procedures in order to address these weaknesses.

Stress testing in the future will also be more dynamic, lasting one to three years, and integrated into a company's capital planning process. The outcomes will be used to assess risk tolerance and make sure that company models are resilient and able to withstand extremely bad circumstances.

A comprehensive approach to uncertainty is required for holistic risk thinking. Economists debated whether risk and uncertainty are the same thing almost a century ago. How confident we may be in our statistical estimators and forecasting powers was the main topic of discussion. There is a growing body of study on ways to quantify ambiguity, or the degree to which we are uncertain about the risk factors and probabilities that cause risk. When expecting high profits, decision-makers might be wary of ambiguity and seek a premium—possibly quantifiable in the financial markets—for taking on uncertain risks. Future decision-making up to the board level should be improved by a more rigorous approach to identifying statistical risk, uncertainty, and ambiguity (and assessing their consequences).

Additionally, adopting a more comprehensive strategy has caused banks to recognise the value of risk culture. Enterprise behaviour is influenced by how an institution perceives and discusses risk. The ability of a bank to "think the unthinkable" and make reasoned judgments under confusing circumstances also has an impact on how the outcomes of enterprise-wide stress testing are understood at the board level.

The best approach is to approach risk and risk management holistically. To put silo-based risk management and comprehensive ERM in direct opposition to one another, however, would be incorrect. The renewed focus on ERM is an addition to ongoing initiatives to enhance our quantitative, granular understanding of particular risks.

2. Risk jumps across risk types in business models and markets

Banks are using scenario stress testing to better understand how risk evolves over time (a year or more), hopping between different risk types. This way of thinking needs to be applied when creating business strategies. Too many banks pursued growth before to the global financial crisis of 2007–2009 utilising business models built on high leverage or erroneous assumptions about the reliability of third-party credit ratings. Many times, the risk function or the chief risk officer were not consulted when developing growth plans. A firm's risk appetite must be established, and the future risk function must analyse each business model's risks (sometimes with the aid of simulations of the worst-case scenario), explain how risks may interact, and develop contingency plans. The important warning signs and the subsequent actions must be decided upon in advance by the companies.

With the expansion of digital enterprises powered by machine learning and new data sources, as well as those leveraging cognitive technologies to provide clients with risk-related services, this may prove to be especially crucial.

3. Numbers and judgment

Risk analysis is anticipated to change as a result of the revolution in computing power and data science, as seen by the emergence of cloud-based, on-demand analytical tools and machine learning technologies. In comparison to the digital revolution that is focused on the client, current progress looks to be somewhat slow. However, that is partially a result of legacy systems and how challenging it is to alter current practises. Risk managers will have access to new streams of integrated business data in the coming years, and they will be able to employ machine learning technology to find patterns and correlations in vast, disparate data sets that at the moment appear insurmountable. Additionally, it will be simpler to gather data live during corporate processes, enhancing vigilance and predictive analytics (as well as classic risk models).

Maintaining transparency in these risk judgments, even when they are entirely automated and subject to human review, will be the main difficulty. Without this openness, automated decision-making and machine learning merely give a boosted version of model risk.

Behavioral science, a relatively new field, has started to shed light on why risk managers and investors occasionally depart from the seemingly reasonable choices that conventional economists expect people will make. Its discoveries include the home bias (where investors prefer investing in their own nation rather than creating diverse global portfolios) and the herding effect (where investors appear to follow each other like a herd of sheep). Along with a deeper understanding of how people respond to risk occurrences, these phenomena need to be more carefully included into risk management.

Future risk managers will therefore work at the nexus of risk, data science, fresh insights into human behaviour, and business acumen. To create the business plan of their company, risk managers will need to think broadly and use fresh strategies. Additionally, they must ensure that their companies respond to risk signals even when such signals are vague and the risk measurements are imprecise. This suggests that numerous new competencies and skills are required, coupled with a new position within organisations. It is an interesting, if occasionally frightening, view.

Reading 09 Learning from Financial Disasters

Learning Objectives

- 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.

INTRODUCTION

This chapter briefly examines case studies of famous financial disasters. The purpose of these case studies is to show how various risk factors can materialize and, when ignored, escalate into major disasters. These cases are classified by the risk factors involved. In each case, however, multiple risk factors simultaneously caused and exacerbated the crisis, leading to major losses.

INTEREST RATE RISK

Over the last century, interest rate risk has caused the failure of individual firms as well as entire industries within the financial services sector. One notable example can be found in the collapse of the U.S. S&L industry in the 1980s.

To mitigate interest rate risk, firms must manage their balance sheet structure such that the effect of any interest rate movement on assets remains highly correlated with the effect on liabilities. This must be the case even in volatile interest rate environments. Such a correlation can be partially achieved using classical duration matching tools. More sophisticated methods involve the use of interest rates derivative products such as caps, floors, and swaps.

The Savings and Loan Crisis

The U.S. S&L industry prospered throughout most of the Twentieth-century thanks to regulations governing interest paid on deposits (i.e., Regulation Q) and an upward-sloping yield curve. In particular, the upward-sloping yield curve meant that the interest rate borrowers paid on a ten-year residential mortgage (a typical product offered by S&Ls) exceeded the rates on the short-maturity savings and time deposits that were an S&L's main source of funding. This is also known as "riding the yield curve".

However, rising inflation in the late 1970s prompted the Fed to implement a restrictive monetary policy, which led to a significant increase in short-term interest rates. The increase in short term rates pushed up funding costs for S&Ls, wiping out the interest rate spread they depended on for their profit margin.

The spike in their short-term funding costs (which were needed to finance long-term fixed-interest rate mortgages) meant that S&Ls generated negative net interest margins on many of their long-term residential mortgage portfolios. The failure of the S&Ls to manage their interest rate risk helped to spark a long-running crisis in the United States, which gathered force through the 1980s as S&Ls desperately sought to repair their balance sheets with new business activities and higher-margin (but riskier) lending. However, these efforts resulted in the industry losing even more money through poorly controlled credit and business risks. Between 1986 and 1995, 1,043 out of 3,234 S&Ls in the United States failed or were taken over. The number of remaining S&Ls eventually fell to fewer than 2,200 and the crisis necessitated what was (at the time) one **of the world's most expensive banking system bailouts**: USD 160 billion. This bailout was funded by the American taxpayers.

FUNDING LIQUIDITY RISK

Funding liquidity risk can stem from external market conditions (e.g., during a financial crisis) or from structural problems within a bank's balance sheet. Most often, however, it stems from a combination of both. The collapse of Bear Stearns and Lehman Brothers at the height of the 2007-2009 financial crisis, along with the near collapse of Long Term Capital Management (LTCM) a decade earlier, offer examples of funding liquidity crises that were prompted by unexpected external conditions and exposed vulnerabilities inherent in the institutions' business models.

Liquidity Crisis at Lehman Brothers

During the late 1990s and early 2000s, investment bank Lehman Brothers invested heavily in the securitized U.S. real estate market. The 150-year-old institution pioneered an integrated business model in which it sold mortgages to residential customers, turned portfolios of these loans into highly rated securities, and then sold these securities to investors.

The real estate market in the United States started to sour in 2006 and housing prices started falling following a years-long boom. During this time, however, Lehman continued to build up its real estate securitization business. Critically, the bank also continued to increase the amount of mortgage-related assets it held as longer-term investments for its own account (rather than simply acting as an agent during the securitization process).

As part of this aggressive growth strategy, Lehman also began to make outsized bets on U.S. commercial real estate. But if the firm's business model came to look like a risky bet on the U.S. housing market, it was ultimately Lehman's leverage ratio and funding strategy that threatened to turn this investment position into a disaster.

Banks are naturally highly leveraged entities (i.e., they take on a large amount of debt rather than issue equity to fund their activities). In the run up to the crisis, however, Lehman (like other investment banks in the boom years) pursued leverage to excess. By 2007, the bank had an assets-to-equity ratio of approximately 31:1. Meanwhile, the bank's funding strategy (i.e., the way it borrowed money to grow its operations) introduced a fatal element of fragility. Specifically, Lehman began borrowing huge amounts of money on a short-term basis (e.g., borrowing daily from the repo markets) to fund relatively illiquid long-term real estate assets. This meant that the firm had to depend heavily on the confidence of its funders and counterparties if it were to continue to borrow the funds necessary to stay in business.

During the second half of 2007, it became evident that the U.S. housing bubble had burst and that the subprime mortgage market was in deep trouble. As a result, confidence began to erode in firms heavily invested in subprime securities. In July of that year, Bear Stearns (another highly leveraged subprime linked firm) had to support two of its hedge funds following steep losses caused by their subprime mortgage exposures. In March 2008, these weaknesses caused Bear Stearns to collapse after its repo lenders and bank counterparties lost confidence in the firm's ability to repay its debts. J.P. Morgan then bought the fallen firm at a fraction of its prior market value.

Next investors turned their attention to Lehman. Specifically, they began to question how accurately the firm had valued its real estate-based assets. Market confidence, so

critical to the firm's funding strategy (and therefore its liquidity), was ebbing fast. As the crisis mounted, many of Lehman's major counterparties began to demand more collateral for funding transactions, others began reducing their exposure, and some institutions simply refused to deal with the firm. Attempts to organize an industry rescue or to sell the firm to another large bank ultimately failed. In the early hours of September 15, 2008, **Lehman Brothers was forced to file for bankruptcy**, inciting months of panic and uncertainty in the global financial markets.

Liquidity Crisis at Continental Illinois

The case of Continental Illinois Bank is an example of how internal credit portfolio problems can precipitate a funding liquidity crisis. In this case, these problems were exacerbated by weaknesses in the institution's funding strategy.

Continental Illinois was once the largest bank in Chicago. Starting in the late 1970s, the bank began pursuing an aggressive growth strategy that saw its commercial and industrial lending jump from USD 5 billion to over USD 14 billion in the five years prior to 1981. During that time, the bank's total assets grew from USD 21.5 billion to USD 45 billion.

The first sign of Continental's problems surfaced with the closing of 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 were too large for it to service, Penn Square would pass it on to a larger institution such as Continental Illinois. But as oil and natural gas prices decreased after 1981, some firms began to default on their debt. In 1982, Penn Square became insolvent and regulators stepped in to close the bank.

By then, Continental held more than USD 1 billion in loans to Penn Square's oil and gas customers, and therefore suffered heavy losses as defaults rose. While many other banks also suffered credit losses during this period, Continental was unusual in that it had only a tiny retail banking operation and a relatively small amount of core deposits. Therefore, it relied primarily on federal funds and floating large issues of certificates of deposit (CDs) to fund its lending business.

When Penn Square failed, Continental found itself increasingly unable to fund its operations from the U.S. markets. As a result, it began to raise money at much higher rates in foreign wholesale money markets (e.g., Japan). But when rumors about Continental's worsening financial condition spooked the international markets in May 1984, the bank's foreign investors quickly began to withdraw their deposited funds. Continental Illinois was confronted with a full-blown liquidity crisis as depositors withdrew USD 6 billion in only ten days. **Regulatory authorities eventually stepped in to prevent a domino effect** on other banks, which they feared might put the entire U.S. banking system at risk.

Northern Rock—Liquidity and Business Models

The 2007 failure of mortgage bank Northern Rock is a more recent illustration of liquidity risk arising from structural weaknesses in a bank's business model. In this case, a combination of an excessive use of short-term financing for long-term assets and a sudden loss of market confidence triggered a funding liquidity crisis that rapidly led to disaster.

Northern Rock was a fast-growing medium-sized mortgage bank based in the United Kingdom. The bank had been growing assets at around 20% per year for several years by specializing in residential mortgages, and it continued to expand aggressively in the marketplace into the first quarter of 2007. The bank's rate of growth was supported by a business model and funding strategy that was unusual among U.K. banks. Specifically, the bank relied on an originate-to-distribute approach, by which it raised money through securitizing mortgages, selling covered bonds, and making use of the wholesale funding markets. As a result, Northern Rock relied much more heavily on investors and wholesale markets and less on retail deposits for funding in comparison to many of its U.K. peers. The bank hoped to mitigate potential weaknesses in this funding strategy by diversifying its funding markets geographically.

For example, it tapped markets in continental Europe and the Americas as well as in the United Kingdom. As it turned out, however, the bank had overestimated the benefits of geographical diversification. After years of a strong economy and rising housing prices, widespread doubts about mortgage-related assets began to surface among investors early in 2007. These doubts were initially triggered by rising default rates in the U.S. subprime market but soon spread globally to asset-backed securities (ABS) as an investment class, then to institutions that invested in or depended on these securities and eventually to the interbank markets.

When the interbank funding market froze in early August 2007, all of Northern Rock's global funding channels seized up simultaneously in a scenario that the bank's executives later claimed was "unforeseeable." Ironically, earlier in the summer of 2007, the bank had announced increased interim dividends after U.K. 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 regulatory capital requirements.

When Northern Rock became unable to fund itself through interbank loans, U.K. authorities began to discuss various strategies to relieve the bank's difficulties. News of the Bank of England's planned support operation for Northern Rock leaked, setting the scene for a run on deposits in mid-September. The panic was exacerbated by the tight rules then in effect for compensating depositors, and calm only (slowly) returned after U.K. authorities publicly promised that deposits would be repaid. Northern Rock eventually accepted emergency government support and then public ownership.

Lessons Learned

As a result of the 2007-2009 crisis, the U.S. Federal Reserve began to mandate liquidity stress testing programs for the largest banks. These programs are aimed at ensuring that banks have liquidity and funding strategies that will survive systemwide stress scenarios. In essence, the challenge of managing funding liquidity risk lies partly in optimizing the bank's borrowing sources and their composition. This optimization is often accomplished by managing the contractual maturities of assets and liabilities, either directly or synthetically, using derivatives such as interest rate swaps. Like most complicated decisions, however, asset/liability management (ALM) decisions are driven by trade-offs.

- There is a trade-off between funding liquidity and interest rate risk: When funding liabilities have shorter duration than loan assets, the bank is exposed to

less interest rate risk and more funding liquidity risk. The opposite is true when liabilities have longer duration compared to loan assets.

- There is also a 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. However, this will clearly cost more than cheaper shorter-duration funding.

Banks may also mitigate funding liquidity risk by reducing the maturity of their assets (e.g., commercial loans), but this is not always possible because asset maturity is often driven by borrower demand, the nature of a bank's business, and its competitive environment.

As it is not possible to perfectly coordinate liquidity, firms also need emergency liquidity cushions to ensure they can meet their commitments. The larger and better quality the cushion, the lower the risk. However, this risk reduction comes at a cost, as highly liquid and marketable assets yield lower returns than less liquid assets. Credit lines also command a cost, even if the funds are not drawn. Again, banks must consider the significant tradeoff between pursuing a risky funding liquidity strategy and the cost of that strategy compared with less risky strategies and liquidity reserves. It follows that all the components of an ALM policy are linked (i.e., interest rate risk management, funding liquidity risk management, profit planning, product pricing, capital management, and fundamental business strategies) and must be part of a holistic and integrated approach to balance-sheet management.

HEDGING STRATEGY

Developing and implementing effective hedging strategies can be both beneficial and challenging. This is true not just for banks and other financial institutions but for non-financial firms as well. The function(s) or individual(s) responsible for developing hedging strategies need access to relevant information (e.g., market data or corporate information), and oftentimes advanced (or at least apppropriate) statistical tools. One necessary step in this process involves selecting appropriate models to use for both pricing and hedging. These are sometimes developed in-house but oftentimes are acquired from external vendors, as are the data used in the modeling, estimation, and hedging process.

Regardless of what tools or data are eventually selected, it is critical that the risk management function has a deep understanding of their proper uses and limitations. The choice of whether to use static or dynamic hedging strategies is a key tactical decision. A static strategy involves the purchase of a hedging instrument that very closely matches the position to be hedged and is typically held for as long as the underlying position is kept (or at least for a set period of time).

A static strategy has the advantage of being relatively easy to implement and monitor. A dynamic strategy, on the other hand, involves adjusting the hedge through a series of ongoing trades to contiuously (or frequently) calibrate the hedge position to the (changing) underlying exposure. As such, a dynamic strategy typically involves greater managerial effort to implement and monitor, and may involve higher transaction costs. Note that a static approach focuses on the result of the strategy at the horizon, whereas dynamic hedging tries to rebalance the strategy over short intervals of time (e.g., on a daily basis).

Firms that implement dynamic hedging strategies must have the appropriate models and expertise to trade in the markets and effectively monitor their positions. This, however, will not necessarily preclude these firms from making mistakes in the implementation and communication of a risk management strategy. The following section illustrates this by examining a dynamic strategy put in place by Metallgesellschaft Refining & Marketing, Inc. (MGRM).

Metallgesellschaft—How a Dynamic Hedging Strategy Can Go Wrong

MGRM was a U.S. subsidiary of Metallgesellschaft AG, an industrial conglomerate based in Frankfurt, Germany. In 1993, MGRM entered into long-term, fixed-price contracts to deliver oil products (primarily gasoline and heating oil) to end-user customers.

Because MGRM could not change its prices after these contracts were signed, it was exposed to the risk of rising energy prices. Lacking a liquid market for appropriate long-term futures contracts would allow it to hedge its price risk, MGRM implemented a dynamic hedging strategy that used short-dated energy futures contracts. This strategy required that the hedging instruments (i.e., the futures contracts) be "rolled forward" each month as they expired. The derivative position was adjusted monthly to reflect the changing amount of outstanding contracts to be hedged in order to preserve a one-to-one hedge. "Such a strategy is neither inherently unprofitable nor fatally flawed, provided top management understands the program and the long-term funding commitments necessary to make it work," according to Culp and Miller (1995).

The type of dynamic hedging strategy implemented by MGRM is known as a rolling hedge, and it can be profitable when assets for immediate delivery are priced higher (i.e., the spot price) than assets for future delivery (i.e., the futures price).

This type of pricing curve situation is known as backwardation. When the firm rolls the hedge position in a market characterized by backwardation, the contract that is about to expire is sold at a price that is higher than that of the replacement longer-delivery contract and thus there is a resulting rollover profit. However, this type of strategy can result in losses when the opposite price relationship exists (a situation known as contango).

MGRM therefore was exposed to curve risk (i.e., the risk of shifts in the price curve between backwardation and contango). Additionally, the firm was exposed to basis risk resulting from deviations between short-term prices and long-term prices.

Spot oil prices fell significantly in 1993, from nearly USD 20 a barrel mid-year to less than USD 15 a barrel by year-end. This led to USD 1.3 billion in margin calls on MGRM's long futures positions that had to be met in cash. While MGRM had unrealized economic gains on its original short forward contracts, it had a (temporary) substantial negative cashflow. The problem was exacerbated when the oil price curve changed shape, moving from backwardation to contango. MGRM's parent company, which had been told the position was hedged and therefore did not expect a negative cashflow, ordered the hedges liquidated in December 1993. This resulted in large paper losses being turned into large realized losses.

Accounting issues and hedging considerations

Another important aspect of a hedging strategy is the time horizon over which it is implemented. As described in the discussion of static and dynamic hedging strategies, horizons can be fixed (e.g., quarter-end or year-end) or rolling. Regardless of the choice of horizon, performance evaluations and investment horizons should be aligned.

Accounting issues and potential tax implications need to be considered when devising a hedging strategy. Accounting rules related to derivatives and hedging can be quite complex and are subject to change. A derivative and the underlying position it is intended to hedge must be perfectly matched (e.g., regarding dates and quantities) in order for them to be reported together in operational profit without the need to report an accounting profit or loss. Without such a matching, the International Financial Reporting Standards (IFRS) require that the hedge's mark-to-market profit (or loss) be recorded. If the hedge is at least 80% effective, the resulting profit or loss can be recorded in the firm's operational or gross profit. Otherwise, the financial position will be recorded as a financial expense, while the underlying position will be recorded as an **operational expense**.

How derivatives are accounted for will directly impact not only how they are reported in a firms quarterly and annual financial reports but on a firm's profit and loss (P&L) statement as well. The MGRM case highlights the discrepancy between economic and accounting hedging, and between hedging the P&L or hedging the cashflows. Although MGRM was nearly fully hedged in economic terms, it was fully exposed in accounting terms and was therefore not prepared to absorb liquidity risk.

The choice of the derivatives used in a hedging strategy may have very different tax implications and this can have a big impact on the cash flows of a firm. Tax treatment may also vary from country to country and can sometimes result in a multinational corporation finding it advantageous to hedge positions related to business in one country by using derivatives in another country. Getting competent professional guidance on tax matters is therefore critical when developing and implementing a hedging strategy.

MODEL RISK

Sophisticated financial products often rely on valuation models to determine their prices. Models can be theoretical (e.g., CAPM) or they can be statistically based (e.g., the term structure of interest rates). Institutions are exposed to risks arising from the use of models when pricing these financial products. Model risk can stem from using an incorrect model, incorrectly specifying a model, and/or using insufficient data and incorrect estimators One way a model can be problematic is if its underlying assumptions are flawed (e.g., assumptions about the underlying asset price or interest rate process). For example, a bond pricing model might incorporate an assumption of a flat yield curve, when in fact the curve is upward-sloping and unstable. This type of risk is both common and dangerous and can be among the most difficult risks to detect. Unfortunately, the annals of finance history are filled with examples of strategies based on faulty assumptions, as well as other types of flawed models, processes, and controls. What follows are a few relatively well-known examples to illustrate this point.

The Niederhoffer Put Options

Victor Niederhoffer was a star trader who ran a very successful and well-established hedge fund. One strategy of the fund involved writing large quantities of uncovered (i.e., "naked") deep out-of-the-money put options on the S&P 500 Index and collecting the option premiums. Of course, because these were deep out-of-the-money, the premiums collected from these options were quite small. An assumption underlying this strategy was that a one-day market decline of more than 5% would be very rare. In fact, if market returns were normally distributed, a fall of this magnitude would be virtually impossible.

The strategy was undone, however, when the stock market fell by over 7% in one day in October 1997. The sharp drop in U.S. equity prices followed a large overnight decline in the Hang Seng Index, which in turn was the result of a crisis developing in Asian markets. On the back of this shock, liquidity in the markets dried up. As a result, the fund was unable to meet over USD 50 million in margin calls and its brokers liquidated Neiderhoffer's positions for pennies on the dollar, effectively wiping out the fund's equity.

The lesson from this case is that one can construct a strategy with options that will produce a small profit over an extended period. Nevertheless, in such strategies there can be a small probability for a major loss. In other words, competitive financial markets rarely offer a "free lunch."

Long Term Capital Management

The demise of Long Term Capital Management (LTCM) in August and September of 1998 was notable due to the size of the fund's exposures and the pedigree of the individuals involved. Founded in 1994 by John Meriwether, LTCM's principals included former Federal Reserve Board Vice-Chairman David Mullins, Nobel laureates Robert Merton and Myron Scholes, several world-renowned academics, and experienced traders from the famous Salomon Brothers' bond arbitrage desk. Before its failure, LTCM had USD 4.8 billion in equity and USD 125 billion in assets, making for a 25-to-1 leverage ratio.

LTCM's downfall was triggered in August of 1998, when the government of Russia declared a moratorium on its debt and devalued its currency (i.e., the ruble). These actions caused the value of LTCM's holdings to fall over 40%, a loss of nearly USD 2 billion. concerned about a potential systemic crisis, the Federal Reserve Bank of New York brokered the rescue of LTCM by a group of banks that agreed to inject USD 3.5 billion into the fund in exchange for a 90% equity stake and control of its management.

How could LTCM have been so adversely affected by a single market event? The reason lay in an arbitrage strategy the fund employed that was based on market-neutral trading (also known as relative-value trading). These strategies typically involve the purchase of one asset and the simultaneous sale of another and are designed to exploit relative mispricings between the assets. As a result, they generate profits when the price spread between assets moves in the anticipated direction, regardless of directional movements in the overall market.

Many of LTCM's strategies, based on extensive and intensive empirical research by top-level academics and practitioners at the firm, appeared safe at first glance. The firm

made its trades based on the assumption that the spreads between sovereign and corporate bonds in various countries were too wide and would eventually revert to their "normal" levels. For instance, LTCM would purchase UK corporate bonds and sell (or "short") appropriate UK government bonds to capture a perceived relative-value opportunity. Other trades were motivated by the fact that several European countries were scheduled to join the European Economic and Monetary Union (EMU) and convergence of sovereign bond yields was anticipated. Trades of this type might involve, for instance, buying Spanish or Italian government debt and selling German bunds. As long as the yield spread narrowed, these positions would make money regardless of movements in absolute prices.

The limited returns from these low-risk strategies came under increasing pressure as more traders entered the market to take advantage of the same perceived opportunities. To boost performance (measure by return on equity), LTCM used leverage. With a 25-to-1 leverage ratio, for example, LTCM could turn a 1% return on assets into a 25% return. This was aided by LTCM's ability to obtain large amounts of financing, collateralized by the bonds it invested in. Part of the fund's ability to access such large loans was due to its strategies being widely perceived as low-risk in nature.

LTCM's failure reflected its inability to anticipate the dramatic increase in correlations and volatilities and the sharp drop in liquidity that can occur during an extreme crisis. LTCM also succumbed to an internal liquidity crunch brought on by large margin calls on its futures holdings. Ironically, LTCM's strategies were valid in the medium term, and as the crisis ended, the banks that took over LTCM realized substantial profits.

Trading Model

The breakdown in the historic correlation and volatility patterns assumed in LTCM's models led to most of its losses. The factors that were most relevant during the market turmoil included the following.

- U.S. Treasury interest rates and stock prices fell in tandem because investors had deserted the stock market and started purchasing U.S. government bonds in a flight to quality. In normal markets, stock returns and interest rates are negatively correlated (i.e., when interest rates fall, stock prices rise).
- Liquidity vanished in many markets simultaneously and made the unwinding of positions exceedingly difficult. Portfolios that seemed to be well-diversified across markets began to behave as if they were highly concentrated in a single market, and market-neutral positions became directionally exposed (usually to the wrong side of the market).

Risk Measurement Models and Stress Testing

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 an investment (or set of investments) given normal market conditions over a specific time horizon and at a given confidence level. LTCM felt that it had structured its' portfolio so that the fund's risk should not have exceeded that of the S&P 500. The problems encountered at LTCM shed light on how assumptions made when calculating regulatory VaR calculations do not necessarily apply to hedge funds.

- The time horizon for economic capital should be the time it takes to raise new capital, liquidate positions in an orderly manner, or the period over which a crisis

scenario will unfold. Based on the experience of LTCM, ten days is clearly far too short a time horizon to determine a hedge fund's VaR.

- Liquidity risk is not factored into traditional static VaR models. Such models assume that normal market conditions prevail and that markets exhibit perfect liquidity.
- Correlation and volatility risks (i.e., the risk that the realized correlations and volatilities significantly deviate from expectations) can be captured only through stress testing. This was probably the weakest point of LTCM's VaR system.

Federal Reserve Bank of New York President William McDonough Federal Reserve Bank of New York testified before Congress that:

We recognize that stress testing is a developing discipline, but it is clear that adequate testing was not done with respect to the financial conditions that precipitated Long-Term Capital's problems. Effective risk management in a financial institution requires not only modeling, but models that can test the full range of financial transactions across all kinds of adverse market developments.

During the run-up to its collapse, LTCM experienced daily volatility of more than USD 100 million, more than twice the level it envisioned. Furthermore, despite estimating its ten-day VaR to be USD 320 million, LTCM suffered losses of over USD 1 billion. Simply put, LTCM's risk model had fatal flaws that ultimately contributed to the firm's demise.

London Whale

During the first half of 2012, J.P. Morgan Chase lost billions of dollars from an exposure to a massive credit derivatives portfolio in its London office. The following case study of the event was compiled using word-for-word extracts from the 300-page report produced by a subsequent investigation by the U.S. Senate.

"JP Morgan Chase & Company is the largest financial holding company in the United States, with USD 2.4 trillion in assets. It is also the largest derivatives dealer in the world and the largest single participant in world credit derivatives markets. Its principal bank subsidiary, JP Morgan Chase Bank, is the largest U.S. bank. JP Morgan Chase has consistently portrayed itself as an expert in risk management with a "fortress balance sheet" that ensures taxpayers have nothing to fear from its banking activities, including its extensive dealing in derivatives. But in early 2012, the bank's Chief Investment Office (CIO), which is charged with managing USD 350 billion in excess deposits, placed a massive bet on a complex set of synthetic credit derivatives that, in 2012, lost at least USD 6.2 billion.

The CIO's losses were the result of the so-called "London Whale" trades executed by traders in its London office—trades so large in size that they roiled world credit markets. Initially dismissed by the bank's Chief Executive Officer as a "tempest in a teapot", the trading losses quickly doubled and then tripled 1 7 despite a relatively benign credit environment. . . "

". . . In 2006, the CIO approved a proposal to trade in synthetic derivatives, a new trading activity. In 2008, the CIO began calling its credit trading activity the Synthetic Credit Portfolio (SCP).

Three years later, in 2011, the SCP's net notional size jumped from USD 4 billion to USD 51 billion, a more than tenfold increase. In late 2011, the SCP bank rolled a USD 1

billion credit derivatives trading bet that produced a gain of approximately USD 400 million. In December 2011, JPMorgan Chase instructed the CIO to reduce its Risk Weighted Assets (RWA) to enable the bank, as a whole, to reduce its regulatory capital requirements. In response, in January 2012, rather than dispose of the high risk assets in the SCP—the most typical way to reduce RWA—the CIO launched a trading strategy that called for purchasing additional long credit derivatives to offset its short derivatives positions and lower the CIO's RWA in that manner. That trading strategy not only ended up increasing the portfolio's size, risk, and RWA, but also, by taking the portfolio into a net long position, eliminated the hedging protections the SCP was originally supposed to provide."

Operational Risk

"In its first four years of operation, the SCP produced positive revenues, but in 2012, it opened the year with losses. In January, February, and March, the number of days reporting losses far exceeded the number of days reporting profits, and there was not a single day when the SCP was in the black. To minimize its reported losses, the CIO began to deviate from the valuation practices it had used in the past to price credit derivatives. In early January, the CIO had typically established the daily value of a credit derivative by marking it at or near the midpoint price in the daily range of prices (bid-ask spread) offered in the marketplace.

Using midpoint prices had enabled the CIO to comply with the requirement that it value its derivatives using prices that were the "most representative of fair value". But later in the first quarter of 2012, instead of marking near the midpoint, the CIO began to assign more favorable prices within the daily price range to its credit derivatives. The more favorable prices enabled the CIO to report smaller losses in the daily profit/loss (P&L) reports that the SCP filed internally within the bank."

". . . by March 16, 2012, the SCP had reported year-to-date losses of USD 161 million, but if midpoint prices had been used, those losses would have swelled by at least another USD 432 million to a total of USD 593 million." One result of the CIO's using more favorable valuations was that two different business lines within JPMorgan Chase, the CIO and the Investment Bank, assigned different values to identical credit derivatives holdings. Beginning in March 2012, as CIO counterparties learned of the price differences, several objected to the CIO's values, resulting in collateral disputes peaking at USD 690 million. In May, the bank's Deputy Chief Risk officer directed the CIO to mark its books in the same manner as the Investment Bank, which used an independent pricing service to identify the midpoints in the relevant price ranges. That change in valuation methodology resolved the collateral valuation disputes in favor of the CIO's counterparties and, at the same time, put an end to the mismarking."

"In contrast to JPMorgan Chase's reputation for best-in-class risk management, the whale trades exposed a bank culture in which risk limit breaches were routinely disregarded, risk metrics were frequently criticized or downplayed, and risk evaluation models were targeted by bank personnel seeking to produce artificially lower capital requirements.

The CIO used five key metrics and limits to gauge and control the risks associated with its trading activities, including Value-at- Risk (VaR). During the first three months of 2012, as the CIO traders added billions of dollars in complex credit derivatives to the

SCP, the SCP trades breached the limits on all five risk metrics. In fact, from January 1 through April 30, 2012, CIO risk limits and advisories were breached more than 330 times. ". . . The SCP's many breaches were routinely reported to JPMorgan Chase and CIO management, risk personnel, and traders. The breaches did not, however, spark an in-depth review of the SCP or require immediate remedial actions to lower risk.

Instead, the breaches were largely ignored or ended by raising the relevant risk limit." ". . . CIO traders, risk personnel, and quantitative analysts frequently attacked the accuracy of the risk metrics, downplaying the riskiness of credit derivatives and proposing risk measurement and model changes to lower risk results for the SCP. In the case of the CIO VaR, after analysts concluded the existing model was too conservative and overstated risk, an alternative CIO model was hurriedly adopted in late January 2012, while the CIO was in breach of its own and the bank wide VaR limit. The bank did not obtain OCC approval as it should have to use the model for the SCP. The CIO's new model immediately lowered the SCP's VaR by 50%, enabling the CIO not only to end its breach, but to engage in substantially more risky derivatives trading. Months later, the bank determined that the model was improperly implemented, requiring error-prone manual data entry and incorporating formula and calculation errors. On May 10, the bank backtracked, revoking the new VaR model due to its inaccuracy in portraying risk, and reinstating the prior model.

Note: In the above case dates are not important, only focus on sequence of events.

ROGUE TRADING AND MISLEADING REPORTING

Barings 1995

Profits are typically seen as a good thing, particularly at financial firms. The collapse of Barings Bank, caused by the actions of Nick Leeson, should serve as a warning that outsized profits can also be an indicator of unrecognized risk and should be met with as much inquisitiveness as happiness.

In 1992, Nick Leeson moved to Singapore and became the local head of operations for Barings Bank, a centuries-old British financial institution founded in 1762. As part of his role, Leeson executed client trades on the Singapore International Monetary Exchange (SIMEX). Expanding his remit, he received authorization to execute an arbitrage trading strategy designed to exploit price disparities between Nikkei futures contracts listed on the SIMEX and those listed on the Osaka Securities Exchange (OSE). Rather than follow this arbitrage strategy, which involved offsetting trades in the two markets, Leeson instead built speculative positions by buying in one market and holding onto the contracts. His approach quickly generated huge losses.

In addition to his trading authorization, Leeson also controlled the Singapore back office **and he used this dual-role to hide his losses**. Using a reconciliation account, Leeson converted an actual 1994 loss of GBP 200 million into a reported sizable profit of GBP 102 million. Deepening his subterfuge, Leeson managed to have the reconciliation account excluded from the reports sent to the main office in London.

By late 1994, the outsized amount of Leeson's profits began to attract the attention of Barings' risk controllers. Their inquiries to Leeson's superiors were rebuffed, however, who cited Barings' "unique ability to exploit this arbitrage." (It is possible that the extra bonuses his superiors received on the back of Leeson's reported profits may have clouded

their judgement.) The risk controller's suspicions were raised again in January 1995 after Leeson reported a one-week profit of GBP 10 million in January 1995, and once more their concerns were dismissed. Had his superiors investigated the source and plausibility of the profits, simple calculations would have shown that it would have been impossible for Leeson to have made these profits in the manner he claimed, as that would have required trading four times that week's total volume for the Nikkei futures contracts on both the SIMEXand the OSE.

By the time Barings discovered Leeson's rogue trading, the losses he had accumulated had grown too large and the bank was forced to liquidate. Eventually, ING, a Dutch bank, acquired Barings Bank for the ignominious sum of GBP 1.

A main lesson from the Barings collapse is that reporting and monitoring of positions and risks (i.e., back-office operations) must be separated from trading (i.e., front-office operations). Another basic lesson is that outsized or strangely consistent profits (think Bernie Madoff as well) should be independently investigated and rigorously monitored in order to verify that they are real, generated in accordance with the firm's policies and procedures, and not the result of nefarious or unacceptably risky activities. More broadly, it is incumbent upon risk managers to determine if the reported business profits seem logical with respect to the positions held.

Note that Barings' downfall could have been avoided under regulations implemented just a few years later. In addition to setting capital adequacy requirements for market risk, the Basel Committee set limits on concentration risks. Linder the 1996 amendment, banks are required to 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, or had the bank developed and enforced prudent guidelines similar to these rules, Barings would have been prohibited from amassing such large positions and one of the world's most infamous rogue trading scandals might have been avoided.

Large trading volumes and revenues typically result in large bonuses for senior managers. In turn, this compensation framework encourages managers to trust the traders that report to them. Their reports may not be given proper scrutiny by risk managers or other key individuals who might be able to properly question the veracity of the purported profits. One difficulty is that traders can use their superior knowledge of pricing models, or claims of profound market insights, to confound their internal critics.

The antidote to this problem is for senior managers to engage with a healthy skepticism models and strategies that claim to deliver above-market returns and to insist that all models be transparent and independently vetted. It should be remembered that immediate revenues from a transaction (e.g., ten-year credit default swap) cannot be recognized as economic profit. Rather, a transaction's profitability depends on its performance over its life. Unfortunately, accounting procedures can be used to misreport profits for risky derivative instruments.

FINANCIAL ENGINEERING

Forwards, swaps, and options are the main building blocks of financial engineering. They can be used separately to hedge specific risks or be combined to form complex structures that meet client needs.

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 example, consider a U.S. fund manager holding a bond denominated in euros. The fund manager is exposed to interest rate risk in the euro fixed-income market and to currency risk from changes in the dollar/euro exchange rate.

The manager can hedge both risks with a currency swap. Alternatively, he or she can hedge the foreign exchange exposure separately through a currency forward or option. The fund manager could also avoid the trouble of hedging only the currency exposure by entering into a so-called quanto swap. Under this structure, he or she would receive the coupon of the bond in dollars at a prearranged exchange rate and pay the U.S. Libor floating rate.

The financial engineers responsible for devising complex instruments do so to satisfy the risk-return appetites of their clients. But financial engineering is not by itself risk management, and in the world of derivatives the line between hedging and speculation can be blurry. Firms may be tempted to enter into complex transactions that enhance immediate portfolio returns.

However, enhancing returns almost always means taking on more risk in some form or 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 derivative transactions. Or it may be the case that these risks are not fully communicated to senior managers and other stakeholders.

Bankers Trust (BT) & Procter Gamble

Back in the early 1990s, Bankers Trust (BT) proposed that clients Procter & Gamble (P&G) and Gibson Greetings enter complex leveraged swaps to achieve lower funding costs. In the swap with P&G, for example, BT would pay a fixed rate to P&G for five years, while P&G would pay a floating rate, which was the commercial paper rate minus 75-basis points if rates remained stable. But, through a complex formula, the floating rate would increase considerably if rates rose during the period; for example, an increase of 100-basis points in rates produced a 1,035-basis point spread over the commercial paper!

In 1994, the Fed increased the federal funds rate by 250-basis points, causing colossal losses for both P&G and Gibson Greetings. Both companies sued BT for misrepresenting the risk embedded in these complex swap transactions. BT never quite recovered from **the ensuing reputational damage and was eventually acquired by Deutsche Bank**.

Orange County

Repos allow investors to finance a significant portion of their investments with borrowed money (i.e., leverage). But using leverage means that the profit or loss on any position is multiplied; even a small change in market prices can have a significant impact on the investor. Leverage, through the use of repos, was part of the undoing of California's Orange County. In the early 1990s, Orange County treasurer Robert Citron had managed to borrow USD 12.9 billion through the repo market. This enabled him to accumulate around USD 20 billion of securities even though the fund he managed had only USD 7.7 billion in invested assets.

Citron used the borrowed funds to purchase complex inverse floating-rate notes whose coupon payments decline when interest rates rise (as opposed to conventional floaters, whose payments increase in such a circumstance). In the favorable upward-sloping curve environment in the years before 1994, Citron was able to increase the return of the fund by 2% compared to similar pools of assets. However, over the course of 1994, the Federal Reserve raised interest rates by 250-basis points. As interest rates rose, the market value of his positions dropped substantially, generating a loss of USD 1.5 billion by December 1994. At the same time, some of the fund's lenders stopped rolling over their repo agreements. **Ultimately, Orange County was forced to file for bankruptcy**.

This debacle was caused by a combination of excessive leverage and a risky (and eventually wrong) interest-rate bet embedded in the securities bought by the fund. Citron later admitted he did not understand either the position he took nor the risk exposure of the fund.

Firms need to understand the risks that are inherent in their business models. Senior management then needs to deploy robust policies and risk measures tying risk management, and particularly the use of derivatives, to risk appetite and overall business strategy as it has been communicated to stakeholders.

Management and boards should always ask where the risks are hiding and under what circumstances could they produce a loss.

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

Prior to the 2007-2009 financial crisis, some of the biggest buyers of U.S. subprime securities were European banks. Among these institutions were publicly owned banks in Germany called the Landesbanken. While these instruments offered an attractive risk premium, they also required understanding and pricing expertise.

Landesbanks traditionally specialized in lending to regional small- and medium-sized companies. However, during the boom years some began to open overseas branches and develop investment banking businesses. One of the most notorious examples was the Leipzig-based Sachsen Landesbank. Sachsen opened a unit in Dublin tasked with setting up vehicles to hold large volumes of highly rated U.S. mortgage-backed securities. While these vehicles were technically off the parent bank's balance sheet, they benefited from the guarantee of Sachsen itself.

While this operation was highly profitable, it was simply too large when compared to the size of Sachsen's balance sheet. When the subprime crisis struck in 2007, the rescue operation wiped out **Sachsen's capital and the bank had to be sold to Landesbank Baden-Wurttemberg** (i.e., another German state bank).

REPUTATION RISK

A firm's reputation is based on the belief that it can and will fulfil its promises to counterparties and creditors, and that the enterprise is a fair dealer and follows ethical practices.

In recent years, however, concern about reputation risk has become more prominent with the rapid growth of social networks. Rumors can spread quickly on the internet and destroy reputations in a matter of hours. Companies are also under growing pressure to

demonstrate their commitment to environmental, social, and governance-related best practices. As a result, the reputational damage for unethical conduct can be very severe.

Volkswagen Emission Cheating Scandal

A major scandal to hit the German automaker Volkswagen involved regulatory testing. In September 2015, the United States Environmental Protection Agency (EPA) announced that Volkswagen had programmed certain emissions controls on its diesel engines to be activated only during regulatory testing but not during real-world driving. Thus, while nitrogen oxide levels would meet U.S. standards during regulatory testing, they greatly exceeded these standards when the cars were actually on the road. From 2009 through 2015, Volkswagen put this programming in place in over ten million cars worldwide (500,000 in the United States alone). Volkswagen executives in Germany and the United States formally acknowledged the deception on a September conference call with the EPA and California officials.

The damage to Volkswagen, the world's biggest carmaker, was significant. The share price of the company fell by over a third as the scandal unfolded and the firm faced billions of dollars in potential fines and penalties. Numerous lawsuits were filed.

Its reputation, particularly in the important US market, took a severe hit. The reputational effect extended beyond the company itself as German government officials expressed concerns that the value of the imprimatur "Made in Germany" would be diminished because of Volkswagen's actions.

CORPORATE GOVERNANCE

We already know the concept of corporate governance from Reading 03. In the following section we will discuss Enron case study the corporate governance scandal. For exam purpose, please note, JP Morgan and Volkswagen is also the failure caused by poor corporate governance in some part.

Enron

Enron was formed in 1985 following the heavily leveraged merger of InterNorth and Houston Natural Gas. As the result of deregulation, however, the firm lost the exclusive rights to its pipelines. In order to survive, Enron devised a new and innovative business strategy to become a so-called "gas bank."

This strategy 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.

Enron was named "America's Most Innovative Company" in 1995 by Fortune and won this prestigious award for six consecutive years. The firm's shares were worth almost USD 90.56 at its peak in August 2000. That year Enron had 20,000 employees and revenues of nearly USD 101 billion.

Enron constantly pushed for deregulation of the energy market, which would give the firm greater flexibility to pursue its business model. The energy market in California was a prominent example of this push that ultimately led to much criticism as Enron played a key role in the 2000-2001 California electricity crisis.

California had previously capped its retail electricity prices after experiencing a shortage of electricity, which it attributed to market manipulations. By taking power plants offline during times of peak demand, Enron could raise power prices by up to 2,000%.

Because the California government had capped retail electricity prices, Enron's actions squeezed revenue margins across the industry and eventually led to the bankruptcy of Pacific Gas and Electric Company (i.e., one of the largest power companies in the United States) in 2001.

Enron itself declared bankruptcy in December 2001. The largest corporate bankruptcy in U.S. history when it occurred, the firm's collapse has been widely discussed in academic, practitioner, and popular press forums. It is now clear what went wrong Enron was a poster child of corporate governance failure and poor risk management.

Many in Enron's senior management acted in their own self interest and against the interests of shareholders (i.e., this is known as agency risk). 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."

However, Enron's board also failed to fulfill its fiduciary duties to the shareholders. For example, the board was aware of and allowed the CFO to become the sole manager of a private equity fund that did business with Enron. As it turned out, however, the private equity fund lacked economic substance.

Most damning, Enron also used "creative" (i.e., fraudulent) accounting practices to hide flaws in its actual financial performance. As one example, note that Enron transferred its stock to a special purpose vehicle (SPV) in exchange for either cash or notes. The SPV classified the Enron stock as an asset on its balance sheet. In turn, Enron guaranteed the SPVs value to reduce its credit risk. Importantly, Enron failed to adequately disclose the lack of an arm's length relationship between the company and the SPV.

Another example of Enron's duplicity is a scheme by which the firm would build a physical asset and then immediately declare a projected mark-to-market profit on its books. It would do this even though it had not yet made any money from the physical asset. If the revenue from the asset was less than the projected amount, then Enron would simply transfer the asset to an SPV.

The financial loss would therefore go unreported and Enron could write off unprofitable activities without impacting the bottom line. In short, Enron became adept at hiding the financial losses of its operations using a variety of deceptive no techniques.

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 fraudulent accounting practices that led to Enron's collapse. Once the scandal came to light, Andersen was forced to surrender its accounting licenses to the Securities and Exchange Commission (SEC). This was effectively a death sentence for the firm.

In the United States, the Sarbanes-Oxley Act (SOX) of 2002 was a key legislative reform that resulted from the Enron debacle, along with associated changes in stock exchange and accounting rules. SOX created the Public Company Accounting Oversight.

Board (PCAOB), which has assumed an important role in promoting good corporate governance and financial disclosure. As indicated in Chapter 3, boards and audit committees increasingly rely on the chief risk officer (CRO) to integrate corporate governance responsibilities with existing risk management responsibilities to improve overall risk governance.

CYBER RISK

Cyber risk has become a critically important consideration in recent years. Banks' systems can be hacked, their ATMs can be used to steal money and client information, customer identities can be stolen and misused, and so on. Financial institutions are spending billions of dollars every year on their systems to make them safer. These systems must be protected from the outside world as well as from internal misuse. Threats to the banking system from cyberattacks 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 to local regulators.

Swift Case

SWIFT is the world's leading system for transferring funds electronically among banks processing billions of dollars in transactions every day. In fact, SWIFT is considered so reliable that transactions that normally take days (in order to prevent fraud) are instead completed in seconds.

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 the account of Bangladesh Bank (the central bank of Bangladesh) at the New York Fed. The heist involved malware that sent unauthorized SWIFT messages instructing funds to be moved to an account controlled by the hackers. Then, the malware deleted the database record of the transfer and disabled transaction confirmation messages that would have revealed the theft.

Reading 10 Anatomy of the Great Financial Crisis of 2007 – 2009

Learning Objectives

- 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 mortgage and collateralize3d 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 contribute to the financial crisis, including their impact on systemic risk.
- Describe responses taken by central banks in response to the crisis.

INTRODUCTION

The cascade of events that came be known as the Great Financial Crisis of 2007-2009 (GFC) began with a downturn in the U.S. subprime mortgage market in the summer of 2007. The years preceding the crisis saw an exceptional boom in credit growth in the United States, a massive housing price bubble, and an excess of leverage in the financial system that had been building since the previous credit crisis of 2001-2002. The boom years had also been accompanied by a wave of financial innovations related to securitization, which expanded the capacity of the financial system to generate credit assets but outpaced its capacity to manage the associated risks.

Unlike previous U.S. credit crises, the GFC affected investors all over the world. Massive losses spread from subprime mortgages in the United States to other segments of the credit market. Banks began to experience large losses and liquidity problems amid growing uncertainty about the valuation of credit assets. As a result, banks stopped lending to one another. Governments around the world intervened by offering liquidity support facilities and recapitalizing insolvent banks in an effort to encourage bank lending. Many banks failed entirely or were taken over.

February 2008 saw the nationalization of troubled U.K. mortgage lender Northern Rock, a victim of the first bank run that nation had experienced in 140 years. The following month, U.S. investment bank Bear Stearns was absorbed by J.R Morgan Chase in a deal brokered by the U.S. Treasury Department and the Federal Reserve.

The crisis also brought the asset-back commercial paper (ABCP) and repo markets to a halt, causing numerous hedge funds to freeze redemptions or fail. Many special investment vehicles (SIVs) and conduits were also wound down. Credit losses worldwide eventually exceeded USD 1 trillion.

The peak of the subprime crisis came in September 2008, which saw a cascade of events.

- Lehman Brothers declared bankruptcy, leading to an immediate acute reduction in the interbank borrowing market. Banks with excess cash were unwilling to lend money to banks looking for liquidity in the overnight repo markets.
- The last two major investment banks in the United States, Morgan Stanley and Goldman Sachs, were converted to bank holding companies and became regulated by the Federal Reserve. This move gave them access to the Fed's liquidity facilities.
- Fannie Mae and Freddie Mac were nationalized. AIG was brought back from the brink of collapse via a USD 150 billion capital infusion by the U.S. Treasury and the Federal Reserve.
- In Europe, many countries had to step in to provide massive support to their banks. Dutch financial conglomerate Fortis was broken up and sold. Iceland's largest commercial bank, subsequently the entire Icelandic banking system, collapsed.
- Many government budgets in Europe were stretched thin due to the massive cost of the bank rescues, a situation that contributed to a subsequent European sovereign debt crisis in 2010.
- There was a fundamental spillover from the financial crisis to the wider global economy. This resulted in a massive loss of wealth and high unemployment around the world.

SOME HISTORY

Growth in housing demand and concomitant mortgage financing was fueled (in part) by the low interest rate environment that existed in the early 2000s. This demand helped drive substantial increases in housing prices. Low-interest rates also spurred investors, including institutional investors, to look for investments that offered yield enhancement. They found this yield in subprime mortgages, which typically carry premiums of up to 300-basis points over the rates charged to prime borrowers.

Subprime loans also became increasingly in demand for securitization. Through this process, securitizers:

- Created pools of below investment-grade assets;
- Bifurcated the cashflows by model-driven certainty; and
- Packaged the "safest" cashflows into investment-grade securities.

This encouraged banks to develop or grow an originate-to-distribute (OTD) business model. Subprime mortgages became an increasingly large share of the overall mortgage market, rising from 7% of total mortgage originations in 2001 to 20% in 2006.

Many subprime mortgages were structured with low teaser rates for the first few years (which were then followed by much higher rates once the teaser period ended). Many of these mortgages were interest-only over the teaser period as well, meaning that no principal payments were required.

Some borrowers used subprime lending to purchase a house in which they intended to live, whereas others were merely speculating on rising home prices. For either type of borrower, a loan could typically be refinanced into another similar mortgage once the teaser rate period ended (as long as housing prices rose). If refinancing was not possible, a speculator could simply default on the mortgage.

Under the OTD model, losses on subprime mortgages were borne not by the banks that initially made the loans, but by the investors that eventually owned them. This reduced the incentive for the originating banks to conduct the appropriate due diligence (e.g., proper credit assessments on the borrowers and rigorous collateral valuation on the homes being purchased) before extending credit.

Many subprime mortgages were securitized into collateralized debt obligations (CDOs) during this time. These credit risk transfer instruments played a major role in the subsequent sub-prime mortgage meltdown.

Delinquencies on adjustable-rate subprime mortgages rose markedly in 2007 and by August of that year, the rate of serious delinquencies was approaching 16% (roughly triple its level in mid-2005).12 By May 2008, this figure had risen to 25%, leading to a massive number of ratings downgrades for subprime mortgage securitized products.

There are several reasons for why delinquencies rose significantly after mid-2005.

- In a subprime mortgage transaction, the inherent credit quality of the borrower is typically weak and the mortgage is often under-collateralized. Spotty income and payment histories, as well as high debt-to-income ratios, are typical of subprime borrowers.

- Traditionally, first-time home mortgages required a 20% down payment. In 2005, 43% of first-time home buyers paid zero down payment, significantly reducing the collateral cushion in case housing prices declined.
- As mentioned previously, many subprime mortgages included teaser rates. For example, a 2/28 adjustable-rate 30-year mortgage would typically have a teaser rate for the first two years, after which it would reset to a (potentially) much higher rate (i.e., a short-term rate or index plus a several hundred-point spread) for the remaining 28 years. This was not much of a problem as long as a borrower could refinance the mortgage before the reset date. But if the borrower could not refinance and if interest rates increased, the monthly mortgage costs could rise very quickly. As it turned out, interest rates did start to increase, with the rate on the three-month Treasury bill rising from less than 1.0% in April 2004 to over 4.0% in November 2005. Other mortgage features, such as interest-only teaser periods, made this issue even worse.
- The ability to refinance mortgages ahead of the reset date was a common assumption amongst subprime borrowers. However, this ability declined significantly when housing prices began to fall sharply in 2006. Furthermore, subprime mortgage balances quickly began to exceed the market value of the homes that collateralized the loans, increasing the incentive for borrowers to default.
- The heavy demand for subprime mortgage products encouraged questionable practices by some lenders. Some borrowers were steered into subprime mortgages although they qualified for mortgages with more attractive terms. Meanwhile, other borrowers ended up with mortgages they were not qualified to hold and could not afford. Meanwhile, increasingly risky products entered the subprime market, including NINJA loans (i.e., no income, no job, and no assets) and liar loans (which required such a scant amount of documentation that borrowers could safely lie on their applications). In an attempt to take advantage of the lax lending standards and increasingly weak controls, some borrowers and mortgage brokers submitted false documentation that enabled some borrowers to receive funding under fraudulent terms. This situation was exacerbated by the compensation structure for most mortgage brokers, which incentivized increasing the volume of loans originated and not necessarily the long-term performance of those loans. In fact, there were few (if any) consequences to a broker if an originated loan eventually defaulted. Originating brokers therefore had very little incentive to conduct proper due diligence.

THE ROLE OF FINANCIAL INTERMEDIARIES

Banks moved assets to be securitized off their balance sheets to structured investment vehicles (SIVs), also called conduits. SIVs are a limited-purpose, bankruptcy remote companies used by banks to purchase assets. They are typically funded with short-term commercial paper as well as some medium-term notes and capital.

Securitization involves taking a portfolio of existing assets and repackaging their associated cash flows into claims on tranches. Bonds are issued against these tranches and the proceeds are used to purchase the collateral assets.

To appeal to investor demand, the different tranches are typically structured to have a desired credit rating (with most tranches being rated as investment grade). A waterfall

structure is introduced to differentiate the credit risk associated with the claims on the different tranches. The tranches are established in order of safety, beginning with Senior AAA debt (often referred to as super senior), Junior AAA, AA, A, BBB, BB, and so on. To ensure that the super senior tranche receives a AAA rating, a surety wrap was sometimes used.

In theory, the OTD model, coupled with extensive use of securitization, would distribute risk more broadly throughout the financial system. This in turn would make banks less sensitive to credit crises, reduce systemic risk, and give banks additional funding sources to support their lending.

The crisis, however, exposed flaws in this theory. Over the period from 2003 to 2007, banks appear to have used securitization to keep their credit exposures to AAA-rated tranches to generate extra yield without increasing their regulatory capital minimums under Basel II.

For example, a residential mortgage attracts a risk-weighted asset (RWA) of 50%. Meanwhile, a AAA-rated tranche of securitization is only subject to an RWA of 20% (because an asset with such a rating is presumed to be at low risk of default). The AAA rating also served to greatly reduce incentives for investors to investigate and perform proper due diligence on the pool. Accordingly, investors thought they could increase their returns without adding risk by purchasing CDOs, rather than lower yielding corporate bonds or similar assets. As explained in the following section, they were wrong.

ISSUES WITH THE RATING AGENCIES

As part of a CDO structuring process, the equity holders (known as the CDO trust partners) would pay credit rating agencies to rate the various liabilities of the CDO. Because CDO trusts were aware of the requirements and assumptions underlying these ratings, they were able to structure the payment waterfalls and associated liabilities in such a way as to obtain a high percentage of AAA-rated bonds.

The assumptions used in this rating process were based on historical data. However, this data did not reflect the changes in the asset characteristics that were taking place at the time (e.g., the growing number of NINJA loans, liar loans, and subprime mortgages with 100% loan-to-value ratios).

Rating agencies also relied on data received from the issuers and arrangers, who were bundling the mortgages and performing due diligence. In spite of widespread knowledge of declining lending standards and increasing fraud, the rating agencies themselves did not perform any additional due diligence or monitoring of the data.

It is also important to note that subprime mortgage loans were too new in the marketplace to offer long-term data that could inform risk analyses. Therefore, many of the initial ratings assigned to these securitizations (typically the senior tranches that were given AAA ratings) were likely faulty from the outset.

Despite these analytical flaws, there were strong incentives for agencies to provide the required ratings. These agencies are paid to monitor the CDO over its life. But if the CDO trust did not get formed because too few bonds were AAA-rated, the agency would miss this profitable and continual cash stream.

A PRIMER ON THE SHORT-TERM WHOLESALE DEBT MARKET

There are two main instruments that constitute the short-term wholesale debt market: repurchase agreements and commercial paper (CP). Both markets shut down early in the crisis as market participants started to doubt the quality of the collateral.

Repurchase agreements (also known as repos) are used by many financial institutions, including banks, brokerage firms, and money market funds. A standard repo involves

- The sale of an asset; and
- An agreement to buy the asset back at a slightly higher price at a later time.

The seller of the security receives cash at the outset of the repo and can thus be viewed as a borrower in a collateralized loan transaction (with the security serving as the collateral). The buyer of the security, who gives cash at the outset of the repo and then receives a higher sum at the end of the term of the repo, can be considered a lender (with the higher sum representing principal plus interest).

Various types of securities can be used as collateral in repo transactions, ranging from government bonds and high-quality corporate bonds to tranches of securitizations. The quality of the collateral greatly influences the size of the haircut (i.e., the percent reduction from the initial market value the lender is willing to give the borrower), with higher (lower) quality collateral having smaller (larger) haircuts. For example, a haircut of 10% means that a borrower can borrow USD 90 for each USD 100 pledged collateral. A haircut is intended to protect the lender from recovering less than the full value of the loan amount in the event they need to sell the collateral after a default.

Repos are excluded from the bankruptcy process. This means that if one counterparty fails, the other may terminate the transaction unilaterally and either keep the cash or sell the collateral.

In unsecured CP financing, short-term debt is issued but is not backed by any specific assets. Because there is no specific collateral that a lender can seize in the event of default, unsecured CP issuers generally have very high credit quality. If a CP issuer's credit quality deteriorates, such as through a rating downgrade, there is usually an orderly exit through margin calls.

Asset-back commercial paper (ABCP) is a special case of CP where the issuer finances the purchase of the assets by issuing CP, with the assets serving as collateral.

The demand for collateral increased in the years preceding the crisis, driven by the growth of the OTC derivatives markets and an increasing reliance on short-term collateralization by financial institutions. This demand was (in part) satisfied by the issuance of AAA-rated securitization tranches. According to statistics from the Federal Reserve Bank of New York, the total primary dealers' inventory of repos increased from USD 1.6 trillion in 2000 to over USD 4.5 trillion in 2008.

THE START OF LIQUIDITY CRUNCH

Note that SIVs were typically funded short-term and relied on being able to regularly roll over short-term debt to finance their longer dated assets.

As mortgage-backed securities began to lose value, however, the credit quality of many SIVs declined. This led to the rapid downgrading of the credit ratings of the ABCP issued by these SIVs and an increasing skepticism about pledged collateral value, which prevented a growing number of SIVs from rolling over their ABCR Simultaneously, liquidity in the subprime-related asset markets disappeared.

Note that until the middle of 2007, counterparty credit risk was not priced by the market. There was hardly any difference (i.e., only 2- to 5-basis points) between the unsecured overnight index swap (OIS) rate and the swap rates for all reset periods (i.e., three months, six months, one year).

Starting in June of that year, market participants began to worry not only about the value of asset-backed securities but also about how much exposure banks and other financial institutions had to the subprime market. As a result, the OlS-swap spread exploded. It remained high during the crisis, jumped again when Lehman Brothers failed, and did not come back to pre-crisis levels.

At the same time, credit spreads on all credit assets increased substantially, lowering the market price of the credit assets. This led to a systematic increase in haircuts, from zero pre-crisis to more than 45% when Lehman failed in September 2008.

Gorton (2009) gives an illustration of the dynamics that began with a liquidity crisis and ended up in a solvency crisis, especially for highly levered institutions that relied heavily on short-term wholesale funding (repos).

For example, consider a bank with USD 100 in assets. In turn, these assets are backing USD 40 in long-term debt, USD 50 in repo financing, and USD 10 in equity. Suppose repo haircuts increase from zero to 20%, dropping repo financing from USD 50 to USD 40. The bank is now short of funding by USD 10. In a normal market, the bank could simply sell USD 10 in assets. Its new balance sheet would look like the following: USD 90 in assets backing USD 40 in long-term debt, USD 40 in repo financing, and USD 10 in equity.

However, if there is a simultaneous sell off in the markets, the market value of the assets can fall precipitously. If the value of the bank's assets falls below USD 90, then the equity is wiped out and the bank becomes insolvent.

By the summer of 2007, the short-term wholesale funding markets started to freeze, including both the ABCP market and the repo market. Investors stopped rolling maturing ABCP, forcing banks to repatriate SIV assets onto their balance sheets. With the significant increase in repo haircuts, institutions that relied on repo financing were unable to roll their short-term funding. At that point, there were only three outcomes: bailout, merger, or bankruptcy.

This is exactly the scenario that led to the failure of Bear Stearns, mortgage banks Northern Rock in the United Kingdom, IndyMac in California, and Lehman Brothers. ***Note that all these institutions satisfied Basel minimum regulatory capital requirements before they failed. (very important statement for exam)***

Relying heavily on short-term wholesale funding can be dangerous, as it can disappear overnight.

VALUATION UNCERTAINTY AND TRANSPARENCY ISSUES

Uncertainty over the valuation of asset backed structured products exacerbated the crisis by effectively freezing the short term debt market. Following are the source of this problem

First of all, they are difficult to value even when there isn't an ongoing crisis. Their liability structure and cashflow waterfalls tend to be complex and contain different types of collateral and interest rate triggers. Also, even if they share a basic securitization framework, each structured product is unique. Therefore, the model(s) used to simulate the cashflows for each bond must be customized to fit the unique aspects of the structure.

The assets in the collateral pool must also be valued. In the case of ABS trusts, this can require the valuation of thousands of subprime mortgages, with a wide variety of borrower characteristics and loan terms. CDOs may contain securities issued by ABS trusts, while CDO-squared structures contain securities issued by other CDOs. Some asset pools contain synthetic ABS credit default swaps. All of these complex instruments must be valued.

Modeling the cashflows to the trusts can be further complicated by the fact that they are often dependent on the future values and credit ratings of the collateral. All future values and credit ratings must therefore be estimated in order to estimate the value today. The fact that there is often little data available, even to sophisticated investors, on the different asset pools presents another challenge when it comes to valuation.

These products also had transparency issues. Many investors, even seemingly sophisticated investors, simply did not have the in-house expertise to understand the complex products they were buying. Furthermore, they did not understand the potential risks that might arise from the assumptions underlying the valuation and credit rating models. Investors simply did not foresee how these assumptions might fail under stressed conditions. As a result, they chose to be completely reliant on the rating agencies for risk measurement.

At the same time, the valuation of illiquid assets was opaque. With no readily available benchmark prices, this lack of transparency made investors highly skeptical of reported prices when assessing the credit risk of a counterparty.

The lack of transparency extended to types of products within the SIVs, because banks may hold assets until they can be securitized and sold. Their exact holdings are, therefore, often unknown to investors.

The total volume of outstanding commitments that a financial institution had given, including existing backstop lines of credit the bank was committed to or loan commitments for private equity buyouts, was also hard to determine. Many banks also had profitable money market franchises and these relationships carried implicit commitments to these funds in the event they experienced significant difficulties (e.g., a run on the fund).

A wave of uncertainty, combined with a lack of transparency, triggered the subprime crisis in the summer of 2007.

- In June 2007, Bear Sterns tried to rescue two hedge funds that were threatened by losses from subprime mortgages. The prime broker for one of the funds, Merrill Lynch, seized USD 850 million in underlying collateral but had great difficulty selling any of it. Merrill's troubles showed how illiquid the market for some these assets had become.
- In August 2007, BNP Paribas froze (i.e., barred investors from making withdrawals from) three funds with USD 2.2 billion in assets because of an inability to value the subprime assets in the funds.

The market became increasingly concerned that many of the structured products that had been issued in recent years might be mispriced. Worry spread beyond just the products themselves, however, as the significant exposure of large financial institutions to the subprime market was also called into question. Shortly after these events, the markets for wholesale short-term funding effectively shut down.

CENTRAL BANKS TO THE RESCUE

In response to the growing crisis, the Federal Reserve and other central banks from around the world came up with innovative liquidity injection facilities. Between the fall of 2007 and the end of 2008, the Fed created backstop facilities for a majority of the asset classes that experienced stress during the crisis. Its actions included

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

These actions were liquidity-targeted measures. Consequently, the size of central banks' balance sheets increased considerably.

The major government interventions in the United States during the crisis were the following.

- The Term Auction Facility (TAF), a program implemented in December 2007 and designed to provide funds to depository institutions by auctioning funds against a wide range of collateral
- The Primary Dealer Credit Facility (PDCF), which the allowed the Fed to lend funds, via repos, to primary dealers
- The Economic Stimulus Act of February 2008
- A Government takeover of Fannie Mae and Freddie Mac in September 2008
- The Troubled Asset Relief Program (TARP) in October 2008.

SYSTEMIC RISK IN ACTION

Systemic risk is the risk that events at one firm, or in one market, can extend to other firms or markets. In turn, this can put entire markets or economies at risk. Systemic risk played a large role in exacerbating the impact of the crisis.

Note that in the ABCP and repo markets, collateral quality is important in reducing the risk of a default by the borrower. Lenders in these markets need to have confidence in

the nature and value of the assets used as collateral. As the ABCP and repo markets deteriorated, however, this confidence disappeared. Lenders became increasingly concerned about whether the collateral contained subprime mortgages and whether any of the reported valuations could be relied upon. Due to the lack of transparency in these markets, even borrowers without subprime exposure simply could not roll over their debt.

It is often difficult to estimate the price of illiquid assets even under normal market conditions. For many in the summer of 2007 (e.g., BNP Paribas), it became impossible. Managers of money market funds, typically large purchasers of ABCP and active participants in the repo markets, began to flee and to seek refuge in Treasury bills.

The collapse of the ABCP and repo markets had numerous repercussions. Many hedge funds, unable to roll over their debt, were forced to sell assets. As hedge funds tend to hold a wide variety of assets, this impacted many markets. One of the first to be hit was the CDO market, which came under significant selling pressure. Many funds though, feeling that prices were artificially low or simply unable to practically liquidate such holdings, resorted to liquidating other assets. To close out existing positions, some funds sold higher credit-rated assets and bought lower credit-rated assets that were shorted. This pushed the prices of the higher quality assets down and the prices of the lower quality assets up. Some quantitative hedge funds that traded on pricing patterns were adversely impacted by this type of price reversal. Institutional investors and hedge funds unwound carry trades at a loss in an effort to reduce leverage.

At the same time, banks began to hoard cash (in part) due to the uncertainty around the magnitude of possible drawdowns on the backstop credit lines they had extended to SIVs. Adding to banks' concerns were outstanding commitments to underwrite leveraged buyouts. During the first part of August 2007, the three-month Libor (London interbank offered rate) rose over 30-basis points. The reluctance to lend became widespread as credit standards tightened, negatively impacting hedge funds and other financial institutions, squeezing the availability of mortgages (both residential and commercial), and restricting business lending. Thus, a financial crisis became an economic crisis.

Reading 11 GARP Code of Conduct.

Learning Objectives

- Describe the responsibility of each GARP Member with respect to 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.

INTRODUCTION

Note: This is Code/ Guidelines from GARP applicable to its members hence this reading is presented as it is without any modification.

The GARP Code of Conduct ("Code") sets forth principles of professional conduct for "GARP Members" in support of the advancement of the financial risk management profession. which includes

- Global Association of Risk Professionals ("GARP"),
- Financial Risk Management (FRM®)
- Energy Risk Professional (ERP®) certifications
- other GARP certification, diploma holders and candidates,
- GARP's Board of Trustees, its Regional Directors, GARP Committee Members and GARP's staff

These principles promote the highest levels of ethical conduct and disclosure 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.

APPLICABILITY

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.

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 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 endeavour, 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 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 endeavour 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 from 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.