FRM PART - II

Operational Risk

Handouts

CONTENT

Enterprise Risk Management

LOS 1. Describe enterprise risk management (ERM) and compare and contrast differing definitions of ERM.

Firms face a variety of risks owing to their day-to-day operations – risks like market risk, credit risk and operational risk which we refer to as **primary risks**. Traditionally, such primary risks were treated separately and often addressed by different individuals within an institution, who may measure them using different metrics and methodologies. For example, credit experts evaluated the risk of default and traders were responsible for market risks. In reality,

A. **[Risk Interdependence?]** risks are by their very nature dynamic, fluid, and highly interdependent (e.g. market risk affects credit risk) and cannot be separate components and managed independently. Treating them as separate leads to inefficient risk management via over hedging.
B. **[Correct Mapping?]** risks associated with most businesses are not one-to-one matches for the primary risks.
C. **[Risk Aggregation?]** separate treatment make risks difficult to aggregate. Individual risk functions measure and report their specific risks in different methodologies and formats. For example, the treasury function might report on interest rate and FX risk exposures, and use value-at-risk as it's core risk measurement methodology. The credit function would report delinquencies and outstanding credit exposures, and measure such exposures in terms of outstanding balances.

This is where the function of **Enterprise Risk Management (ERM)** steps in. The ERM function is responsible for direct management of certain risks, coordinate risk management activities for whichever other functions are ultimately responsible, and provide overall risk monitoring for senior management. The prime benefit of ERM is to provide top management with the right and timely risk information.

Any kind of fragmented and inconsistent reporting of risk information is not useful for management and the board. Management will clearly benefit from ERM as it provides a **comprehensive** and **integrated** framework to manage risks and help get a sense of the firm's top risks, exposures to these risks and current trends for primary risks (credit, market, operational). ERM also helps provide answers to questions like:

A. Are we in compliance with internal policies, laws and regulations?
B. Were the majority of the company's actual losses and incidents identified by the risk reports?
C. Are we managing businesses on a risk-adjusted profitability basis?

LOS 2. Compare the benefits and costs of ERM and describe the motivations for a firm to adopt an ERM initiative.

2.1 The Benefits of ERM

ERM is about integration, that happens in the following ways:

1. An Integrated Risk Organization

Most organizations already have in place risk management, audit and compliance functions along with specialist risk units for market risk, credit risk etc. An ERM initiative involves a **centralized risk management** unit reporting to the chief executive officer (CEO) and the board, with responsibility for broad policy setting across risk-taking activities.

The appointment of a **Chief Risk Officer** (CRO, reporting to CEO) and the establishment of an enterprise risk function provides the top-down coordination necessary to make various functions work efficiently, better address not only the individual risks but also the interdependencies between these risks.

2. Integration of Risk Transfer Strategies

Under the silo approach, risk transfer strategies were executed at a transaction or individual risk level. For example, financial derivatives were used to hedge market risk and insurance used to transfer out operational risk. This strategy doesn't incorporate diversification within or across risk types and hence results in **overhedging**. An ERM approach takes the **portfolio view of risks and hedges only the residual or aggregate risk** deemed undesirable by management.

The key benefit of ERM that stems from the above integration is that it can prioritize the level and content of risk reporting that should go to senior management. They get an **enterprise-wide perspective** on aggregate losses, policy exceptions, risk incidents, key exposures and early warning indicators. This increases risk transparency throughout an organization.

3. Integration of Business Processes

ERM requires integration of risk management into the business processes of the firm. Instead of adopting a defensive or control oriented approach to manage risk and earnings volatility, ERM supports and influences activities like pricing, efficient capital resource allocation (allocate if risk-adjusted returns outweigh cost of funds) and other business decisions like product development.

The above integration has resulted in significant improvement in business performance. Benefits achieved range from market value improvement, loss reductions, early warnings of risks, reduction in regulatory capital and insurance premiums.

NB: All above improvements stem from taking portfolio view of risks, managing linkages between risk, capital and profitability and rationalizing the firm's risk transfer strategies.

2.2 The Costs of ERM

All benefits of ERM listed above notwithstanding, ERM as an initiative is not easy to implement (especially when it comes to achieving the above said integrations). Implementation of ERM implies a multiyear initiative that requires ongoing senior management sponsorship and sustained investments in human resources and technology. The amount of time and resources dedicated to risk management may not be very different between leading and lagging institutions (with regards to adoption of ERM).

2.3 The Motivations of ERM

Usually, the motivation about a ERM program comes from the following:

A. **[Make managers proactive]** managers often act after either a disaster is averted in their firm or there is an actual crisis at a similar firm,
B. **[Control environment and risk reporting]** board, senior management question the effectiveness of current control environment and risk reporting, followed by critical assessments from auditors and regulators.
C. **[Chief Risk Officer]** this leads to emergence of a 'risk champion' (designated as the Chief Risk Officer or CRO), who will sponsor a major program to establish an ERM approach to deal with risk.
D. **[Stakeholder pressure]** direct pressure may also come from stakeholders (shareholders, employees, rating agencies and analysts) who expect more predictability in firm's earnings.
E. **[Better risk transfer]** firm's may be attracted towards using increasingly available and liquid risk transfer products (derivatives) to remove unpalatable risks.

LOS 3. Describe the role and responsibilities of a chief risk officer (CRO) and assess how the CRO should interact with other senior management.

The CRO is responsible for developing and implementing an ERM strategy including all aspects of risk, especially in financial institutions, energy firms and non-financial firms with significant investment activities. CRO reports to the CEO or chief financial officer (CFO) or directly to the board of directors. Personnel reporting to CRO include the heads of credit risk, market risk, operational risk, insurance, and portfolio management. Responsibilities of CRO include:

A. **[Leadership]** providing overall leadership, vision and direction for ERM,
B. **[Integrated Risk]** establishing an integrated risk framework for all aspects of risks across the organization,
C. **[Risk Management Policies]** developing risk management policies (including quantification of management's risk appetite through specific risk limits).
D. **[Risk Indicators / Risk Reports]** implementing a set of risk indicators and reports, including losses and incidents, key risk exposures, and early warning indicators.

E. **[Capital Allocation]** allocating economic capital to business activities based on risk, and optimizing the company's risk portfolio through business activities and risk transfer strategies.
F. **[Risk Communication]** communicating the company's risk profile to key stakeholders such as the board of directors, regulators, stock analysts, rating agencies and business partners.
G. **[Risk Infrastructure]** developing the analytical, systems, and data management capabilities to support the risk management program.

Some argue that a company shouldn't have a CRO because risk management is ultimately the responsibility of the CEO or CFO. CRO exists because this division represents a core competency that is critical to the success of the firm.

The CEO needs the experience and technical skill that the seasoned professionals in the risk division bring. In particular, the following technical skills are sought after in CRO:

A. **Leadership skills** to hire and retain talented risk professionals and establish the overall vision for ERM,
B. **Evangelical skills** to convert skeptics into believers particularly when it comes to overcoming natural resistance from business lines.
C. **Stewardship** to safeguard the company's financial and reputational assets.
D. **Technical skills** in credit market, and operational risks.
E. **Consulting skills** in educating the board and senior management, as well as helping line managers implement risk management.

LOS 4. Distinguish between components of an ERM program.

A successful ERM program can be broken down into following key components:

4.1 Corporate Governance

Corporate governance ensures that the board of directors and management have established the appropriate organizational processes and corporate controls to manage risk across the company. The **Sarbanes-Oxley Act** provides both specific requirements and severe penalties for noncompliance with newly established governance and disclosure standards. From ERM perspective, the responsibilities for the board of directors and senior management include:

A. **[Risk Appetite]** defining the organization's risk appetite in terms of risk policies, loss tolerance, risk-to-capital leverage, and target debt rating,
B. **[Risk Management]** ensuring that the organization has the risk management skills and risk absorbing capability to support it's business,
C. **[Risk Organizational Structure]** establishing the organizational structure and defining the roles and responsibilities for risk management, including role of CRO,

D. **[Risk Culture]** shaping the organization's risk culture and reinforcing that commitment through incentives.
E. **[Risk Training]** providing appropriate opportunities for organizational learning including lessons learned from previous problems and ongoing training and development.

4.2 Line Management

ERM must align business strategy with corporate risk policy when pursuing new business and growth opportunities. Risks should be fully assessed and incorporated into pricing and profitability targets. For example,

- expected losses and the cost of risk capital should be included in the pricing of loan.
- in business development, risk management issues are considered in new product and market opportunities.

Efficient and transparent review processes will allow line managers to develop a better understanding of those risks that they can accept independently, and those that require corporate approval or management.

4.3 Portfolio Management

Management should set portfolio targets and risk limits to ensure appropriate diversification and optimal portfolio returns. Diversification effects from natural hedges can only be fully captured if an organization's risks are viewed as a portfolio. Firms with implemented ERM would manage all of its liability, investment, interest rate and other risks as an integrated whole in order to optimize overall risk/return.

4.4 Risk Transfer

Risk transfer strategies lower the cost of transferring out undesirable risk, as well as increasing the organization's capacity to originate desirable but concentrated risk. To reduce undesirable risk, management should evaluate derivatives, insurance, and hybrid products and select the most cost-effective one. A company can dramatically reduce its hedging and insurance costs even by incorporating the "natural hedge" that exist in any risk portfolio. By transferring undesirable risks to the secondary market, an organization can increase its risk origination capacity and revenue without accumulating highly concentrated risk positions. **Management can increase shareholder value through risk transfer if the cost of risk transfer is lower than the cost of risk retention.**

4.5 Risk Analytics

If management wants to reduce its risk exposure, risk analytics can be used to determine the most cost-effective way by evaluating risk transfer products such as derivatives. Advanced risk analytics can be used to improve economic value-added-based decision tools by incorporating

the cost of risk. Use of scenario analyses and dynamic simulations can support strategic planning by analyzing the probabilities and outcomes of different business strategies, as well as the potential impact on shareholder value.

4.6 Data and Technology Resources

A challenge of ERM is aggregation of underlying portfolio data (risk positions captured in different front and back-office systems) and market data (prices, volatilities, and correlations). Apart from aggregation, processes should be in place to improve the quality of data. Companies should not wait for a perfect system solution, but should make the best use of what is available and apply rapid prototyping techniques to drive the systems development process.

4.7 Stakeholder Management

ERM can also be used to improve risk transparency to key stakeholders. This would provide the assurance that appropriate risk management strategies are in effect, otherwise, interested parties will see the risk but may not see the controls. This can be done by:

A. **Board of directors**: need periodic reports and updates on the major risks faced by the firm as well as the review and approval of risk management policies.
B. **Regulators**: need be to assured that sound business practices are in place, and that business operations are in compliance with regulatory requirements.
C. **Equity analysts and rating agencies**: need risk information to develop their investment and credit opinions.

Enterprise Risk Management: Theory and Practice

LOS 1. Define enterprise risk management (ERM) and explain how implementing ERM practices and policies can create shareholder value, both at the macro and the micro level.

Over the last ten years, corporate risk management has expanded well beyond insurance and the hedging of financial exposures to include a variety of other kinds of risk such as operational risk, reputational risk, and strategic risk. A corporation can manage the risks it faces in one of two fundamentally different ways:

A. one risk at a time, on a largely compartmentalized and decentralized basis, or

B. all risks viewed together within a coordinated and strategic framework.

The latter approach is often called **Enterprise Risk Management** (ERM). Companies that succeed in creating an effective ERM have a long-run competitive advantage over those that manage and monitor risks individually. ERM creates value through its effects on companies at both a "macro" or company-wide level and a "micro" or business- unit level, which we now explore.

1.1 At Macro Level

The perfect markets view tells us that since shareholders can diversify their own portfolios, the value of a firm does not depend on its total risk. A company's cost of capital depends mainly on the systematic or non-diversifiable component of total risk (measured by beta). Therefore, any efforts to manage total risk should be a waste of corporate resources.

In reality, investors' information is far from complete and financial troubles can disrupt a company's operations. A bad outcome resulting from a risk that was indeed diversifiable can have costs that go well beyond the immediate hit to cash flow and earnings. Such an impact of bad outcomes is referred to as **dead weight costs**. These costs occur because bad outcomes:

A. affect the market's expectation of future cash flows and earnings, which the market now revises to indicate lower growth.

B. result in permanent reduction in value if the company has to cut back on planned positive NPV investments. This happens if the firm does not have excess cash or unused debt capacity, and finds it difficult or expensive to raise new equity.

By hedging or otherwise managing risk, a firm can limit (up to a certain agreed-upon level) the probability that a large cash shortfall will lead to value destroying dead-weight costs. There is a strong case for laying off risks that could otherwise undermine a company's ability to execute its strategic plan.

A firm might ponder over which risks to retain and which all to hedge or transfer. Firms take on many strategic or business risks that they cannot profitably lay off in capital markets or risk transfer markets. The company's management understands these risks better than any insurance or derivatives provider and costs of transferring such risks would likely be

prohibitively high (high enough to compensate the counterparty for transacting with a better informed party and for constructing models to evaluate the risks).

Insurance companies do not offer contracts that provide coverage for earnings shortfalls i.e. there is no market for derivatives for which the underlying is a company's earnings. If such derivatives existed, insured companies can always manipulate the distribution of their future earnings, to increase the payoffs from such insurance policies.

In making decisions whether to retain or transfer risks, companies should be guided by the principle of **comparative advantage in risk-bearing**. A company that has no special ability to forecast market variables has no comparative advantage in bearing the risk associated with those variables. The same company should have a comparative advantage in bearing information-intensive, firm-specific business risks because it knows more about these risks than anybody else. ERM reinforces the message that companies are in business to take strategic and business risks, and should ideally reduce it's exposure to other "non-core" risks. In doing so, ERM effectively enables companies to take more strategic business risk.

1.2 At Micro Level

We have seen that an increase in total risk can end up reducing value by causing companies to pass up valuable projects or otherwise disrupting the normal operations of the firm. These costs associated with total risk should be accounted for when assessing the risk-return tradeoff in all major new investments. If the company takes on a project that increases the firm's total risk, the project should be sufficiently profitable to provide an adequate return on capital after compensating for the costs associated with the increase in risk.

Decision-making by business managers throughout the firm, should take proper account of the risk-return tradeoff of every project. Business managers should therefore be fully aware of the ERM program. Evaluation of risk-return tradeoff of any new or existing project has two components:

A. **[Decentralized evaluation]** Risk evaluations of new projects must be performed (at least initially) on a decentralized basis by the project planners in the business units (a centralized evaluation would lead to corporate gridlock). They should evaluate returns of all new projects in relation to the marginal increases in firm-wide risk.
B. **[Performance Evaluation]** To help ensure that managers do a good job of assessing the risk-return tradeoff, periodic performance evaluations of the business units must take account of the contributions of each of the units to the total risk of the firm. This is done by assigning a level of additional "imputed" capital to the project to reflect such incremental risk. This creates incentives for managers to manage the risk-return tradeoff by refusing to accept risks that are not economically attractive.

Without an ERM program, risks are either:

A. **accounted subjectively**: This leads to promising projects being rejected because their risks are overstated.
B. **ignored**: This can encourage high-risk projects, that too, without the returns to justify them. A division can take a project that another rejects based on a different assessment of the project's risk and associated costs.

A company that implements ERM can transform its culture. Every risk is now "owned", since it affects someone's performance evaluation. Individuals closest to these risks are generally in the best position to assess how to reduce the firm's exposure to them. A risk-based capital allocation system provides managers with more information about how their decisions will affect firm's performance and measures by which their performance will be evaluated.

LOS 2. Explain how a company can determine its optimal amount of risk through the use of credit rating targets.

Let us define "financial distress" to be any situation where a company is likely to feel compelled to pass up positive net present value (NPV) activities. Many companies identify a level of earnings or cash flow that they want to maintain under almost all circumstances (i.e., with a given confidence level, over a one-year period) and then design their risk management to ensure the firm achieves that minimum.

A company cannot guarantee that its cash and earnings will never fall below this level it's aiming to protect, so there will always be some risk of falling into financial distress. The aim of ERM program is not to minimize the probability of distress, but to limit or constrain it to a level that management and the board agrees is likely to maximize firm value. The job of the management therefore is to optimize the firm's risk portfolio by trading off the following:

A. the probability of large shortfalls (and associated costs)
B. the expected gains from taking or retaining risks.

As the firm picks up more risky projects, it's leveraged return increases, but so does it's probability of large shortfalls. The optimization that the firm is therefore trying to achieve is not to minimize risk (it can do this by investing in Treasuries and earning a risk free return) but to achieve the highest return subject to not exceeding a pre-specified probability of financial distress.

A firm's financial distress threshold can be defined by say a minimum level of cash flow, capital or market value. Many companies use bond ratings to define this threshold. For example, a firm can foresee that it will have to start giving up valuable projects if its rating falls to Baa. Given the firm's current rating, it can use data supplied by rating agencies to estimate the average probability that the firm's rating will fall below threshold.

Whether such a probability is acceptable is for firm's top management and the board to decide:

A. For a firm with valuable growth opportunities, chance of having to forgo such investments may be too risky.

B. For a basic manufacturing firm with few growth opportunities, the costs associated with financial trouble would be relatively low. This makes such firms comfortable with a relatively higher probability to fall into distress.

C. For financial institutions, with credit sensitive liabilities like bank deposits and insurance contracts, a much lower probability of distress is desirable.

A firm can specify it's **target debt rating** as one for which sum of all probability of all states below financial distress threshold equals chosen probability of financial distress.

LOS 3. Describe the development and implementation of an ERM system, as well as challenges to the implementation of an ERM system.

The conceptual framework of ERM is composed of following:

2.1 Choosing the Risk Appetite

As discussed in the Learning Objective above.

2.2 Choosing the Amount of Capital

Once the firm has chosen it's target rating, management now estimates the total amount of capital it requires. Since equity capital provides a buffer or shock absorber that helps the firm to avoid default, by choosing a given level of equity, management is also effectively choosing a probability of default that it believes to be optimal. On the other hand, we can also use the probability of default to imply the amount of equity the firm needs to support its current level of risk. However, keeping a large amount of equity is costly, since equity shareholders require a high return.

2.3 Choosing the Mix of Capital and Risk Management

A firm can also assess it's costs of financial distress via criteria other than ratings and ratings thresholds. High levels of volatility in earnings and capital, while not alone sufficient to cause a rating downgrade, could contribute to an increase in overall risk and hence the required level of capital.

When thinking about acceptable levels of volatility, and the equity capital needed to support them, many financial companies use Value-at-Risk as the measure of risk. When risk is represented in terms of VaR, we say that as VaR or volatility increases, the firm will require more capital to achieve the same probability of default or distress. Looking at from a different perspective, we say that for the same VaR level, the firm will require a higher amount of capital if it wants to work with a lower target probability of default.

At this stage, a firm recognizes that it can reduce its required level of equity by using risk management to reduce the probability of default. This will make sense if that option were deemed less costly than holding equity. The optimum level of capital vs risk management happens "at the margin" where the firm becomes indifferent between decreasing risk and increasing capital. For example, at this stage, the firm is indifferent between spending another $10 million to decrease risk by 1% vs saving $10 million in equity capital costs.

So, at this stage, we say that management determines it's optimal combination of capital and risk to yield it's target rating. This can be done by keeping capital constant and altering risk via hedging and project selection or setting capital equal to risk remaining after hedges are in place.

2.4 Decentralizing Risk-Capital Tradeoff

This is done by using a capital allocation and performance evaluation system. Capital allocation works by a manager evaluating the marginal impact of a project on firm's total risk, and only undertaking those projects for which the NPV is large enough to cover the additional cost of capital required to bear the additional amount of risk.

In terms of performance evaluation, a unit or business line contributes to shareholder wealth only insofar as its economic value added exceeds the cost of its contribution to the risk of the firm. In this framework, the capital required to support the contribution of an activity to the total risk of the firm becomes itself a measure of risk—a measure that, can easily be added up across different activities or risks.

Challenges in Implementation of ERM

Implementation of ERM is challenging – a few challenges are described below:

1. Inventory of Risks

To begin with:

A. the firm should identify the risks it is exposed. Usually, banks classify all risks into one of three categories: market, credit, and operational (a catch-all category that includes all risks that are not market and credit risks). Some firms also measure liquidity, reputational, and strategic risks.

B. management must find a consistent way to measure the firm's exposure to these risks so that identically risky activities would be allocated same amounts of capital, else risk would gradually migrate within the organization to those parts of the firm where it received the lowest risk rating and smallest capital allocation.

For an inventory of risks to be useful, the information possessed by people within the organization must be collected, made comparable, and continuously updated. Companies must be able to aggregate common risks across all of their businesses to analyze and manage those risks effectively. There are two approaches that can be used:

A. **top-down perspective**: Firm's ERM leadership and corporate level risk committee have identified all risks that are large enough in aggregate to threaten the firm with financial distress.

B. **bottom-up perspective**: Individual business units and functional areas conduct risk-control self assessments to identify local-level risks, quantify them using a consistent approach, and then aggregate individual risk exposures across the entire organization to produce a firm-wide risk profile that takes account of correlations among risk.

2. Economic Vs Accounting

Management should recognize the limitations of ratings as a guide to a value-maximizing risk management and capital structure policy. Ratings rely on accounting ratios as well as analysts' subjective judgment, and hence are often not the most reliable estimates of a firm's probability of default. In a target rating based approach, apart from keeping required amount of capital, management may also have to target some accounting-based ratios that are important determinants of ratings as well.

The management also has to keep in mind the shortfall metric it is concerned about – is it a shortfall in cash flow (economic) or in earnings (accounting)? Is it a drop in a company's GAAP net worth (accounting) or a market-based measure of firm value (economic)?

A company that cannot borrow against future cash flows would want to keep the metric that it wants to monitor or target as the cash flow volatility. For such a firm, any shortfall in cash flow, by triggering financing constraints, could push the firm into financial distress. If a company is more likely to experience financial distress because the **present value** of future cash flows is low, it's management must model the risk of changes in firm value, which reflects present value of expected future cash flows.

If a company focuses on its economic value, it could result in more volatile accounting earnings. This may not be desirable for companies with debt covenants that specify minimal levels of earnings and net worth or companies whose ability to attract customers depends on credit ratings.

LOS 4. Describe the role of and issues with correlation in risk aggregation, and describe typical properties of a firm's market risk, credit risk, and operational risk distributions.

4.4 Aggregating Risks

To get to firm-wide total risk, the firm that generally begins by measuring market, credit and operational individually i.e. has three separate VaR measures, which are then aggregated. These risks have dramatically different distributions:

A. **Market risk** behaves very much like the returns on a portfolio of securities, which have a normal or symmetric distribution.
B. **Credit risk** has asymmetric distribution because either a creditor pays in full what is owed or it does not, in which case the loss can be large.
C. **Operational risk** also has asymmetric distribution as there tends to be large numbers of small losses, with some chance of large losses, resulting in a distribution with a long tail.

A key ingredient in aggregating risks are correlations between risk types. The probability of experiencing simultaneously highly adverse market, credit, and operational outcomes is typically very low, implying diversification benefits across risk categories. So the firm-wide VaR is thus less than the sum of the market risk, credit risk, and operational risk VaRs.

Since inter-risk correlations are hard to estimate, many companies choose to use averages of correlations used by other firms in their industry rather than relying on their own estimates. Companies should keep in mind the tendency for correlations to increase in highly stressed

environments, and recognizing that such correlations depend to some extent on the actions of the company.

LOS 5. Distinguish between regulatory and economic capital, and explain the use of economic capital in the corporate decision making process.

Regulatory capital (i.e. the minimum requirement on capital imposed by the regulator) may be different from Economic capital (i.e. capital required to maintain a given credit rating). Two cases therefore arise:

A. **Economic** >> **Regulatory**: The regulatory requirements in this case are not binding and would not affect the firm's decisions.
B. **Regulatory** >> **Economic**: In this case, the firm has to maintain excess capital (that what it really needs). If all the firm's competitors face the same onerous regulatory capital requirements, the excess capital is simply a regulatory tax. If some competitors however, could provide the firm's products without being subject to the same regulatory capital, these less regulated competitors could offer the products at a lower price and the firm would risk losing business to them.

A downside of regulatory capital is that it is generally defined in terms of regulatory accounting. This may become an issue if accounting capital does not accurately reflect the buffer stock of equity available to the firm. The firm may have valuable assets that, although not marked to market on its books, could be sold or borrowed against. The amount of its GAAP equity capital is only part of the story, and the composition and liquidity of the assets matters as well. If the firm incurs a large loss and has no liquid assets it can use to finance it, the fact that it has a large buffer stock of book equity will not be very helpful.

There are significant costs associated with carrying too much equity. If the market perceives that a company has more equity than it needs to support the risk of the business, it will reduce the firm's value to reflect management's failure to earn the cost of capital on that excess capital. When a company undertakes a new risky activity, the probability that it will experience financial distress increases, thus raising the expected costs of financial distress.

A way to avoid these additional costs is by raising enough additional capital so that taking on the new risky activity has no effect on the probability of financial distress. The cost of the impact of a new risky activity on the firm's total risk is to evaluate how much incremental capital would be necessary to ensure that the new risky activity has no impact on the firm's probability of financial distress. Keep in mind that the capital that the firm raises (meant for purpose of acting as a buffer for losses) needs to be invested in such a way that the investment does not increase the risk of the firm.

At any time, a project's contribution to the firm's total risk depends on the risk of the other projects and their correlations. When business units are asked to make decisions that take into account a project's marginal contribution to firm-wide risk, they must have enough information to know how to evaluate that contribution. Many companies sidestep this issue and ignore correlations altogether, i.e. the project receives no benefit from diversification,

and the contribution of the project to firm-wide risk would then be the VaR of the project itself.

One way to account for diversification benefits under a system where correlations between businesses or projects are not readily available or accounted for, is for the firm to reduce the cost of equity or hurdle rate used to evaluate projects that are less than perfectly correlated with the firm's existing projects. We dig deeper into risk based capital budgeting and performance evaluation approaches in the subsequent reading on RAROC.

Operational & Integrated Risk Management

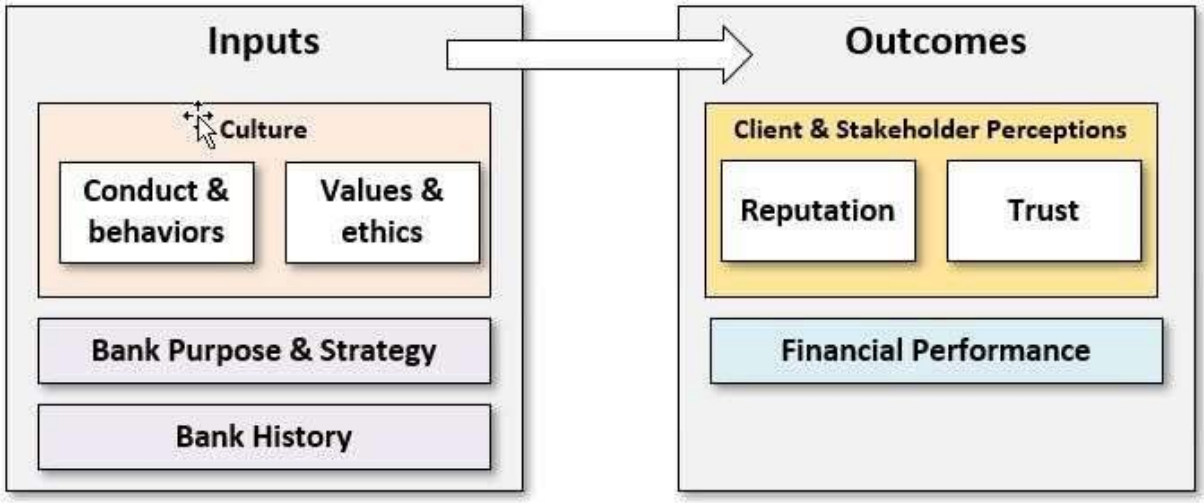
“Banking Conduct and Culture: A Permanent Mindset Change” G30 Working Group, 2018.

“Banking Conduct and Culture: A Permanent Mindset Change”

"Banking Conduct and Culture: A Permanent Mindset Change" (Introduction through Lessons Learned only)

- **Describe challenges faced by banks with respect to conduct and culture, and explain motivations for banks to improve their conduct and culture.**
- **Explain methods by which a bank can improve its corporate culture, and assess progress made by banks in this area.**
- **Explain how a bank can structure performance incentives and make staff development decisions to encourage a strong corporate culture.**
- **Summarize expectations by different national regulators for banks' conduct and culture.**
- **Describe best practices and lessons learned in managing a bank's corporate culture.**

This report follows an earlier report by the Group of Thirty (G30)[1] that defined **culture** as "the mechanism that delivers the values and behaviors that shape conduct and contributes to creating trust in banks and a positive reputation for banks among key stakeholders, both internal and external."[2] To compare, our FRM says **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."[3]
The G30 used a framework to identify two broad outcomes: client and stakeholder perceptions; and financial performance. See the diagram below (our Visio render of their Figure 1).



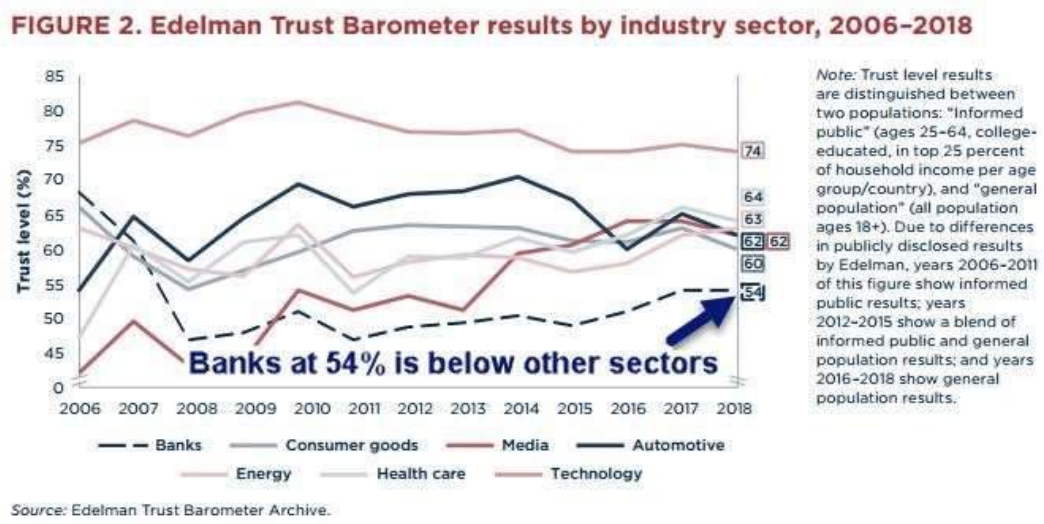
Describe challenges faced by banks with respect to conduct and culture (C&C) and explain motivations for banks to improve their C&C

Motivations for a bank to improve conduct and culture

To build trust and reputation after the global crisis: The aftermath of the 2008-09 global financial crisis (GFC) revealed a rapid decline in the reputation of, and trust in, the banking industry. Improving bank culture and conduct was a near-universal priority from the perspective of bank managers, supervisors, clients/customers, investors, and (government) regulators.

- The industry faced penalties ranging between US$350 to US$470 billion, which included fines and settlement charges for matters related to poor conduct.
- With widely known cases of conduct failures, institutional clients and retail customers are becoming more interested in better management of the conduct and culture of banks.

Continuing low trust levels and negative reputation: Though banks have put in much effort to improve their conduct and culture, and more than a decade has passed since the financial crisis, the industry still suffers from a bad reputation. In order to rebuild their reputation and regain public trust, the banks are forced to improve their conduct and culture. At present, the trust



levels remain low (see Figure 2[4]) compared to other industries and has not yet recovered to the pre-crisis levels.

Various incidents of misconduct across the global banking industry like lack of customer protection, inadequate anti-money-laundering measures, manipulation of market benchmark rates, dishonest traders, etc., are still being reported, even though stricter regulations have been put in place after the crisis. These continue to have a negative impact on the industry.

The ongoing scandals (Figure 3) reveal that misconduct is not limited to specific geographical areas or a narrow range of topics, but relevant to all banks globally and to all lines of business within banks.

Figure 3[5]: Examples of high-profile and public conduct scandals since the financial crisis

Timeline	Banks	Scandals
2011	**UBS**	**Rogue Trader:** Trader undertook US$2 billion worth of unauthorized trades using EU ETF arbitrage loophole
2012	**Standard Chartered**	**Violated U.S. Sanctions** against Iran, Libya, Cuba, and Sudan
	UBS, Rabobank, Barclays, **Deutsche Bank, RBS**	**LIBOR Manipulation:** Colluded to manipulate LIBOR submissions to benefit trading positions
	HSBC	**Money Laundering:** Allowed Columbian & Mexican drug cartels to launder US$900 million through its U.S. banks
	Llyods banking group, RBS, HSBC, Barclays	**Mid-selling:** Banks misguided and mis-sold payment protection insurance and other complex financial products to customers
	JP Morgan	**Rogue Trader: "**London Whale" accumulated US$ 2 billion worth of derivatives positions
	NOMURA	**Insider Trading:** Leaked nonpublic info on firms undergoing IPOs to favored fund managers
2013	**JP Morgan**	**Foreign Bribery:** Awarded more than 100 jobs & internships to 'princelings' referred by government officials in Asia
2014	**UBS, RBS, HSBC, Citi, J.P. Morgan, Bank of America**	**FX market manipulation:** Colluded over six years to manipulate FX spot markets using exclusive chatrooms & coded language
	Credit Suisse	**False filling tax returns:** Assisted U.S. taxpayers in hiding offshore accounts
	BNP Paribas	**Violated U.S. Sanctions** against Sudan, Cuba, and Iran
	COMMERZ BANK	**Violated U.S. Sanctions** against Iran and Sudan
	Commonwealth Bank, ANZ, nab, Macquaire bank, Westpac	**Rate manipulation allegations** of BBSW benchmark rate

2015	**Commonwealth Bank**	**Unsuitable Financial Advice:** Encouraged more than 3,500 clients to undertake risky, inappropriate investments
	ABN-AMRO	**Mortgage Fraud:** Mortgage advisors forged client signatures in revised documentation on mortgages
	WELLS FARGO	**Fraudulent accounts:** Opened millions of fraudulent savings & checking accounts without customer consent
2016	**bsi, FALCON PRIVATE BANK**	**Money Laundering:** Bankers participated in and coordinated money laundering activities linked to corrupt Malaysian 1MBD fund
	Postal Savings Bank of China, ICBC	**Loan fraud:** 19 banks granted loans to criminals who illegally pledged gold of low purity as collateral
	Punjab National Bank	**Fraudulent transactions:** Issued fraudulent guarantees for diamond merchant firms to withdraw unsecured loans from overseas branches
	WELLS FARGO	**"Forced" auto insurance sales:** Sold auto collateral protection insurance to more than 550,000 customers who did not need coverage
2017	**Commonwealth Bank, AMP**	**Fees for "no service":** Charged thousands of customers for financial advice that was not delivered
	TD Bank	**Aggressive sales targets:** Increased overdraft protection amounts & credit card borrowing limits without customer authorization
	Commonwealth Bank	**Money Laundering:** Negligence led to more than 50,000 breaches of AML & counterterrorism laws worth US$ millions
	ABLV	**Violated international sanctions** against North Korea & bribed Latvian officials to prevent tougher AML rules
	ING Bank	**Money Laundering:** An investigation open in 2016 has resulted in a US$900 million fine for failing to prevent years of money laundering abuse
	Deutsche Bank	**Money Laundering:** Failed to prevent a US$ 10 billion Russian money-laundering scheme, resulting in US$630 million in fines
	Danske Bank	**Money Laundering:** CEO resigns amid probe into US$200 billion money-laundering scheme perpetrated at its Estonia branch

Competition from alternative service providers: Many new entrants who are ready to provide banking services (like fintech start-ups, technology firms, retailers, and telecom companies) are lining up in competition with banks. Regaining public trust by managing culture and conduct has become important for the survival of banks that are at risk of displacement by such competitive forces. Where the workforce is a competitive differentiator, a potential shortage of talents may be instigated by the below concerns:

- Problems concerning client attrition along with acquisition and retention of talents may surface if trust and reputation are not regained through proper culture and conduct.
- For e.g. banking problems have prodded millennials to choose sectors other than banking as their career destination.
- Banks have not been able to attract diverse talents due to their not so supportive cultures.
- Also, with digitization, any gap in a bank's technology capabilities forces it to compete for the human resource pool that is already in high demand by other industries.

To stabilize the broader financial system: Culture and conduct of a bank are gaining importance in the light of regaining trust and rebuilding reputation. By practicing good culture and sound conduct, banks are able to better fulfill their role in society, in the process contributing to the stability of the financial system as a whole.

- Since banking services are considered a public good (as it benefits the entire society, from sourcing to transacting of funds globally,) failure of this particular function affects the entire economy and not only the shareholders.
- Moreover, since products and services related to banking are somewhat complex and difficult to comprehend, the public looks forward to the banks to provide sound advice based on its expertise, keeping the clients best interest in mind.
- In the long term, putting the customers first instead of concentrating on short-term gains leads to sustainable shareholder value.

Challenges faced by banks with respect to culture and conduct

Though banks are executing the needed policy changes and processes to improve culture and conduct and to alleviate incidents of potential misconduct, still culture and conduct have to be fully integrated into how banks do business. For instance, wall street recording its highest bonuses in 2017 since the year 2006 makes us ponder if profound changes are possible with respect to conduct and culture in an industry that promotes potential upsides to push the boundaries.

Also, there are concerns raised about the reduced impact of lessons learned during the financial crisis with the passage of time. There are even possibilities of embracing the old practices again, especially so, if interest rates improve, regulation becomes loose and when the economic conditions turn good. As regulations are pulled back over time in the post-global financial crisis era, firms are faced with even greater challenges with regard to their focus on conduct and culture. Some of the challenges faced by the banks in this regard are explained below.

Possibility of a build-up of culture and conduct fatigue: In geographical areas where there has been a continuous focus on issues related to conduct and culture, the inclination has been to just move on with business.

- There are huge chances for progress related to culture and conduct to be just initialized and then forgotten.
- However, for continuous success and sustainability, good culture and conduct has to become internalized as a way of doing business and cannot be conducted separately from other business activities as if they are issues merely related to human resources.

Changes in management and leadership capabilities: So far, the banking industry has mostly used quantitative metrics, which are direct to evaluate. However, greater importance placed on culture and conduct requires a shift in management capabilities.

- Management has to make more room for judgment calls and to involve more fully in daily business activities so as to manage not just the "what" but also the "how". Therefore, sustainable cultural changes at large firms may insist upon improving the leadership capabilities to focus on including newer skills like people management rather than building up the financial acumen alone.
- Substantial management skills are also required to develop an atmosphere at the firm that is psychologically safe and empowers employees to be genuine, where diversity flourishes, and where group thinking and decision making is supported.

Move towards refined and effective management style: Moving towards a more refined and effective style of management is difficult in many banks with the shortages in leadership faced.

- It can be seen that historically banks advanced their best performers into the management category without giving much consideration to their ability or interest in management. Also, not much time was spent on training to improve their management skills.
- Rewarding management roles to employees was considered as a job well done instead of as a benefit, commitment, and responsibility to develop others and promote the long-term sustainability of the firm.
- The leadership gap in middle management layers, with low skill and capacity to manage

the “how” of performance, and less capacity to affect and handle team member behaviors are noted.

- Many banks that did not give due importance to improving management and leadership capabilities are now forced to invest in the same to catch up with the lost time.

Progress on conduct: Though the broader meaning of good conduct will remain the same, the focus points will change as the markets and business models continue to emerge.

- Challenges to address new scenarios for misconduct may evolve over time. For e.g., risks involved with pricing contracts in London Inter-bank Offered Rate (LIBOR) transition; new General Data Protection Regulation (GDPR) requirements; risks related to bias in automated black-box systems and artificial intelligence (AI).

Rolling bad apples: Sometimes it is easy for employees with poor conduct records to leave one company for another without being punished for the consequences of their dishonest actions. The banking industry has to address this concern, drawing lessons from other professional industries.

The banking sector continues to suffer when employee rights and privacy issues come in conflict with the industry’s capacity to protect itself from such toxic employees.

Potential supervisory gaps and conduct arbitrage. With diverse views evolving on conduct and culture and numerous supervisory approaches across jurisdictions, there arise high possibilities for conduct arbitrage.

- Conduct arbitrage occurs when large firms take advantage of the poorer supervisory oversight in jurisdictions that may have less focused and demanding laws on culture and conduct.
- Moreover, Open Banking developments have made competitive lines indistinct across banks, technology companies, retailers, and telecom companies, which has led to concerns regarding fair competition and customer protection.

Explain methods by which a bank can improve its corporate culture, and assess progress made by banks in this area.

To improve the conduct and culture of banks, across both the *what* and the *how* areas :

The What: Banks should define their desired cultural values through a rigorous set of principles, and mechanisms that lead to high standards of values and related conduct consistent with the purpose of the organization and its broader role in society.
The How: Banks should integrate the desired culture through continuous monitoring and determination, in the following four areas: senior accountability and governance, performance

management and incentives, staff development and promotion, and an effective three lines of defense.

The ways for improving the conduct and culture of banks, as recommended by the *Group of Thirty* (2015 and 2018 recommendations)[6] are presented here:

1. **A fundamental shift in the overall mindset on culture**

- Banks should reinforce the messages in their actions and in their internal communications.
- Banks' behaviors and conduct should be open to constructive internal challenges.
- The "tone from the top should receive more importance than the "tone from above"

2. **Senior accountability and governance**

- Oversight of embedded values, conduct, and behaviors should receive regular attention in boards' agenda setting, given the sensitivity to reputational risk.
- Board charters should include responsibility for oversight of values and conduct.
- Boards should build a reputation, values, and conduct risk tolerance dashboard to aid in their evaluation of cultural issues.
- The CEO and Executive team should be highly visible in championing the desired values and conduct and face material consequences if there are persistent or high-profile breaches.
- Asset owners and third-party fund managers should tell boards directly that they consider effective governance and accountability to be a priority cultural matter for the firm and investors.
- The board should reevaluate its governance structure to ensure one specific and dedicated board committee has oversight of the bank's conduct and culture.

3. **Performance management and incentives**

a. Banks should consider the potential impact of outsized incentives in their compensation mechanisms.

b. Banks should remove the link between quantitative sales targets and compensation for sales staff to minimize the pressure that can lead to misconduct and help staff prioritize meeting customer/client needs

c. Banks should explore ways to celebrate role models in behavior, both in business decisions and in individual actions.

4. **Staff development and promotion**

   a. Banks should buttress first-line skills and ensure that frontline management and leadership are properly trained in how to conduct judgment-based staff evaluation and deal with identified breaches.

   b. Institutions should formulate and implement systemwide values and conduct the evaluation process for internal promotions and external hires.

   c. Banks should make efforts to promote diversity and inclusion in the workplace in their hiring and staff development practices.

   d. Banks should promote an environment of "psychological safety" that encourages employees to speak up and escalate issues or share feedback without fear of retribution; bullying or aggressive management styles must not be tolerated.

   e. Banks should establish credibility and enforcement through their disciplinary mechanisms for conduct breaches to ensure employees take these measures seriously.

   f. Banks should focus on hiring people who align with the bank's purpose and values as they strive to create the right culture for their organization, recognizing that recruiting is a critical element to creating the right culture.

   g. Banks should use surveillance technology (e.g. AI, machine learning, etc.) to improve the culture

5. **An effective three lines of defense**

   a. Staff and management in the business (first line of defense) should shoulder the largest responsibility for judging whether a behavior is in line with the bank's values and desired conduct.

   b. Banks should allocate clear second-line ownership to Compliance or Risk Management functions and ensure that the designated function is on the Executive team.

   c. Banks should provide assurance to all employees that reports of wrongdoing in the workplace will be taken seriously and confidentially without reprisal. Banks should challenge the conventional wisdom on legal impediments and ensure that robust penalties and appraisal processes are in place.

   d. Staff rotation between control and business functions may be beneficial and help develop the desired firm-wide cultural mindset.

   e. Banks should ensure that the third line of defense is robust, has operational independence, is suitably staffed, and has a clear mandate to examine adherence to standards.

6. **Regulators, supervisors, and enforcement authorities**

   a. Conduct-of-business and prudential supervisors can, however, gauge the effectiveness of board and management processes that generate tangible oversight and change in values and conduct.

   b. Conduct-related assessment should be embedded into the core supervisory work, rather than developed as an "add-on" task or objective.

   c. Industry-led standard-setting initiatives should be encouraged.

Progress made by banks in improving corporate culture

Considering the geographical and firmwide differences, it is not completely possible to evaluate the progress made by banks in improving the culture at a global level. For instance, those banks in countries affected the most by the financial crisis (e.g. USA, UK, Europe) have focused on this topic for more than a decade, while the others in less affected countries (e.g. Australia) have only recently started this journey. In terms of efforts put in by the banks, the progress is easily observable but how the efforts impact outcome is hard to demonstrate. Given this, the inputs and efforts made by banks to improve culture and a range of views on the industry-wide progress are explained here.

Although the industry level mindset on culture has advanced, tangible progress is seen to be slow. This is because the public continues to expect higher standards of good conduct from banks and also due to improvement in transparency levels (due to social media). Integrating culture in a more fundamental way and to prove the effects of cultural change is still a big challenge for the industry. Furthermore, there is a widening gap between firms that adopt a complete, multifaceted approach with active board-level commitment and firms that narrowly focus on misconduct management and compliance for solving cultural issues.

Explain how a bank can structure performance incentives and make staff development decisions to encourage a strong corporate culture.

Performance Management and Incentives

To encourage a strong corporate culture, the banks can structure their performance incentives and compensation measures so that it falls in line with cultural expectations rather than focusing on profitability or high performance alone.

- Sometimes exceptionally large incentives are allocated to business activities based on the higher risks they assume. While such activities are incentivized for potential gains, their potential losses have limited sharing. Therefore, these kinds of activities should be scrutinized by banks so that firm values and ethics are not downplayed in the process.
- When business decisions, for example, that promote the bank's purpose or values are

undertaken instead of the ones that are economically profitable, they must be encouraged and celebrated. Similarly, individuals, for instance, who have exhibited outstanding behaviors must be honored.

- In bringing about a cultural change, structuring incentives so that there is positive reinforcement for desired behaviors is more effective than focusing on negative consequences to reduce unwanted behavior.
- Particularly, banks can incorporate cultural and behavioral expectations into performance scorecards, and accordingly, adjust compensation at all levels of management. That is, there should be a shift from completely results-based compensation to a balanced-scorecard based compensation structure.
- Banks need to experiment with alternative performance measures to achieve the right balance between promoting good conduct and achievement of strategic goals. Banks should include nonfinancial performance measurements like conduct, customer outcomes, assessment against firm values, etc. into their remuneration processes. Then the results of these measures should be linked to compensation, career progression and, where necessary, termination.
- Associating employee's pay with sales target incentives may provoke misconduct, lead to troublesome subcultures within firms, and cause dreadful outcomes that are harmful to customers and damage the reputation of the bank. Instead of sales-oriented incentives, those based on team goals and customer satisfaction outcomes can be promoted.
- Though compensation influences behavior, leadership plays a key role in driving behavior. So, the reliance on compensation should be minimized and importance should be given to leadership to modify conduct by gaining insights about how employees exhibit various behaviors under different circumstances.
- Compensation structures, when amended in isolation, will have a limited effect on culture since compensation is often a by-product of its environment rather than a driver. In case misconduct happens, it should be studied whether it was caused by the incentive itself or if the incentives were an indication of the wrong mindset that ultimately led to that misbehavior.
- Practically, it is easier to evaluate direct results than behaviors, and difficult to discipline high performers for breach of conduct. However, if necessary, top management should have the willingness and courage and take steps to terminate high performers for misconduct. This sends a strong message at all levels of the firm and adds credibility to the focus towards a balanced performance management culture.
- Banks need to not only act on but publicize acts of misconduct when needed. Where necessary they should even be ready to forego revenue opportunities in order to maintain a strong culture.

- However, in certain jurisdictions with strong employee protection, handling breaches of misconduct could turn difficult. Moreover, with widespread social justice campaigns and interruption from activist investors in the present times, ethical and legal considerations need to be aligned properly.

Staff Development and Promotions

To encourage a strong corporate culture at banks, training programs for the staff should be undertaken to translate the firm's values and principles into day to day responsibilities and expectations around behavior.

- Banks may use various scenarios or role-play based or industrial theater approaches and use a blend of live and web-based mechanisms to provide content that interprets the culture into daily practical behavior.
- Since banking is a complex process wherein rules and policies are not always possible or even desirable, staff also need training to face situations with a large number of decisions that are vague and complex to understand. So, staff requires training in terms of knowledge, skills, and tools in such areas where judgment is necessary.
- At the same time, too much training can have a numbing effect on staff and sometimes can have the opposite effect than that is intended. So the right training for the right staff at the right time is necessary. That is, the training should be targeted specifically and not force everyone to do everything.
- Promotion and hiring decisions should make use of conduct screens that assess the recruits' alignment with the firm's purpose, values, and expectations on behavior. For example, conduct interview questions, ethical screening, and different forms of personality assessments, etc. are useful tools in conduct screening.
- Use of surveillance technology (for e.g. AI, machine learning) at banks helps in better use of available data with advanced analytics, so as to detect or predict potential conduct events. However, with heightened surveillance capabilities, while banks work towards improving their conduct management, they should also ensure staff with some level of privacy and trust.
- While senior leadership, the tone from the top and leading by example are significant, at the same time, the role played by middle management in instilling cultural reforms and promoting values to lower levels of the organization is also noteworthy. Therefore, middle management should be equipped with the skills, training, and resources to meet different expectations, transform into remarkable leaders, and continue to support cultural reforms. Also, given that middle management is closest to daily operations, they should actively deal with emerging influences on culture.
- Diversity and inclusion in the workplace should be encouraged through hiring and staff

development practices. A diverse workforce that is fully engaged and empowered leads way to better decision-making processes and outcomes and stronger institutions.

- Banks should encourage an atmosphere of “psychological safety” that inspires the employees to communicate and share feedback without any fear of consequences. Aggressive management styles in any form must not be tolerated. Mechanisms such as hotlines and escalation channels and their effective operation should be taken care of. These can be used in combination with other activities like holding frequent forums for communication, avoiding too much focus on mistakes, and following up on any issues responsibly within the allocated time frame. Equipping managers with the capability and skills to distinguish cases of honest mistakes vs. cases of misconduct is important for staff well-being and safety.
- Disciplinary mechanisms for conduct breaches should be in such a way that the employees take these measures seriously so that the bank's credibility and enforcement are established. Cases of misconduct should be treated fairly. That is, the standards should be applied consistently, irrespective of business performance. For e.g., an employee must not escape punishment for misconduct just because he is a high performer. While the banks must act tough in cases of misconduct, at the same time, they should not create a culture of intolerance or fear when honest and reasonable mistakes are committed. This concept is important for banks to innovate and develop new capabilities. So, the desire and need to innovate should be balanced with reducing unintended negative outcomes.
- To create the right culture, banks should hire staff who align with their own purpose and values. This may necessitate changes to the interview process, like providing hiring staff with tools to assess recruits’ behavioral competencies and a sense of ethics. Within the limits allowed by the privacy and employment laws, banks need to advance their assessment of the culture and ethical fit of new recruits. At the same time, there must be balance so that cultural fit is not used as an excuse for lack of diversity in the organization.

Describe best practices and lessons learned in managing a bank's corporate culture.

After years of progress on improving banking culture and conduct, industry leaders have reported eight important lessons they learned during the process.

Summary of the lessons learned

1. Managing culture is not a one-time event, but a continuous process under progress that must be reinforced in the daily business operations and embedded permanently into the way of doing business.
2. Leadership plays a significant role in integrating conduct and culture from the top down to throughout the entire firm (commencing with the board and senior management, more importantly including middle management and down to the ordinary staff). To emphasize the point that the advice from above is as significant as the advice from the top, managers at all levels of the organization need to be trained, promoted, and supported.
3. Conduct management is not only about misconduct but also more broadly about conduct risk management. That is, not just misbehavior on purpose, but unintentional wrongdoings arising from decisions and/or lack of skills and knowledge need attention.
4. Culture management needs a multifaceted approach and alignment of multiple cultural levers at the same time which includes structural elements like processes and policies, and also human elements like beliefs and attitudes.
5. Diverse opinions on culture will lead to better and more sustainable outcomes for all stakeholders. Diversity in thoughts, problem-solving abilities, and leadership styles helps attain better results in an organization.
6. Cultural norms and beliefs cannot be measured clearly but the behaviors and outcomes that culture promotes can and should be measured properly.
7. Regulation plays a limited role in culture management as culture cannot be defined by rules. However, regulation is effective in providing guidance related to basic principles of good conduct, diverting banks' attention to areas of constant misconduct, and in helping to understand the lessons learned from across the industry. Supervision can effectively monitor and give feedback that assists management in improving culture and conduct.
8. Communication and sharing of industry-wide best practices will help in building up trust, leading way to a better and stronger banking sector.

Operational & Integrated Risk Management

Alessandro Carretta and Paola Schwizer, Risk Culture in Banking (Palgrave Macmillan, 2017)

Chapter 2: Risk Culture

Chapter 2: Risk Culture

- **Compare risk culture and corporate culture and explain how they interact.**
- **Explain factors that influence a firm's corporate culture and its risk culture.**
- **Describe methods by which corporate culture and risk culture can be measured.**
- **Describe characteristics of a strong risk culture and challenges to the implementation of an effective risk culture.**
- **Assess the relationship between risk culture and business performance.**

Compare risk culture and corporate culture and explain how they interact.

Corporate culture is the link that helps in understanding individual and social behavior within corporate organizations. Generally, culture in any organization is seen as the outcome of shared values, basic underlying assumptions and business experiences, behavior and beliefs, as well as strategic decisions. Overall, culture is a set of experiences, beliefs and behavioral patterns and is particularly considered as a key tool that drives corporate behavior.

According to Caretta et.al[1], "The corporate culture shapes the beliefs, attitudes, and behaviors in all the different aspects of organizational life: purpose of the firm, performance, external relationships with customers and suppliers, internal relationships between units and individuals, risk, etc."

In terms of economic literature, culture is considered a mechanism that makes the corporation more efficient through simplified communication and decision-making process. With the shift in the role of banks from being public institutions to profit-driven private entities over a period of time, corporate culture has also evolved accordingly. These shifts underscore the significance of studying the effect of corporate culture on banks' performance and competitiveness.

Risk culture is a subculture within the framework of corporate culture in financial institutions i.e., it is a part or element of the general organizational and business culture with a central role in financial firms. Along with organizational rules and controls, the risk culture governs the effective ability of the decision-makers to understand, evaluate, and manage risk.

Caretta[2] et.al. define risk culture as:

- "A bank's norms, attitudes, and behaviors related to risk awareness, risk-taking and risk management and controls that shape decisions on risks. Risk culture influences the decisions of management and employees during the day-to-day activities and has an impact on the risks they assume" (FSB 2014; BCBS 2015).
- Or, alternatively: "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" (IIF 2009).

[1] Alessandro Carretta and Paola Schwizer, Risk Culture in Banking (Palgrave Macmillan, 2017).

[2] Alessandro Carretta and Paola Schwizer, Risk Culture in Banking (Palgrave Macmillan, 2017).

Risk can be seen in a negative or in a positive way; as a setback that should be avoided, or as an opportunity to be sought. Thus, it is necessary to differentiate between a healthy risk culture and risk avoidance.

- **A sound or healthy risk culture** optimizes risk-taking and risk management and does not necessarily minimize it. A sound risk culture ensures setting up of right risk objectives, directing behaviors towards effective risk management that is in alignment with the objectives of the firm, as well as continuous and careful monitoring of the risk. Normally, the risky businesses (e.g. insurance, trading) have a strong risk culture.
- On the other end, **risk aversion** is not identified with a healthy culture, as witnessed in conservative and overbearing financial institutions, with a stagnant performance. In reality, such firms have a "control culture" or a "compliance culture", and not necessarily a "risk culture".

Interaction of corporate culture and risk culture

With the rise in complexity of various operations and roles and activities undertaken by the banking business, many subcultures are formed at all levels of the organization. The risk management team's opinion of, for instance, the business environment, may vary substantially from the point of view of other departments. In this case, risk culture interacts with the presiding corporate culture and other subcultures to establish a continuous balance between the need for integration and the choice for differentiation between the varying perspectives of the different business units. This balance is a requisite for adapting to the environment and the changes in business.

Moreover, there is empirical evidence that the geographical area and the nature of the business affect the risk culture of the organization. According to a Deloitte survey (2013), cultural problems are seen to be higher for US and British banks than for Asian banks, with European banks taking the middle position. In terms of business, investment banks are more affected by cultural issues followed by universal banks, whereas in the case of retail banks and mutual banks, the cultural failings seem to be lower.

The business risk cultures are expected to be different based on:

1. importance or the attention given to risk and its role in organizational culture
2. risk return tradeoff or the appetite for risk
3. nature of risks that are peculiar to the business

For e.g. credit risk in commercial banking; market risk in trading; reputational risk in private banking.

Explain factors that influence a firm's corporate culture and its risk culture.

The culture of an organization or **corporate culture** very much depends on its **national culture** and **environment.**

National culture

Although certain countries are more homogeneous than others and sometimes geographical areas having a similar culture belong to different nations, national culture is relevant for studying corporate culture.

According to Hofstede, the dimensions of national cultures are embedded in an individual's unconscious values. Even though national cultures vary at the level of habitual, unconscious values held by most of the individuals, as long as they are developed in childhood, are notably stable over time. Hence it might take generations to change national values. Even though practices (e.g. rituals) vary with circumstances, the underlying values are the same. As a result, even though differences exist between countries, they still have a historical continuity.

Environment

Culture is largely influenced by its environment. Empirical research by International Monetary Fund reveals that firms operating in environments with low risk aversion, greater individualism and in sectors lacking transparency in information tend to exhibit a more aggressive risk culture. External regulation, as well as internal supervision, affect the corporate culture to a large extent. While the organization is a fundamental unit for the analysis of culture and risk culture, the individual is key in terms of personal integrity and inclination towards risk.

The **nature of the business** by itself mainly determines the **risk culture** in financial institutions. The business-driven factors that affect risk culture are grouped into structural, contingent, and evolutionary factors. [3]

Structural/endogenous factors

They are inherent and stable features of the business, like the kind of activities performed, the customers served, the economics, etc.

1. **Activities performed:** Different business activities embody different kinds of risks depending on various aspects like those mentioned below.
    a) **Nature:** For e.g., commercial banking is associated with credit and liquidity risks; asset management with reputational risk; trading with market risk, etc.
    b) **Time horizons**: For e.g. market risk is a volatile, short-term risk but credit risk is a medium-term risk.
    c) **Effects on financial results:** For e.g. productive risks may lead to economic losses, conduct risk to loss of customers and compliance costs, and liquidity and reputational risks to the collapse of the firm itself.

    Risks in mass-market businesses with economies of scale and standard processes, like retail banking, payments, etc. will differ from those in customized and service-intensive businesses like investment banking and wealth management.

[3] Risk Culture in Different Banks Businesses, Marco Di Antonio

2. **Nature and role of customers:** Customer relationships differ with the type of business, for instance, corporate banking and wealth management are centered mainly around customers; customers play an important role in retail banking; customer presence is only felt in the form of counterparties in securities trading and sales. As a result, the importance of customers, as well as compliance and reputational risks is different.
   The optimal risk/return combinations that customers seek are also variable. For example, high-net-worth individuals investing in hedge funds are more risk-seeking than retail customers investing in mutual funds or pension funds.
3. **The economics of business:** The profits of a business vary based on the amount of risk taken. For example, proprietary trading profits come from taking considerable risks, gains in investment banking are associated with innovation and the related risks, whereas stable but lower earnings in retail banking are linked to the lesser risk-seeking and cautious approach.

Contingent/exogenous factors

They are external factors that might change over time and which indirectly affect risk culture. Furthermore, they generally function differently in different businesses and so they are differentiating factors of the business risk culture. The important ones are:

1. **Market competitiveness:** Generally, competitiveness in the markets forces the banks to improve their performance levels.
2. **Regulation:** Better regulation leads to a healthier risk culture.
   - In general, less regulated businesses are more risk-oriented than highly regulated ones. For example, hedge funds vs. mutual funds, shadow banking vs. traditional banking, investment banking vs. commercial banking.
   - Also, protective regulation (e.g. deposit insurance schemes) may create moral hazard and hence reduce the risk aversion of the firm.
3. **History and evolution of the business:** The history of the business is significant from two points of view.
   - One, it is observed that prior successes in an organization establishes and strengthens its culture. For instance, long periods of stable markets and steady profits of retail banks consolidated their cautious risk culture; impressive profits and growth of US investment banks bolstered their aggressive risk culture; the past nature of non-profit, state-owned Italian banks affected their risk culture.
   - Second, historical moments of evolution, whether changing slowly or suddenly, affect the risk culture. The business culture is shaped by shifting attention towards deregulation, competition and free markets, thereby moving towards acceptance of higher levels of risk.
4. **Size and diversification:** The size and the degree of diversification of financial institutions affect the corporate risk culture.
   - The optimal size of an organization varies according to business activities. For example, in organizations where economies of scale and scope are important, like

universal banks, asset management, and payment institutions, the size will be larger than in community banks and private banks. And in such large firms with quick growth, cultural changes are more difficult to execute. The large size impedes the risk messages in getting across from the top management to the front office.

5. **Ownership model:** The ownership model is another main factor affecting the organizational culture.
   - For instance, public companies are willing to assume more risks in order to improve the bank's profits due to increasing pressure from investors. Given the asymmetric incentive system of the limited companies, i.e., unlimited profits vs. limited losses, this pressure is increased by the changing risk behavior of shareholders.
   - Other ownership structures are more risk-averse. For example, a state-owned bank gives importance to stability rather than profitability; owners of a mutual bank are also customers and hence take decisions based on the long-term horizon; family-owned banks are averse to taking risks since the shareholders invest a considerable amount of their personal wealth in them.
6. **National culture:** National culture is associated with business risk culture in the sense that some businesses are more prevalent in specific countries. The national culture's role in influencing risk culture has been studied by many researchers.
   - Kanagaretnam et al. (2011) observe that in the years before the crisis (1993–2006) aggressive risk-taking activities were more likely in countries with low uncertainty avoidance and high individualism.
   - Breuer et al. (2014) notice that individualism is linked to overconfidence and over-optimism and has a significantly positive effect on individual financial risk-taking.
7. **Strategic orientation:** Strategic orientation refers to the important trade-off choices taken at a strategic level which is determined by the business of the financial institution. Five kinds of trade-off choices that affect the risk culture are identified.
   - **Short-term vs. long-term outlook on business:** A short-term perspective of the business reduces the focus on risk and risk culture.
   - **Shareholder vs. stakeholder orientation:** In case of shareholder orientation (e.g. global universal banks), the customer and compliance risks are possibly higher than in case of stakeholder orientation (e.g. community or mutual banks).
   - **Transaction vs. relationship approach to business:** The attention to customer risk is lower with transaction approach to business (e.g. trading, some sectors of investment banking and product specialization), whereas in business activities with a relationship approach (e.g. corporate banking, private banking, retail banking) the focus on risk is higher.
   - **Innovation vs stability:** In innovative businesses (e.g. investment banking) the disposition towards risks is higher than for stable businesses (e.g. retail banking)
   - **Profitability versus risk:** The risk appetite will be higher for such businesses where profit is considered more important than risk.

8. **Organizational systems and practices:** The organizational systems and practices have a two-way connection to business culture.
    - In this context, performance measurement and compensation systems gain importance. For example, if the organizational risk culture statements underscore the focus on risk, but if compensation is based on short-term profitability, the risk culture weakens. The performance metrics vary based on business types. For instance, the "pay for performance" system is more significant in investment banking than in other sectors.
9. **Individual culture of the employees:** The individual culture of the staff is interconnected with the group culture, culture of organizational units, businesses, and headquarters. While corporate culture affects individual culture, the opposite is also true: the culture of the individuals also influences corporate culture.
    - Culture is spread partly from top-down, through leaders, and partly created from the bottom-up, by the regular staff.
    - An organization consisting of men and younger workforce is more risk-oriented than one with women or older workforce.
    - Generally, people choose to work in a company whose business activities and functions align more with their own set of values. By doing so, they reinforce the existing organizational culture. For example, job seekers in a community or retail bank are less aggressive, less competitive and less risk-oriented than those looking for an investment banking job.

Evolutionary factors

The change in contingent factors over time leads to evolving business risks, and therefore changing risk cultures. Such factors function as the evolutionary factors of the business risk culture.

- The changes that affect all the businesses are called ***convergent evolutionary factors***. Those factors that might affect only one or a few businesses are called ***divergent evolutionary factors.***

Some of the important evolutionary factors are explained below.

1. **Increasing market competition:** Growing competition challenged the survivability of banks and emphasized the need for comparison across bank performances.
2. **Deregulation:**
    - Some examples of this deregulation were: permitting the use of internal models for capital adequacy calculation (Basel 2); the removal of the net capital rule for the largest US broker-dealers (2004), allowing consolidation between investment and commercial banking (1999); liberalizing of sub-prime loans.
3. **Bank ownership:** The changes in bank ownership ushered in a more risk-oriented culture. The four main changes that occurred in terms of ownership were:
    - **Concentrated to fragmented ownership:** They were shifts from concentrated ownership, which had an industrial and long-term orientation, to fragmented

ownership, i.e., a public company with a short-term outlook embraced by institutional investors.

4. **Objectives:** As a result of the above-mentioned factors, the objectives of the financial institutions underwent a change.
   - They focused more on, growth, profitability, and efficiency rather than on customers, personnel and social dimension. For example, many retail banks shifted their focus from prudent risk culture to a "profit culture" which had more productive risk and a "sales culture" which had higher customer risk.
   - All these shifts led to the creation of financial products that were less favorable for the customers. Also, the corporate culture became more inclined towards commercial and competitive features, with less consideration given to the interests of the customers and the society as a whole.
5. **Bank success stories:** With the importance given to growth and profitability, aggressive investment banks that came out with success stories became the standard of reference to other commercial or universal banks.
   - The investment banking divisions became the most profit-making units of large financial institutions.
   - Capital markets were subject to a lengthy period of stability (the Great Moderation) and risky securities appeared to be less risky.
6. **Growth and diversification:** As a result of the growth and diversification of financial institutions, risk management became more complex, the risk culture turned out to be heterogeneous, and the relationship with the customers became distant and informal.
   - Risk controls were seen more as a deterrent to growth and profitability.
   - In large and diversified financial institutions, where the risk culture of retail banking came into conflict with that of investment banking, the latter dominated due to its better financial performance.
7. **Complex products:** As the complexity of products increased, difficulty in comprehending the technical features of new products were more frequently observed, However, risks associated with such complex products were somehow underrated as the banks became overconfident about the effectiveness of their risk management systems.
8. **Organizational practices:** The awareness about risk reduced with some kinds of organizational practices.
   - With too much dependence on short-term financial gains, financial institutions failed to consider important issues like quality of service to customers, business sustainability, compliance with rules and controls. "Profit culture" and a "sales culture", were promoted instead of a "risk culture".
9. **Individual culture:** There were also shifts leading to changes in the individual culture of the personnel with more appetite for risk (as described famously by the "greed is good"

motto). With more aggressive and risk-taking staff moving towards the more successful and dynamic sectors, an adverse selection (Sub prime) transpired in the financial system.

10. **Economic culture:** Overall, all these above changes led to the change in the economic culture. The free-market model (MBS) was interpreted in an extreme way with more emphasis on the efficiency of capital markets, their risk management capability, and the merits of financial innovation. Thus, while these functions were overvalued, the risks associated with them were notably underestimated. (Subprime crisis)

Describe methods by which corporate culture and risk culture can be measured.

Corporate and risk culture can be measured using either qualitative or quantitative methods.

Qualitative methods: They involve ethnographic analysis and case studies, which leads to in-depth analysis but their results may not be comparable.

- Direct observation is one method by which culture can be assessed as many of its aspects are silent.
- However, this method is more subjective and so prevents other researchers from replicating the analysis and confirming its results.

Quantitative methods: Quantitative methods analyze culture indirectly by observing progress in a company's risk governance in relation to its risk return profile.

- They use standardized and statistical tools.
- These may not provide in-depth observations but are more *objective* and *comparable*

The aim is to establish a homogenous method that reflects the needs of companies and the environment, which gives way to a *comparable* and *compliant* approach. Numerous survey (and other) methods and metrics are used by firms to study cultural attitudes and behavior.

Survey methods and metrics[4]

There are a range of approaches used by financial institutions to evaluate culture and cultural progress. Some of these methods are described below.

Employee engagement and culture survey: Many firms make use of an annual employee engagement survey combined with culture and other modules added to this survey.

Customer perceptions and outcomes: Culture can be assessed in the form of behavioral outcomes it generates. Specifically, firms may use customer satisfaction scores and other test outcomes like e.g. mystery shopping or regular online panels of customers.

Indicator dashboard: Various indicators are sometimes collaborated by firms into "culture dashboards". They include:

- For Customers: satisfaction scores, complaints
- For Employees: engagement scores, speaking up scores, turnover, absence rates, grievances, use of whistleblowing lines
- Conduct and risk: conduct breaches, clawbacks, material events, and escalations

Validation: Companies use the following methods to validate cultural progress:

- Consultancy firms' benchmarking exercises
- Other external benchmarks
- Internal Audit assessments
- Triangulation across various data sources, e.g. staff and customer surveys

4 Banking Standards Board, 2016, Risk Culture, Alessandro Carretta and Paola Schwizer

Describe characteristics of a strong risk culture and challenges to the implementation of an effective risk culture.

Table 1: Sound risk culture indicators (FSB 2014)[5]

Indicators	Subindicators	
Tone-from-the- Top	Leading by example	•The Board and Senior Management (B&SM) have a clear view and monitor RC; they proactively address weakness. • B&SM promote through behaviors, actions, and words RC. • B&SM promote through behaviors, actions, and words a healthy skepticism, challenge, and open communication • B&SM establish, monitor, and support Risk Appetite Framework (RAF), which is integrated in strategy • Talent development, succession planning, and 360-review process, etc. are in place to avoid the dominance by small groups • B&SM is subject to the same expectation for integrity, risk governance, and RC as employees
	Assessing espoused values (questioning)	• B&SM systematically assess whether the advertised values are communicated and proposed by management and staff (tone-at-the-middle) • B&SM assess if risk appetite framework and business strategy are clearly understood
	Understanding and awareness (fake policy)	• Appropriate mechanism ensures risk appetite, risk management, and strategy are alighted and embedded in decision-making at all levels • B&SM have clear views on business lines more challenging in the risk management (e.g. business lines with doubt results or with nonfinancial risk that cannot be quantified) • B&SM monitor if management addresses risk issues raised by board, supervisors, and control functions
	Learning from past experiences	• Root causes of processes' risk management weaknesses are reviewed at appropriate levels • Assessment and communication of lessons learned from past events, both failures, and successes, are seen as an opportunity to enhance RC

[5]FSB Table as summarized by the authors, Risk Culture in the Regulation and Supervision Framework, Alessandro Carretta and Paola Schwizer

Indicators	Subindicators	
Accountability	Ownership of risk	• Clear expectations are set with respect to the monitoring and reporting of, and response to, current and emerging risk information • Mechanisms are in place for the sharing of information on emerging, as well as low probability and high impact risk (vertically and horizontally) • All the members of the organization are held accountable for his or her actions not aligned with institutions values regardless of the financial result
	Escalation Process	• Appropriate escalation process with clear consequences of noncompliance • Systematic assessments on employees' awareness and environmental openness • Mechanism for employees to report concerns when they feel discomfort about products or practices • Whistleblowing procedures
	Clear consequences	• Consequences are clearly established, articulated, and applied for anyone supporting excessive risk-taking relative to RAF, whether positive revenue or net income was generated • Nonadherence is understood to have a potential impact on an individual's compensation and responsibilities, career progression, or termination. It may result in termination
Effective communication and challenge	Open to alternate views	• Alternative views are encouraged, valued, respected, and occurred in practice • Mechanisms are in place as well as alternate views.
	Stature of control function	• Control function (CF) shares the same stature as the business line and it is proactively involved in decisions. • CF operates independently and has access to the B&SM. • CF has sufficient stature to effectively exert control tasks

Incentives	Remuneration	• Compensation structure supports core values and sound risk-taking behavior • Compensation structure is supported by a well-documented process • Remuneration and performance metrics consistently support desired risk-taking behaviors and encourage employees to act in the interest of the greater good of the company, rather than for themselves or their business line • Annual performance review and objectives setting are linked to promoting values and desired behaviors • Incentive compensation programs systematically include individual and group adherence to the financial institution's core values, risk culture, and cooperation with internal control functions and supervisors and respect of risk limits

Indicators	Subindicators	
	Succession planning	• Succession planning processes for key management positions include risk management experience and not only revenue-based accomplishments
	Talent development	• Understanding key risks, essential elements of risk management, and the institution's culture is considered a critical skill set for senior employees • Job rotation between control functions and business lines • Training programs are available for all staff to develop risk management competencies

Challenges to implementation of an effective risk culture

Codes and standards of conduct have been established for some time now in the banking industry. Rather than their development, their effective execution and enforcement across diverse business lines and jurisdictions is of key importance.

Effective implementation of conduct risk management in financial institutions calls for fundamental changes in culture and behavior across the industry which would take time. Also, the process of cultural change is very demanding as it involves many stakeholders like investors, management, bank staff, government, regulatory authorities, and clients. As such, all stakeholders should come together in a common effort to promote a better banking culture.

Presented below are some of the challenges faced by the financial institutions in implementing an effective risk culture.[6]

1. **Integration in business decision-making:** Embedding of the cultural code and conduct into the day to day business decisions and activities challenges the existing consensus about success in an organization. All stakeholders, including clients and shareholders, should be included in embracing these changes.
2. **Consistency of messages and action:** The board and top management decisions on conduct issues may not be supported by consistent actions across all levels of the organization and across functions like hiring, promotions, professional standing, and success which becomes a challenging issue. This requires cooperation from all parts of the organization as cultural issues cannot be segregated into different business functions. Also, senior management must take accountability for driving these cultural changes.
3. **Cross-border and cross-cultural issues:** Each stakeholder has different expectations and notions about the role of financial services providers. So, conduct risk management, and also rules regarding incentives based on conduct vary across jurisdictions. These challenges make it difficult for multinational firms to develop consistent conduct behaviors across the institution.
4. **Common taxonomy for conduct risk:** A consistent set of cultural definitions, methods of assessment, and measurement of conduct risk is not yet completely developed. The integration of conduct risk in all the above aspects of a firm's business is still evolving. As of now, conduct risks vary across product lines and change with the organizational structure of business units within firms.
5. **Grey areas:** Sometimes behaviors and actions of the personnel may be at odds with the cultural values of the firm, i.e. they may not be ethically right but at the same time they may not be illegal also. During such times, it becomes difficult to take a preplanned course of action as judgment is required in decision making. Firms should establish frameworks to address such grey areas.

   Leadership should take responsibility to address and resolve such weak areas in conduct risk management. A cooperative attitude on identifying conduct risks, such as "reporting in the public interest" by involving business lines, is considered a better approach than "whistleblowing", which creates conflict between employees and the institution. However, regulatory laws should be strong and transparent enough to let firms decide about dealing with breaches in conduct.
6. **Role of directors:** As much as board supervision is important for strengthening conduct risk management, it is also critical to establish balance between the accountability of individual executives and the board. Since it is observed that boards are witnessing increased pressure, it could deter experienced and qualified experts from serving on them.

6 Financial Stability Board, Risk Culture, Alessandro Carretta and Paola Schwizer

Assess the relationship between risk culture and business performance.

It is well known that culture is an important tool that affects corporate behavior and as a result, its performance, **but there is still no consensus on how this occurs.**

- While some researchers observe culture to have a fixed effect on firm performance, others propose that it is a variable and it changes with time. In recent times, culture is being viewed as a variable and accordingly, financial institutions are creating frameworks and tools to manage and measure it.
- In theory, a culture suitable for being measured in terms of its business performance is possible. A suitable culture refers to the standard set of assumptions and adopted behavior that aligns with the company's values, which serves to improve the market value of the company.
- Leadership gives guidance on cultural issues, spreads a firm's values through effective communication, serves as good examples for the staff to follow and reinforces the positive impact of culture on both individual and organizational performance. Economic literature further reiterates that culture is a mechanism that improves the communication and decision-making process in an organization, thereby making it more efficient. In this context, according to Stulz (2014), **a strong culture has high fixed costs but reduces its marginal costs.**

P1.T7. Operational & Integrated Risk Management

Mark Carey "Management of Risks Associated with Money Laundering and Financing of Terrorism," GARP Risk Institute, February 2019

“Management of Risks Associated with Money Laundering and Financing of Terrorism”

"Management of Risks Associated with Money Laundering and Financing of Terrorism"

This chapter summarizes the following reports[1]:

- Basel Committee on Banking Supervision, 2016, "Sound Management of Risks Related to Money Laundering and Financing of Terrorism."
- Financial Action Task Force, 2016, "The FATF Recommendations."
- Board of Governors of the Federal Reserve System, Federal Deposit Insurance Corporation, Financial Crimes Enforcement Network, National Credit Union Administration, Office of the Comptroller of the Currency, 2018, "Joint Statement on Innovative Efforts to Combat Money Laundering and Terrorist Financing."

Explain best practices recommended for the assessment, management, mitigation and monitoring of money laundering and financial terrorism (ML/FT) risks.

Financial institutions, especially banks, are the hub of the worldwide money transaction system. Invariably, criminals and terrorists use these institution's services to fund their activities or to convert money related to criminal activities (e.g. tax evasion) to an unblemished or clean form. Banks are therefore susceptible to such illegal dealings which may cost them in terms of reputation, fines, or court verdicts, which may lead to constraints in continuing with their proficient business practices.

Hence, many countries have established laws and regulations concentrating on restricting the use of financial services to fund criminal activities, especially those related to money laundering (ML) or financing of terrorism (FT). Normally ML or FT would be considered operational risk, but risk management related to ML or FT has evolved into a distinct subfield. This is because of reasons such as more attention being given by regulators to this problem, hefty fines related to such activities, and the innovative ideas perpetrated by criminals and terrorists.

Along with the normal focus on governance activities and rules and procedures, other activities involved in ML/FT risk management include[2]:

- Risk assessment
- Customer due diligence and acceptance (CDD) [aka Know Your Customer (KYC)]
- Transaction and other monitoring
- Reporting of suspicious activity and freezing assets
- Addressing risks associated with global operations
- Attention to third-party risk and correspondent banking risks
- Awareness of an array of official sector pronouncements.

The best practices recommended in terms of assessment, management, mitigation and monitoring of risks associated with ML and FT are explained here.

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1 Chapter 17 Management of Risks Associated with Money Laundering and Financing of Terrorism, Mark Carey, GARP Risk Institute.

2 Financial Action Task Force, 2016, "The FATF Recommendations."

Risk Assessment: The risks related to ML/FT that are innately present within the financial institutions' business and customer base should be understood well and evaluated accordingly.

- All applicable risk factors related to country, sector, bank, and business relationship levels should be studied. Also, customer base, available products and services, and delivery channels should be observed.
- For each customer or business connection, a profile or record containing their usual activities should be created, so that any illegal activities that occur can be detected.
- The details of risk assessment should be well-documented for reviewing purposes.
- Global banks should be alert with regard to country-level risk assessments and reports.

Risk management: The standard risk management practices that should at least be minimally followed by the banks in particular areas are presented below.

Governance

- Activities dealing with risk assessment, policies, organization, risk management, and compliance in the context of ML/FT should be supported and supervised by the board of directors.
- A chief officer specifically dealing with ML/FT should be hired for the same reason.

Three lines of defense

- **First Line:** Business units are responsible for identifying, evaluating, and managing risks related to ML/FT. They are also accountable for written policies and procedures, training staff, and screening potential employees.
- **Second Line:** The risk function owned by the chief ML/FT officer should take charge of supervising the effectiveness of the first line of ML/FT risk management and compliance. When second line employees are faced with conflicts of interest, that situation should be rectified or prevented. The chief ML/FT officer should report directly to senior management or the board of management.
- **Third Line:** The auditing process involving ML/FT risk management and controls should be carried out independently by internal and/or external auditors.

Customer Due Diligence and Acceptance: Activities of high-risk customers (those having past criminal records and with substantial and irregular cashflows in their account) should be scrutinized carefully and continuously as against low-risk customers (long time clients with steady and smaller cashflow accounts).

Well-built customer identification and acceptance policies and procedures should be used to distinguish the customers by their risk levels. However, those policies and procedures should not pose a hazard to the general public or financially needy people from using banking services.

- A customer identity verification process should be adequately performed with the guidance of written policies and procedures, without which a business relationship should not be commenced. Trustworthy and independent sources of data and information should be utilized for customer identification. A client's home jurisdiction(s) should be examined, specifically for incidents related to ML/FT activities. The motives behind the opening of customer accounts should also be researched.

- Proper checks related to a prospective client's background, profession, source of wealth and income, and country of origin and residence should be conducted.
- Politically exposed persons (PEP), like past government officials, are likely to be classified under high-risk customers, owing to corruption issues.
- Evidence regarding a client's prior banking relationships may be necessary but not a sufficient condition to categorize them under low-risk.
- Financial institutions operating internationally, especially those falling under a territory with a lack of access to client information across borders, find due diligence and supervising activities to be tedious. Whatever be the case, efforts should be taken to collect and examine as much information as possible across the group.
- In some areas, third parties may be allowed to perform customer due diligence. In such cases, the management of ML/FT risks by third parties should be checked for its rigorousness and the process should be backed by documentation.

Transaction and other Monitoring and Reporting: Customer and transaction accounts should be checked for strange and suspicious activities related to potential ML/FT.

- For each customer or business relationship, a profile containing their usual activity and transactions should be established and monitored which makes it easier to screen any unlawful transactions as and when they occur.
- Monitoring should encompass each and every account and transaction.
- For high-risk customers, the monitoring will be even more powerful and extensive.
- When changes are noticed in the customer's risk profile, monitoring should be increased accordingly.
- Customer due diligence data should be used in monitoring.
- Automated monitoring is likely needed for large and multifaceted institutions and their businesses that are more spread out geographically.
- Institutions should keep a record of their monitoring activities in the form of documents.
- Illegal or unlawful activity detected during monitoring should be reported to the relevant authorities, specifically in territories where such law is mandatory.

Correspondent Banking: Correspondent banking comprises of providing banking services by one bank (correspondent bank) on behalf of another bank (respondent bank). In the context of ML/FT, the issue of correspondent banks implementing cross-border payments for respondent bank's clients is critical.

- Since the correspondent bank does not directly deal with the client of the respondent bank, due diligence should be performed effectively. This includes collecting details about services rendered, counterparties related to risky activities, and the quality of the respondent banks' management of ML/ FT risks. The agreements in this regard between the correspondent and respondent banks should set out their respective duties.
- Sometimes the correspondent bank has to deal with the client of a respondent bank, thereby involving nested respondent banks. Such nested banking activities are prone to ML/FT risk, specifically so if they involve cross border activities.
- In certain cases, based on the intensity of risky activities related to ML/FT, the corresponding bank may appropriately end its dealing with a respondent bank.

Wire Transfers: When banks carry out wire transfers through payment messages, details about the originating bank and the client should be shown and these records should be monitored.

International Scope: Those financial institutions that are spread internationally with manifold businesses and across multiple countries should pursue the following actions.

- They should strictly adhere to the laws and regulations of every country they operate in. If a particular country's laws and regulations do not impose satisfactory ML/FT risk management, they should contemplate on winding up business in such a country.
- They should follow consistent policies and procedures across all of the companies that come under their group.
- Overall communication and sharing of data and information across the group should be done effectively, and such information obtained at the group level should be used in monitoring and risk assessment.

To restrict worldwide ML/FT activity, it is crucial for financial institutions to conduct supervisory examination and enforcement in each country of its existence.

P2. T7. Operational & Integrated Risk Management

“Guidance on Managing Outsourcing Risk,” Board of Governors of the Federal Reserve System, December 2013

“Guidance on Managing Outsourcing Risk”

"Guidance on Managing Outsourcing Risk"

Explain how risks can arise through outsourcing activities to third-party service providers, and describe elements of an effective program to manage outsourcing risk.

Explain how financial institutions should perform due diligence on third-party service providers.

Describe topics and provisions that should be addressed in a contract with a third-party service provider.

Explain how risks can arise through outsourcing activities to third- party service providers, and describe elements of an effective program to manage outsourcing risk.

Financial institutions are increasingly outsourcing their business functions or activities to third party service providers. The use of service providers to perform operational functions presents various risks to these institutions. Some risks are inherent to the outsourced activity itself, whereas others are introduced with the involvement of a service provider. If not managed effectively, the use of service providers may expose financial institutions to risks that can result in regulatory action, financial loss, litigation, and loss of reputation.

The following risks could arise while entering into or while managing outsourcing activities.

- ***Compliance risks*** arise when the services, products, or activities of a service provider fail to comply with applicable laws and regulations.
- ***Concentration risks*** arise when outsourced services or products are provided by a limited number of service providers or are concentrated in limited geographic locations.
- ***Reputational risks*** arise when actions or poor performance of a service provider causes the public to form a negative opinion about a financial institution.
- ***Country risks*** arise when a financial institution engages a foreign-based service provider, exposing the institution to possible economic, social, and political conditions and events from the country where the provider is located.
- ***Operational risks*** arise when a service provider exposes a financial institution to losses due to inadequate or failed internal processes or systems or from external events and human error.
- ***Legal risks*** arise when a service provider exposes a financial institution to legal expenses and possible lawsuits.

Elements of an effective program to manage outsourcing risk

Due to these risks, policies governing the use of service providers should be formed by the company. These policies should establish a service provider risk management program that addresses these risks. Also, it should provide oversight and controls commensurate with the level of risk presented by the outsourcing. It should focus on outsourced activities:

- that have a substantial impact on a financial institution's financial condition
- that are critical to the institution's ongoing operations
- that which involve sensitive customer information or new bank products or services
- that which pose material compliance risk.

The depth and formality of the service provider risk management program will depend on the criticality, complexity, and number of material business activities being outsourced.

While the activities necessary to implement an effective service provider risk management program can vary based on the scope and nature of a financial institution's outsourced activities, effective programs usually include the following core elements:

1. **Risk assessments:** A financial institution should determine whether outsourcing an activity is consistent with the strategic direction and overall business strategy of the organization. Then it should analyze the benefits and risks of outsourcing the proposed activity as well as the service provider risk, and determine cost implications for establishing the outsourcing arrangement.

   Consideration should also be given to the availability of qualified and experienced service providers to perform the service on an ongoing basis. Also, management should consider the financial institution's ability and expertise to provide appropriate oversight and management of the relationship with the service provider. This risk assessment should be updated at appropriate intervals and risk mitigation plans should be revised based on the results of the updated risk assessment.

2. **Due diligence and selection of service providers:** A financial institution should conduct an evaluation of and perform the necessary due diligence for a prospective service provider prior to engaging the service provider. The depth and formality of the due diligence performed will vary depending on the scope, complexity, and importance of the planned outsourcing arrangement, the financial institution's familiarity with prospective service providers, and the reputation and industry standing of the service provider. Throughout the due diligence process, financial institution technical experts and key stakeholders should be engaged in the review and approval process as needed.

3. **Contract provisions and considerations:** Financial institutions should understand the service contract and legal issues associated with proposed outsourcing arrangements. The terms of service agreements should be defined in written contracts that have been reviewed by the financial institution's legal counsel prior to execution. The characteristics of the business activity being outsourced and the service provider's strategy for providing those services will determine the terms of the contract.

4. **Incentive compensation review:** Financial institutions should also ensure that an effective process is in place to review and approve any incentive compensation that may be embedded in service provider contracts, including a review of whether existing governance and controls are adequate in light of risks arising from incentive compensation arrangements. Whether the incentives provided might encourage the service provider to take imprudent risks should be considered. Inappropriately structured incentives may result in reputational damage, increased litigation, or other risks to the financial institution.

5. **Oversight and monitoring of service providers:** To effectively monitor contractual requirements, financial institutions should establish acceptable performance metrics that the business line or relationship management determines to be indicative of acceptable performance levels. It should be ensured that personnel with oversight and management responsibilities for service providers have the appropriate level of expertise and stature to manage the outsourcing arrangement. The oversight process, including the level and frequency of management reporting, should be risk-focused.

   Higher risk service providers may require more frequent assessment and monitoring and may require financial institutions to designate individuals or a group as a point of contact. Further, more frequent and stringent monitoring is necessary for service providers that exhibit performance, financial, compliance, or control concerns. For lower risk service providers, the level of monitoring can be lessened.

6. **Business continuity and contingency plans:** Various events may affect a service provider's ability to provide contracted services. For example, services could be disrupted by a provider's performance failure, operational disruption, financial difficulty, or failure of business continuity and contingency plans during operational disruptions or natural disasters. Financial institution contingency plans should focus on critical services provided by service providers and consider alternative arrangements in the event that a service provider is unable to perform.

Explain how financial institutions should perform due diligence on third-party service providers.

The overall due diligence process includes a review of the service provider with regard to:

1. **Business Background, Reputation, and Strategy: Financial institutions should**:
   - review a prospective service provider's status in the industry and corporate history and qualifications
   - review the background and reputation of the service provider and its principals
   - ensure that the service provider has an appropriate background check program for its employees.

The service provider's experience in providing the proposed service should be evaluated in order to assess its qualifications and competencies to perform the service. The service provider's business model, including its business strategy and mission, service philosophy, quality initiatives, and organizational policies should be evaluated. Financial institutions should also consider the resiliency and adaptability of the service provider's business model as factors in assessing the future viability of the provider to perform services.

Financial institutions should check the service provider's references to ascertain its performance record, and verify any required licenses and certifications. Financial institutions should also verify whether there are any pending legal or regulatory compliance issues (for example, litigation, regulatory actions, or complaints) that are associated with the prospective service provider and its principals.

2. **Financial Performance and Condition:** Financial institutions should review the financial condition of the service provider and its closely-related affiliates. The financial review may include:

   - The service provider's most recent financial statements and annual report with regard to outstanding commitments, capital strength, liquidity and operating results.
   - The service provider's sustainability, including factors such as the length of time that the service provider has been in business and the service provider's growth of market share for a given service.
   - The potential impact of the financial institution's business relationship on the service provider's financial condition.
   - The service provider's commitment (both in terms of financial and staff resources) to provide the contracted services to the financial institution for the duration of the contract.
   - The adequacy of the service provider's insurance coverage.
   - The adequacy of the service provider's review of the financial condition of any subcontractors.
   - Other current issues the service provider may be facing that could affect future financial performance.

3. **Operations and Internal Controls**: Financial institutions are responsible for ensuring that services provided by service providers comply with applicable laws and regulations and are consistent with safe-and-sound banking practices. Financial institutions should evaluate the adequacy of standards, policies, and procedures. Depending on the characteristics of the outsourced activity, some or all of the following may need to be reviewed:

   - Internal controls;
   - Facilities management (such as access requirements or sharing of facilities);
   - Training, including compliance training for staff;
   - Security of systems (for example, data and equipment);
   - Privacy protection of the financial institution's confidential information;
   - Maintenance and retention of records;
   - Business resumption and contingency planning;
   - Systems development and maintenance;
   - Service support and delivery;
   - Employee background checks; and
   - Adherence to applicable laws, regulations, and supervisory guidance.

Describe topics and provisions that should be addressed in a contract with a third-party service provider.

Elements of well-defined contracts and service agreements usually include:

- ***Scope:*** Contracts should clearly define the rights and responsibilities of each party, including:
  - support, maintenance, and customer service; contract timeframes; compliance with applicable laws, regulations, and regulatory guidance; training of financial institution employees; ability to subcontract services; distribution of any required statements or disclosures to the financial institution's customers; insurance coverage requirements; and terms governing the use of the financial institution's property, equipment, and staff.
- ***Cost and compensation***: Contracts should describe the compensation, variable charges, and any fees to be paid for non-recurring items and special requests. Agreements should also address which party is responsible for the payment of any legal, audit, and examination fees related to the activity being performed by the service provider. Where applicable, agreements should address the party responsible for the expense, purchasing, and maintenance of any equipment, hardware, software or any other item related to the activity being performed by the service provider. In addition, financial institutions should ensure that any incentives provided in contracts do not provide potential incentives to take imprudent risks on behalf of the institution.
- ***Right to audit:*** Agreements may provide for the right of the institution or its representatives to audit the service provider and/or to have access to audit reports. Agreements should define the types of audit reports the financial institution will receive and the frequency of the audits and reports.
- ***Establishment and monitoring of performance standards:*** Agreements should define measurable performance standards for the services or products being provided.
- ***Confidentiality and security of information:*** Consistent with applicable laws, regulations, and supervisory guidance, service providers should ensure the security and confidentiality of both the financial institution's confidential information and the financial institution's customer information. Information security measures for outsourced functions should be viewed as if the activity were being performed by the financial institution and afforded the same protections.

  Service agreements should also address service provider use of financial institution information and its customer information. Information made available to the service provider should be limited to what is needed to provide the contracted services. Service providers may reveal confidential supervisory information only to the extent authorized under applicable laws and regulations.

  If service providers handle any of the financial institution customer's Nonpublic Personal Information (NPPI), they must comply with applicable te privacy laws and regulations. Financial institutions should require notification of any breaches involving the disclosure of NPPI data. Misuse or unauthorized disclosure of confidential customer data by service providers may expose financial institutions to liability or action by a federal or state regulatory agency. Contracts should clearly authorize and disclose the roles and responsibilities of financial institutions and service providers regarding NPPI data.

- ***Ownership and license:*** Agreements should define the ability and circumstances under which service providers may use financial institution property inclusive of data, hardware, software, and intellectual property. Agreements should address the ownership and control of any information generated by service providers. If financial institutions purchase software from service providers, escrow agreements may be needed to ensure that financial institutions have the ability to access the source code and programs under certain conditions.
- ***Indemnification:*** Agreements should provide for service provider indemnification of financial institutions for any claims against financial institutions resulting from the service provider's negligence.
- ***Default and termination***: Agreements should define events of a contractual default, list of acceptable remedies, and provide opportunities for curing default. Agreements should also define termination rights, including change in control, merger or acquisition, increase in fees, failure to meet performance standards, failure to fulfill the contractual obligations, failure to provide required notices, and failure to prevent violations of law, bankruptcy, closure, or insolvency. Contracts should include termination and notification requirements that provide financial institutions with sufficient time to transfer services to another service provider. Agreements should also address a service provider's preservation and timely return of financial institution data, records, and other resources.
- ***Dispute resolution***: Agreements should include a dispute resolution process in order to expedite problem resolution and address the continuation of the arrangement between the parties during the dispute resolution period.
- ***Limits on liability*****:** Service providers may want to contractually limit their liability. The board of directors and senior management of a financial institution should determine whether the proposed limitations are reasonable when compared to the risks to the institution if a service provider fails to perform.
- ***Insurance*****:** Service providers should have adequate insurance and provide financial institutions with proof of insurance. Further, service providers should notify financial institutions when there is a material change in their insurance coverage.
- ***Customer complaints:*** Agreements should specify the responsibilities of financial institutions and service providers related to responding to customer complaints. If service providers are responsible for customer complaint resolution, agreements should provide for summary reports to the financial institutions that track the status and resolution of complaints.
- ***Business resumption and contingency plan of the service provider:*** Agreements should address the continuation of services provided by service providers in the event of operational failures. Agreements should address service provider responsibility for backing up information and maintaining disaster recovery and contingency plans. Agreements may include a service provider's responsibility for testing of plans and providing testing results to financial institutions.

- ***Foreign-based service providers:*** For agreements with foreign-based service providers, financial institutions should consider including express choice of law and jurisdictional provisions that would provide for the adjudication of all disputes between the two parties under the laws of a single, specific jurisdiction. Such agreements may be subject to the interpretation of foreign courts relying on local laws. Since foreign law may differ from local law, institutions should seek legal advice regarding the enforceability of all aspects of proposed contracts with foreign-based service providers and the other legal ramifications of such arrangements.
- ***Subcontracting:*** If agreements allow for subcontracting, the same contractual provisions should apply to the subcontractor. Contract provisions should clearly state that the primary service provider has overall accountability for all services that the service provider and its subcontractors provide. Agreements should define the services that may be subcontracted, the service provider's due diligence process for engaging and monitoring subcontractors, and the notification and approval requirements regarding changes to the service provider's subcontractors. Special attention should be paid to any foreign subcontractors, as information security and data privacy standards may be different in other jurisdictions. Additionally, agreements should include the service provider's process for assessing the subcontractor's financial condition to fulfill contractual obligations.

Principles for the Sound Management of Operational Risk.

Operational risk - risk of loss resulting from failure or people, process or system. It excludes strategic and reputational risk but includes legal risk

3 lines of defense include -

(i) Business Line Management - "first line of defense". Risk must be identified and managed in each diff BL (i.e., within various products, activities and processes).

(ii) Functional independent CORF - This is the second line of defense which works in compliment with first line of defense. Responsibilities of CORF include

- Measure operational risk
- Establish reporting process for OR.
- Establish risk committees to measure and monitor OR.
- Report OR to BOD. (∵ CORF has to be independent - they have to report to CFO/CRO/COO directly and with dotted lines to Board's Risk Committee).

Basically work towards develop-ing OR frame-work in the firm.

CORF challenges each BL's contribution to risk measurement

Each bank will have a CORF that will vary depending on the size of the bank and complexity of organisation. eg.- Large banks - formalised and fully staffed separate group. small banks - OR management part of broader risk management. CORF should have sufficient no. of skilled people in its units

(iii) Independent review - Review of OR by personnel who is qualified and trained at this - can be internal or external third party. Must include both verification and validation

Lo 2 Principles of OR management.

1. Maintain strong RM culture led by bank's BOD and senior managers.
2. OR framework must be fully developed and integrated into the RM process of the bank.
3. BOD should approve and periodically review the framework - BOD should oversee (supervise) senior management for OR framework implementation

4. BOD should identify all types and levels of OR and should approve it with bank's risk appetite and tolerance statements.

5. Senior management should develop the governance structure in line with this risk appetite and tolerance statements

6. Senior management should identify and asses all types of OR (i.e., understand risk incentives).

7. New lines of business should require approval for potential OR

8. Process on monitoring OR and material exposure should be in place done by senior management and supported by everybody.

9. Strong internal controls, risk mitigation and risk transfer strategies in place.

10. Business operations must be resilient i.e., withstand large losses.

11. Clear disclosure to outside stakeholders.

Few other responsibilities of BOD/ Senior Management.

① Establish code of conduct or ethics policy – BOD should provide the code to senior management in establishing code of conduct

① Senior management ensures risk training to all levels of banks.

BOD and senior management should thoroughly understand the nature and complexity of all risks.

BOD should ensure management is following best practices.

BOD should establish clear lines of responsibilities within the management

NOTE: Governance structure - Governance structure should be commensurate with the size and complexity of the firm. We should consider -

→ Committee structure for large complex banks, for ① firm level risk unit should oversee all risk, ② management level risk committee should reports to ①.

→ Committee composition - members should have business experience, financial experience and RM experience. There should be an independent non-executive board member.

→ Committee operation - frequent meeting and complete recording.

NOTE - Risk transfer should be seen as a compliment to rather than replacement for RM controls.

① Continuity plans (unforeseen disruptive events) - plans should include impact analysis and plans for recovery. Identify key personnel and business and identify key external third parties.

② Periodically review continuity plans.

Tools for identifying and assessing OR. SLIMR CAM.

Scenario Analysis - subjective process - identify potential risk events and assess potential outcome (expert opinion)

Loss data.

Internal operational loss data - insights into causes of large losses (exceeding threshold.) by business line management which can be reviewed and challenged by 2nd line of defense.

External operational loss data - insights into gross loss amount, date, RR

Indicators - KRI and KPI, measures the changes in key risk indicators and triggers are present to see if risk is above threshold.

Measurement - output from R can be used as input in OR. model. Banks uses these models to calc economic and regulatory cap.

Risk assessments - address potential threats. RSA - process of banks along with defense, threat and vulnerabilities (think SWOT analysis)

RCSA - considers risk before risk controls - inherent risk.
risk after risk control - residual risk.

- Comparative Analysis - Combine all tools to get a picture of OR.
- Audit findings - identify weakness and inherent OR.
- Mapping. - Map business processes to key risks.

los 5,6- Pg 7-8

5 components of Effective Control Environment

Control Environment

Risk Assessment

Control Activities

Information and Communication

Monitoring Activities.

ORMF - The Framework.

must
Define, describe and classify OR and operational loss exposure. These components should be integrated in the bank's overall RM and the entire framework should be documented in BOD's approved policy.

What should ORMF cover?

- Proper lines of responsibility (reporting, accountabilities.)
- Bank's risk appetite and tolerance.
- Tools to assess and mitigate risk, limits.
- Common language or taxonomy (for consistency of risk identification and management).
- Create process for review and then review.
- Compensation plans should be aligned with risk appetite and risk tolerance.

ERM

ERM is the process of managing all of a corporation's risk within an integrated framework. - cohesive framework.

Benefit of ERM - comprehensive program for managing risk that allow business to achieve ideal balance b/w risk and return.
optimise total risk of firm.

Macro Level.

Optimising risk return trade off using ERM helps the firm in
(i) maintain access to capital markets.
(ii) implement strategy and business plan.

In perfect market, hedging diversifiable risk creates no value to shareholder who can eliminate the risk by diversifying this portfolio.

But in imperfect market, hedging diversifiable risk is beneficial as, if company's CF falls and they want funds from the market to fund projects - they might not get it or it might be expensive - losing these projects can permanently damage shareholder's value. so for timely access to cap market and to implement strategies risk is imp.

Micro level (Decentralisation)

Manager should not only view the risk of a project ~~microsco~~ individually but should also consider its effect on the total firm's risk. This decentralisation has 2 components -

Business units must be evaluated based on their contribution to the total risk of the firm.

Any manager will now see the new project with respect to the risk of the entire firm.

Reasons why decentralisation is imp).

(i) Transformation into a risk management culture of the firm.
(ii) Risk is owned i.e., compensation for employees based on risk adjusted return.

OpRisk Data and Governance.

6.1. 7 Basel II event risk categories and examples of OR in each category.

1. Execution, Delivery and Process Management.
losses from failed transaction processing or process management from relations with trade counterparties and vendors.

(i) Transaction Capture, Execution and Maintenance. data entry, delivery failure, accounting errors.
(ii) Monitoring and Reporting. mandatory reporting failure
(iii) Customer Intake and Documentation. missing client permission, incomplete doc
(iv) Customer/Client Account Management. unapproved access, incorrect client records with loss incurred.
(v) Trade Counterparties non-client counterparty misperformance or dispute
(vi) Vendors and Suppliers outsourcing or vendor disputes.

NOTE: Financial firms often deal with large numbers and execution of transactions on a daily basis and thus EDPM errors occurs in high frequency as compared to other categories.

2. Clients, Products and Business Practices.
losses arising from unintentional or negligent failures to meet a professional obligation to specific clients (including fiduciary and suitability requirements) or from the nature or design of a product.

(i) Suitability, Disclosure and Fiduciary. Fiduciary violations, disclosure issues, privacy violation, a/c churning.
(ii) Improper Business or Market Practices. Antitrust, improper trade, insider trading, market manipulation.
(iii) Product Flaws. defects, model errors.
(iv) Selection, Sponsorship, and Exposure client guideline failure or excess client limit.
(v) Advisory Activities. advisory performance disputes.

NOTE: Severity and frequency of losses can vary among categories. The first 2 event types have higher frequency and severity. In the CPBP, frequency of loss events are less than the EDPM category.

3. Business Disruption and System Failures
losses arising from disruption of business or system failure. failed activity eg leading to loss such as hardware, software, telecommunications and utility outage.

4. Internal Fraud.
losses due to acts intended to defraud, misappropriate property or circumvent regulations, the law or company policy.
(i) Unauthorized activity intentionally not reporting transactions, intentional mismarketing of positions.
(ii) Theft and fraud. extortion, embezzlement, misappropriation of assets, forgery, tax evasion and bribe.

5. External Fraud.
losses due to acts intented to defraud, misappropriate property or circumvent the law by a third party.
(i) Theft and fraud check kiting
(ii) Systems security hacking damage, theft of info with monetary losses.

6. Employment Practices and Workplace Safety.
losses arising from acts inconsistent with employment, health or safety laws or agreements from payment of personal injury claims or from diversity / discrimination events.
(i) Employee relations compensation, benefit, termination
(ii) Safe environment liabilities from accidents, employee health and safety, worker's compensation.
(iii) Diversity and discrimination.

7. Damage to physical assets.
losses arising from loss or damage to physical assets from natural disaster or vandalism or terrorism.

Every loss event is mapped to a risk event category but some losses may fall under more than one category.
The modeling of differs for each category so consistency is more important than accuracy when assigning loss events.
The process of identifying and classifying risks is called OpRisk taxonomy.

Lo 2. Collecting and Reporting Internal Loss Data.

Collecting and analysing OR events provides insights into a firm's OR exposures. Many firms adopt Basel II categories at the highest level and customise lower level entries. A min of 5 years of historical data is required to satisfy Basel II regulatory guidelines.

Basel II requires a high degree of reliability in the loss data from diverse geographical areas of the financial institution. This is challenging and must ensure accuracy and should have checks and balances (for human errors).

Financial institutions create OpRisk filters for identifying operational events used in calculating operational losses. Although expensive but they assure accuracy of the data collection process.

Basel II requires financial institutions to select a loss threshold for loss data collection. OpRisk managers should not set loss threshold too low or high.

When quantifying capital requirements, Basel II does not allow recoveries of losses, because gross losses give a more realistic view of potential large losses. Timeframe for recoveries also needs to be considered.

The IASB established guidelines on loss provisions on the reporting of expected operational losses. Important requirements for reporting are -

- loss provisions are not recognised for future operational losses
- loss provisions are recognised for onerous contracts where the costs of fulfilling obligations exceed expected economic benefits.
- loss provisions are only recognised for restructuring costs when a firm has a detailed restructuring plan in place. *

Other points -

* should not include provisions related to relocation of staff, marketing, equipment investments or distribution investments.

Loss provisions must be recognised on B/s when firm has a current obligation regarding a past loss event and, when firm is likely to be obligated for a loss and it is possible to establish a reliable estimate of loss amount.

Gains from disposal of assets or expected reimbursements linked to loss should not be included.

Reimbursements can only be recognised as a separate asset.

Lo 3. Identifying, Controlling and Assessing OR.

The OpRisk manager should map each business unit's processes, risks and control mechanisms.
A Risk Control Self Assessment (RCSA) requires the documentation of risks and provides a rating system and control identification process. This provides the foundation in the OpRisk framework. It is performed every 12-18 months and expert opinion helps provide qualitative measures for effectiveness in the process. The experts ~~perform~~ evaluate and colour rate the performance as Red, Amber or Green (RAG) to indicate level of risk.

Steps in designing a RCSA program -

Step 1. Identify and assess risks - identifying key functions and risk scenarios, exposure, correlation risk etc.

Step 2. Controls added to the RCSA program to mitigate risks identified. Manager assesses residual risk even after controls are set.

Step 3 Risk metrics such as KRI or internal loss events are linked to the RCSA program for review. Should include o' all external data and risk benchmarks for OR.

Step 4 Control tests assess effectiveness of controls to mitigate risks.

Challenge - Ability to interpret output data of RCSA framew

as outputs may give a false sense of security of risks being under control.

↳ self assessment process.

Key Risk Indicators (KRIs) - The first step in creating a OpRisk model is identifying key factors of a business unit process. During the process, assumptions are made to determine proxies on inputs. The data collection process is automated. Even though it is costly, they provide the best means for measuring and controlling OpRisk.
In a control environment Regulators prefer KRI as other measures only indicate based on historical losses.
KRI's are used as warning lights or red flags highlighting concerns for the firm.

Both external data and internal control factors are used to explain specific business environments. in the RCSA framework Banks may use external databases to gather information regarding losses for risks they have not been exposed to and therefore lack any relevant internal data.
Methods for gathering external data

Internal Development	Consortia	Vendors.
media such as news or magazines.	Operational Risk data exchange Association (ORX)	can be used for scenario analysis
- least expensive	- low loss reporting threshold.	- higher loss threshold
- not that accurate.	- no details on losses	- may not be accuriate
- may overlook relevant data	- only used for measurement	

4. Scenario Analysis

It is a process of evaluating a portfolio, project or asset by changing economic, market, industry or company specific factors. Inputs are collected from external data, expert opinions, internal loss trends or KRIs.

↳ from structured workshops for financial institutions, surveys, meetings.

Scenario analysis models are especially useful for estimating losses when loss data in emerging risks is not available.

Challenges and Biases.

- Expert opinions are subject to numerous biases. It is often difficult to quantify this advice to losses of the firm. Expert biases are the disparity of opinions and knowledge regarding amount and frequency of losses.

- Presentation bias occurs when the order of information presented impacts experts' opinion.

- Context bias occurs when questions are framed in a way that it influences the responses of the experts.

- related to lack of info available. - can result to over or under estimate loss

  - Availability bias is related to the expert's (easy, easier) experience in dealing with a specific event or loss risk.
  - Anchoring bias occurs when experts limit the range of loss estimate based on personal experience
  - The availability of information to an expert results in confidence bias.

- obtained in structured workshops having group setting.

  - Huddle bias / Anxiety bias occurs when people tend to avoid conflicts and not express information that is unique because it results in diff opinions.
  - Possibility of gaming i.e., some experts may not provide useful information in workshops.
    Top experts may be unwilling to join workshops which attracts less experienced experts who have inexpert opinion.

Delphi technique.

This technique is ~~obtai~~ designed to obtain the most reliable consensus of opinions from a group of experts. It is useful where historical data is limited.

Step 1. Discussion and feedback is gathered from a large no. of participants having diverse exposure and experience.

Step 2. Information collected is summarized and presented to a workshop group from various business or locations.

Step 3. Evaluate differences in feedback.

Step 4. Reccommendations made.

The Delphi technique is applied to overcome the following issues –

- precise mathematical models are not available but subjective opinions can be gathered from experts.
- experts have a diverse background but little experience in communicating within expert groups.
- group meetings are costly
- large no. of opinions required and face-to-face meetings not feasible.

Lo 5. Operational Risk Profiles.

Basel II categorises level 1 business units into – Trading and Sales, Corporate Finance (IPO, M&A, strategic planning), Retail Banking, Commercial Banking, Payment and Settlement, Agency Services, Asset Management and Retail brokerage.

[refer book for data] OpRisk Profiles Showing Frequency / Severity (V.)

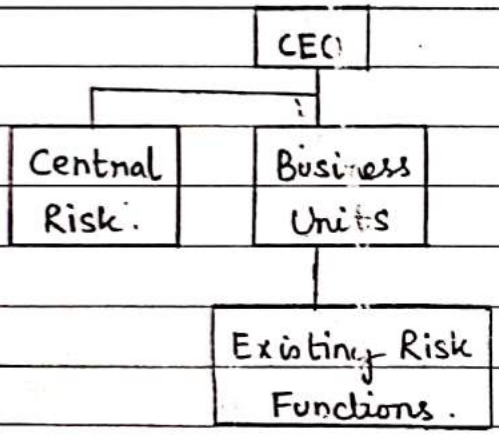
Event Type	Trading and Sales	Corporate Finance	Retail Banking	Asset Management	Retail Brokerage
Internal Fraud	✓	✓	✓	✓	✓
External Fraud					
EDPM					
CPBP					
.					
.					
.					

There was no loss frequency or severity for the insurance sector, as they are still in the early stage and there is no data available. The sector is divided into life, health and property and casualty. uses OR capital requirement model
The insurer must have accurate actuarial calculations to price the premiums.
Some major OR for insurers are misselling products to clients, fraudulent sales techniques, customer frauds, discrimination litigation and incomplete policy litigation.

Lo 6. Organisational Structures for Risk Governance.

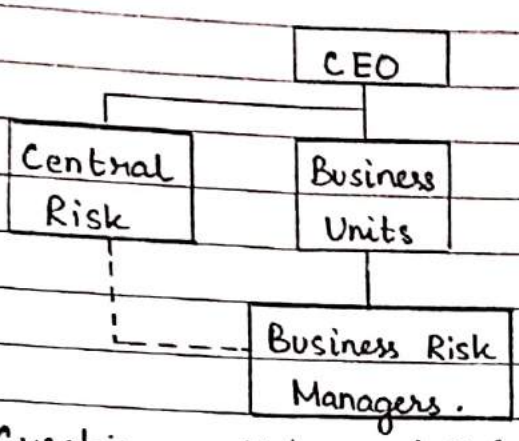
All stakeholders should be informed of the OR framework to ensure accuracy of data and systems in place.
4 main organisational designs for OR framework are given below -

Design 1 Central Risk Function Coordinator.



This involves a small Central Risk group for OR management
The risk manager is more as a coordinator of risk management. He gathers data and reports directly to the CEO or BOD.
There exists a conflict of interest for reporting directly to management or stakeholder who maximise profit. (they also control their compensation). Thus it will be successful if business units are responsible for central risk functions without being influenced by upper management.

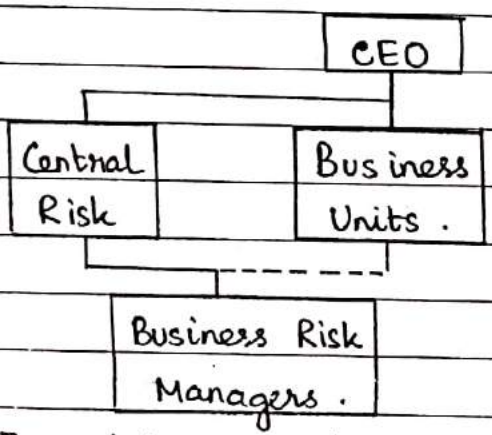
Design 2 Dotted Line or Matrix Reporting.



Creating a link or dotted line from the business risk manager to the central risk function is a progression in this design. But the manager is still directly influenced by the CEO. Thus it will be successful if there is strong risk culture.

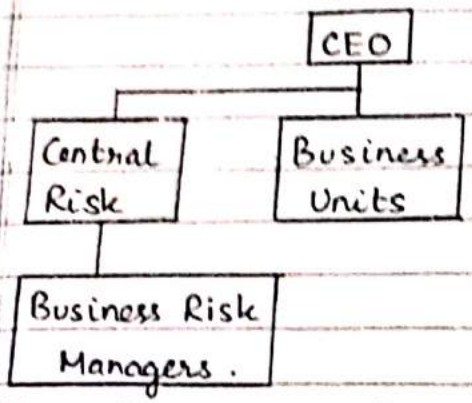
This design is preferred when there is distrust of the central risk function.

Design 3 Solid Line Reporting.



The solid line indicates that each business unit has a risk manager reporting directly to central risk function. This design is more popular for larger firms having centralized management. ~~and also~~ It enables central risk function to priortize risk management goal and create a more homogeneous risk culture.

Design 4 Strong Central Risk Management.



There is a Corporate Chief Risk Officer who is responsible for OR management throughout the firm. The central risk manager monitors OR and reports directly to the CEO or BOD. This structure is prefered by regulators as there is one direct line.

NOTE: Most firms start at design 1 and progress to design 4.

Information Risk and Data Quality Management

los a Identify the most common issues that result in data errors

Data errors may lead to inconsitent reporting, ~~income~~ incorrect product pricing and failures in trade settlement. Most common data issues are as follows -

- Data entry errors
- Missing data
- Duplicate records
- Inconsistent data
- Nonstandard formats.
- Complex data transformations
- Failed identity management processes.
- Undocumented, incorrect or misleading metadata

eg.- payroll to ficticious employees, underbilling for services rendered, underestimating insurance risk due to missing and inaccurate values.

los b Explain how a firm can set expectations for its data quality and describe some key dimensions of data quality used in this process.

Dimensions that characterize acceptable data -

(i) ACCURACY - Degree to which data correctly reflects the real world objective intended to model. Measurement is done by comparing data to a identified authoritative source of correct information. eg.- compare temp recorded in thermometer and real temp.

NOTE - complete(ii) does not mean accurate

(ii) COMPLETENESS - Extent to which the expected attributes of data are provided. Can be measured using rules relating to varying levels of constraint eg.- customer's primary no. (mandatory) is given but secondary no. (optional) is not given - data considered complete.

NOTE - consistent(iii) does not imply accuracy

(iii) CONSISTENCY - Measuring reasonable comparison of values b/w multiple data sets. Concept of consistency is broad and may require that data values from separate data sets must not

conflict with each other. 3 types of consistency –

→ Record level – consitency b/w data value sets within same record

→ Cross record level – consistency b/w data value sets in diff records

→ Temporal level – consistency b/w data value sets within same record at diff points of time.

(iv) REASONABLENESS – Measures confirmity with consistency expectations. eg.- Int exp in I/S should be consistent with the debt in B/S

(v) CURRENCY – Measures the degree to which data is considered relevant and useful given that the passage of time will make it less current and less correct. In other words it is the lifespan of data after which it needs to be checked and refreshed. Measurement is done by determing the frequency at which data needs to be updated as well as verifying that the data is up to date.

(vi) UNIQUENESS – It asserts that no ~~entry~~ entity exists more than once within the data set and there is a key that can be used to uniquely access each entity.

Others – Semantic consistency, Structural format conformance, timeliness and valid ranges, valid within defined data domains.

los c Describe the operational data governance process, including the use of scorecards in managing information risk.

Operational data governance – collective set of rules and processes regarding data that allow an organisation to have confidence in the quality of data effectively satisfying the business needs.
It aims to detect data errors early so that they can be dealt with on a timely basis.

Data Validation Vs Data Quality Inspection.

① process which reviews and measures the conformance of data with defined business	① process which – • reduces errors to a manageable level. • identify data flaws and make adjustment

specifications. to allow data processing to be completed
• & mitigation or remediation of root causes of errors.

② one-time process ② ongoing process

Data quality Scorecard

→ Base-level metric - Used to measure quality against defined dimension. They quantify specific acceptable levels of defined data quality rules to arrive at a data quality score.

→ ~~Corpora~~ Complex metric - This involves applying specific weights to a collection of existing metrices to compute a 'rolled up score'. This provides a qualitative overview of how data quality impacts the organisation. Complex data quality metrics can be accumulated for reporting in different ways -

(i) by issue
(ii) by business process or
(iii) by business impact.

(i) Data quality issues view - It provides the impact of specific data quality problems. Ideal for data analysts who want to prioritize tasks for diagnosis and remediation.
Drill down helps obtain information on the sources of data problems and identifies 'rogue processes'.

(ii) Business process view - It determines exactly where in the business process the data problem is arising from. Ideal for operational manager for examining risks and failures and solving the problem efficiently.
Drill down helps in isolating the source of data issue at specific stage of business process.

(iii) Business impact view - It displays the aggregation of different issues on business impact - more combined and summarized view. Ideal for senior manager for a high-level overview

of risks with data quality issues and how these risks are introduced in the enterprise.
Drill down will point to the business process from where the issue originates and further, specific issues within each of the business process.

Motivation - Data quality scorecards allow managers to take advantage of opportunity to assess the relationship b/w impacts of flawed data vs the pre-defined parameters of acceptable data quality.
∴ scorecards -

→ Summarise imp organisational information
→ provide warning signs to management when corrective actions are required.

Mechanics - Data quality scorecard comprises of a hierarchy (base level and complex) with different levels of accountability. Also, scorecards can be customised to present varying levels of detail for different users.

Supervisory Guidance on Model Risk Management

LOS 1. Describe model risk and explain how model risk can arise in the implementation of a model.

1.1 What is a 'model'?

The term "model" refers to a quantitative method, system, or approach that applies statistical, economic, financial, or mathematical theories, techniques, and assumptions to process input data into quantitative estimates. A model consists of three components:

A. [Information Input] Delivers assumptions and data to the model;
B. [Processing Component] Transforms inputs into estimates;
C. [Reporting Component] Translates the estimates into useful business information.

The above definition covers quantitative approaches whose inputs are partially or wholly qualitative or based on expert judgment, provided that the output is quantitative in nature. Models inherently simplify representations of real-world complex relationships, so as to focus attention on particular and most important aspects. The quality of a model can be measured using a number of metrics: precision and accuracy (for models that forecast future values), discriminatory power (for models that rank order risks), robustness, stability and reliability.

1.2 When can model risk arise?

Model risk occurs primarily for two reasons:

A. [Inaccurate Outputs] The model may have fundamental errors and may produce inaccurate outputs. The mathematical calculation and quantification exercise underlying any model generally involves application of theory, choice of sample design and numerical routines, selection of inputs and estimation, and implementation in information systems. Errors can occur at any point from design through implementation. In addition, shortcuts, simplifications, or approximations used to manage complicated problems could compromise the integrity and reliability of outputs from those calculations.

B. [Incorrect / Inappropriate Use] Models by their nature are simplifications of reality, and real-world events may prove those simplifications inappropriate. The model may even be used outside the environment for which it was designed. Banks may do this intentionally as they apply existing models to new products or markets, or inadvertently as market conditions or customer behaviour changes. Decision makers need to understand the limitations of a model to avoid using it in ways that are not consistent with the original intent.

LOS 2. Describe elements of an effective process to manage model risk.

2.1 Sources and Magnitude

Banks should identify the sources of risk and assess the magnitude. Model risk increases with greater model complexity, higher uncertainty about inputs and assumptions, broader use, and larger potential impact. Banks should consider risk from individual models and in the aggregate. Aggregate model risk is affected by interaction and dependencies among models; reliance on common assumptions, data, or methodologies; and other factors that could adversely affect several models and their outputs at the same time.

2.2 Effective Challenge

This involves critical analysis by objective, informed parties who can identify model limitations and assumptions and produce appropriate changes. Effective challenge depends on a combination of:

A. [Incentives]: Stronger when there is greater separation of that challenge from the model development process and when challenge is supported by well-designed compensation practices and corporate culture.
B. [Competence]: Technical knowledge and modelling skills are necessary to conduct appropriate analysis and critique.
C. [Remediation / Influence]: Actions are taken to address model issues. Influence comes from a combination of explicit authority, stature within the organization, and commitment and support from higher levels of management.

2.3 Tools for managing model risk

Model risk cannot be eliminated, has to be managed effectively. Tools to manage model risk include:

A. establishing limits on model use
B. monitoring model performance
C. adjusting or revising models over time
D. supplementing model results with other analysis and information
E. informed conservatism in either the inputs or the design of a model or through explicit adjustments to outputs (though not an excuse to avoid improving models).

NB: Materiality considerations If at some banks the use of models is less pervasive and has less impact on their financial condition, then those banks may not need as complex an approach to model risk. Where models and model output have a material impact on business decisions, including decisions related to risk management and capital and liquidity planning, model risk management framework should be more extensive and rigorous.

LOS 3. Explain best practices for the development and implementation of a model.

Model risk management should include disciplined and knowledgeable development and implementation processes that are consistent with the situation and goals of the model user and with bank policy. The judgment of developers and their technical knowledge influences the appropriate selection of inputs and processing components, and ultimately, the extent of model risk. Modelling is a multidisciplinary activity drawing on economics, finance, statistics, mathematics, and other elds. Models are employed in real-world markets and events and therefore should be tailored for specific applications. The subjectivity involved elevates the importance of sound and comprehensive model risk management processes.

3.1 Model Development and Implementation

A. [Documentation] An effective development process begins with a clear statement of purpose to ensure that model development is aligned with the intended use. The design, theory, and logic underlying the model should be well documented and generally supported by published research and sound industry practice. Documentation should include model methodologies and processing components that implement the theory, the mathematical specification and the numerical techniques and approximations, should be explained in detail with particular attention to merits and limitations.

B. [Data Quality and Relevance] Developers should be able to demonstrate that data and information used to develop a model are suitable for the model and consistent with theory. If data proxies are used, they should be carefully identified, justified, and documented. If assumptions are made to adjust the data and information, these factors should be properly tracked and analysed so that users are aware of potential limitations, especially as they relate to new products, instruments, or activities.

C. [Testing] Various components of a model and its overall functioning need to be evaluated to determine whether the model is performing as intended. The following need to be noted:

- Model testing includes checking the model's accuracy, robustness, stability, limitations and behavior over a range of input values.
- It should also assess the impact of assumptions and identify situations where the model performs poorly or becomes unreliable.
- Testing should be applied to actual circumstances under a variety of market conditions, including scenarios that are outside the range of ordinary expectations (i.e. extreme values), and should encompass the variety of products or applications for which the model is intended.
- The impact of model results on other models that rely on those results as inputs should also be evaluated.
- The nature of testing and analysis will depend on the type of model (the appropriate statistical tests depend on specific distributional assumptions and the purpose of the model). Any single test is rarely sufficient, so banks should apply a variety of tests to develop a sound model.

- Testing activities should be appropriately documented.

D. [Qualitative aspects] At times, banks may take statistical output from a model and modify it with judgmental or qualitative adjustments as part of model development. Banks should ensure that any such adjustments made as part of the development process are conducted in an appropriate and systematic manner, and are well documented. Model calculations should be properly coordinated with the capabilities and requirements of information systems into which models are typically embedded. Sound model risk management depends on substantial investment in supporting systems to ensure data and reporting integrity, together with controls and testing. (1)

3.2 Model Use

The following aspects need to be noted:

A. [Useful Feedback] Model use provides additional opportunity to test whether a model is functioning effectively and to assess its performance over time as conditions and model applications change. It can serve as a source of productive feedback and insights from a knowledgeable internal team – a feedback that can provide valuable business insight during the development process. Business managers affected by model outcomes may question the methods or assumptions.

B. [Weak Challenge] Challenge from model users may be weak if the model does not materially affect their results, if the resulting changes in models are perceived to have adverse effects on the business line, or if change in general is regarded as expensive or difficult. User challenge also has a limited focus – users focus on aspects of models that have the most direct impact on the user's measured business performance or compensation, and thus may ignore other elements.

C. [Asymmetric Challenge] Users are less likely to challenge an outcome that results in an advantage for them. They may incorrectly believe that model risk is low simply because outcomes from model-based decisions appear favorable to the institution.

D. [Conservatism] Model uncertainty and inaccuracy can at times be quantified (by an assessment of the potential impact of factors that are unobservable or not fully incorporated in the model, or by the confidence interval around a statistical model's point estimate). In some cases, only a qualitative assessment is possible. In either case, it can be prudent for banks to account for model uncertainty by explicitly adjusting model inputs or calculations to produce more severe or adverse model output in the interest of conservatism. Banks may even hold an additional cushion of capital (conservatism w.r.t capital) to protect against potential losses associated with model risk.

NB: Banks should be careful in applying conservatism because:

- the impact of such conservatism in complex models may not be obvious or intuitive.
- model aspects that appear conservative in one model may not be truly conservative compared with alternative methods.
- initially conservative assumptions may not remain conservative over time

- conservatism can become an impediment to proper model development and application if it is seen as a solution that dissuades the bank from making the effort to improve the model
- excessive conservatism can lead model users to discount the model outputs.

Banks should justify and substantiate claims that model outputs are conservative with a definition and measurement of that conservatism that is communicated to model users. In some cases, sensitivity analysis or other types of stress testing can be used to demonstrate that a model is indeed conservative.

LOS 4. Describe elements of a strong model validation process and challenges to an effective validation process.

4.1 Model Validation

Model validation is the set of processes and activities intended to verify that models are performing as expected. It also identifies potential limitations and assumptions, and assesses their possible impact. To provide effective challenge, model validation should be performed by staff with appropriate incentives, competence, and influence. The following need to be noted about model validation:

A. [Scope] All model components, including input, processing, and reporting; both in-house and vendor models. The rigor and sophistication of validation should be commensurate with the bank's overall use of models, the complexity and materiality of its models, and the size and complexity of the bank's operations.

B. [Independence from Model Development] Validation should be done by people who are not responsible for development or use of models. While independence may be supported by separation of reporting lines, it should be judged by actions and outcomes. Some validation work may be most effectively done by model developers and users.

C. [Quality of Review] This is determined by evaluating the extent and clarity of documentation, the issues identified by objective parties, and the actions taken by management to address model issues.

D. [Role of Compensation / Culture] Banks can support appropriate incentives in validation through compensation practices and performance evaluation standards that are tied directly to the quality of model validations and the degree of critical, unbiased review. Corporate culture plays a role if it establishes support for objective thinking and encourages questioning and challenging of decisions.

E. [Requisite Skills] Sta doing validation should have the requisite knowledge, skills, and expertise. They should have a significant degree of familiarity with the line of business using the model and the model's intended use. A model's developer is an important source of information but cannot be relied on as an objective or sole source.

F. [Requisite Stature / Authority] Model validation staff should have an explicit authority to challenge developers and users and to elevate their findings, including issues and deficiencies.

The individual or unit to whom those staff report should have sufficient influence or stature within the bank to ensure that any issues and deficiencies are appropriately addressed in a timely and substantive manner. Stature is reflected in reporting lines, title, rank, or designated responsibilities.

G. [Approach for New Models] The rigor should be proportional to potential risk presented by use of the model. If significant deficiencies are noted, use of the model should not be allowed or permitted under tight constraints until those issues are resolved. If the deficiencies are too severe, the model should be rejected. If data scarcity or other limitations present obstacles to validation, this fact should be documented and communicated.

H. [Ongoing Validations] On an ongoing basis, model validators should track known model limitations and identify any new ones. Validation is an important check on model use during periods of benign economic and financial conditions, when estimates of risk and potential loss can become overly optimistic, and when the data at hand may not fully reflect more stressed conditions. Ongoing validations help ensure that changes in markets, products, exposures, activities, clients, or business practices do not create new model limitations.

I. [Validation Frequency] Validations should happen at least annually but more frequently if warranted. These initiatives could simply arm previous validation work, suggest updates to previous validation activities, or call for additional validation activities. Material changes to models should also be subject to validation.

J. [Spotting Performance Trends] Validation also can reveal deterioration in model performance over time and can set thresholds for acceptable levels of error, through analysis of the distribution of outcomes around expected or predicted values. If outcomes fall consistently outside this acceptable range, then the models should be redeveloped.

4.2 Key Elements of Comprehensive Validation

4.2.1 Evaluation of Conceptual Soundness

A. [Quality of Model Design / Construction] This entails review of documentation (specially, limitations and assumptions of model) and empirical evidence supporting the methods used and variables selected for the model (specifically, judgment used in model design is well informed, consistent with published research and with sound industry practice). Additional analysis and testing may be done, if deemed necessary. This would involve comparison to alternative theories and approaches, checking the relevance of the data used to build the model should be evaluated to ensure that it is reasonably representative of the bank's portfolio or market conditions, depending on the type of model.

B. [Sensitivity Analysis] This would check the impact of small changes in inputs and parameter values on model outputs to make sure they fall within an expected range. Varying several inputs simultaneously as part of sensitivity analysis can provide evidence of unexpected interactions, particularly if the interactions are complex and not intuitively clear. Stressing inputs to extreme values verifies that the model is robust and establishes boundaries of model performance by

identifying the acceptable range of inputs as well as conditions under which the model may become unstable or inaccurate. If a model demonstrates instability, management should consider modifying certain model properties, putting less reliance on its outputs, placing limits on model use, or developing a new approach.

C. [Qualitative Checks] Qualitative information and judgment used in model development should be evaluated, including the logic, judgment, and types of information used. This helps set appropriate conditions for model use. These checks should be conducted in an appropriate and systematic manner, are well supported and documented.

4.2.2 Ongoing Monitoring

A. [Purpose] It confirms that the model is appropriately implemented and is being used and is performing as intended. It evaluates whether changes in products, exposures, activities, clients, or market conditions necessitate adjustment, redevelopment, or replacement of the model and verifies that any extension of the model beyond its original scope is valid. The limitations of the model are regularly assessed over time.

B. [Frequency] Monitoring should occur periodically, with a frequency appropriate to the nature of the model, the availability of new data or modelling approaches, and the magnitude of the risk involved.

C. [Component 1: Process Verification] This component checks whether all model components are functioning as designed:

- internal and external data inputs continue to be accurate and of highest quality;
- computer code implementing the model is subject to rigorous quality (i.e. correct) and change control procedures (i.e. cannot be altered except by approved parties, changes are logged and can be audited);
- system integration needs to be checked as it tends to be very complex. User-developed applications, such as spreadsheets or ad hoc database applications used to generate quantitative estimates, are particularly prone to model risk.
- reports should be accurate, complete, and informative, and that they contain appropriate indicators of model performance and limitations.
- sensitivity analysis should be regularly performed as part of ongoing monitoring.
- if models only work well for certain ranges of input values, market conditions, or other factors, they should be monitored to identify situations where these constraints are approached or exceeded.
- should include the analysis of overrides with appropriate documentation (i.e. cases where model output is ignored, altered, or reversed based on the expert judgment of model users). If the rate of overrides is high, or if the override process consistently improves model performance, it is often a sign that the underlying model needs revision or redevelopment.

D. [Component 2: Benchmarking] This refers to comparison of a given model's inputs and outputs to estimates from alternative internal or external data or models (useful both in model

development and in ongoing monitoring). Benchmarks include models from vendor rms or industry consortia. For derivatives, these include alternative models that are more accurate or comprehensive but too time consuming to run on a daily basis. Benchmark models should be rigorous and benchmark data should be accurate. Discrepancies between the model output and benchmarks should trigger investigation into the sources and degree of the differences. The results of that analysis may suggest revisions to the model. However, differences do not necessarily indicate that the model is in error – the differences may be due to the different data or methods used. If the model and the benchmark match well, that is evidence in favor of the model, but should not grant a false degree of comfort.

4.2.3 Outcomes Analysis

A. [What is it?] A comparison of model outputs to corresponding actual outcomes. The precise nature of the comparison depends on the objectives of a model, and might include an assessment of the accuracy of estimates or forecasts, an evaluation of rank-ordering ability. If outcomes analysis points to poor performance, the bank should take action to address those issues.

B. [How is it done?] Outcomes analysis typically relies on statistical tests or other quantitative measures. It can also include expert judgment (qualitative checks) to check the intuition behind the outcomes and confirm that the results make sense. The choice of technique should be based on the model's methodology, its complexity, data availability, and the magnitude of potential model risk to the bank. Ideally, it should be a "range of tests" – designed for each situation, as not all will be effective or feasible in every circumstance or for each model. It should be conducted on an ongoing basis.

C. [Model Updates] A parallel outcomes analysis needs to be done, under which both the original and adjusted models' forecasts are tested against realized outcomes. If the adjusted model does not outperform the original model, developers, users, and reviewers should realize that additional changes — or even a wholesale redesign are likely necessary before the new adjusted model is formally adopted.

D. [Backtesting] A form of outcomes analysis, involves the comparison of actual outcomes with model forecasts during a sample time period not used in model development. It is generally done using expected ranges or statistical confidence intervals around the model forecasts. When outcomes fall outside those intervals, the bank should analyse the discrepancies and investigate the causes that are significant in terms of magnitude or frequency. This analysis can help detect the cause:

- omission of material factors from the model?
- errors with regard to other aspects of model specification such as interaction terms or assumptions of linearity?
- purely random and thus consistent with acceptable model performance?

E. [Complementing Backtesting] Backtesting models with long forecast horizons would require a long amount of time to accumulate the necessary data. In such cases, testing should be

supplemented by evaluation over shorter periods. Early warning metrics should be designed to measure performance beginning very shortly after model introduction and trend analysis done of performance over time.

F. [Other Cases] If back-testing or sensitivity analysis are not possible for various reasons (e.g. lack of data or price un-observability), even more attention should be paid to the model's limitations when considering the appropriateness of model usage. Senior management should be fully informed of those limitations when using the models for decision making.

4.3 Vendor Models

Vendor products should be incorporated into a bank's broader model risk management framework following the same principles as applied to in-house models, although the process may be somewhat modified. The following need to be noted:

A. [Model Selection] There are appropriate processes in place for selecting vendor models. Banks should require the vendor to provide developmental evidence explaining the product components, design, and intended use. Vendors should provide appropriate testing results, and clearly indicate the model's limitations and assumptions and where the product's use may be problematic.

B. [Vendor's Ongoing Responsibility] Banks should expect vendors to conduct ongoing performance monitoring and outcomes analysis, with disclosure to their clients, and to make appropriate modifications and updates over time.

C. [Bank's Own Validation] Note the following:

- External models may not allow full access to computer coding and implementation details, so the bank may have to rely more on sensitivity analysis and benchmarking.
- A bank's customization choices should be documented and justified as part of validation. If vendors provide input data or assumptions, or use them to build models, their relevance for the bank's situation should be investigated.
- The bank also should conduct ongoing monitoring and outcomes analysis of vendor model performance using the bank's own outcomes.

D. [Contingency Plans] The bank needs to have as much knowledge in-house as possible, in case the vendor or the bank terminates the contract for any reason, or if the vendor is no longer in business – there should be contingency plans in place for such scenarios.

Validating Rating Models

LOS 1. Explain the process of model validation and describe best practices for the roles of internal organizational units in the validation process.

1.1 Defining a Rating System

We dene a rating system (or model) as all the methods, processes, controls and data collection and IT systems that support the assessment of credit risk, assignment of internal risk ratings and quantification of default and loss estimates.

1.2 The Validation Requirement

The validation of internal ratings is strictly required by the Basel Committee (2004) for banks willing to opt for Internal Rating Based (IRB) approaches . This validation is both from a regulatory point of view (because capital adequacy depends on rating systems as per Basel II) and from a business management point of view (because key decisions concerning individual loans underwriting decisions as well as credit portfolio management decisions depend on rating systems).

1.3 The Validation Process

In the validation process, the bank has to verify the reliability of the results generated by the rating system and its continued consistency with regulatory requirements and operational needs. According to the 'proportionality principle', the scope and depth of quantitative and qualitative validation should be correlated with the type of credit portfolios examined, the overall complexity of the bank, and the stability of markets. The following points need to be noted:

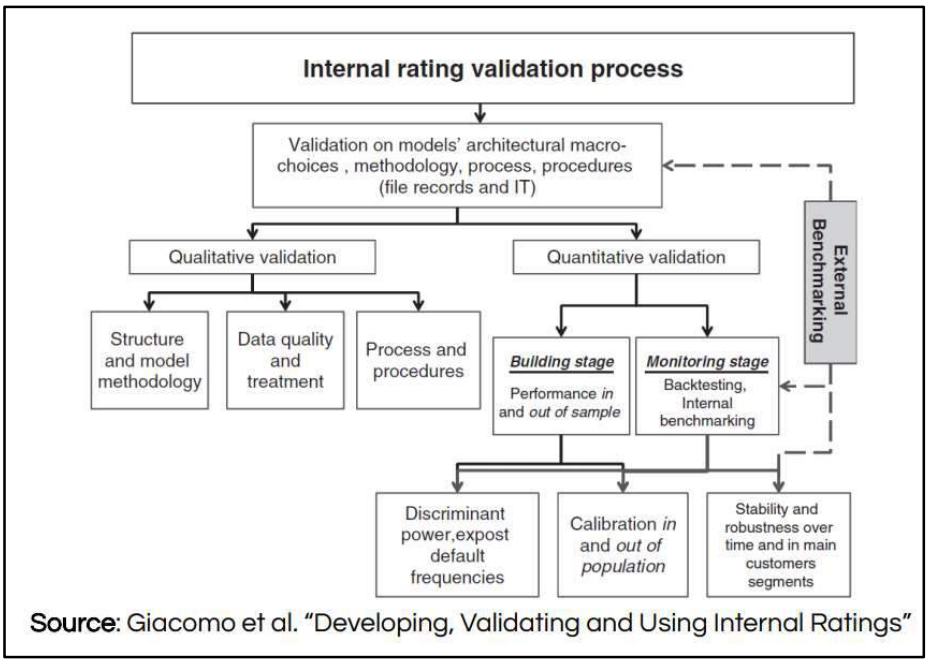
A. [The Process] It consists of a set of formal activities, instruments, and procedures for assessing the accuracy of the estimates of all material risk components and the predictive power of the overall performance system.

B. [Regulatory Guideline] The Basel II regulation states that: 'The institution shall have a regular cycle of model validation that includes monitoring of model performance and stability, review of model relationships, and testing of model outputs against outcomes'.

C. [Validation Specifics] The validation process can be seen to include:

- statistical comparisons of actual risk measures against the ex-ante estimates,
- checking of parameter calibrations,
- benchmarking and stress tests,
- analyses of all the components of the internal rating system, including operational processes, controls, documentation, IT infrastructure and their overall consistency,
- a 'use test' i.e. a critical verification that the rating system is actually used (and how it is used) in the various areas of bank operations.
- analysis of contingent solutions planned in case the robustness of the model falls or is lacking.

The validation process is summarized in the figure below:



Source: Giacomo et al. "Developing, Validating and Using Internal Ratings"

1.4 Roles of Internal Validation Units

A. [Board of Directors] All material aspects of the rating and estimation processes must be approved by the bank's board of directors or a designated committee thereof and senior management.

B. [Senior Management] Senior management must provide notice to the board of directors or it's designated committee of material changes or exceptions from established policies that will materially impact the operations of the bank's rating system. Senior management also must have a good understanding of the rating system's design and operation, and must approve material differences between established procedure and actual practice.

C. [Credit Control] Management and staff in the credit control function must meet regularly to discuss the performance of the rating process, areas needing improvement, and the status of efforts to improve previously identified deficiencies.

A few best practices in respect of the validation process are listed below:

A. [Closing the Loop] Senior management must consider recommendations produced by the validation process and review reports produced by the internal audit unit.

B. [An Independent Unit] The validation process is performed by a specic organizational unit, which is independent of other functions devoted to develop and to maintain model tools, handle credit risk processes and procedures and those involved in assigning ratings and lending. Validation unit personnel should not be subordinate to persons responsible for the activities listed above.

C. [Non-independence albeit with Precaution] If compliance with the above independence requirement proves to be burdensome, the validation unit may be involved in the rating system

design and development process, provided that appropriate organizational and procedural precautions are adopted and respected.

D. [Validation vs Audit] The validation unit should also be independent from the internal audit function, which should review the validation process and findings.

E. [Importance of Documentation] The scope, transparency, and completeness of documentation are essential, since validation is mostly performed on the basis of the documentation received by functions in charge of the model development and implementation.

F. [Cross-border Operations] For banking groups with significant cross-border operations, the parent company has to ensure that the organization of the validation and review functions within the group enable the unified management and control of models and rating systems.

Various processes and roles of validation and control of Internal Rating Systems are summarized below:

	Models	Procedures	Tools	Management decision
Basic Controls	**Task**: model development and back testing **Owner**: credit risk models development unit	**Task**: credit risk procedures maintenance **Owner**: lending units / internal control units	**Task**: operations maintenance **Owner**: lending units / IT / internal audit	**Task**: lending policy applications **Owner**: central and decentralized units / internal control units
Second controls layer	**Task**: continuous test of models / processes / tools performance **Owner**: lending unit / internal audit		**Task**: lending policy suitability **Owner**: validation unit / internal audit	
Third controls layer	Risk Management/ CRO	Organisation / COO	Lending unit / CLO / COO	Lending unit – CLO / CRO
Accountability for supervisory purposes	Top management / Surveillance Board / Board of Directors			

Source: Giacomo et al. "Developing, Validating and Using Internal Ratings"

LOS 2. Compare qualitative and quantitative processes to validate internal ratings, and describe elements of each process.

2.1 Quantitative vs Qualitative

Qualitative validation ensures the proper application of quantitative methods and the proper usage of ratings. Quantitative validation comprises all validation procedures of ratings in which statistical indicators are calculated and interpreted on the basis of an empirical dataset.

A rating procedure should only be applied in practice if it receives a positive assessment in the qualitative area. A positive assessment by the quantitative validation (alone) is not sufficient. A negative quantitative assessment should not be considered decisive because statistical estimates are subject to random actuations and a certain degree of tolerance in the interpretation of results should be allowed.

2.2 Qualitative Validation

We focus on proper choice of the models architecture in relationship to the market segments in which the model is going to be used and ensure the transparency of the assumptions and/or evaluations which form the basis of the rating models design. In qualitative validation, we focus on following five main features:

2.2.1 Obtaining probabilities of default

Different methods of rating assignment produce PDs in distinctive ways:

A. Statistical models are developed on the basis of an empirical dataset, to determine the PD for individual rating classes by calibrating results with the empirical data (e.g. mapping of distance-to-default to historical default probability).

B. Logistic regression enables the direct calculation of default probabilities.

It is possible to validate the calibration of the rating model (ex-post) using data gathered from the operational deployment of the model. Using this data, the default parameter can be constantly monitored and validated over time to maintain PDs aligned with real world outcomes.

2.2.2 Rating system completeness

Completeness means banks need to take all available information into account when assigning ratings to borrowers or transactions. Many default risk models use a small number of characteristics of the borrower to infer its creditworthiness. It is important to verify the completeness of factors at least in model building stages and/or in the operational use (for instance, analyzing the scope of overrides proposed by credit analyst). The possibility to force variables to enter into the model in order to increase the completeness of the relevant risk factors should be verified. Usually, the computer-based processing of information enables expert systems and fuzzy logic systems to take a larger number of characteristics into consideration.

2.2.3 Rating system objectivity

A good rating system needs procedures that capture creditworthiness factors clearly and also minimize room for interpretation or biases.

A. [Judgment-based Approaches] Herein, objectivity can only be ensured by precise and plausible guidelines, common cultural backgrounds, appropriate training, ongoing benchmarking, and adequate organizational choices (team work, supervision, balancing individual analysts' specialization by sector, and analysts' teams' cross-sector mix).

B. [Statistical Models] These are already very objective – when the model is fed by the same information, unavoidably the same results are obtained.

2.2.4 Rating system acceptance

Rating systems have also to be accepted by users (internal users such as credit analysts, credit offcers, and loan offcers). The validation process should verify that rating models are well understood and shared by the users.

A. [Closeness to Expectations] The rating system should not produce classifications that are very often too far from those expected by bank analysts and offcers;

B. [Acceptance of Mechanical Rating Models] For small and medium enterprises, mechanical rating models often have higher discriminatory power than a poorly structured judgment based approach developed by poorly experienced and trained credit offcers. However, they are less easily accepted because many actors do not have enough technical knowledge to understand them. Hence, an adequate education and level of disclosure on model frameworks are required.

C. [Acceptance of Heuristic Rating Models] Heuristic models are designed on the basis of experts' experience in lending and their assessments are close to common culture – these models are more easily accepted.

D. [Acceptance of Fuzzy Logic Rating Models] Acceptance of fuzzy logic systems / artificial neural networks may be lower as they require a greater degree of technical knowledge and added complexity, which makes it difficult to comprehend their results.

2.2.5 Rating system consistency

Models have to be coherent and suitable for the borrowers to which they are applied and with the theoretical frameworks of users. If relationships between indicators arise which contradict economic theory, they have to be excluded from further analyses to ensure consistency.

A. [Heuristic Models] These do not contradict recognized scientific theories as these models are based on the experience and observations of credit experts.

B. [Statistical Models] These depict business inter-relationships directly from empirical datasets and consistency should be checked.

2.3 Few Basel Guidelines

A. [Accounting for all Information] Mechanical models have lower chance of idiosyncratic errors, but may use limited information. Sufficient human judgement and human oversight is necessary to ensure that all relevant and material information, including that which is outside the scope of the model, is also taken into consideration, and that the model is used appropriately. So models must be part of a broader rating system, in which other methodologies add further information and expertise assuring completeness.

B. [Supervisory Requirements] The bank should satisfy its supervisor that a model or procedure has good predictive power and that regulatory capital requirements will not be distorted as a result of its use. The variables that are input to the model must form a reasonable set of predictors. The model must be accurate on average across the range of borrowers or facilities to which the bank is exposed and there must be no known material biases.

C. [Data Related Issues] The bank must have in place a process for vetting data inputs. Data inputs should be representative of the population of the bank's actual borrowers or facilities.

D. [Model Results + Judgment] When combining model results with human judgement, judgements must take into account all relevant and material information not considered by the model, and there must be written guidance describing how human judgement and model results are to be combined.

E. [Understanding Role of Individual Factors] The influence of individual factors on rating results should be comprehensible and in line with the current business research and practice.

F. [Model Review] The bank must have procedures for human review of model based rating assignments. There must be a regular cycle of model validation that includes monitoring of model performance and stability; review of model relationships; and testing of model outputs against outcomes. Special emphasis is to be placed on documenting the models statistical foundations, which have to be in line with the standards of quantitative validation.

LOS 3. Describe challenges related to data quality and explain steps that can be taken to validate a model's data quality.

3.1 Challenges and Validation of Data Quality

Good data can give outstanding results using simple models, whereas the most advanced models cannot overcome poor data quality. A comprehensive dataset is an essential prerequisite for quantitative validation. The following points need to be noted:

A. [Prime responsibility] The validation unit has a central role in conforming the dataset quality, reliability and completeness of defaulted observations for model development, rating quantification, and validation.

B. [Consistent definitions] The consistency of default definition used throughout data collection processes and its compliance with the Basel II definition of default are both critical.

C. [Lending technology] Sample size is important as well as sample homogeneity (i.e. the sample must be generated by the same 'lending technology' – set of information, rules, contracts, and policies applied to credit origination and monitoring). Practically, we rarely observe procedures

and processes that remain constant for ve or more years of an entire credit cycle. Changes are more frequent because of the increasing technological opportunities to speed up processes and efficiency, discontinuities in the economic environment, bank mergers and acquisitions.

D. [Credit cycle coverage] Since macroeconomic conditions are one of the most important determinants of default rates, the dataset should be generated by considering an entire credit cycle; otherwise, estimates will be dependent on specific favorable or unfavorable cycle stages.

E. [Preliminary data treatment] The validation process should pay attention to activities such as finding and managing outliers, missing values, and poor data representativeness for some customers' segments.

F. [Multiple samples] While samples used in model building should have some desirable properties such as low heteroscedasticity, no abnormal values etc., actual populations do not share these properties. So we need a proper calibration and, to perform out-of-sample analyses it is advisable therefore, to build various samples, one dedicated to support model building and others used for out-of-sample, out-of-time, and out of universe validations of a model's performance (out-of-sample observations are created from the same lending technology, but are ones that were not used in the development sample).

G. [Verifying central tendency over time] The validation unit should verify the central tendency (average default rate produced by the model) over time through back testing and stress testing. It should carefully monitor market prices, signals from marketing people, results of big ticket transactions (syndicated loans, securities placing, securitisation, and so forth) and fully exploit any other opportunity to benchmark the bank against direct competitors.

3.2 A Note about Calibration

If the observed in-sample default rate diverges from the total population, then calibration should reflect this divergence. This divergence may simply be due to the fact that bank's lending technology is selecting borrowers better or worse than competing banks or lending technology has changed (if the model is not re-calibrated, it continues to apply old criteria to new states of business). If this divergence is significant, a model revision may be required. Remember that even small changes in model calibration have a big influence on a model's cut-o and on estimated default rates.

The lending process is relatively slow in producing evident results because statistical repetitions in lending activities are relatively limited and it takes time to directly assess the effects of an incorrect parameter. There is also the impact of credit cycle movements. A robust check on validity of average default rate can take 18-36 months.

Calibration turns into a managerial decision, which is partly based on empirical evidence and partly depends on strategies and policies (such as fixing the implicit 'risk appetite' of the organization). Two cases arise:

A. [Optimistic estimates ($\pi < \pi$actual)] These reduce the risk perception and determine aggressive competitive policies. If rating is also used for pricing purposes, then prices would not fully reffect the credit risk embedded in transactions (and loss provisions would be underestimated).

B. [Pessimistic estimates ($\pi > \pi$actual)] A conservative credit policy is adopted in this case, which would lead to missed business opportunities, to overestimated provisions, and to lower credit market shares.

LOS 4. Explain how to validate the calibration and the discriminatory power of a rating model.
We now take a look at quantitative validation, which covers four main areas:

4.1 Sample Representativeness

Focus here on sample size and it's characteristics (relative to the population). The real constraint is usually given by the subsample size of defaulted rms, as some loan portfolios are characterized by very few defaults. The validation unit has to set an adequate margin of conservatism in the assumption of risk parameters and pay particular attention to analysis techniques adopted in this estimation process and to their limitations.

For sample creation, we need to apply speficic techniques such as 'bootstrap procedures' to randomly generate many samples by extracting an equal number of units from the non defaulted group without re-introduction. On each of these samples the rating model is completely re-assessed, extracting the entire set of statistical information. The set of models is then analyzed. If a clear convergence on a final stable result is found, we can infer that the model solution is stable and robust enough. If not, there would be a severe risk of instability and a more in-depth analysis would be needed. A way to overcome these problems is to find more homogenous subsets (applying cluster analysis, for instance). The model could be adapted to the specific features of these subsets, adopting different calibrations or integrating a specific successive qualitative analysis, maybe based on experts' judgments.

4.2 Discriminatory Power

[Definition] This refers to the fundamental ability of a rating model to differentiate between defaulting and performing borrowers over the forecasting horizon (12 months for PD estimation) – more generally, the model's ability to rank borrowers. It is necessary to use longer forecasting horizons in order to validate discriminatory power (for installment loans is often the entire period of the credit transaction).

[Process] The discriminatory power of a model can only be reviewed ex post using data on defaulted and non-defaulted cases (back testing). Various analyses are possible (listed below):

- statistical tests such as Fisher's r^2, Wilks' λ , Hosmer-Lemeshow;
- migration matrices
- accuracy indexes such as Lorentz's concentration curves and Gini ratios (ROC)
- classification tests (binomial test, type 1 and type 2 errors).

4.3 Dynamic Properties

This aspect refers to stability of rating systems and properties of migration matrices. These matrices can be built once the rating system has been operational for at least two years. Desirable properties of migration matrices are:

- Transition rates to default should be in ascending order as rating classes worsen.
- High values should be on the diagonal and low values o-diagonal, which would signal that ratings are stable over time (also an indication of a through-the-cycle rating).
- Off-diagonal values should be in descending order when departing from the diagonal (means that rating movements are gradual).

These properties have to also hold for longer time horizons than one year, which means that ratings change over time but without large leaps. If analyses of rms' fundamentals are dominant in rating assignment, ratings change slowly over time. Stability is a desirable technical property for many economic reasons, such as lower pro-cyclical effects and longer 'far-sightedness' of credit allocation.

4.4 Calibration

Calibration is a critical issue because of the scarcity of statistical tools that are available. Due to the limitations of using statistical tests to verify the accuracy of the calibration, benchmarking (i.e. comparison of a bank's ratings or estimates to results from alternative sources) can be a valuable complementary tool for the validation of estimates for the risk components PD, LGD and EAD.

Validating calibration means analyzing differences between forecasted PDs and realized default rates. The Basel Committee paper indicates a few tests to assess proper calibration:

A. Binomial Test Applied to one rating category at a time.

B. Chi-square Test Simultaneously checks several rating categories.

C. Normal Test Applied to a single rating class but is a multiperiod test based on a normal approximation of the distribution of the time-averaged default rates and on the assumptions that the mean default rate does not vary too much over time and that default events in dierent years are independent.

D. [Trac Light Approach] This is a multiperiod back testing tool.

Capital Planning at Large Bank Holding Companies

LOS 1. Describe the Federal Reserve's Capital Plan Rule and explain the seven principles of an effective capital adequacy process for bank holding companies (BHCs) subject to the Capital Plan Rule.

[What is it?] The Federal Reserve's Capital Plan Rule requires all U.S.-domiciled, top-tier BHCs with total consolidated assets of $50 billion or more to develop and maintain a capital plan supported by a robust process for assessing their capital adequacy. The Federal Reserve's assessment of a BHC's capital planning process includes an evaluation of the risk-identification, measurement, and management practices that support the BHC's capital planning and stress scenario analysis, an assessment of stressed loss and revenue estimation practices, and a review of the governance and controls around these practices.

[The Seven Principles] This set of seven principles on which the Federal Reserve assesses BHCs for managing and allocating capital resources is called the Capital Adequacy Process (CAP):

Principle 1: Sound foundational risk management The BHC has a sound risk-measurement and risk-management infrastructure that supports the identification, measurement, assessment, and control of all material risks arising from its exposures and business activities.

Principle 2: Effective loss-estimation methodologies The BHC has effective processes for translating risk measures into estimates of potential losses over a range of stressful scenarios and environments and for aggregating those estimated losses across the BHC.

Principle 3: Solid resource-estimation methodologies The BHC has a clear definition of available capital resources and an effective process for estimating available capital resources (including any projected revenues) over the same range of stressful scenarios and environments used for estimating losses.

Principle 4: Sufficient capital adequacy impact assessment The BHC has processes for bringing together estimates of losses and capital resources to assess the combined impact on capital adequacy in relation to the BHC's stated goals for the level and composition of capital.

Principle 5: Comprehensive capital policy and capital planning The BHC has a comprehensive capital policy and robust capital planning practices for establishing capital goals, determining appropriate capital levels and composition of capital, making decisions about capital actions, and maintaining capital contingency plans.

Principle 6: Robust internal controls The BHC has robust internal controls governing capital adequacy process components, including policies and procedures; change control; model validation and independent review; comprehensive documentation; and review by internal audit.

Principle 7: Effective governance The BHC has effective board and senior management oversight of the CAP, including periodic review of the BHC's risk infrastructure and loss and resource estimation methodologies; evaluation of capital goals; assessment of the appropriateness of stressful scenarios considered; regular review of any limitations and uncertainties in all aspects of the CAP; and approval of capital decisions.

LOS 2a. Describe practices that can result in a strong and effective capital adequacy process for a BHC in the following areas - Risk Identification

The following points should be remembered about risk identification:

A. [Comprehensive?] All risks are accounted for in capital determination - full set of potential exposures stemming from on- and off-balance sheet positions, including those that could arise from provisions of non-contractual support to off-balance-sheet entities, and risks conditional on changing economic and financial market conditions during periods of stress.

B. [True Risk Reduction?] Assess any assumptions about risk reduction resulting from risk transfer and/or mitigation techniques, including, for example, analysis of the enforceability and effectiveness of any guarantees or netting and collateral agreements and the access to and valuation of collateral as exposures and asset values are changing rapidly in a stressed market.

C. [Dynamic Risk Profile] Maintain a comprehensive inventory of risks, and refresh it in face of new products and activities or change in the BHC's strategic direction.

D. [Capital Adequacy and Capital Planning] Risk measures should support BHCs' assessments of capital adequacy and may be helpful in capital contingency plans as early warning indicators or contingency triggers, where appropriate. BHCs should be able to demonstrate how their identified risks are accounted for in their capital planning processes. If certain risks are omitted from the enterprise-wide scenario analysis, BHCs should note how these risks are accounted for in other aspects of the capital planning process.

E. [Difficult to Quantify Risks?] Large, complex BHCs are often exposed to risks, that are either difficult to quantify or not directly attributable to any of the specific integrated firm-wide scenarios (e.g. reputational risk, strategic risk, and compliance risk). Many BHCs used internal capital targets to account for such risks, putting in place an incremental cushion above their targets to allow for difficult-to-quantify risks. The risks being addressed by putting in place a cushion above the capital target should be clearly articulated, and how this cushion is related to identified risks.

LOS 2b. Describe practices that can result in a strong and effective capital adequacy process for a BHC in the following areas - Internal Controls

A BHC should have a strong internal control framework that helps govern its internal capital planning processes. The following points need to be remembered:

A. [Scope of Internal Controls] Address its entire capital planning process — risk measurement and management systems used to produce input data, models and other techniques used to generate loss and revenue estimates; aggregation and reporting framework used to produce reports to management and boards; and the process for making capital adequacy decisions — ensure they are functioning as intended. Management responds quickly and effectively to any issues identified devotes appropriate resources to continually ensure that controls were functioning effectively.

B. [Internal Audit] Audit should perform a review of the full process, not just of the individual components, periodically to ensure that it is functioning in accordance with supervisory and BHC board's expectations and with a BHC's board of directors' expectations. Internal audit should review the manner in which deficiencies are identified, tracked, and remediated. Audit staff should have the appropriate competence and influence / stature and independence from management.

C. [Independent Model Review and Validation] This is for models used in internal capital planning. Validation staff should have the necessary technical competencies + stature + independence from model developers and business areas. Model validation should include checks on conceptual soundness, verification of processes, benchmarking, analysis of it's outcomes, it's use for estimating net income and capital in stressed conditions. If model weakneses are identified, there should be a process to incorporate well-supported adjustments to model estimates (management overlay). Use of models that are not validated should be restricted.

D. [Policies and Procedures] There should be policies and procedures covering the entire capital planning process (to ensure a consistent and repeatable process for all components of the capital planning process and provide transparency to third parties). Policies should be reviewed and updated at least annually and there should also be evidence that management and staff are adhering to policies and procedures. There should be a formal process for any policy exceptions.

E. [Ensuring Integrity of Results] BHCs should have internal controls that ensure the integrity of reported results and the documentation, review, and approval of all material changes to the capital planning process and its components. Specific controls should be in place to:\

- ensure that MIS are sufficiently robust to support capital analysis and decision-making, with sufficient flexibility to run ad hoc analysis as needed;
- provide for reconciliation and data integrity processes for all key reports;
- address the presentation of aggregate, enterprise wide capital planning results;
- ensure that reports provided to senior management and the board contain the appropriate level of detail and are accurate and timely.

F. [Documentation] BHCs should have clear and comprehensive documentation for all aspects of their capital planning processes, including their risk measurement and risk management infrastructure, loss and resource estimation methodologies, the process for making capital decisions, and efficacy of control and governance functions.

LOS 2c. Describe practices that can result in a strong and effective capital adequacy process for a BHC in the following areas – Governance

The board, along with senior management should establish a comprehensive capital planning process that fits into broader risk management processes and that is consistent with the risk-appetite framework and the strategic direction of the BHC. The following are to be remembered:

A. [Board of Directors] The board has the ultimate oversight responsibility and accountability for capital planning and should be in a position to make informed decisions on capital adequacy and capital actions, including capital distributions. It should include capital measures under current conditions as well as on a post-stress, pro-forma basis. To this end, the board should receive sufficient information to understand the BHC's material risks and exposures and to inform and support its decisions on capital adequacy and planning (at least quarterly). It should include sufficient details on scenarios used for the BHC's internal capital planning and a discussion of key limitations, assumptions, and uncertainties within the capital planning process and summary information about mitigation strategies to address key limitations. The board should take action when weaknesses in internal capital planning are identified.

B. [(Additional) Board Reporting] Adequate reporting to board also includes information about the independent review and validation of models, information on issues identified by internal audit, as well as key assumptions underpinning stress test results and a discussion of the sensitivity of capital levels to those assumptions.

C. [Senior Management] Ensures that capital planning activities authorized by the board are implemented in a satisfactory manner and is accountable to the board for the effectiveness of those activities. It should ensure effective controls are in place, including ensuring that the BHC's stress scenarios are sufficiently severe and cover the material risks and vulnerabilities facing the BHC. Senior management should make informed recommendations to the board of directors about the BHC's capital, including capital goals and distribution decisions. It should ensure that capital goals have sufficient analytical support and identify weaknesses and potential limitations in the capital planning process + evaluate them for materiality. For any such weaknesses, it should develop remediation plans.

D. [Documenting Decisions] BHCs should document decisions about capital adequacy and capital actions taken by the board of directors and senior management, and describe the information used to reach those decisions.

LOS 2d. Describe practices that can result in a strong and effective capital adequacy process for a BHC in the following areas - Capital Policy.

2d.1 Capital Policy

A capital policy is the principles and guidelines used by a BHC for capital planning, capital issuance, and usage and distributions. It should include internal capital goals; quantitative or qualitative guidelines for dividends and stock repurchases and strategies for addressing potential capital shortfalls. The capital policy must be approved by the board, and should also address roles and responsibilities of decision makers, process and data controls, and validation standards.

The policy should describe processes surrounding how common stock dividend and repurchase decisions are made specifically:

- [Metrics affecting distributions] Main factors and key metrics that influence the size, timing, and form of capital distributions;
- [Analytical inputs] Analytical materials used in making capital distribution decisions;
- [Circumstances that alter distribution] Specific circumstances that would cause the BHC to reduce or suspend a dividend or stock repurchase program;
- [Replacing equity] Factors the BHC would consider if contemplating the replacement of common equity with other forms of capital;
- [Roles + responsibilities] Key roles and responsibilities, including the individuals or groups responsible for producing the analytical material referenced above, reviewing the analysis, making capital distribution recommendations, and making the ultimate decisions.

2d.2 Capital Goals and Targets

[Goals vs Targets] BHCs should establish capital goals aligned with their risk appetites and risk profiles as well as expectations of internal and external stakeholders, providing specific goals for the level and composition of capital, both current and under stressed conditions. These goals should be sufficient to allow a BHC to continue its operations during and after the impact of stressful conditions. Capital targets should be set above capital goals to ensure that capital levels will not fall below the goals during periods of stress.

[Determining Inputs] To determine capital distributions, BHCs should explicitly take into account general economic conditions and their plans to grow their on and off-balance-sheet size and risks organically or through acquisitions. BHCs should consider the impact of external conditions during both normal and stressed economic and market environments on their overall capital adequacy and ability to raise additional capital. This should include the potential impact of contingent exposures and broader market or systemic events, which could cause risk to increase beyond the BHC's chosen risk tolerance level.

[Calculate what?] BHCs should calculate and use several capital measures that represent both leverage and risk, including quarterly estimates of regulatory capital ratios under both baseline and stress conditions.

2d.3 Capital Contingency Plan

[Defining the plan] Specific capital contingency actions consider how to remedy any current or prospective deficiencies in capital position. These should include a detailed explanation of the circumstances along with their associated capital triggers (i.e. metrics that provide an "early warning" of capital deterioration) — for both baseline and stress scenarios. Triggers should also be established for other metrics and events such as liquidity, earnings, debt and credit default swap spreads, ratings downgrades, stock performance, supervisory actions, or general market stress. Weak practices set triggers based on actual results but not on projected results, or based on minimum regulatory capital ratios only with no consideration of the expectations of other stakeholders. The capital contingency plan should be reviewed and updated as conditions warrant.

[Assumptions incorporated] The capital plan should recognize that certain capital-raising and capital-preserving activities may not be feasible or effective during periods of stress. BHCs should have an understanding of market capacity constraints including debt or equity issuance and also contemplated asset sales. Plans with overly optimistic assumptions or excessive reliance on past history are considered weak.

[Actions taken] Management action should include escalation to the board, potential suspension of capital actions, and/or activation of a capital contingency plan.

LOS 2e. Describe practices that can result in a strong and effective capital adequacy process for a BHC in the following areas - Scenario Design

2e.1 Design Practices
Under the Capital Plan Rule, a BHC is required to use a BHC-developed stressed scenario that is appropriate for its business model and portfolios and associated vulnerabilities.

- Some BHCs designed stress scenarios using internal models and expertise.
- Other BHCs used vendor-defined macroeconomic scenarios or vendor models to define customized scenarios.
- BHCs with stronger scenario-design practices used internal models in combination with expert judgment or tailored third-party-defined scenarios to their own risk profiles and vulnerabilities.

Although they are required to submit only one BHC stress scenario for CCAR, BHCs should develop a suite of scenarios that collectively capture their material risks under a variety of stressful circumstances and should incorporate them into their overall capital planning processes.

2e.2 Scenario Design and Severity
[Key Guideline] Scenario design should reflect the BHC's unique vulnerability to factors that affect it's firm-wide activities and risk exposures, including macroeconomic, market-wide and firm-specific events i.e. tailored specifically to stress the BHC's key vulnerabilities and idiosyncratic risks depending on it's business model, mix of assets and liabilities, geographical footprint and revenue drivers.

[Examples of Risks] Risks observed in practice include a significant counterparty default; a natural disaster or other operational-risk event; and a more acute stress on a particular region, industry, and/or asset class as compared to the stress applied to general macroeconomic conditions.

[Another Guideline] BHC stress scenarios should not feature assumptions that specifically benefit the BHC (example that they would be viewed as strong compared to their competitors in a stress scenario). The scenario should result in a "substantial stress" for the organization, including a significant reduction in capital ratios relative to baseline projections and strains on its ability to generate revenue and absorb losses.

2e.3 Variable Coverage
The set of variables that a BHC includes in its stress scenario should be sufficient to address all material risks arising from its exposures and business activities — especially all relevant variables that

facilitate pro forma financial projections. BHCs should have a consistent process for determining the final set of variables. The link between the variables included in the scenario and sources of risk should be transparent.

2e.4 Clear Narratives

The scenario should be supported by a clear narrative describing how the scenario addresses the particular vulnerabilities and material risks facing the BHCs, how the scenario variables correspond to variables in the BHC's internal risk-management models and how the paths of the scenario variables related to each other in an economically intuitive way.

LOS 2f. Describe practices that can result in a strong and effective capital adequacy process for a BHC in the following areas - Estimation Methodologies for Losses, Revenues and Expenses

A BHC's capital plan must include estimates of projected revenues, expenses, losses, reserves, and pro forma capital levels, including any minimum regulatory capital ratios over the planning horizon under expected conditions and under a range of stressed scenarios.

The Federal Reserve generally expects BHCs to use models or other quantitative methods but qualitative approaches may be appropriate due to data limitations, new products or businesses.

2f.1 General Expectations: Quantitative and Qualitative Basis

2f.1 .1 Quantitative Basis

The following aspects need to be noted:

A. [Data Use] Generally, BHCs should develop and use internal data to estimate losses, revenues, and expenses but it may be more appropriate for BHCs to use external data to make their models more robust. This external data should reasonably approximate underlying risk characteristics of BHCs portfolios.

B. [Estimation Methods] No specific estimation method, but estimates should be sufficiently granular so that BHC can identify common, key risk drivers and capture the effect of changing conditions and environments.

C. [Proper Segmenting] While BHCs often segment their portfolios and activities along functional areas, such as by line of business or product type, the leading practice is to determine segments based on common risk characteristics (e.g., credit score ranges or loan-to-value ratio ranges) that exhibit meaningful differences in historical performance. Ensure that each risk segment has sufficient data observations to produce reliable model estimates.

D. [Segment-wise Estimations] BHCs should separately estimate losses, revenues, or expenses for portfolios or business lines that are sensitive to different risk drivers or sensitive to risk drivers in a markedly different way. Such differences can become more pronounced during periods of stress.

E. [Sensitivity Analysis] BHCs have used sensitivity analysis to test the robustness of models and help ensure that core assumptions are clearly linked to outcomes. Another method is to use results from different estimation approaches (challenger models) as a benchmark.

F. [Using Third Party Models] BHCs should ensure that their internal staff have working knowledge and a good conceptual understanding of the design and functioning of third party models and their potential model limitations. Sensitivity analysis can be particularly helpful in understanding the range of possible results of vendor models that have less transparent or proprietary elements.

G. [Time Horizon?] Some BHCs generated annual projections for certain loss, revenue, or expense items and then evenly distributed them over the four quarters of each year. This is only acceptable when a BHC can clearly demonstrate that the projected item is highly uncertain and the practice likely results in a conservative estimate.

2f.1 .2 Qualitative Basis

The following aspects need to be noted:

A. [Expert Judgment + Management Overlay] BHCs may use a management overlay to account for the unique risks of certain portfolios that are not well captured in their models, or otherwise to compensate for specific model and data limitations.

B. [Focus on Process] BHCs should ensure that they have a transparent and repeatable process and that key assumptions are consistent with assumed scenario conditions (and are clearly documented).

C. [Review] Any management overlay or qualitatively derived projections should be subject to effective review and challenge. Extensive use of management judgment to adjust modeled estimates should trigger review and discussion as to whether new or improved modeling approaches are needed.

D. [Reporting] In reporting to the board of directors, management should always provide both the initial results and the results after any judgmental adjustments.

2f.1 .3 Conservatism and Crediblity

[Conservative Assumptions] BHCs should use conservative assumptions throughout the stress testing process — models are developed using data that contain sufficiently adverse outcomes. Applicability of key assumptions should be reviewed and BHCs should critically assess how historically observed patterns may change in unfavorable ways during a period of severe stress. BHCs should not rely on favorable assumptions that cannot be reasonably assured to occur in stressed environments (assumptions about possible management actions ex ante in anticipation of stressful conditions, such as preemptively rebalancing their portfolios or otherwise adjusting their risk profiles to mitigate the expected impact).

[Event Inclusion] BHCs should generally include all applicable loss events in their analysis, unless a BHC no longer engages in a line of business or its activities have changed such that the BHC is no longer exposed to a particular risk (but not selectively exclude losses).

2f.1 .4 Documentation of Estimation Practices

The Federal Reserve expects BHCs to clearly document their key methodologies and assumptions used to estimate losses, revenues, and expenses (with relevant macroeconomic or other risk drivers, and demonstrated relationships between these drivers and estimates). Also to be documented are qualitative overlays to model outputs, and purely qualitative estimates.

2f.2 Loss Estimation Methodologies

2f.2.1 General Guidelines

A. [Choice and # of Variables] There should be a sound theoretical basis for macroeconomic and other explanatory variables (risk drivers) used to estimate losses. There should be a strong empirical relationship exists between those variables and losses. Using additional variables can enhance the sensitivity of loss estimates to a given scenario and also improve the overall fit of the model.

B. [Loss Aggregation] Aggregation process to compute enterprise-wide scenario analysis results (from losses of portfolios and activities) should be a repeatable process, with the ability to combine disparate risk measures (such as accounting-based and economic loss concepts), different measurement horizons, or otherwise dissimilar loss estimates.

C. [Automated vs Manual] BHCs with leading practices used automated processes that showed a clear audit trail from source data to loss estimation and aggregation, with full reconcilement. BHCs with lagging practices exhibited a high degree of manual intervention in the aggregation process.

2f.2.2 Retail and Wholesale Credit Risk

[Internal + External Data] BHCs used different estimation methods for different portfolios. Due to availability of a richer set of retail loss data, BHCs generally used internal data to estimate defaults or losses on retail portfolios and only infrequently used external data with longer history to benchmark estimated losses on portfolios that had more limited loss experience in the recent downturn. For wholesale portfolios, some BHCs supplemented internal data with external data or used external data to calibrate their models due to a short time series.

[Segmentation] The level of segmentation depends on the type and size of portfolio and estimation methods used. BHCs often segmented the retail portfolio based on some combinations of product; lien position; risk characteristics such as credit score, loan-to-value ratio, and collateral and underlying collateral information. BHCs with stronger practices had segmentation schemes with sufficient granularity to capture exposures that react differently to risk drivers under stressed conditions. BHCs with weaker practices used a single model for multiple portfolios, without sufficiently adjusting modeling assumptions to capture the unique risk drivers of each portfolio.

[Type of Methods] Estimation methods can be either an accounting-based loss approach (that is, charge-off and recovery) or an economic loss approach (that is, expected losses). BHCs have flexibility in selecting a specific loss or estimation approach; however, it is important for BHCs to understand differences between the two loss approaches, particularly in terms of the timing of loss recognition, and to account for the differences in setting the appropriate level of reserves at the end of each quarter.

[Method 1: Expected Loss Approaches] The following points need to be noted:

A. [Same Formula, Tweaked Inputs] BHCs with leading practices were able to break down losses into PD, LGD, and EAD components, separately identifying key risk drivers for each of those

components. Some BHCs used long-run average PD, LGD, and EAD for a particular segment, to estimate losses (not appropriate for projecting losses under stress). For stressed scenarios, BHCs used econometric models to estimate losses under a given scenario, where the estimated PDs were conditioned on the macroeconomic environment and portfolio or loan characteristics.

B. [LGD] BHCs with leading practices clearly tied LGD to underlying risk drivers, accounted for collateral and guarantees, and also incorporated the likelihood of a decline in collateral values under stress. Most BHCs often applied a simple, conservative assumption (e.g., 100 percent LGD for credit cards), based stressed LGD on their experience during the crisis, or scaled up the historical average LGD using expert judgment. In any case, BHCs should benchmark their estimates with external data or research and analysis. Note that BHCs with lagging practices modeled LGD using a weighted-average approach at an aggregate portfolio level.

C. [EAD] Although some BHCs found a relationship between EAD and credit quality, most BHCs did not model EADs to vary according to the macroeconomic environment, in large part due to data limitations. BHCs with stronger practices included the use of loan equivalent calculations and credit-conversion factors.

[Method 2: Rating Transition Matrices] The following points need to be noted:

A. [Approach] This approach creates a stressed rating transition matrix for each quarter, which is then used to estimate losses for their wholesale portfolios under stress. Following steps are used: (1) converting the rating transition matrix into a single summary measure; (2) estimating a time-series model linking the summary measure to scenario variables; (3) projecting the summary measure over the nine-quarter planning horizon, using the parameter estimates from the time-series model; and (4) converting the projected summary measure into a full set of quarterly transition matrices.

B. [Requirements] These models will require a robust time series of data and there should be a statistically significant relationship between the transition behavior and macroeconomic variables. To overcome these data limitations, BHCs have often relied on third-party data to develop rating transition models. Rating transition models also require well-calibrated + granular ratings systems that capture differences in the potential for defaults and losses for a given set of exposures in various economic environments.

C. [Weak Practices] BHCs with weaker practices relied on a risk rating process that historically resulted in lumpiness in rating upgrades and downgrades or material concentrations in one or two rating categories. As a result, these BHCs often produced transition matrices with limited sensitivity to scenario variables, and resulting estimates were more consistent with long-term average default rates than with default rates that would be experienced under severe economic stress.

[Method 3: Roll-Rate Models] The following points need to be noted:

A. [Approach] These models estimate the rate at which loans that are current or delinquent in a given quarter roll into delinquent or default status in the next period (conceptually similar to rating transition models). Robust time series data allow the BHC to establish a strong relationship between roll rates and scenario variables, while the availability of granular data enables BHCs to model all relevant loan transitions and to segment the portfolio into sub-portfolios.

B. [Cons] Roll-rate models often have a weak predictive power outside the near future, particularly if they are not properly conditioned on scenario variables. It is a weaker practice to use roll-rate models in conjunction with vintage model (described next), as it can introduce unexpected jumps in estimated losses.

[Method 4: Vintage Loss Models (Age-Cohort-Time models)] The following points need to be noted:

A. [Approach] Used specifically for retail portfolios, application of these models first segment retail portfolios by vintage and collateral or credit-quality-based segments. Losses are estimated using a multistep process — developing a baseline seasoning curve for each segment and using a regression model to estimate sensitivity of losses to macroeconomic variables at each seasoning level.
B. [Pros] These models allow for natural segmentation of portfolios by cohort and maturity, and are easy to apply to credit products (such as auto loans) that exhibit lifecycle effects.
C. [Cons] These models can be very challenging to construct, calibrate, and validate — it may be difficult to separately identify vintage effects from the effects of macroeconomic variables. These models generate results that are representative of average years, rather than during the period of stress.

[Method 5: Charge-off Models] The following points need to be noted:

A. [Approach] Net charge-off (NCO) models estimated a statistical relationship between charge-off rates and macroeconomic variables at a portfolio level, and often included autoregressive terms (lagged NCO rates), but did not capture variation in sensitivities to risk drivers across important portfolio segments nor accounted for changes in portfolio risk characteristics over time.
B. [Cons] NCO models often exhibit lower explanatory power, they implicitly assume that historical charge-off performance is a good predictor of future performance (which may not be realized under very stressful scenarios).

[Method 6: Scalar Adjustments] The following points need to be noted:

A. [Approach] Simple scalars are used to adjust portfolio loss estimate under a baseline scenario upward for stress scenarios. Scalars have been calibrated based on some combination of historical performance, the ratio of modeled stressed losses to baseline losses estimated for other portfolios, and expert judgment.
B. [Pros] Easy to develop, implement, and communicate.
C. [Cons] Lacks transparency and lacks sensitivity to changes in portfolio composition and scenario variables.

2f.2.3 Available-for-Sale (AFS) and Held-to-Maturity (HTM) Securities

[Approach] BHCs should test all credit-sensitive AFS and HTM securities for potential other-than-temporary impairment (OTTI) regardless of current impairment status. The threshold for determining OTTI for structured products should be based on cash-flow analysis and credit analysis of underlying

obligors (and not based on ratings based thresholds). Most BHCs used a ratings-based approach to determine OTTI of direct obligations such as corporate bonds, based on the projection of ratings migration under a stress scenario and a ratings-based OTTI threshold.

[Drivers + Validation] BHCs should have quantitative methods that capture appropriate risk drivers (security-specific and country-specific) and explicitly translate assumed scenario conditions into estimated losses. Additionally, models should be independently validated for their use in projecting OTTI losses for specific classes of securities. Management judgment needs to be limited and well supported in the methodology documentation. The approaches and assumptions chosen for OTTI loss estimation should be conservative, e.g. recognizing losses in early quarters rather than over the entire scenario horizon.

2f.2.4 Operational Risk Losses

[General Guideline] Capital Plan Rule does not require BHCs to use advanced measurement approach (AMA) models for stressed operational-risk loss estimation. However, BHCs that have developed a rich set of data to support the AMA should consider leveraging the same data and risk-management tools to estimate operational losses under a stress scenario.

[Incorporating the Elements] BHCs should use internal operational loss data as a starting point to provide historical perspective, and then incorporate forward-looking elements, idiosyncratic risks, and tail events to estimate losses. Most BHCs have supplemented their internal loss data with external data (scaled). Few BHCs have incorporated business environment and internal control factors they can help identify areas of potential risk and help BHCs select appropriate scenarios that stress those risks.

The following points need to be noted:

A. [Internal Data Collection and Data Quality] Internal data-collection methods should be robust and complete i.e. capture all key elements, such as critical dates (i.e., occurrence, discovery, and accounting), event types, and business lines. BHCs should use complete data sets of internal losses and not judgmentally exclude certain loss data (large items such as legal reserves and tax/ compliance penalties, losses from merged or acquired institutions or loss data from discontinued business lines). If BHCs do not have the data from potential mergers and acquisitions, one way to account for this limitation is to scale existing internal data using the size of operations and apply an add-on to applicable business lines or units of measure.

B. [Correlation with Macroeconomic Factors] Most BHCs (with large data-sets) have attempted to identify correlation between macroeconomic factors and operational-risk losses. BHCs that did not identify a significant correlation typically developed other methodologies, such as scenario analysis layered onto modeled results, to project stressed operational-risk losses (reasonable if BHCs can demonstrate that their approach conservative).

C. [Common Operational-Loss-Estimation Approaches] BHCs with stronger practices used a combination of approaches to incorporate historical loss experience, forward-looking elements, and idiosyncratic risks into their stressed loss projections (can help address model and data

limitations). Some BHCs used separate models for certain events types such as fraud or litigation. A few approaches are listed below:

- Regression Models are used to estimate loss frequency and loss severity, stressed on the basis of observed correlations with macroeconomic variables and operational risk losses. Meaningful correlations with loss severity are not usually found, so BHCs use loss severity based on the most recent crisis period.
- Modified Loss-Distribution Approach (LDA) in which the BHC adjusts the LDA approach either by modifying the less frequency distribution (based on correlation with macroeconomic variables) or altering the confidence interval chosen in the LDA (from the 99.9 percentile required by AMA). BHCs have used either the mean or median for the baseline estimates and higher confidence intervals—typically ranging from 70th percentile to 98th percentile — for the stressed estimates. Additionally, some BHCs have used different confidence intervals for different event types. The Federal Reserve expects BHCs to implement a credible, transparent process to select a percentile; be able to demonstrate why the percentile is an appropriate choice given the specific scenario under consideration; and perform sensitivity analyses.
- Scenario Analysis is used to determine a management overlay that is added to losses estimated using a model-based approach (to incorporate idiosyncratic risks or to capture potential loss events that the BHC had not previously experienced). Scenario analysis can help compensate for limitations in data. The Federal Reserve expects BHCs to provide an appropriate rationale for the specific scenarios included in their loss estimate.
- Some BHCs used historical averages of operational risk losses, to estimate operational-risk losses under stress scenarios (for event types where no correlation between macroeconomic factors and operational-risk losses was identified but used a regression model for event types where correlations were identified). When used alone, this approach is backward looking and excludes potential risks the BHCs have not experienced. When using historical averages, BHCs should support the chosen time periods, thresholds, and any excluded or adjusted outliers and demonstrate that loss estimates are consistent with what are expected in the stress scenario.

D. [Legal Losses] A number of BHCs have analyzed and projected legal losses separately from non-legal losses. Various methods have been used, such as applying a judgment-based add-on for significant losses; using legal reserves; using historical averages; or creating separate regression models for the clients, products, business practices and event type. Some BHCs have developed hazard-rate models based on historical loan performance to estimate default rates and then estimated repurchase claim rates.

2f.2.5 Market Risk

[Deterministic vs Probabilistic Approaches] Probabilistic approaches generate a distribution of potential portfolio-level profit/loss (P/L) and deterministic approaches generate a point estimate of portfolio-level losses under a specific stress scenario. A probabilistic approach can provide useful insight into a range of scenarios that generate stress losses. However it is complex and often lacks transparency. It can be difficult to communicate the relevant scenarios it difficult for management and the board of directors to readily discern what actions could be taken to mitigate portfolio losses in a given scenario. The Federal Reserve expects BHCs using a probabilistic approach to provide

evidence that such an approach can generate scenarios that are potentially more severe than what was historically experienced, and also to clearly explain how BHCs use the scenarios associated with tail losses to identify and address their idiosyncratic risks. A deterministic approach generally produces scenarios that are easier to communicate to senior management and the board. However, a deterministic approach often uses a limited set of scenarios, and may miss certain scenarios. For CCAR, most BHCs generally relied on a deterministic approach, for which, they use a three-step process:

A. [Stress Scenarios] Consider a number of market shock scenarios that address the breadth of BHCs' risks before selecting the scenario included in their capital plans. Scenario design is based on a combination of historical events (that present a core theme) and hypothetical projections (an overlay developed using expert judgment and knowledge of BHC's positions and market developments) to develop the market shock scenarios. The scenarios should account for BHCs' idiosyncratic risks, in the event of a market-wide or firm-specific stress. They should stress positions or products in which the BHC has a large market share and should also consider more unusual basis risks arising from complex interdependent positions. BHCs that only use a scenario that closely mirrors the Federal Reserve's global market shock component should be aware that such an approach may omit significant risks that are unique to their positions.

B. [Translating Scenarios to Risk Factor Shocks] BHCs translated these scenarios into concrete specification of individual risk factors that were the actual inputs to pricing models (as instantaneous market shocks for stress testing). Given the uncertainty surrounding a firm's ability to exit or manage positions during a period of severe market stress, this is an appropriate practice. The size of shocks assumed in the stress scenario is often quite large and could result in implausible outcomes such as negative risk-free rates or negative forward rates. BHCs should take care in modeling dislocations and discordant moves of risk factors that normally move similarly. Additionally, while dislocations and discordant moves are expected under stress, BHCs should have a process to assess that the resulting joint moves of risk factors are reasonable. Also, moves implied by a stress scenario may require risk-factor mappings that deviate from the normal mappings.

C. [Revaluation Methodologies and P/L Estimates] Practical revaluation methods may embed a number of approximations (to economize on computational costs related to running a large number of scenarios daily) which could introduce mismeasurement into the stress test results. BHCs should generally use "full-revaluation" methods for stress testing, given the very large risk-factor moves, especially for nonlinear positions with value dependent on multiple risk factors. BHCs can use approximation methods on a limited basis if extensive tests and analyses suggest that the potential mismeasurement from using such methods is not significant. For certain parameters that are not easily "market observable" (e.g., correlations for credit default baskets and correlations for certain interest rate and exchange-rate pairs), BHCs should consider suitably perturbed values of the model parameters. BHCs should identified key P&L drivers in terms of positions, asset classes, and risk types. BHCs should also conduct sensitivity analysis to ensure that P/L estimates under the stress scenario are robust, without being unduly sensitive to small changes in inputs, assumptions, and modeling choices.

2f.2.6 Counterparty Credit Risk

[Losses from Counterparty Defaults] Defaults of counterparties or issuers and/or reference entities are typically not embedded directly within the instantaneous market shock scenarios. BHCs use a probabilistic approach based on PD, LGD, and EAD of counterparties to estimate losses from possible defaults over some future horizon (e.g., to the typical margin period of risk). BHCs also considered explicit default scenario of one or more of their largest counterparties and/or customers.

[Risk Mitigants and Other Assumptions] Some BHCs have incorporated management responses to the stress, assuming, for example, some positions would be sold or hedged over time under the stress scenario. The Federal Reserve expects any assumptions about risk mitigation to be conservative. BHCs should be able to demonstrate that such actions are consistent with established policy, supported by historical experience, and executable with high confidence in the market environment contemplated by the scenario. It may not be reasonable to assume that BHCs can easily sell their positions to other BHCs under the stress scenario. In addition, BHCs should avoid making unrealistic assumptions about their ability to foresee precisely how a scenario would play out, and take action on the basis of that information.

2f.2.7 Pre-Provision Net Revenue (PPNR) Projection Methodologies

The Capital Plan Rule requires BHCs to estimate revenue and expenses over the nine-quarter planning horizon. In projecting these amounts, BHCs should consider not only their current positions, but also how their activities and business focus may evolve over time under the varying circumstances and operating environments reflected in the scenarios being used.

[General Considerations] BHCs should have methodologies that generate robust projections of PPNR. The scenario analysis program should be:

A. consistent with the current and projected paths of on-and off-balance-sheet exposures, risk-weighted assets (RWA), and other exposure assumptions;
B. consistent with assumed scenario conditions;
C. in accordance with the same accounting basis that would be used to calculate relevant capital ratios;
D. at a level of granularity consistent with the materiality of revenue and expense components and sufficient to capture differing drivers of revenue and expenses across the organization.
E. consider the effects that regulatory changes (e.g., changes in deposit insurance coverage limits) may have on their ability to replicate historical performance.
F. ensure that projections present a coherent story within each scenario, clearly establish a relationship among revenue, expenses, the balance sheet, and any applicable off-balance-sheet items and document how their process generates a consistent and coherent evolution.

[Observed PPNR Projection Practices] BHCs with stronger practices demonstrated:

A. strong interactions among central planning functions, business lines, and the treasury group, with an open flow of information and a robust challenge process (better than approaches in which the central group simply aggregated projections).

B. projections based on a full exploration of the most relevant relationships between assumed scenario conditions and revenues and expenses. Business-line expertise was leveraged revenues and expenses were segmented for projection purposes.

C. not relying exclusively on the line-item definitions in regulatory reports. These BHCs often established a process to clearly map internal BHC reporting conventions to the various line items on the FR Y-14 schedules.

D. adjustment of budget or baseline estimates, with budget estimates largely qualitatively derived through input from a variety of business lines and/or stakeholders across the BHC. Some BHCs relied heavily on baseline estimates to develop stress scenario outcomes without considering favorable strategic actions and assumptions incorporated into baseline results that might not be realistic or feasible under stressed conditions.

E. starting off with weak models either as a frame of reference or a starting point to translate economic factors into estimates of key PPNR components, but then adjusting the results using expert judgment. In such cases, BHCs should thoroughly explain and document why results, once adjusted, are consistent with the scenario conditions.

F. use of external data to augment and extend their internal data in cases where BHC-specific data were limited or, where appropriate, or by considering whether longer time series of available aggregate data would be preferable. Using limited data is problematic if the BHC experienced favorable conditions (e.g. significant recovery) during this period.

Specific expectations for projecting key components of PPNR are given below:

A. [Net Interest Income] A. [Consistency of Assumptions] Balance sheet assumptions used to project net interest income should be consistent with balance sheet assumptions considered as part of loss estimation as well as with other asset and liability management assumptions. Loan pricing should be consistent with both scenario conditions and competitive and strategic factors, including projected changes to the size of the portfolio. Deposit projections should incorporate the impact of strategic plans and pricing on deposit growth or decline.

B. [Current + Dynamic Evolution] Net interest income projections are expected to incorporate the balances and contractual terms of current portfolio holdings as well as the behavioral characteristics of these portfolios. BHCs should be able to capture dynamic conditions for both current and projected balance sheet positions (prepayment rates, new business spreads, re-pricing rates due to changes in yield curves).

C. [Product Characteristics] Some BHCs specified product characteristics and conducted analysis around these characteristics both for current assets and new originations. They also attempted to capture the product mix changes that would occur as a result of customer and market conditions (e.g., changes in domestic deposit mix due to anticipated growth in demand for time deposits for a specified scenario). BHCs provided detailed tables explaining underlying assumptions such as balance drivers and spread and growth assumptions by product.

D. [Loan Loss Projections] Some BHCs partially integrated loss projections into net interest income projections but did not adequately align all projection-related assumptions. (For example, without considering the changing relative performance portfolios over the course of the scenario not fully capture the behavioral characteristics of the loan portfolio).

E. [Amortization of Discounts or Premiums] BHCs had net interest income projection methodologies that captured adjustments in the amortization of discounts or premiums for assets held at a value

other than par that would occur under various scenarios (yields would adjust under varying scenarios as amortization schedules change due to changes in expected payment speeds).

F. [Loan Pricing] For pricing, many BHCs assumed a constant spread to a designated index. BHCs with stronger practices considered whether this assumption was consistent with historical experience and assumed scenario conditions as well as the BHC's strategy. Some BHCs recognized that new business pricing could differ as a result of tightening or widening of spreads.

B. [Non-interest Income]

A. [Consistency of Projections] BHCs are expected to produce stressed projections of non-interest income that are consistent with assumed scenario conditions, as well as with stated business strategies. Stronger methodologies estimated non-interest income at a granular enough level to capture key risk factors or characteristics specific to an activity or product (different methods for brokerage activities and fund management).

B. [Connect with Balance Sheet Items] BHCs should establish relationships between material components of non-interest income and the balance sheet for components that are highly correlated with the path of the balance sheet, such as some kinds of loan-related fee income.

C. [Connect with Broad Indices] Although relationships between revenue and trading assets or off-balance sheet items may be weak over short periods, BHCs should nevertheless establish a procedure for projecting relevant balance sheet and RWA categories in support of those revenues and test for the reasonableness of the implied return on assets (ROA). If a BHC estimates trading or private equity revenue by tying balance changes to changes in broad indices, the BHC should establish the level of sensitivity of its positions relative to the indices and not automatically assume a perfect correlation between the two.

D. [Mortgage Service Rights] BHCs with mortgage servicing right (MSR) assets should ensure that delinquency, default, and voluntary prepayment assumptions are robust and scenario-dependent. These models should capture macroeconomic variables, especially home prices. For those BHCs that routinely hedge MSR exposure, hedge assumptions and results should reflect the stress scenario. BHCs with stronger practices used an optimization routine that dynamically rebalanced the hedge portfolio each quarter.

E. [Aligned + Capacity Constraints] BHCs with stronger practices considered individual business models and client profiles when projecting revenue and fee income from various business activities. They also considered capacity constraints when estimating mortgage loan production and loan sales over the scenario horizon.

F. [Weaker Practices]

- using same strategic business assumptions in both baseline and stressed scenarios, along with favorable assumptions about new business and market share gains.
- not using significant declines in revenue, even if they are correlated with macroeconomic or other drivers.
- using a limited set of scenario variables or drivers, resulting in estimates that are inconsistent with the scenario — for e.g. only interest rates only to project origination activity.
- wrong regressions — e.g. regressing high level revenue items against scenario factors rather than considering how scenario conditions would affect the key drivers of those line items (such as volume).

C. [Non-Interest Expense] BHCs should fully consider the various impacts of the assumed scenario conditions on their non-interest expense projections, including costs that are likely to increase during a downturn (costs like credit collection costs). The following need to be noted:

- Non-interest expense projections should be consistent with balance sheet and revenue estimates and should reflect the same strategic business assumptions.
- To the extent the projections assume mitigating actions to offset revenue declines, BHCs should demonstrate that such actions are attainable in the scenario, given assumed asset levels and the resources necessary to support operations.
- If the projections embed material expense reductions, such assumptions should be supported with analysis of historical data or empirical evidence and subject to challenge and review.
- BHCs are expected to evaluate the timing of projected strategies and their impact on future revenue, expenses, and operating structure.
- Strong practices involve using estimation methodologies that consider drivers of individual expense items and sensitivity of those drivers to changing scenario conditions and business strategies. Timely cuts in non-interest expenses may not be possible as the BHC may not be able to react timely to a stressful scenario or may be subject to existing contractual obligations.
- Weaker practices involve expense estimates that are unrealistic in light of assumed scenario conditions e.g. dramatic cuts in marketing expenses, when they be not be reasonable or harmful for future revenue growths. Such assumptions imply perfect knowledge of conditions as they unfold.

LOS 2g. Assessing the impact of capital adequacy, including risk-weighted asset (RWA) and balance sheet projections.

2g.1 Projecting Balance Sheet Positions and RWAs

BHCs should have a well-documented process for generating projections of the size and composition of on- and off-balance sheet positions and RWA over the scenario horizon. Estimating the evolution of balance sheet size and composition under stress integrates many interrelated features - loan balances and the stock of AFS securities at a point in time will depend upon origination, purchase, and sale activity from period to period, as well as maturities, prepayments, and defaults. Most BHCs made direct projections of balances for each major segment of the balance sheet (e.g., loans, deposits, trading assets and liabilities, and other assets) for each quarter of the scenario horizon.

2g.2 Best Practices

The following need to be noted about best practices involved (done by BHCs with strong practices):

A. [Integrating Behaviors] BHCs often faced challenges in integrating the ultimate balance projections with other aspects—for example, borrower or depositor behavior. BHCs with stronger practices separately considered the drivers of change to asset and funding balances, such as contractual paydowns, modeled prepayments, nonperformance, and new business activity for assets, rather than simply projecting targeted balances directly. Each element was

separately assessed for consistency with scenario conditions and other management assumptions.

B. [Arriving at Reasonable Projections] BHCs either directly considered the impact of various factors in their projections of various balance sheet items or had procedures to evaluate the reasonableness of any implied behavior by including input from business-line leaders in the process and iterating to reasonable estimates in a well-supported and transparent manner.

C. [Relationships under Stressed Conditions] BHCs should clearly establish and incorporate into their scenario analysis the relationships among and between revenue, expense, and on- and off-balance sheet items. If Asset Liability Management (ALM) software is not used, the BHC must have a process that integrates balance sheet projections with revenue, loss, and new business projections and ensure appropriate relationships between them are maintained.

D. [Avoid Favorable Assumptions] BHCs should not rely on favorable assumptions that cannot be reasonably assured in stress scenarios given the high level of uncertainty around market conditions. Examples of such assumptions are:

- large changes in asset mix that serve to decrease BHCs' risk weights and improve post-stress capital ratios but that are not adequately supported or reflected in PPNR or loss estimates;
- "flight-to-quality" assumptions and funding mix changes that increase deposits and reduce the dollar cost of funding;
- significant balance sheet shrinkage with no consideration of the potential losses associated with reducing positions in periods of market stress;
- operating margin improvement

If favorable assumptions are to be made, BHC should have sufficient evidence that these assumptions hold good in a stress scenario.

E. [RWA Projections] These should be in line with corresponding projections of on- and off-balance-sheet exposures and their risk attributes and should be consistent with the severity of the stress conditions under each scenario.

- For general credit exposures, BHCs should ensure sufficient granularity to allow for application of regulatory risk weighting.
- For trading exposures, BHCs should translate scenario variables into risk-parameter estimates that drive RWA calculations.
- No RWA reductions allowed for potential data or model enhancements to RWA calculation methodologies.

F. [Documentation + Validation] All assumptions made should be documented, methodologies and resulting estimates should be independently reviewed.

2g.3 Allowance for Loan and Lease Losses (ALLL)

BHCs should maintain an adequate ALLL along the scenario path and at the end of scenario horizon. The following points need to be noted:

A. [Are Reserves Adequate?] Reserve adequacy should be assessed against projected size, composition, and risk characteristics of the loan portfolio throughout the scenario horizon.

B. [Are Reserves Build-up and Release Consistent?] ALLL build and release should be consistent with the scenario path, portfolio credit quality, loss recognition approach, loan loss estimates, and loan portfolio balance projections.

C. [Handling Delayed Loss Recognition] In using such practices (such as net charge-off models), BHCs should adequately build reserves to account for losses not recognized during the scenario horizon.

D. [Coverage Tests] If the approach relies on top-down coverage levels, BHCs should compare coverage ratios and loss-emergence periods to historical stress environments and to internal policies and explain the differences if material differences exist.

2g.4 Aggregating Projections

BHCs should have a well-established and consistently executed process for aggregating loss, revenue and expense, and on- and off-balance sheet and RWA estimates, to assess the post-stress impact of those estimates on capital ratios. Effective implementations of aggregation process include establishing of centralized groups that:

A. combine losses, revenues, balance sheets and RWA projections,

B. provide strong governance and controls for this process,

C. ensure coherence of component estimates and aggregate results,

D. apply and document and adjustments.

The following best practices need to be remembered:

A. [Relationships Still Valid?] In assessing consolidated financial results, BHCs should account for any potential changes in relationships between losses and financial performance drivers during periods of stress.

B. [Inconsistent Sensitivities?] Look out for instances when exposures with similar underlying risk characteristics that are part of different portfolios or business lines exhibit different sensitivities to scenario conditions. Are they due to inconsistent assumptions? Due to inconsistent modeling assumptions?

C. [Post-stress Vs Baseline] If post-stress outcomes are more favorable than those under baseline conditions, BHCs should critically evaluate the reasonableness and consistency of assumptions across portfolios, business lines, and other areas of loss and revenue estimation.

D. [Reporting Systems] Using standalone tools or spreadsheets in the aggregation process is a weak process. If a BHC needs to use standalone tools or spreadsheets due to systems limitation, management should ensure robust controls are in place, including access and change controls, and should maintain an audit trail and document all approvals for any adjustments made. There should be reconciliation procedures and data quality and logic checks in place to ensure that the results from the enterprise-wide scenario analysis reconcile to both management reporting and regulatory reports, with a transparent mapping between various reporting taxonomies.

Range of Practices and Issues in Economic Capital Frameworks

In this reading, we begin with describing the challenges that appear in various areas within the framework for economic capital implementation.

LOS 1.1 Within the economic capital implementation framework describe the challenges that appear in: Defining Risk Measures

The choice of risk measure has important implications for the assessment of risk (the choice has an impact on relative risk levels of asset classes and thus on the bank's strategy). An ideal risk measure should be:

A. Intuitive: It should meaningfully align with some intuitive notion of risk, such as unexpected losses.
B. Stable: Small changes in model parameters or assumptions should not produce large changes in the estimated loss distribution and the risk measure.
C. Easy to compute: A complex risk measure is desirable only if incremental gain in accuracy outweighs the cost of the additional complexity.
D. Easy to understand: It should be easily understood by the bank's senior management, so as to impact daily risk management and business decisions.
E. Coherent: It should satisfy conditions of monotonicity, positive homogeneity, translation invariance and subadditivity (where subadditivity ensures that a risk measure appropriately accounts for diversification).
F. Simple Risk Decomposition: It should allow for simple allocation of diversification benefits to business lines.

We now look at how the following risk measures fare:

Aspect	Risk Measure: Standard Deviation
Intuitive	Sufficiently intuitive.
Stable	Not stable, because it depends on assumptions about loss distribution.
Easy to Compute	Yes
Easy to Understand	Yes
Coherent	No, since it violates monotonicity.
Simple (and meaningful) risk decomposition	Simple, but not very meaningful.

Aspect	Risk Measure: Value-at-Risk (VaR)

Aspect	Risk Measure: Value-at-Risk (VaR)
Intuitive	Yes
Stable	Not stable, because it depends on assumptions about loss distribution.
Easy to Compute	Yes, provided loss distribution is available or can be constructed.
Easy to Understand	Yes. Easy to communicate to senior management due to its link with target rating.
Coherent	No, since it violates subadditivity. Still sub-additive for elliptical distributions (e.g. normal).
Simple (and meaningful) risk decomposition	Not simple, internal capital allocation and limit setting for sub-portfolios may become problematic (since diversification benefits cannot be clearly allocated).

Aspect	Risk Measure: Expected Shortfall (ES)
Intuitive	Sufficiently Intuitive.
Stable	Stable, but it depends on loss distribution. Helpful for allocating the overall portfolio capital to individual facilities.
Easy to Compute	Sufficiently easy, but requires estimate of loss distribution
Easy to Understand	Sufficiently easy. Does not afford a clear link to a bank's desired target rating.
Coherent	Yes
Simple (and meaningful) risk decomposition	Relatively simple and meaningful.

Aspect	Risk Measure: Spectral and Distorted Risk Measures
Intuitive	No. Requires choice of spectrum or distortion function.
Stable	Depends on choice of loss distribution.
Easy to Compute	Sufficiently easy (requires weighting of quantiles)
Easy to Understand	Not immediately understandable.
Coherent	Yes
Simple (and meaningful) risk decomposition	Relatively simple and meaningful.

We see that all risk measures have strengths and weaknesses, since no single measure can capture all the complex elements of risk measurement. VaR and ES are the two most widely used risk

measures, with ES being increasingly used (at confidence level consistent with overall VaR) for capital allocation with a bank.

Note that the non-subadditivity of VaR can occur when assets in portfolios have very skewed loss distributions or when the loss distributions of assets are smooth and symmetric, but their dependence structure is asymmetric. The lack of subadditivity for VaR is probably more of a concern for credit risk and operational risk than for market risk, where an elliptical model may be a reasonably approximate model for various kinds of risk-factor data.

LOS 1.2 Within the economic capital implementation framework describe the challenges that appear in: Risk Aggregation

All the risk types (market, credit, operational) can be present in banks' portfolios, but the portfolio may erroneously be represented with a single risk type. A loan portfolio that is held to maturity and managed on an accrual accounting basis is often considered as representing credit risk and not market risk. A trading portfolio of credit derivatives is often taken to represent mainly market risk by virtue of it containing actively traded exposures that are marked-to-market.

Banks can aggregate risks in two ways:

A. Risk Type Silos: aggregate risk initially into silos by risk-type across the entire bank before combining the silos. This helps perform inter-risk aggregation at a single stage in a centralised and more consistent way.

B. Business Silos: Grouping risks first by business unit leverages the existing organizational structures within the bank and deals with inter-risk relationships at an earlier stage of aggregation.

Aggregation methodology has two components:

2.1 Unit of Account

Before aggregation, risk types need to be expressed in comparable units of common risk currency. Here, there are three main characteristics to deal with:

A. Risk Metric: For the purpose of quantifying diversification across risk types, it is important to check if the risk metric has the subadditivity property.

B. Confidence Level: Different risk types have different loss distributions and different confidence levels, with long-tailed risk distributions suggest using higher confidence levels. The choice of confidence level can influence the ranking of risks, since risk types with a longer loss tail tend to dominate as the confidence level increases.

C. Time Horizon: Different types of risk are managed over different horizons – horizon for traded portfolios can be days, while for less liquid exposures, such as loans, it can be one year or longer. A common horizon of one year horizon is typically chosen, which requires market risk to be scaled up using methods such as the square-root of-time rule.

2.2 Inter-Risk Diversification

We know that VaR fails to satisfy the subadditivity property, so VaR of a pooled portfolio can be higher than the weighted sum of VaR of the individual constituent portfolios. Even for other risk metrics, aggregate risk may be larger than the sum of its components metrics, if the chosen measure of dependence structure (say covariance, which we know is a linear measure of dependence) is not able to fully capture and summarize the dependencies across risks.

For example, measuring separately the market and credit risk components in a portfolio of foreign currency denominated loans can underestimate risk, since probabilities of obligor default will also be affected by fluctuation in the exchange rate.

Note that the degree of diversification is also related with the granularity of the classification system of risks. The more granular the classification system the more reduced should be the scope for intra risk diversification and the higher the scope for inter-risk diversification.

2.3 Aggregation Approaches

There are five common aggregation approaches:

A. Simple summation: In this approach, we add individual risk or capital components.

Pros	Cons
Simple, considered conservative.	Doesn't differentiate between risk types, imposes equal weights, doesn't capture nonlinearities.

B. **Constant diversification**: Similar to summation, but subtracts a fixed percentage from the overall figure.

Pros	Cons
Simple, and is able to recognize diversification effects.	The fixed diversification effect is not sensitive to underlying interactions between components. As with summation, doesn't capture non-linearities.

C. Variance covariance: Total risk is weighted sum of components, using bilateral correlation between risks.

Pros	Cons
Simple and intuitive, analytical	Correlations difficult to obtain. Doesn't capture non-linearities.

D. Copulas: Combine marginal distributions through copulas.

Pros	Cons
More flexible than variance-covariance. Allows for non-linearities and higher order dependencies.	Choice of copula can have a large impact. Entire distribution to be input (parameterization of each is difficult).

E. **Full Modelling / Simulation**: Simulate the impact of common risk drivers on risk components and construct joint distribution.

Pros	Cons
Theoretically appealing, most accurate and intuitive.	Most demanding in inputs and on IT. Time consuming. Not always accurate.

While variance covariance method remains to be the most popular choice, correlations that reflect these institution-specific characteristics can be difficult as well as costly to estimate and validate (particularly true for operational risk for which data is very scarce). By focusing on average covariance between risks, the linearity assumption tends to underestimate dependence in the tail of loss distribution and effects of skewed distributions and non-linear dependencies.

In practice, correlations can be estimated from co-movement of asset price indices representative of various risk factors or from externally supplied inputs (this is especially true for small and medium sized institutions).

Banks use variance covariance method, with following adjustments or changes:

A. correlations are biased upwards to reduce the need for expert judgment.
B. dimensionality of the matrix may be limited by consolidating risk categories to a small number (such consolidation itself represents a form of aggregation and embeds correlation assumptions).
C. correlations are sourced from stressed periods when they may be higher than their averages,
D. market and credit risk correlation is usually assumed to be a higher value, business risk and credit risk / market risk correlation is assumed to be a lower value, and a very low correlation between operational risk and all other risks.

LOS 1.3 Within the economic capital implementation framework describe the challenges that appear in: Validation of Models

Validation provides evidence that the model (in this case the economic capital model) works as planned. It aids in identifying model limitations, since no model is ever a perfect representation of reality. While validation can help assess many aspects of models, such as its risk sensitivity, it is less powerful about aspects such as confirming the accuracy of high quantiles in a loss distribution.

Validation of economic capital models differs from validation of an Internal Ratings Based (IRB) model as the output is a distribution rather than a single predicted forecast against which actual outcomes

may be compared. Economic capital models are conceptually similar to VaR models, though the long time horizon, high confidence levels, and scarcity of data force validation methods to be different from those of VaR.

The bank has primary responsibility for validation. Validation is an iterative process, for which there is no single method. Validations should encompass both quantitative and qualitative elements, and validation processes and outcomes should be subject to independent review.

3.1 Qualitative Processes

A. Use Test: If a bank is actually using its risk measurement systems for internal purposes, then regulators can place more reliance on the systems' outputs for regulatory capital. It requires gaining a careful understanding of which model properties are being used and which are not.

B. Qualitative Review: It involves review of documentation, review of development work, dialogue with model developers, review and derivation of any formulae.

C. Qualitative Review: It also includes comparison with what other rms are known to do, and with publicly available information. This review aims to answer questions like does the model work in theory? Does it incorporate the right risk drivers? Is any theory underpinning it conceptually well-founded? Is the mathematics of the model right?

D. Systems Implementation: Involves extensive testing prior to implementation, such as user acceptance testing (UAT), checking of model code etc. evaluating whether the model is implemented with integrity.

E. Management Oversight: Involves senior management in the validation process, in reviewing output from the model, and using the results in business decisions.

F. Data Quality Checks: Involves processes to assure completeness, accuracy and appropriateness of data used in the model. Includes data cleaning processes such as identifying errors, reviews of proxy data, review of any processes that need to be followed to convert raw data into suitable model inputs (e.g. scaling processes), and verification of transaction data such as exposure levels.

G. Examination of assumptions – sensitivity testing: Certain aspects of models are 'built-in' and cannot be altered without changing the model. Assumptions to be examined include ones about any fixed model parameters such as correlations or recovery rates or assumptions about the shape of tail distributions.

3.2 Quantitative Processes

A. Validation of inputs and parameters: Involves validation of model parameters (e.g. ones in IRB and correlations) that are estimated. A complete input parameter validation requires validation of parameters not included in IRB, such as correlations, which can be checked against historical data or market-implied parameters such as implied volatility or implied correlation. The materiality of any differences can be checked through sensitivity testing.

B. Model replication: Try to replicate the model results obtained by the bank using independently developed algorithms and an alternative source of data. The technique also may be helpful in

code checking and in determining whether the databases analyzed in the validation process are those used by the bank.

C. Benchmarking and hypothetical portfolio testing: Examination of whether the model produces results comparable to a standard reference model. For example, this step may compare risk ranking provided by internal rating systems vs agency ratings. Hypothetical portfolio testing means comparison of models against the same reference portfolio. Note that benchmarking can only compare one model against another and may provide little assurance that the model accurately reflects reality.

D. Backtesting: Back testing addresses the question of how well the model forecasts the distribution of outcomes. It is useful for models whose outputs can be characterized by a quantifiable metric with which to compare an outcome. In practice, not yet a key component of banks' validation practices for economic capital purposes.

E. Profit and loss attribution: Involves analysis of profit and loss on a regular basis (e.g. annually) and comparison between causes of actual profit and loss and the risk drivers in the model. Attribution is not widely used except for market risk pricing models.

F. Stress testing: Involves stressing of the model (inputs and assumptions) and comparison of model outputs to stress losses. Not widely used for economic capital models.

Institutions should recognize clearly that when validation is difficult and has limitations, model's users and senior management should be informed that full validation could not be conducted. They then understand that there is greater uncertainty around the output from models, which should be treated with extra conservatism.

LOS 1.4 Within the economic capital implementation framework describe the challenges that appear in: Dependency Modelling in Credit Risk

Here, we are referring to the dependency structure (linear or non-linear) between borrowers, the modelling of which can be challenging. These dependencies can be modelled by:

A. credit risk models (such as KMV, CreditMetrics, CreditRisk+). Asset correlations amongst obligors is captured in terms of common dependence on systematic risk factors (e.g. country, region or industry of borrower). Systematic risk factors fluctuate via joint normal distribution and all borrowers are linked to them to varying degrees.

B. models based on copulas

C. models that are based on the asymptotic single-risk-factor (ASRF) model, also called singlefactor Gaussian copula model.

With the ASRF approach, banks may use their own estimates of correlations or may use multiple systematic risk factors in order to address concentrations (this raises concerns about the method used to calibrate the correlations and the ways in which the bank addresses the infinite granularity and single-factor structure of the ASRF model).

The differences in economic capital estimates between the models can be explained in terms of the following factors:

A. correlation structure,

B. treatment of interest payments due between time zero (point of valuation) and the time horizon (point of default), and whether this was accounted for in definition of loss,

C. other modelling differences.

Note that in mark-to-market mode, where changes in revaluations at the horizon for non defaulted assets may also be correlated, and where the impact of differences in the modelling of correlations is larger, roughly one third of the observed difference in economic capital estimates is attributable to the correlation assumptions.

Another issue involves the sensitivity of economic capital estimates to changes in portfolio concentrations and model parameters. Differences in correlations could be structural in nature since different models may use different data to calibrate correlations (e.g. historical equity returns versus default rate data), or could be due to time-varying correlations.

Supervisors can question the accuracy and robustness of correlation estimates used by banks since these estimates depend heavily on model assumptions and can significantly influence economic capital calculations. The validity of the following assumptions has been drawn into question:

A. the asymptotic single-factor Gaussian copula approach

B. the normal distribution for the variables driving default

C. the stability of correlations through time

D. the joint assumptions of correctly specified default probabilities and doubly-stochastic processes, which imply that default correlation is adequately captured by common risk factors.

Owing to simplifying assumptions made by various portfolio credit models:

A. they cannot replicate the time-clustering of defaults that is observed in markets,

B. they inadequately integrate the correlation between PD and LGD (wrong way risk)

C. they tend to inadequately model LGD variability

The above effects can lead to an underestimation of economic capital needed.
Additionally, since rating transitions are sensitive to the business cycle, the sample period used to calibrate the dependency structure (expansionary vs recessionary period) is important in assessing whether correlation estimates are overestimated or underestimated.

Furthermore, if a structural credit risk model is used, that assumes that unobservable asset returns can be approximated by equity prices changes, such a model fails to account for the fact that the relationship between asset returns and equity prices is unobservable and could in-fact be non-linear. The use of equity prices to estimate credit default probability is problematic because equity prices also include information that is irrelevant for credit risk purposes.

Banks may use a regulatory-type approach for credit risk purpose, which highlights further issues:

A. If Basel ASRF model is used, correlations are explicit inputs that need to be estimated – there might be limited historical data to do so or assumptions used to estimate correlations may not align with those of the ASRF model.

B. If a bank uses the Basel risk weight model (with either supervisory or with its own correlations), it must account for concentration risk (both single name and industry/ regional concentrations) by other measures and/or management methods (e.g. limit setting), and supervisors will have to evaluate these approaches.

Again, remember that use of mis-specified or incorrectly calibrated correlations and use of a normal distribution (which fails to replicate the tails of the distribution of asset returns) can lead to significant inaccuracies in measures of portfolio credit risk and economic capital.

LOS 1.5 Within the economic capital implementation framework describe the challenges that appear in: Evaluating Counterparty Credit Risk

We have learned that Counterparty Credit Risk (CCR) centres on the measurement and management of financial exposure and the resulting credit risk associated with credit extension activities to a wide range of counterparty types.

Challenges involved in CCR, which arise in gathering data from multiple systems, measuring exposures from potentially millions of transactions (many of which exhibit optionality) spanning variable time horizons ranging from overnight to >30 years, tracking collateral and netting arrangements and categorizing exposures across thousands of counterparties.

Note that counterparty credit risk measurement combines the tools from standard market risk measurement with the tools from standard credit risk determination.

5.1 Market Risk Related Challenges

Market risk measurement practices are used, for example, in mapping derivatives exposures to a set of market risk factors, simulating those factors out to a forward-looking time horizon, and determining the distribution of the level of exposures over various risk factor realizations. Differences in using market risk models for VaR vs for credit exposure are:

A. Full portfolio vs Netting Set: VaR computations can be run by combining all portfolio positions in a single simulation, but for exposure computations, only positions in the same netting set can be combined together.

B. Choice of Horizon: Market risk VaR calculations are performed for a single day or a 10-day holding period. Credit exposure calculation must be performed for multiple time horizons, which unlike VaR are long dated.

5.2 Credit Risk Related Challenges

These are:

A. While PD and LGD may be available for counterparties that have a credit rating, these have to be estimated for other counterparties (say, for hedge funds). For hedge funds, there may be little transparency in terms of underlying fund volatility, leverage, or types of investment strategies employed, thereby making the estimation task difficult.

B. In the cases of counterparties to which the institution has other credit exposures the institution will typically be using the same PD used for the other exposures, but will need to arrive at a facility-specific LGD.

5.3 Wrong Way Risk Challenges

Wrong Way Risk happens when there is interaction between market risk and credit risk aspects of CCR. Owing to this, PD and LGD may tend to rise at the same time as the exposure to the counterparty is rising. The challenges are:

A. Wrong-way risk is sometimes difficult to identify, as it requires understanding the market risk factors that the counterparty is exposed to, and relating those factor sensitivities to the factor sensitivities of the institution's own exposures to the counterparty.

B. Understanding the counterparties' risk factor sensitivities can be challenging, especially for counterparties that tend to be opaque.

C. Even when wrong-way risk can be identified directionally, it is often difficult to quantify its magnitude.

5.4 Operational Risk Challenges

CCR is a very resource-intensive activity, requiring specialized systems and personnel to effectively implement. Daily limit monitoring, marking-to- market, collateral management processes, and intraday liquidity and credit extensions are all complicated processes. Operational risk exposure stemming from these processes is captured within an operational risk quantification process (and not within CCR).

Additionally, risks that are not captured and are difficult to quantify are risks of new or rapidly growing businesses, risks in new products or processes, risks in intraday extensions of credit, and risks in areas where there have been few historical instances (but severe consequences if they were to happen).

5.5 Margined Vs Non-margined Counterparties

A margined counterparty (having a CSA) has agreed to post collateral (cash or securities) when their exposure to the financial rm is positive. The modelling difference between margined vs non-margined counterparties surrounds the treatment of the look-ahead forecasting period:

A. Margined: Forecasting period is short, associated with a reasonable 'cure period' between when a counterparty misses a margin call and when the underlying positions can be closed out.

B. Non-margined: Forecasting period is generally much longer, as long as the life of the contract.

Variation in modelling horizons makes the aggregation of risk across margined and non margined a challenge. Another challenge is to model gap risk (also for margined parties).

5.6 Aggregation Challenges

For economic capital purposes, risk measures must be aggregated in a sensible, rigorous, and risk-sensitive way with other exposures, which presents the following challenges:

A. For economic capital purposes, risk measures must be aggregated in a sensible, rigorous, and risk-sensitive way with other exposures, which presents the following challenges:

B. Counterparty credit risk must be aggregated with other credit risk-taking activities of the rm (loans in the banking book and credit risk in the trading book), also with overall market and operational risk.

C. It may be difficult to break down CCR exposure by product, risk factor, geography, business line or legal entity (owing to intensity of calculations involved).

LOS 1.6 Within the economic capital implementation framework describe the challenges that appear in: Assessing Interest Rate Risk in Banking Book

Interest rate risk refers to the exposure of a bank's financial condition to adverse movements in interest rates. Changes in interest rates affect an institution's earnings by altering interest sensitive income and expenses, and the underlying value of an institution's assets, liabilities, and o-balance sheet instruments because the present value of future cash flows changes when interest rates. An indirect effect can also occur, which is linked to the impact that rate changes can have on business volumes.

The main challenges in the calculation of economic capital for interest rate risk in the banking book come from:

A. the long holding period assumed for a bank's structural balance sheet.

B. the need to model indeterminate cash flows on both the asset and liability side due to the embedded optionality of many banking book items.

The main sources of interest rate risk in the banking book are:

A. repricing risk: arising from differences in the maturity and repricing terms of customer loans and liabilities.

B. yield curve risk: arising from asymmetric movements in rates along the yield curve.

C. basis risk : arising from imperfect correlation in the adjustment of the rates earned and paid on different financial instruments with otherwise similar repricing characteristics.

D. embedded options: Retail products in the banking book that have embedded options include bonds and notes with call or put provisions, loans such as mortgages which give borrowers the option to prepay balances (prepayment option).

We now look into optionality in banking book.

1. Asset Side

Prepayment risk is most important risk here – the borrowers in fixed-rate mortgages can choose to exercise the prepayment option and prepay their mortgages as interest rates fall. This makes cash flows associated with a mortgage uncertain and the expected life of a mortgage can be much shorter than its stated maturity.

The price-yield curve for mortgages exhibits negative convexity and price compression. Holders of mortgages are forced to invest the cash flows that are prepaid at a lower rate of interest. When interest rates rise, the speed of mortgage prepayments slows down, the duration of mortgages increases, thereby resulting in a steeper decline in value of these instruments compared to option-free bonds.

2. Liability Side

On the liability side, non-maturity deposits contain two embedded options:

A. The institution holds the option to determine the interest rate offered to depositors and when to change the rate. This makes the deposit behave like a floating rate bond.

B. The depositor holds the option to withdraw all or part of the balance in the deposit account at par. This option is akin to depositor being able to put the bond back to the institution.

The two embedded options induce a volume risk, which cannot be hedged directly since the volume is not traded in the market. When market interest rates change, banks respond with a lag, and change deposit rates by less than the change in market rates. Also, deposits are sticky and most stay at the institution for months or years.

3. Banks Pricing Behavior

Deciding on the responsiveness of individual bank interest rates to changes in market rates requires:

A. a model for the analysis of the persistence of the volumes of different non-maturity banking products

B. a model for the determination of bank interest rates, taking into account general market conditions, customer relationships, bank commercial power, and optimal commercial policies.

Changes in market interest rates may also result in changes in banks' interest rate policy, driven by changes in the competitive environment and the need to defend market share. The following need to be noted:

A. Banking interest rates pass-through is relatively slow and heterogeneous across both products and countries.

B. Pricing adjustments are slower for retail banking products (e.g. deposits, consumer loans, mortgages) than for corporate products.

C. short-term products are more responsive than long-term.

D. Banks adjust their loan lending rate faster during periods of monetary tightening, and their deposit rates faster during periods of monetary easing.

A relevant aspect for determining bank interest rates is the pricing for credit risk. To determine the price of credit risk applied on different banking products, we need a pricing rule that links the credit spread to changes in macroeconomic conditions and interest rate variations. Interest rate stress scenarios should incorporate the possible interaction of interest rate and credit risk factors.

4. Choice of Stress Scenarios

The current regulatory choice of a stress scenario focuses on parallel shifts in the yield curve of +/- 200 basis points (which adequately cover volatilities across G10 countries).

Pros:

These shocks are very simple and easy to communicate and that it is easier to compare the impact of these shocks on different portfolios.

Cons:

- These shocks are not probabilistic and hence very hard to integrate into economic capital models based on VaR.
- It is not necessarily sensitive to the current rate or economic environment.
- It doesn't take into account changes in the slope or curvature of the yield curve
- It doesn't allow for an integrated analysis of interest rate and credit risk on banking book items.

There are other scenario design suggestions that have been proposed in the recent years:

A. Based on Historical Distributions: Include the 1st and 99th percentile of observed interest rate changes over the last five years.

B. Based on Principal Component Decomposition of Yield Curve: PC components are used to produce realistic scenarios of interest rate changes along various points of the yield curve and reproduce correlation observed between original interest rates. PC components can be used in Monte Carlo Simulations and hence help in arriving at a level of confidence for all possible scenarios.

C. Based on GARCH models: Use simple autoregressive (AR) models (with GARCH effects) to simulate the evolution of individual interest rates over a specific horizon. A forward looking approach, which incorporates information about current rates and volatility.

D. Based on Options: Extracting future distribution of interest rates from prices of options (connect with chapter on Volatility Smiles).

E. Based on Macroeconomic Factors: Simulate a distribution of future yield curve changes based on macroeconomic fundamental (but their explanatory power may be weak).

F. Linking Credit and Interest Rate Risk: Credit risk and interest rate risk in banking book are interdependent. Any loss distribution for credit risk but condition on macro and interest rate environment and any decreases in net interest income due to default must be accounted for. All future cash flows must be simulated, which requires models that can price assets in future (conditional on the then simulated macro and interest rate environment).

LOS 2. Describe the BIS recommendations that supervisors should consider to make effective use of risk measures not designed for regulatory purposes.

1. Use of economic capital models In assessing capital adequacy.

A bank using an economic capital model in its dialogue with supervisors, should be able to demonstrate how the economic capital model has been integrated into the business decision-making process in order to assess its potential impact on the incentives affecting the bank's strategic decisions about the mix and direction of inherent risks. The bank's board of directors should also be able to demonstrate conceptual awareness and understanding of the gap between gross (stand alone) and net enterprise wide (diversified) risk when they define and communicate measures of the bank's risk appetite on a net basis.

2. Senior Management

The viability, usefulness, and ongoing refinement of a bank's economic capital processes depend critically on the existence of credible commitment or "buy-in" on the part of senior management to the process. It should recognise the importance of using economic capital measures in conducting the bank's business and capital planning, and should take measures to ensure the meaningfulness and integrity of economic capital measures. In addition, adequate resources should be committed to ensure the existence of a strong, credible infrastructure to support the economic capital process.

3. Transparency and Integration Into decision making.

A bank should effectively document and integrate economic capital models in a transparent way into decision-making. Economic capital model results should be transparent and taken seriously in order to be useful to senior management for making business decisions and for risk management. A bank should take a careful approach to its use of economic capital in internal assessments of capital adequacy. For this purpose, greater emphasis should be placed on achieving robust estimates of stand-alone risks on an absolute basis, as well as developing the flexible capacity for enterprise-wide stress testing.

4. Risk Identification.

Risk measurement begins with a robust, comprehensive and rigorous risk identification process. If relevant risk drivers, positions or exposures are not captured by the quantification engine for economic capital, there is great room for slippage between inherent risk and measured risk. Not all risks can be directly quantified. Material risks that are difficult to quantify in an economic capital framework (e.g., funding liquidity risk or reputational risk) should be captured in some form of compensating controls (sensitivity analysis, stress testing, scenario analysis or similar risk control processes).

5. Risk Measures

All risk measures observed in use have advantages and disadvantages which need to be understood within the context of their intended use. There is no singularly preferred risk measure for economic

capital purposes. A bank should understand the limitations of the risk measures it uses, and the implications associated with its choice of risk measures.

6. Risk Aggregation

A bank's aggregation methods should address the implications stemming from the definition and measurement of individual risk components – accuracy of aggregation process depends on the quality of the measurement of individual risk components, as well as on the interactions between risks embedded in the measurement process. Risk measurement parameters such as the confidence level or measurement horizon should be harmonized. Care must be taken to ensure that the aggregation methodologies used (eg. variance covariance matrices, use of broad market proxies, and simple industry averages of correlations) are representative of the bank's business composition and risk prole.

7. Validation

Validation of economic capital models should be consistent and rigorous, aimed at demonstrating that the model is fit for purpose and should use multiple techniques and tests. If a model is used for capital determination, validation tools should demonstrate to a reasonable degree that the capital level generated by the model is sufficient to absorb losses over the chosen horizon up to the desired confidence level. The results of such validation work should be communicated to senior management to enhance economic capital model usage.

8. Dependency modelling in credit risk

Banks should carefully assess the extent to which the dependency structures they use are appropriate for their credit portfolio. Banks should identify and understand the main limitations of their credit portfolio models and their implementation. They should address those limitations by using adequate supplementary risk management approaches (eg. sensitivity analysis, scenario analysis, timely review of parameters).

9. Counterparty credit risk

A bank should understand the trade-offs involved in choosing between the currently used methodologies for measuring counterparty credit risk. Complementary measurement processes such as stress testing should also be used, though it should be recognized that such approaches may still not fully cover all counterparty credit risk exposures. A range of aggregation challenges need to be overcome before a rm can have a bank-wide view of counterparty credit risk for economic capital purposes.

10. Interest rate risk in the banking book

Close attention should be paid to measuring and managing instruments with embedded option features, which if not adequately performed can present risks that are significantly greater than suggested by the risk measure. Trade offs between using an earnings-based or economic value based approach to measuring interest rate risk in the banking book need to be recognized. The use of an

earnings based measure creates aggregation challenges when other risks are measured on the basis of economic value. Conversely, the use of an economic value based approach may create inconsistencies with business practices.

LOS 3a. Describe the constraints imposed and the opportunities offered by economic capital within the following areas: Credit portfolio management

Credit portfolio management refers to activities in which banks assess the risk/return proles of credit portfolios and enhance their profitability through credit risk transfer transactions and/or control of the loan approval process. The creditworthiness of each borrower is assessed in a portfolio setting. A loan with a higher stand-alone risk does not necessarily contribute more risk to the portfolio, it is it's marginal contribution to portfolio that is critical.

Economic capital can help measure the level of concentration, and determine choice of hedging facilities to reduce it. The use of credit portfolio management for reducing economic capital seems to be less dominant than for "management of concentrations" and for "protection against risk deterioration".

LOS 3b. Describe the constraints imposed and the opportunities offered by economic capital within the following areas: Risk Based Pricing

One may assume banks to be price takers in terms of pricing behavior, but loans markets are segmented. In wholesale segment, banks tend to behave more as price-takers, and in commercial banking segment, where, due to well-known market imperfections (eg. information asymmetries, monitoring costs, etc.), banks have a greater ability to set prices for their customers.

From an operational point of view, decisions on deals will be based on ex ante considerations with regard to expected RAROC in a price-taking environment (leading to rejection of deals whose RAROC is below a given threshold) and on the proposal of a interest rate to the customer in a price-setting environment. In both cases, decisions are driven by a floor (the minimum RAROC or minimum interest rate) computed according to the amount of economic capital allocated to the deal.

The pricing of credit risk products will include the cost of funding (such as an internal transfer rate on funds), the expected loss (in order to cover loan loss allowances), the allocated economic capital, and extra-return (with respect to the cost of funding) as required by shareholders. Economic capital influences the credit process through the computation of a (minimum) interest rate considered to be adequate for increasing shareholders' value. Depending on the product and the internal rules governing the credit process, decisions regarding prices can sometimes be overridden (but such overrides may require the decision be elevated to a higher level of management).

LOS 3c. Describe the constraints imposed and the opportunities offered by economic capital within the following areas: Customer and product profitability analysis, customer segmentation and portfolio optimisation.

The measurement of performance can be extended down to the customer level, through the analysis of customer profitability. Such an analysis aims at providing a broad and comprehensive view of all the costs, revenues and risks (and, consequently, economic capital absorption) generated by each single customer relationship.

While implementation of this kind of analysis involves complex issues related to the aggregation of risks at the customer level, its use is evident in identifying unprofitable or marginally profitable customers who attract resources that could be allocated more efficiently to more profitable relationships. This task is generally accomplished by segmenting customers in terms of ranges of (net) return per unit of risk. By providing evidence on the relative risk-adjusted profitability of customer relationships (as well as products), economic capital can be used in optimizing the risk-return trade-o in bank portfolios.

LOS 3d. Describe the constraints imposed and the opportunities offered by economic capital within the following areas: Management incentives.

To ensure that economic capital directly affects the objective functions of business decision makers, it should influence their incentive structure. Incentives motivates majority of bank managers, and makes them involved in the technical aspects of economic capital allocation process. However, evidence suggests that compensation schemes rank quite low among the actual uses of economic capital measures at the business unit level.

NOTES

FRM PART – II – LIQUIDITY RISK NOTES

CONTENT

LIQUIDITY RISK

What is Liquidity? **ASSET:** Convertibility to cash

INDIVIDUAL/FIRM: credit worthiness

1. TRANSACTIONS LIQUIDITY RISK

"Risk that buying/selling asset will result in an adverse price move".

2. FUNDING LIQUIDITY RISK

(BALANCE SHEET RISK)

"Risk that creditors either withdraw credit or change terms at which it is given (tenor, collateral, rate) in response to deteriorating borrower's credit quality or financial conditions as a whole".

Maturity mismatch (high yielding long term assets + low cost short term borrowing) (upward sloping t/s) → Higher risk (roller risk: debt cannot be refinanced / refinanced at ↑ rates).

FUNDING LIQUIDITY → TRANSACTION LIQUIDITY

Quoted interest ↑ / collateral ↑ → Early unwind → Unexpected sell orders

TRANSACTION LIQUIDITY FUNDING LIQUIDITY

Leveraged market Participant + Perception of illiquid assets → Lack of funding sources / Higher haircuts.

Sell liquid assets

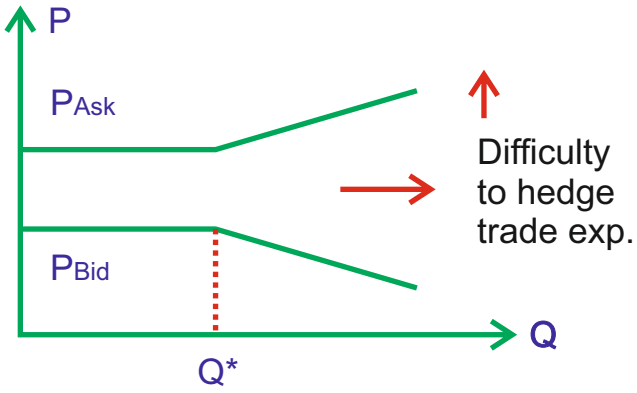
Liquidity Risk ↔ systemic Risk

E.g. disruptions in payment, clearing, settlement systems.

LIQUIDITY TRADING RISK

"Ability to liquidate/execute a trade at little/no cost, risk of inconvenience".

$P_{transaction} = f(P_{mid}, Q$
 # batches, Eco Environment)
(Overall mkt. liquidity)
(* opp. In retail mkt)



- Trade Processing Costs
- Inventory Management
- Adverse selection (information vs noise) (lemons risk)
- Differences of opinion

DIMENSIONS OF TRANSACTION LIQUIDITY

- Tightness (Bid Ask)
- Depth (Adverse price impact)
- Resiliency (Slippage)
- Immediacy
- Breadth

MODELING ASPECTS

$p = P_{Ask} - P_{bid}$ $s = \frac{P_{ask} - P_{bid}}{P_{mid}}$ Buy: P Sell : (Spread risk factor)

COST OF PORTFOLIO LIQUIDATION

NORMAL	STRESSED
Liquidity costs add up! Small(er) positions better (consider position limits)	= f (c). Empirical distribution. Perfectly correlated.

LIQUIDITY ADJUSTED VaR:

LIQUIDITY STRATEGIES

AN OPTIMAL LIQUIDATION :- n days. q_i each day

LIQUIDITY RISK

REALIZED PRICE: $P_{mid}(1-s/2)\min\left(\lambda\sqrt{\sum_{i=1}^{n}\sigma^2 x_i^2}+\sum_{i=1}^{n}q_i\times\frac{p(q_i)}{2}\right)\ s.t\ \sum_{i=1}^{n}q_i=Q$

(Trade off !)

AN ORDERLY LIQUIDATION: $\lambda.\sigma\%(Q.P_{mid})\sqrt{\frac{(n+1)(2n+1)}{\sigma n}}$ Q/n each day

AN ALTERNATE MEASURE (Price Impact) : $|R_{daily}|/\$\ daily\ volume$

FUNDING LIQUIDITY RISK

"Inability to meet cash needs as they arise".

- LIQUIDITY STRESSES (no appetite for credit risk, flight to quality)
- LIQUIDITY MISMATCH (overly aggressive funding decisions)
- LOSS OF CONFIDENCE (bank runs, roll - over difficult)

All three happen together ! Predict & ensure cash needs are met !

SOURCES OF LIQUIDITY

1. Cash & Treasury Securities (low return).
2. Liquidating Trading Book (liquidity in stressed?)
3. Ability to Borrow (high rates, shorter maturity, stricter collateral)
4. Wholesale & retail deposits (wholesale more volatile all FIS offer attractive rates at same time)
5. Securitisation (liquidity backstop to SIVS & failure of ABCP)
6. Central Bank Borrowing (Collateral, high interest, reputation)

RESERVE REQUIREMENTS

- % of deposits.
- Placed with central bank
- Affects ($ controls) money supply

CASE STUDIES

1. NORTHERN ROCK
   So went but loss of confidence (Mortgage business)
   ↓
   Institutional & Retail
2. ASHANTI GOLDFIELDS
   Short gold contracts (fwds)
   ECB limits → Price ↑ gold sales
   ↓
   Margin Calls
3. METALLGESELL-SCHAFT
   Fixed price contracts + long position in short dated futures.
   Price Fell → Margin Calls.

MANAGING FUNDING LIQUIDITY RISK

- Cash Buffers
- Unpledged Assets
- Credit Lines

REGULATION

New Ratios In Basel III : LCR & NSFR

PRINCIPLES FOR MANAGING LIQUIDITY

1. LR Framework to maintain sufficient liquidity
2. LR Tolerance (as per business strategy)
3. Governance senior management (execution) & Board (annual review & approve)
4. Pricing, Risk (VaR), new product approvals, risk taking incentives
5. LR monitoring (project CF needs over various horizons & control)
6. Funding needs across legal entities, business lines.
7. Funding strategy & diversification in source & tenor. What factors can limit quickly raising funding?
8. Intra day liquidity Payment & settlement in normal & stressed.
9. Collateral Management- Encumbered ? legal entity? Physical loc?
10. Stress Testing Short & Long term. Specific & General. Use to adjust strategy & contingency.
11. Formal contingency funding plan. Range of scenarios, responsibility, triggers. Tested & updated.
12. Assets as cushion. Unencumbered high quality, no legal, reg, operational impediments.
13. Disclosures for mkt participants LR framework, position.
14. Supervisors to assess.
15. Supplement by internal reports, mkt info
16. Intervention & timely remediation
17. Interaction & communication (more freq in stressed times)

LIQUIDITY BLACK HOLES

"A Crowded Exit" : Everyday wants to sell

1 POSITIVE (Destabilize) & NEGATIVE FEEDBACK TRADERS (Restore Equilibrium)

- Trend / Break out Investing
- Stop-less Rules
- Dynamic Hedges
- Synthetic Options (long put)
- Margins (highly leveraged traders, impact of volatility on margin calcs)
- Predatory Trading
- Relative Value Traders: Illiquid Bond Liquid Bond. (LTCM) LTCM reinforced flight to quality.

2 LEVERAGING & DELEVERAGING CYCLES

Excess liquidity → Easy credit (low spreads) → Incentive to ↑ leverage → Demand for assets ↑ → Asset ↑ → Lev ↓

Liquidity Shortfall → Low Credit supply → Reduce Leverage → Selling → Asset ↓ → Lev ↑

Hedge Funds Most affected.

3 IRRATIONAL EXUBERANCE

Exuberance about trade/asset class → Exposure ↑ & profits ↑ → Bubble Burst → Simultaneous unmind. (Banks: Losses, curtailed lending)

NB: Role of Compensation/Incentives)

4 REGULATION

Mkt Risk: σ , P ↑ → VaR ↑ → Capital ↑ → Exposure ↓(Similar Posn)

Credit Risk: Point - in - time PD input for credit risk.

5 LACK OF DIVERSITY

Banks & FIS regulated same way. Hedge funds add diversity. Follow contrarian strategy (that VaR based FIs cannot).

Transaction liquidity risk and funding liquidity risk are interrelated and one can lead to the other

Date
Page

Liquidity and Leverage

This chapter is divided into mainly 5 parts

1. Sources of liquidity risk
   - Transaction Liquidity Risk and its sources
   - Funding Liquidity Risk and its sources.

   The funding liquidity risk may be caused by many reason like asset liability mismanagement or other hedge fund strategies which also leads to systematic funding liquidity risk

2. Collaterals
   - Economics of collateral market
   - Types of collateral market.

3. Usage of leverage ratio and leverage effect to decide the level of financial leverage in organisation.

4. Measuring financial leverage of various exposures using economic balance sheets

5. Measure liquidity risk
   - Confidence interval of Transaction Cost
   - Liquidity adjusted VaR.

This chapter basically focuses on the proper management of liquidity risk and leverage as these were the 2 important causes of LTCM failure. Also Basel 3 has tried to cater to liquidity risk and leverage by asking banks to maintain high quality liquid assets and a controlled leverage within the bank.

classmate
Date
Page

Summary

- Liquidity Risk. (LR)
  - Types of LR.
    - → Funding LR
    - → Transaction LR
    - → Systemic risk
  - Measures of LR.
    - CI of Transaction Cost
      - CI of bid ask spread
      - if CI ↑ ⇒ risk ↑
    - Liquidity Adjusted VaR.
- Leverage.
  - Decide upon the leverage level using
    - Leverage ratios
    - Economic B/S.

Liquidity Risk.

- Transaction Liquidity Risk (not able to buy or sell financial assets without compromising the prices)
- Funding Liquidity Risk (B/S risk). (not able to raise capital without compromising on the terms)
  - Sources:
    - Borrower's credit position is deteriorating
    - Asset Liability maturity mismatch.- Funding LT asset with ST liabilitie

*

* The liquidity risk can also cause systemic risk in the organisatio

Sources of Transaction Liquidity Risk

1. Large transactions (huge trade (scarcity ↑ supply).
short term imbalance b/w demand and supply. causing the price to change.
2. Trade processing cost
i.e., the costs to find the counterparty, this does not increase the liquidity risk until the trading system gets affected. (market mein news chala gayi that cp mil nahi rahe)

ABCP & SIV had offered maturity transformation & liquidity transformation i.e ABCP was shorter term & more liquid compared to long term assets in SIV. However, they did not fully transfer risk & lead to leverage & fragility in the system.

3. Inventory Management of Dealers.
Dealers provide trade to clients immediately, so they maintain inventory by holding long or short positions, causing volatility exposure for the dealer. This volatility exposure needs to be compensated by a bid ask spread.

4. Adverse Selection
Dealers need to be compensated by bid ask spread for the risk in dealing with well informed traders.
toh buying selling mein nahi karna payenge

Asset Liability Management
- Banks are using short term sticky deposits for funding the less liquid long term assets

Fractional Reserve Banking System.

suppose $100 received as deposits, so $10 kept in treasury and $90 lent out for 1%

- If withdrawls increases higher than reserves → suspension of convertibility of assets into cash → run on the bank → liquidity risks increases further → fragility increased as new capital cannot be raised.
- Also due to asset liability maturity mismatch there is roll over risk in case of upward sloping yield curve but this is less extreme compared to run on banks.

Systemic Risk.
Funding liquidity risk can become a systemic risk
a) In systemic funding risk both lender and borrower are impacted.
lender → risk of not getting the money back.
borrower → not able to roll over

b) There were various hedge fund strategies that led to systemic funding liquidity risk.
(i) Leveraged buyouts i.e, use of debt to buyout equity of a fi

Debt ——— Bank ⟶ CDO, CLO.

⇓

To buyout equity of firm.

CLO ⟶ Investors.

In 2008 demand of CDO, CLO fell, their prices got low so crisis occurred. → entire funding in the economy gets dried up → so LBO aggregated the crisis even more. Some loans were called 'hung loans' as they had not been distributed to investors.

(ii) Merger Arbitrage Hedge Funds. - In merger arbitrage strategy the arbitrager goes long on the target and short on the acquirerer. Because of financial crisis a lot of merger deals were called off, causing a huge loss in all these positions →, systemic risk in the entire economy.

(iii) Convertible arbitrage hedge funds :- Buy convertible bonds and short a replicating portfolio (C^+, NCB^+ (at rf)) This strategy was aimed to earn arbitrage profit from the fact that the prices b/w the convertible bond and the replicating portfolio will converge. However in 2008 the gap widened instead of converging causing huge losses for the hedge fund.

Liquidity Issues faced by Money Market Mutual Funds.

- Money market mutual funds invest in money market securities of high credit quality of short maturities.
- The market risk and credit risk of assets is low but still material.
- Although the mutual funds do not mark to market their assets daily however if the assets fluctuate in value daily, the investors get a negative signal somehow causing unlimited instantaneous redemptions (breaking the buck) which can even aggrevate the issue and cause the NAV of money market mutual funds < 1.

Collateral markets

Economics of Collateral markets

Advantages and Features. ①

Types.

② Margin Loans ③ Repo Agreements ④ Securities Lending ⑤ To Re Su

① The advantage of having a collateral is enhancement of borrowing ability at less cost. and short position in securities can be established.
eg.- short sell the stock and whatever money you get put i as collateral.

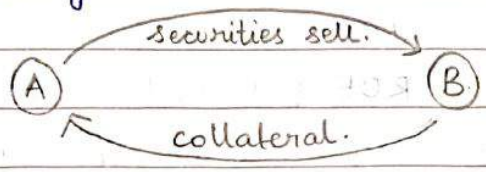
Features of collateral market - haircut
eg.- collateral = $110m, loan gin = $100m
So $10 is haircut.
Variation margin
eg.- difference to be mainted is $10. Later on suppose collateral value is $107 and loan was $100.
So additional funds to be deposited is $3 to maintain the difference of $10. Variation margin = $3 i.e., the addition fund deposit to maintain the difference.

Rehypothecation i.e., circulating of collateral got, by pledging process. Securitisation creates securities which can be pledged as collateral for credit

② Margin Loans - borrowing money from brokers to purchase the share. The shares are not maintained in buyer's name but in the street name a/c of broker.
legal rights with broker
Say margin = 30%. so 30% of the trade will be funded by equity investor and 70% can be taken on margin loan

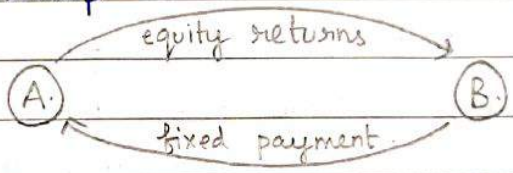
(3) Repurchase Agreements – Securities sold with an intention to buy-back at a later date at a higher price. Earlier treasury securities were used as collateral. but now-a-days even high yield bonds and structured credit products are also used as collaterals.

(4) Securities Lending –



This transaction is structured as a sale and the lender retains the collateral. The lender can invest the collateral anywhere he wants. The borrower will only pay a rebate fees to the lender.

(5) Total Return Swap



NOTE All these types of collateral markets have one common theme i.e, enjoying the right on securities without actually investing and buying it.

Leverage Ratios

$$\text{Leverage Ratio} = \frac{\text{Total assets}}{\text{Total equity}}$$

Leverage effect i.e., the effect on ROE because of usage of debt i.e., trading on equity.

$$ROE = (ROA \times \text{Leverage Ratio}) - (\text{Leverage Ratio} - 1)\, kd.$$

eg.- suppose return on assets when both debt and equity are used is 8%. Debt = 50%, equity = 50%.

$\therefore LR = \frac{0.5 + 0.5}{0.5} = 2.$

Case 1 - kd = 9%.

$\therefore ROE = 8\% \times 2 - (2-1)9\%$

$= 7\% \quad < ROA$ (as debt is expensive)

Case 2 - kd = 7%.

$\therefore ROE = 8\% \times 2 - (2-1)7\%$

$= 9\% \quad > ROA$

As long as ROA > kd, ROE keeps increasing. but this does not mean leverage can be increased infinitely, we decide the leverage ratio based on target hurdle rat

eg.- required ROE = 10%. and suppose kd = 6%.

$\therefore 10\% = 8\% \times 2 - (LR-1)6\%$.

$\therefore LR = 2$

Sometimes we want to see the effect of increasing levera

Effect of increasing leverage = $\frac{\text{Change in retained earnings}}{\text{Change in leverage ratio}}$

NOTE: We can use either book value or market value or NAV for computing LR.

Impact on Financial Leverage of explicit trades (eg.- margin purchases or bond issues) is quite clear. However the impact of implicit trades (eg.- derivatives) is not much clear, it can be measured through economic b/s.

eg.- Initial B/S.

Assets.		Liabilities	
Cash	100	Debt	0
		Equity	100

$\therefore LR = 1.$

Case 1 - Suppose you buy stock worth 100 on margin basis wherein 50% is own funds and 50% is borrowed.

Economic B/S

Assets		Liabilities.	
Cash	100	Equity	100.
	-50		
	50	Debt	50.
Stock	100.		

∴ LR = 1.5

Case 2 - Borrow $100 worth of stock and short sell it.
Cash is to be kept as collateral.
Firm is required to deposit money in margin a/c suppose $

Economic B/S.

Stock	100	
To Stock Payable		100. → cannot be netted off.
Cash	100	
To Stock		100.
Broker	150	
To Cash		150. →

Economic B/S.

Assets		Liabilities	
Broker	150	Stock Payable	100
Cash	100	Equity	100
	100		
	-150 50		

LR = 2.

So in case of short transactions (implicit transactions) LR is much more than margin transactions.

Case 3 - Suppose you are long GBP forward @ 0.70/£ and notional value of transaction is $100
For economic B/S we can assume short $100 and long GBP 70.

Economic B/S

A		L		
GBP	70	$	100.	(implied leverage)

Case 4 - Call options. Suppose index value = $100 and call delta = 0.5, Position can be thought of as $50 position in index and $50 loan can be considered in the liability side as the premium to be paid.

Confidence Interval on Transaction Cost
Assuming the bid ask spread follows a ND, the 99% CI on transaction cost = estimate of the asset's next day mid price $\left(\frac{\text{ask} + \text{bid}}{2}\right)$ × 99% (spread risk factor)

spread risk factor → Half of $\mu + z \times SD$.
z = 2.33
μ → Expected bid ask spread.
SD → SD of spread

Liquidity Adjusted VaR
Suppose your position is $100 and each day trading occurs for $1. So it will take 100 days to liquidate the position. We need to find out the liquidity VaR over this 100 day period. One method is VaR × $\sqrt{t}$ → this will overestimate the VaR. The correct method is VaR of 1 day × $\sqrt{\frac{(1+t)(1+2t)}{6t}}$

Characteristics used to measure market liquidity.

Width	Depth	Resiliency
⇓	⇓	⇓
the round trip cost. Narrow bid ask spread. = tight width = high liquidity.	the order size required to move the price adversely. higher depth = higher volume = higher liquidity	time taken by heavy order to move the market price away from equilibrium price. higher the time, higher the liquidity

$$\left[\frac{LVaR}{VaR}\right]_{combined} = \left[\frac{LVaR}{VaR}\right]_{exogenous} \times \text{Endogeneous factor}$$

$$\downarrow$$

$$\left[1 + (\text{Percent of market size} \times \text{elasticity})\right]$$

Estimating Liquidity Risk.

1. Liquidity risk is the degree to which a trader does not trade a position without excess cost, risk or inconvenience

2. We can measure liquidity risk using bid ask spread i.e., $\frac{\text{ask rate} - \text{bid rate}}{\text{mid rate}}$ where mid rate $= \frac{\text{ask} + \text{bid}}{2}$.
When bid ask spread widens, the mid prices are frictional as no trade can take place at that price

3. Endogeneous vs Exogeneous liquidity.
If the size of our trade is negligible in relation to the market, our trade will have no effect on liquidity. Of course the liquidity risk represented by bid ask spread can change but such a change would be exogeneous. On the other hand LTCM liquidity risk was endogeneous as its own trade had a huge impact on market liquidity.

4. Calculation of liquidity Risk.

- Liquidity risk in normal scenario
  - ⇓ Exogeneous liquidity adjusted VaR and endogeneous liquidity adjusted VaR.
    - 1, 2 assuming constant spread.
    - 3, 4 assuming stochastic spread.
    - using ND or lognormal Dist
- Liquidity risk in stressed scenario.
  - Crash Matrix Approach
  - Extreme Value Theory Approach
  - Crisis Scenario Approach

~~Case 1 – Static spread and assuming ND~~

Before quantifying the liquidity risk in diff cases, we need to understand 2 things –

(i) We prefer parsimonious models over sophisticated models. So its best practice is that calculate the VaR normally and account for liquidity risk using an add on to the normal VaR, the add on being liquidity ~~adjusted VaR~~ cost.

(ii) Suppose bid = 700, ask = 780. it is illogical for any trader or investor to indulge in round trip i.e., buying at ask rate of 780 and selling at bid rate of 700, therefore incurring a cost of 80, thus your transaction cost is never equal to ask - bid. Since an investor is either buying or either selling, the transaction cost needs to be calculated with respect to a representative price on the screen i.e., mid price of 740.

∴ Transaction cost = ½ spread. → Ask - Mid / B Mid - Bid

Spread in % terms = $\frac{\text{ask} - \text{bid}}{\text{mid}}$

Case 1 eg.- SD = 4% and we are calculating the VaR at 95% confidence level. Constant spread = 3%.

Sol.

Assuming expected return on asset = 0.	Assuming expected return on asset = 1.6%
95% VaR = $\mu - z\sigma$	95% VaR = $\mu - z\sigma$
$= z\sigma$	$= 1.6 - 1.64 \times 4$
$= 1.64 \times 4$	$= 4.96\%$
$= 6.56\%$	
Liquidity cost = ½ × 3%	Liquidity Cost = ½ × 3%
$= 1.5\%$	$= 1.5\%$
∴ L VaR = 6.56 + 1.5	∴ L VaR = 4.96 + 1.5
$= 8.06\%$	$= 6.46\%$
$\frac{\text{LVaR}}{\text{VaR}} = \frac{8.06}{6.56} = 1.23$ times.	$\frac{\text{LVaR}}{\text{VaR}} = \frac{6.46}{4.96} = 1.30$ times.

Case 2 - Constant spread and assuming asset follows a lognormal dist.

Same data as case 1.

$\mu = 0$

$VaR = 1 - e^{\mu - z \times SD}$ (asset will fall $-z \times SD$ of its current value)

$= 6.35\%$

Liquidity cost $= 1.5\%$

$\therefore LVaR = 6.35 + 1.5$

$= 7.85\%$

$\therefore \frac{LVaR}{VaR} = 1.23$ times.

$\mu = 1.6\%$

$VaR = 1 - e^{\mu - z \times SD}$

$= 4.84\%$

Liquidity Cost $= 1.5\%$

$\therefore LVaR = 4.84 + 1.5$

$= 6.34\%$

$\therefore \frac{LVaR}{VaR} = \frac{6.34}{4.84} = 1.30$ times

Case 3 - Normal VaR but exogeneous stochastic process.

Suppose mean spread $= 3\%$ and SD of spread $= 5\%$.

Spread $= \mu \pm 2 \times SD$ → as TC add ⇒ double tail.

$\mu = 0$

$VaR = 6.56\%$

Liquidity Cost $= \frac{1}{2}$ Spread

$= \frac{1}{2}(\mu + 2 \cdot SD)$

$= 6.4\%$

Worst case when spread is higher, ∴ feeling of +, 2.5% in each tail

$\therefore LVaR = 6.56 + 6.4$

$= 12.96\%$

$\therefore \frac{LVaR}{VaR} = 1.98$ times

$\mu = 1.6\%$

$VaR = 4.96\%$

Liquidity Cost $= \frac{1}{2}$ Spread

$= \frac{1}{2}(\mu + 2 \times SD)$

$= 6.4\%$

$\therefore LVaR = 4.96 + 6.4$

$= 11.36\%$

$\therefore \frac{LVaR}{VaR} = 2.29$ times

Case 4 - Lognormal VaR and exogeneous stochastic spread.

$\mu = 0$

$VaR = 6.35\%$

Liquidity Cost $= 6.4\%$

$\therefore LVaR = 12.75\%$

$\mu = 1.6\%$

$VaR = 4.84$

Liquidity Cost $= 6.4\%$

$\therefore LVaR = 11.24$

$\therefore \frac{LVaR}{VaR} = 2$ times.

$\therefore \frac{LVaR}{VaR} = 2.32$ times

NOTE In all the above cases we need to upscale the liquidity adjusted VaR to encorporate endogeneous liquidity.

Endogeneous liquidity factor = 1 + elasticity

$$\text{elasticity} = \frac{\%\text{ change in price of asset}}{\text{proportion of market traded}}$$

Elasticity is the change in price of asset due to a 1 %. position that trade has in the market

eg.- elasticity = 0.4 and the trader is trading 6% of the total asset. $\therefore$ loss = $6 \times 0.4 = 2.4\%$.

Endogeneous liquidity factor = 1.024.

Taking eg of case 4 (subcase 2), combined $\frac{LVaR}{VaR}$

$= 2.32 \times 1.024 = 2.375\%$.

Stressed VaR.

We would like to quantify the liquidity risk also called cash flow at risk in 2 stages

Stage 1 - Under normal market circumstances

Captured by LVaR.

Stage 2 - Under crisis situation.

Everybody is wanting to sell the asset and therefore one has to suffer massive losses to liquidate a position. Bid ask spread widens significantly such that the ruling mid price has no significance. Margin calls are triggered, there is extra collateral requirement and the LVaR computed under normal circumstances is a gross understatement of the true liquidity risk.

MARKET IMPERFECTIONS → ILLIQUIDITY

CLIENTELE EFFECTS & PARTICIPATION COSTS

- Entry Costs (time, money, skills)
- Barriers (capital, expertise, experience)

TRANSACTION COSTS

- Commissions, taxes, due diligence, title transfers, professional fees.
- A trade always possible?

SEARCH FRICTIONS

- Costs to search an opposite party.
- Valuation capital? expertise?

ASYMMETRIC INFO^{n}

- does it know something I don't?
- let's look for a non - predatory counterparty

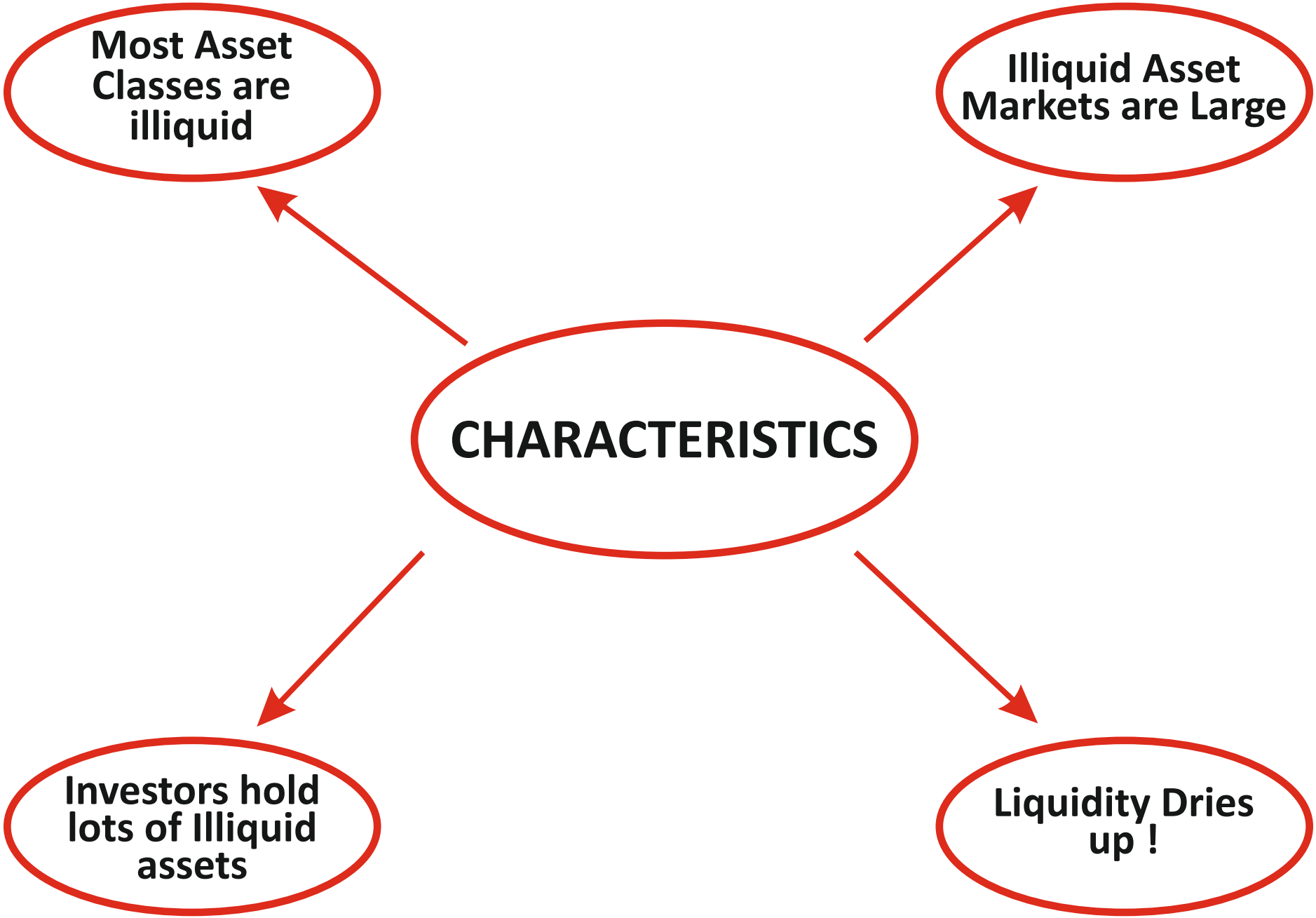
PRICE IMPACT

Large Trade → Adverse Impact

FUNDING CONSTRAINTS

Illiquid Assets ⊕ Leverage

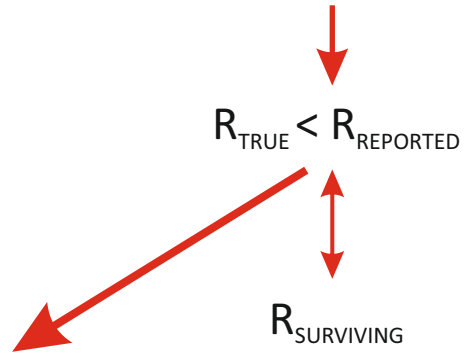
Funding


Most Asset Classes are illiquid
Illiquid Asset Markets are Large
CHARACTERISTICS
Investors hold lots of Illiquid assets
Liquidity Dries up !

Illiquid Assets: Biases

1. SURVIVORSHIP BIAS

Poor performing funds → Stop reporting € fail



"Reporting Bias"

Impact of bias:- via mutual funds

1 % - 2%

Hedge funds: even larger

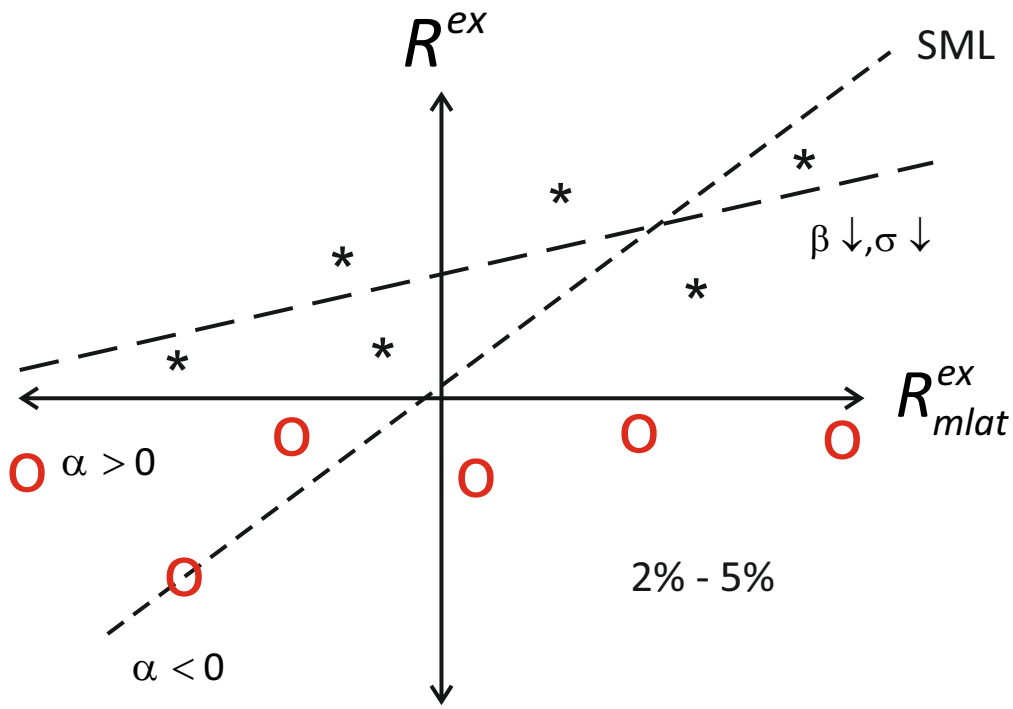
2. INFREQUENT TRADING

Impact: Estimates of σ, ρ, β

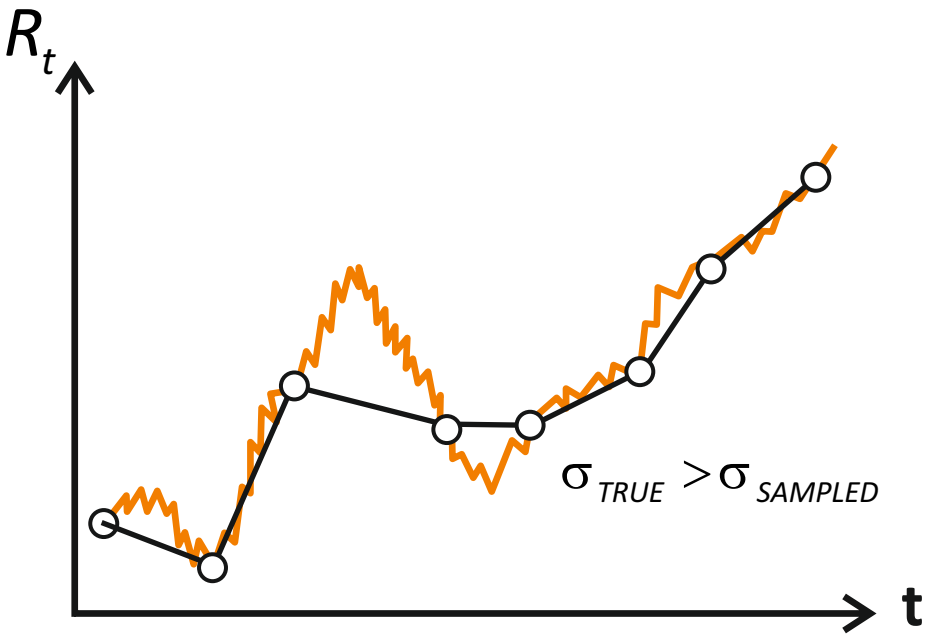
biased downwards

Infrequent sampling → smoothing

3. SELECTION BIAS



UNSMOOTHING



Filtering Algorithms: Separate signal from noise

Unsmoothing: noiser returns from smooth

r^*_t (SMOOTH) $\longrightarrow$ r_t (NOISY)

$$r^*_t = c + \varnothing r^*_{t-1} + \varepsilon_t \Rightarrow AR(1)$$

Drift; auto correlation (p(1))

$$E(r^*_t) = \frac{c}{1-\varnothing} \quad \text{var}(r^*_t) = \frac{\sigma^2_\varepsilon}{1-\varnothing^2}$$

$$\varepsilon_t \sim (0, \sigma^2_\varepsilon)$$

$$r_t = \left(\frac{1}{1-\varnothing}\right) r^*_t - \left(\frac{\varnothing}{1-\varnothing}\right) r^*_{t-1}$$

$$= \left(\frac{1}{1-\varnothing}\right)\left(c + \varnothing r^*_{t-1} + \varepsilon_t\right) - \left(\frac{\varnothing}{1-\varnothing}\right) r^*_{t-1}$$

$$= \frac{c + \varepsilon_t}{1-\varnothing} \Rightarrow \rho(1) = 0$$

$$\text{var}(r_t) = \frac{1+\varnothing}{1-\varnothing}\text{var}(r^*_t); \; 1\varnothing1 < 1$$

$$r^*_t = (1-\varnothing) r_t + \varnothing\, r^*_{t-1}$$

ABOUT UNSMOOTHING

1. Affects risk, not expected returns

$$\bar{R} \approx \frac{R_{first} + R_{last}}{2}$$

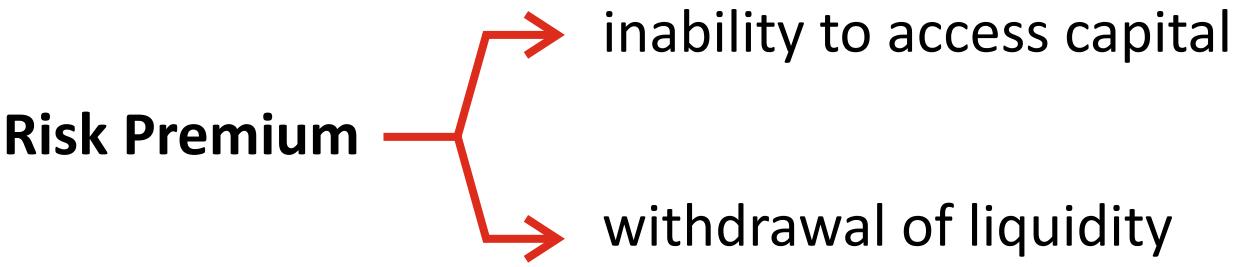
2. Are observed returns uncorrelated?

Appraisal Process $\Rightarrow$ Auto - correlation € Smoothing

3. Autocorrelation in true returns?

Information inefficiency (unavailable + slow spread) $\oplus$ slow moving capital

ILLIQUIDITY RISK PREMIUM



Earning illiquidity premium

a. Passive allocation

b. Liquidity security selection

c. Market making

d. Dynamic strategies (long - short)

ACROSS ASSET CLASSES

- No pigeon holes.
- Overall, a positive rel^{n}

a. Biases **b.** Ignored Risks? (S & P 500 better?)

c. Market Index/ Idiosyncratic?

d. Active vs Passive

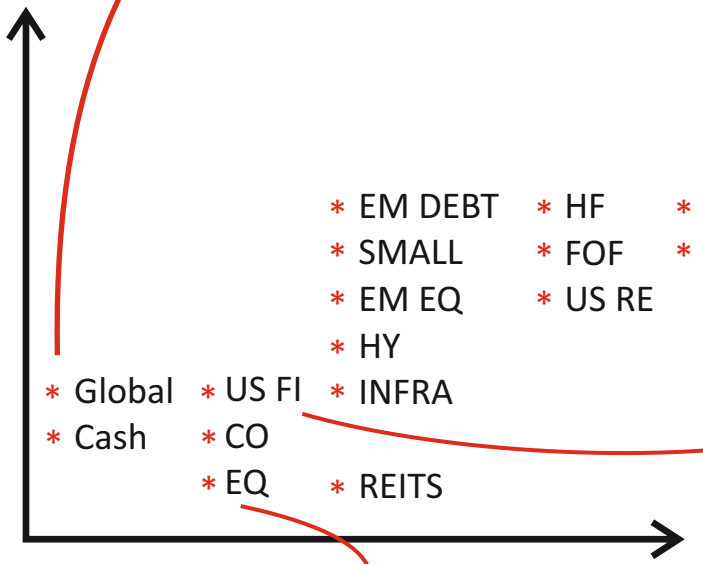
(Manager skill) (Factor Risk)

"a bet on talent"

WITHIN ASSET CLASSES

More illiquid ⇒ Higher return

method : Dynamic + Rebalance



US TREASURIES

on-the-run vs off- the -run

crisis { Treasury bonds < Treasury notes (5%) }

* EM DEBT * HF * VC
* SMALL * FOF * BUYOUTS
* EM EQ * US RE
* HY
* INFRA

* Global * US FI
* Cash * CO
* EQ

* REITS

CORPORATE BONDS

illiquid / high bid - ask

⇓

High returns

7% variation in IG

22% variation in Junk

△ bid ask = 1 bp

↳ △Y = 2 bp

EQUITIES

Measures: bid-ask, volume,
signed volume, n, p
Illiquidity betas
Risk premiums: - 8%

OBSERVATIONS

1. $r.p_{within} > r.p_{across}$

⇑

Limited integration across
(switch capital € strategies)

⇓

Mispricing of illiquidity across
(institutional constraints, slow moving capital, limits to arbitrage)

2. Risk premium (magnitude): small ⇐ Overpay for illiquid (Buyout)

3. Secondary Markets (PE): Valuations + Partial liquidation (LP_s)

Allow exit + huge bid - ask

4. Hedge Funds: lower discounts (vs PE): access to capital at

Certain dates (lock in expired + notice)

PORTFOLIO CHOICES

1. GENERAL CONSIDERATIONS

- investment horizon
- no tradeable indices (benchmark)
- talented manager
- additional costs
- models (liquid + illiquid)

2. TRANSACTION COSTS

- High $\Rightarrow$ no trade regions

$\Uparrow$

MV $\notin$ MC

- Short coming $\Rightarrow$ "a trade is always possible"
  delays (due diligence, legal transfer) + market freezes

3. INFREQUENT TRADING

- Trade at "liquidity events"
- Illiquidity perception

$\Downarrow$

Risk averse (both)

- Solvency ratio portfolio
  Decisions + payout

4. MODEL TAKEAWAYS

- $\triangle t_{(\text{liquidity events})} \uparrow \Rightarrow W^* \downarrow$
- W_{ACTUAL} VS W^*, $\overline{W} > W^*$
- "unhedgeable risks" in illiquid $\Rightarrow$ consume less
- illiquidity arbitrages x
- $\triangle t_{(\text{liquidity events})} \uparrow \Rightarrow$ r. p $\uparrow$

CUSTOMER RELATIONSHIP DOCTRINE ↔ LIABILITY MANAGEMENT (buy funds: loans, reserves)

Short term (rollover/int rate risk), suppliers have high elasticity, flexible (duration, $), price is control lever, firm cannot set price. Less regulated.

1. **FEDERAL FUNDS MKT:** Reserves / pmts/ G-secs. Transferred via Fedwire: immed. Available money Fed doesn't pay interest, no legal reserve on Fed funds borrowings. Main use: legal res. & loan demand. Condit for policy initiatives. (FOMC)

   Fund brokers/ correspondent (Accommodating)
   (facilitate lending & borrowing)
   Int rate: negotiated
   (Guided by "Effective int Rate", Tiered rates)
   Tenor: **overnight** (unwritten, **unsecured***)
   Term (written), continuing contracts (auto)

2. **REPURCASE AGREEMENTS:** Collat Fed Funds (lower cost), Fed Wire, Mechanics? , O/N or Term.

   Int Cost = $ * r * # days/360.

   Collateral: specific vs General (low cost subs^{n})
   (diff basket returned) (allows netting, more efficient use of collateral, trans^{n} cost ↓, liquid). (free of reserves)

3. **BORROWING FROM FEDERAL RESERVE BANK:**
   Discount window, collateralized (G-secs, Fed. Agency secs, HG Commercial Paper) "discount rate.

PRIMARY CREDIT: o/n- weeks, healthy Inst^{n} Rate: $r_{TARGET + 0.25\%}$ no proof, can sub loan.

SECONDARY CREDIT: Primary **x**, monitoring, Rate: $r_{PRIMARY + 0.50\%.}$ RESOLVE problems, assist in pvt. borrowing, but not assist expansion.

SEASONAL CREDIT: longer periods, cover seasonal swings in deposit/loans.
Rate: **Avg (EFFR, SEC. Mrt 90d CD)**

Long term support only f "viable entity". Else liable to FDIC.

4. **ADVANCES FROM FHLB:** stable funding, below mkt rates (fixed/var) collat.by mortgages. O/N- 20yrs, members hold stock & rec.divs. If borrowing fails, FHLB is first in queue.

5. **LARGE NEGOTIABLE CDS** cd: int bearing receipt (tenor, int calcs.) (Domestic/ Euro/Yankee/Thrift). Large denominations, short maturities (fd-1/2 years)

   Negotiable: sold in secondary markets Liquidity T, Bearer form. No impact to DI.
   Lever: Offered rate. ACT/360 convention.
   Interest rates quoted on "interest bearing basis"
   Int paid every 6m if $T_M > 1$ yr.
   Variable rate CDS: LIBOR/Avg rate for prime quality CDS
   No legal reserve reqd. generally stable.

   But inst^{n} has to work
   Extra hard to ensure earning vol↓

6. **EUROWRRENCY DEPOSIT MARKET** In USD, outsider United States. unregulated. US banks also use overseas branches to tap mkt. (liabilities to foreign branches).
   Fixed rate deposits/floating rate CDs, rates.
   O/N – 6m) (Reset 3m/6m) (1y – 20y)
   Large $: TAP CDs small $: TRANCHE CDs
   An active resale market; arbitrage wrt US cds.

7. **COMMERCIAL PAPER MARKER:** S/T (3/4d – 9m) Working capital, Discount from face value. Industrial paper(Raw materials), Finance paper(purchase loans, grant funds for new loans).

8. **LONG TERM SOURCES** > 1 yr. mortgages issued, capital notes & debentures (supplement equity capital). Regulatory restrictions, create maturity mismatch wrt assets, liab. Long term → gauge issuer's default risk.

TOTAL NEED FOR NONDEPOSIT FUNDS

new loans, G- secs, drawing of credit lines

Available Funding Gap = current projected loans & Investments current / Expected Deposit Inflows € other funds.

Future eco. conditions, int. rates, CF patterns.
Add a buffer for "unexpected" element.

FACTORS TO CONSIDER

1. **RELATIVE COST:** Cheapest EFFR < Domestic CDs, Eurocurrency deposits < CP < Disc. Window
   EFER: ready availability, flexible, maturity but volatile rate (Fed's target rate).
   Negotiable CDS & CP: Stable rate (> EFER) (higher avg maturity, placement costs). (better for long – term funding needs).

$$\text{Effective Cost} = \frac{r_t \times \$ + \text{NIC} \times \$}{(\$ - \text{DI} - \text{non EA})}$$

   (vs Deposits) Costs/Profits of non – deposits are more volatile.

2. **RISK FACTOR:** Interest rate risk – short term, volatile. Credit Availability risk rationing of credit to soundest/ loyal. Others: deny credit/ make price high.

   Negotiable CDs, Euro – dollar, CP

3. **TENOR/MATURITY & DELAY:** CP & long term debt: Delay's Fed Funds: Quick

4. **SIZE OF BORROWING INSTITUTION:** Standard trading unit: **$1 million.**
   Eurodollar market:- min. credit rating. Active Secondary mkt for prime rated CDs. Small den loans: Fed Funds market, Discount window.

5. **REGULATIONS:** Amount, frequency, use of funds. CDs: min Td Discount Window: Cap, Legal reserve req. "Risk of new regulations".

OVERALL COST OF FUNDS

1. HISTORICAL AVERAGE COST (PAST)

$$\text{Wtd. Avg Int} = \frac{\sum \text{Inti}}{\sum \text{Funds}_i}$$

$$Break-even\ Cost = \frac{\sum (Int_i + OC_i)}{\sum Funds_i - non\ EA}$$

$$WACC = Break-even\ cost + \frac{\frac{r_E.E}{(1-t)}}{\left(\sum Funds_i - non\ EA\right)}$$

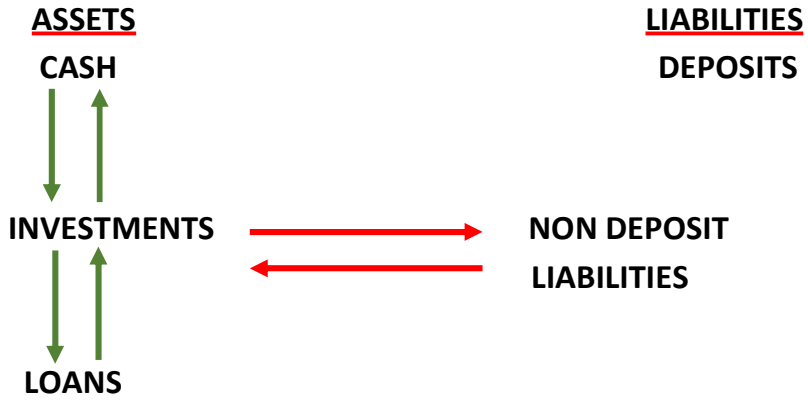
2. POOLED FUNDS APPROACH (FUTURE)

$$Pooled\ Deposit\ \&\ non-deposit\ Funds\ Expense = \frac{\sum E(Int_i) + OC_i}{\sum Funds_i}$$

$$Hurdle\ Rate\ of\ \text{Return over all earning assets} = \frac{\sum E(Int_i) + OC_i}{\sum (Funds_i - non\ EA_i)}$$

Source of Funds	Secured	Reserve	Insurance	Cost	Tenor	Stability
Federal Funds Market	No	No	No	Low	O/N	Rollover Risk
				Lower than Fed Funds		
Repurchase Agreements	Yes	No	No	Rate	O/N or Term	Rollover Risk
Federal Discount Window	Yes	No	No	High	O/N or Longer periods	Stable
Advances from FBLB	Yes	No	No	Low	O/N – 20 years	Stable
Negotiable CDs	No	No	Yes	Competitive with CP, T - Bills	7d to 1 yr/2 yr	Rollover Risk
Eurocurrency Deposits	No	No	No	May be different than domestic CDs (demand & supply, difference in credit risk perceptions).	O/N to 6m(Fixed), 1 yr – 2 yr (Floating)	Rollover Risk
Commercial Paper	No	No	No	Higher than CDs	< 270 days	Rollover Risk

ROLE OF INVESTMENTS



FUNCTIONS OF INVESTMENT P/F

- ❑ Stabilize income
- ❑ Offset loan credit risk
- ❑ Provide geographic diversification
- ❑ Backup source of liquidity
- ❑ Reduce tax exposure.
- ❑ Serve as collateral.
- ❑ I/R hedges.
- ❑ Provide flexibility.
- ❑ Dress up the bal - ance sheet.

INVESTMENT INSTRUMENTS AVAILABLE

Money Mkt Instruments	Capital Mkt Instruments
$T_M < 1$ yr, low risk, Liquid	$T_M < 1$ yr, high return, capital gains.

FACTORS AFFECTING CHOICE

1. Expected Return: YTM, HPR (investments sold before maturity to meet loan growth)
2. Interest Rate Risk: IR ↑ ⇒ loan demand ↑ sell bonds @ loss. (& vice versa) (tax & high yield on loans).
3. Tax Exposure: municipal bonds are tax – exempt
   * Before tax gross yield × (1 – t) = After tax gross yield
   * TEY = After tax gross yield / (1 – t)
   * net return = $(R_{nom} – R_F) + (t \times \%\ deduct \times R_F)$

   Tax Swapping/Portfolio Shifting
4. Credit/default risk: corporate bonds. Regulators: min threshold rating (BBB/Baa) Hedges available.
5. Business Risk: Local/Global economy. Prefer "out – of – market" purchases.
6. Liquidity Risk: Breadth/ depth of resale market: Treasury & Fed – agency securities High liquidity → lower yield.
7. Call Risk: Called when rates fall. Buy bonds with long deferments/avoid callable.
8. Prepayment Risk: Loan refinancing (I = (WAC – R) × WALS × A – K) CPR = FCI)

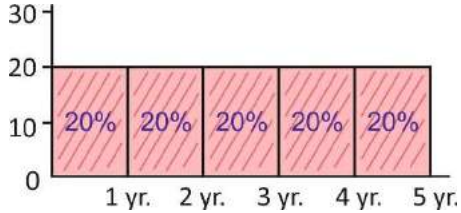
   Turnover: PSA models. Rates ↓ ⇒ prepayments ↑ Expected loss in interest income vs. Quicker Cash.
9. Inflation Risk: Hedge: S/T securities, variable rate instruments, TIPS (incomplete hedge).
10. Pledging Req: Govt. deposits, discount window, Repo Treasury & Federal @ par, municipal @ discount.

Treasury Bills	Short-term Treasury Notes/Bonds	Federal Agency Securities	Certificate of Deposit
< 1 year, trade at discount. Safe, stable prices, Liquid, Good collateral, Pledge behind government deposits.	1-10 years (Notes), >10 years (Bonds), within one year of maturity. Coupon instruments. Safe, Good resale market. Good collateral. Less marketable, but relatively higher yield than T-bills.	Marketable notes/bonds sold by agencies. Safe (but not guaranteed by Government), hence low yields (still, higher than US Gov Securities).	Interest bearing receipt. Low risk investment, yield higher than Treasuries. Jumbo CDs are insured upto $250k. Fixed/Variable rates.
Low yields, taxable income.	More price risk, taxable income.	Less marketable vs Treasuries. Taxable gains/income.	Penalty on early withdrawal. Limited resale market (exists for longer tem CDs).
International Eurocurrency Deposits	**Banker's Acceptances**	**Commercial Paper**	**Short - term Municipal Obligations**
Time deposits, fixed maturity, issued by largest banks outside U.S. Low risk, higher yields than on domestic CDs (since, not insured).	A bank's promise to pay the holder an amount of money on future date (on customer's behalf). Resale market, sold at discount to par. Eligible for borrowing at Federal Reserve.	Unsecured, Low risk, Short maturity, High quality borrowers. Some issued discount to par, others are coupon bearing.	Tax exempt interest income. E.g. tax-anticipation notes (TAN), revenue anticipation notes(RAN).
Volatile interest rates, taxable income.	Limited availability at specific maturities. Issued in odd denominations. Taxable Income.	Volatile market, poor resale market. Taxable Income	Limited resale market. Taxable capital gains.
Treasury Notes and Bonds	**Municipal Bonds**	**Corporate Notes and Bonds**	**Asset Backed securities**
Safe. Good resale market. Good collateral for borrowing. Can be pledged behind government deposits.	Tax exempt interest income. High credit quality (General Obligation GO bonds, Revenue Bonds). Selected securities are highly liquid and marketable.	Higher pretax yields (vs G-secs). Attractive to insurance cos and pension funds. Help to lock – in higher long term rates of return.	Higher pretax yields than on Treasuries. Can serve as collateral for borrowing additional funds.
Low yields (vs private bonds), Taxable gains and income. Limited supply of long tenors.	Volatile market. Some issues have limited resale potential. Taxable capital gains.	Limited resale market. Inflexible terms. Taxable gains and income.	Less marketable, more unstable than Treasuries. Carry substantial default risk. Taxable gains and income.

YIELD CURVE: - Implicit forecast of future interest rate changes.
Some indication of relative value.
Above curve ≡ Buy.

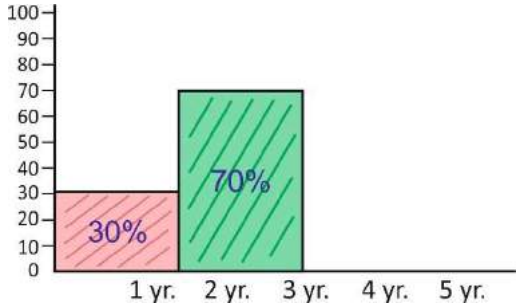
Signals about stage of business cycle: Expansionary (Rise) Recessions (Fall)
Risk-return tradeoff info: - duration risk & liquidity risk in L/T bonds.

1. LADDER/SPACED MATURITY



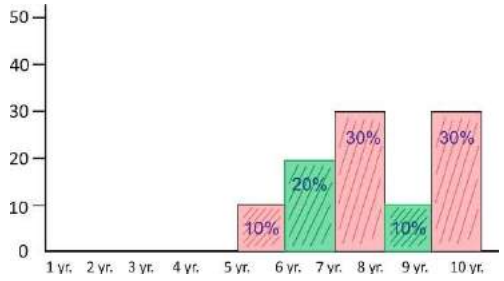
Doesn't maximize income, reduces income fluctuations. Little mgmt expertise reqd.

2. FRONT- END LOAD MATURITY



Strengthens liquidity position Avoids large capital losses if interest rates rise.

3. BACK-END LOAD MATURITY

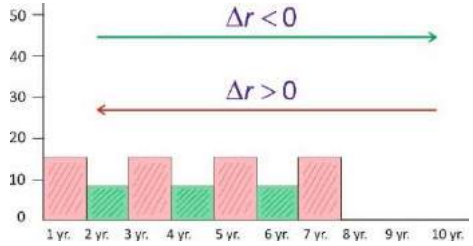


Maximize income potential (if interest rates fall). Liquidity req. met from money market borrowings.

4. BARBELL STRATEGY

meet liquidity Needs. **Achieve earnings Goals**

5. RATE EXPECTATIONS APPROACH



Securities trades happen if: - Exp. After tax returns can be ↑ via tax mgmt. higher yields can be locked in if E (ΔT) < 0. Overall asset quality can be improved w/o sacrificing yield. (e.g. problems in loan pf).

7. CARRY TRADE

Borrow short term (e.g,. pledge liquid securities in a repo)

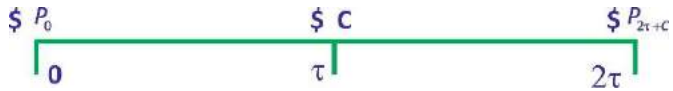
&

& invest in longer dated income generating assets.
Carry income = f (slope)

8. RIDING YIELD CURVE

Sell security (maturing & already gained)
& reinvest in long - dated & high yield security.
High current income & greater future returns.

9. IMMUNIZATION



$$HPR = \frac{(P_{2\tau} + C) + C(1+R) - P_0}{P_0}$$

Optimum: - D = 2t

ESTIMATING LIQUIDITY NEEDS

Liquidity reserves: Planned Component + Protective Component (Philosophy & Attitude)

1. SOURCES & USES OF FUNDS APPROACH

$L_t > O$ Surplus & $L_t < O$ Deficit

Step 1: Forecast loans & deposits for planning period

$$\text{Loans} = f\left[E\left(\frac{\Delta GDP}{\Delta t}\right), E(Corp.Earnings), \frac{\Delta Money\ Supply}{\Delta t}, E(\text{Prime loan rate} - CP/CD), Ti^e\right]$$

$$\text{Deposits} = f\left[E\left(\frac{\Delta Income}{\Delta t}\right), E\left(\frac{\Delta \text{Retail Sales}}{\Delta t}\right), \frac{\Delta Money\ Supply}{\Delta t}, E(y_{MM}), Ti^e\right]$$

Forecasting: - Trend Component Seasonality Component Cyclical Component

$\Delta L_t = \Delta \text{ Deposits}_t - \Delta \text{ Loans}_t$

Raise funds in periods where: $\Delta L_t < 0$

Profitably invest funds where: $\Delta L_t > 0$

2. STRUCTURE OF FUNDS APPROACH

Deposits & non – deposits

HOT MONEY (95%)	VULNERABLE FUNDS (30%)	STABLE FUNDS (15%)

Liability Liquidity Reserve = 0.95 (Hot money – Reserves)
+ 0.30 (vulnerable – Reserves)
(Deposits in correspondent Banks, Treasury Bills, Repos) + 0.15 (Stable – Reserves)
Total liquidity reqd = liability Liquidity Reserve + (potential loans - Actual loans)

"subjective estimate"

A Probability based refinement: -

OUTCOME	BEST	MOST PROBABLE	WORST
Description	max deposits min loans	"	min deposits max loans.
Liquidity Position	L_1	L_2	L_3
Probability	P_1	P_2	P_3

L: Avg val Deposits – Avg vol Loans

$E(L) = P_1 L_1 + P_2 L_2 + P_3 L_3$

3. LIQUIDITY INDICATOR APPROACH

Experience & liquidity ratios (firm/industry)

- **Cash position** = $\frac{\text{Cash \& deposits due}}{\text{Total assets}}$
- **Liquid Securities** = $\frac{\text{US Govt. Securities}}{\text{Total assets}}$

- **Net Fed funds & Repo position:**

$$\frac{\text{Fed funds sold} + \text{Reverse repos} - \text{Fed funds bought} - \text{Repos}}{\text{Total assets}}$$ (+)

- **Capacity ratio:** $\frac{\text{net loans \& leases}}{\text{Total assets}}$ **(illiquid)** (−)

- **Pledged securities ratio:** $\frac{\text{Pledged Securities}}{\text{Total Securities}}$ (−)

- **Hot money ratio:** $\frac{\text{MM / short term assets}}{\text{Volation liabilities}}$ (+)

$$= \frac{\text{Cash} + \text{Deposits held} + \text{S/T securities} + \text{F/F loans} + \text{R/repo}}{\text{Large CD}_s + \text{Eurocurrency deposits} + \text{F/F borrowings} + \text{Repos.}}$$

- **Deposit brokerage index:** $\frac{\text{Brokered deposits}}{\text{Total deposits}}$ (−)

(I/R sensitive; quickly; withdrawn)

- **Core deposit ratio:** $\frac{\text{Core deposits}}{\text{Total assets}}$ (+)

Core deposits: **Small denomination (< look)**

Checking & savings accounts.

- **Deposit composition ratio:** $\frac{\text{Demand deposits}}{\text{Time deposits}}$ (−)

- **Loan commitments ratio: -** $\frac{\text{Unused loan commitments}}{\text{Total assets}}$ (−)

nB:- **Indicators based on assets/ stored liquidity decline during rising loan demands.**
Opp. for indicators based on purchased liquidity.

nB:- **Compare ratios vs institutions of similar size & operating in similar markets.**

SIGNALS FROM MARKETPLACE

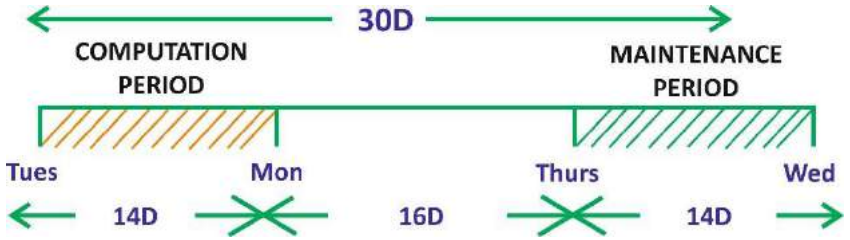
- **Public Confidence: Losing money/deposits?**
- **Stock price behavior: perception of liquidity crisis?**
- **Risk premiums on CDS / other borrowings.**
- **Forced asset sales? Any losses?**
- **Meeting commitments to credit customers.**
- **Borrowings from central Bank**

Large volume? More frequently?

LEGAL RESERVES & MONEY POSN MGMT

Legal reserves (U.S): Vault cash & deposits in Reserve Account
Small banks hold reserves at Fed- approved Inst?
Who? Commercial/ savings bank, SLA, credit unions, branches of foreign banks offering deposits.
Why? Monetary policy Implementation.

LAGGED RESERVE ACCOUNTING



min Avg Reserves = Daily Avg net Transaction Amt × Reserve Reqd. (Tiered)
+ Daily Avg non-Transaction liabilities × Reserve Reqd.

Sat & sun use Fridays numbers. "Weekend Game" (out of country/use "sweep" accounts)

High reserve ratio demand deposits ⟷ high interest savings account/MMMF/Repos

maintenance Period: - "On Average" deduct average daily value cash during computation period.

AN ALLOWANCE: DI Can make up to 4% daily average error without penalty. (make up in next 2- week reserve computation period).

EXCESS Explicit penalty (Dis_C Rate + 2%)

SHORTFALL: Implicit penalty (monitoring)

CLEARING BALANCES:- @ Fed for checks/debits. Via Fed's check Clearing facilities.
Req:- min daily avg amount over 2- week period.

Credit earned(2 – week period) = Avg clearing balance × Annual F/F rate × $\frac{14}{360}$

MAINTAINING RESERVES

Excess reserves? Sell federal Funds to other DIS. Deficit reserves? Borrow from Federal funds market (volatile on bank Settlement Day), sell liquid Securities, repos, draw upon balances @ correspondent banks, sell time deposits (CDS), eurocurrency market.
Small DIS: usually surpluses. Large: Borrowers.

FACTORS IN CHOOSING SOURCES:

- Immediacy of need.
- Relative costs & risks.
- Rules & Regulations (Discount Window)
- Duration of need.
- Interest rate outlook (Future liq deficit? Lowest cost in future)
- Access to a given market
- Outlook for monetary policy

GLOBAL BANKS: INTERNATIONAL DIVERSIFICATION

'Expansion in banks' global balance sheets (rapid financial innov^{n}, ↑USD claims on non-bank entities - retail/corporate lending, loans to hedge funds, structured finance products)

"CROSS CURRENCY FUNDING"

1. Borrow DC, convert to FC @ Spot → purchase FC hedge
   FX ← Asset
2. Convert DC liability to FC using FX swaps
   (off b/s hedge, Rollover risk) purchase FC asset
3. Borrow directly in FC (interbank mkt/non - bank market participants/central banks).
   (ZERO FX EXPOSURE)
   Delivery of FC reqd when liability due.

Magnitude of Funding risk? :- Degree of maturity transformation (investment horizon of FC assets > Maturity of FX swaps)

FC Funding Gap: - $\left(A_i - L_i^{LT}\right) - (A_i \hat{L} A_i^1) = A_i^{LT} - L_i^{LT}$

Why imp? Central banks (lender of last resort in domestic context) cannot "create" FC (limited by exchange rate regime/FX reserves)

Measurement: - ON CONSOLIDATED basis (bank level)

Large measured "mismatches" on B/S of subsidiary may be hedged off b/s offset by position of another subsidiary.

THE US DOLLAR SHORTAGE

- ↑ctpty risk & liquidity concerns → interbank funding↓
- Dislocations in FX swap markets.
- General instability in "non-bank" sources.)
  MMMF runs → withdrawal from bank issued paper, central banks withdraw FX reserves)
- Banks unable to reduce USD assets.
  (evaporating liquidity; SIV asset repatriation.)
- Effective holding period↑ Maturity of funding↓

Endogenous rise in maturity mismatch

INTERNATIONAL POLICY RESPONSE

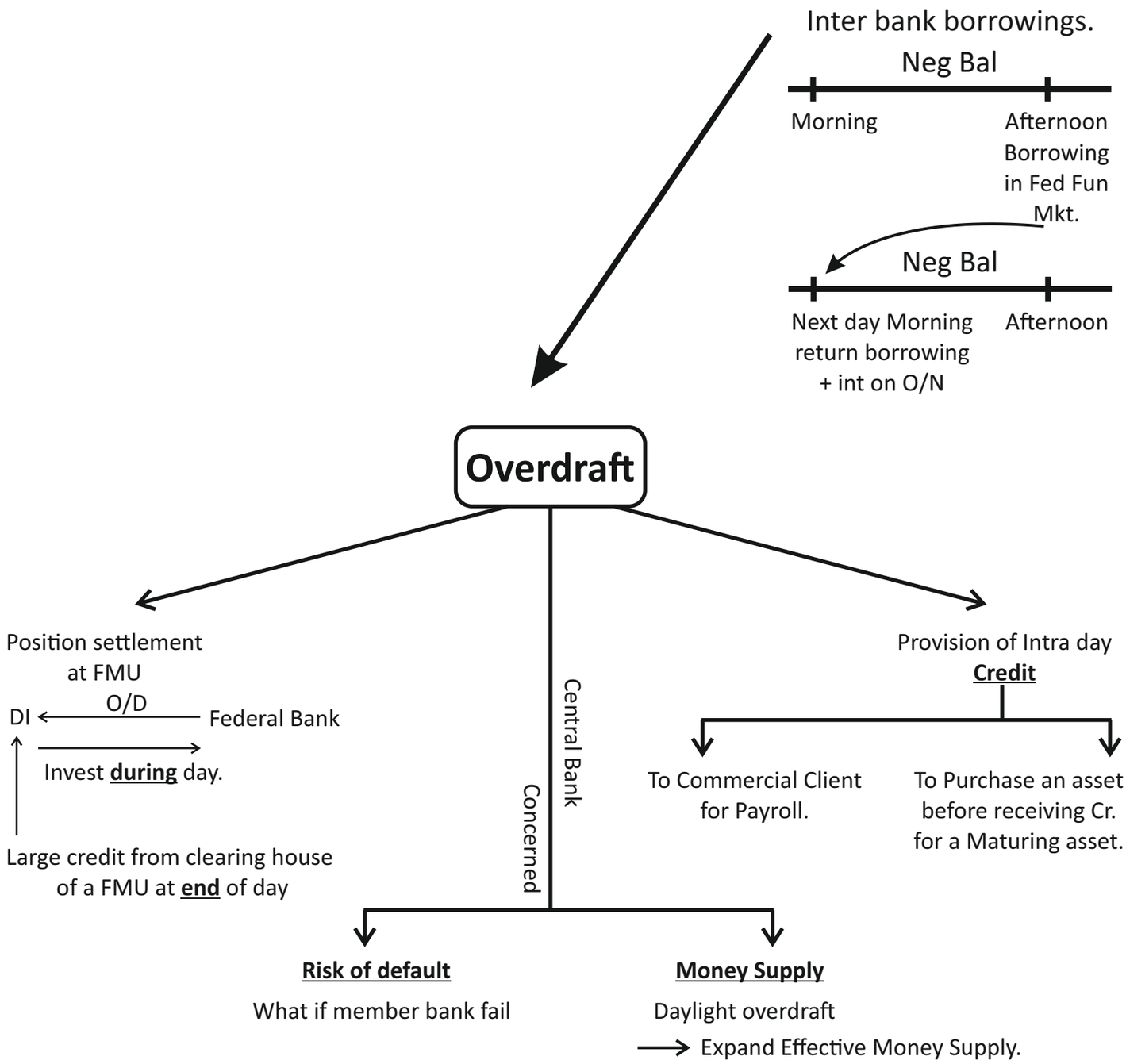
Central banks (ECB, SNB, bank of Canada, bank of England, Bank of Japan) entered into swap lines (unlimited) with Federal Reserve

Federal Reserve effectively engaged in INT'L LENDING OF LAST RESORT: collateralized loan to central banks → USD auctions in resp. jurisdictions.

A void distress selling of USD assets.

- Fed has power to create any of money.
- Collateralized (no credit risk). No moral hazard. (monitoring delegated to central banks/authorities)

Intraday Liquidity



Funding Uses

Outgoing Wire Transfers
Payment on behalf of client or own A/Cs.

Settlement at PCS systems CH
late afternoon source or use depending on net position

Funding of Nestro A/Cs
Cash transfer to correspondent bank for service provided

Collateral Predging
Collateral Calls for OTC.

Asset Purchase
Purchasing Pre planned securities, fixed assets, New Loans

Funding Availability

Cash Balances
Cash on B/S at beg of day
+
Deposits at CB
+
Deposits at Core Bank

Incoming Funds Flow
Real Time or Batch oriented

Intraday Credit
Credit line or O/D permitted by CB

Liquid Assets
Cash MM deposits, Govt. Dept ST

O/N Borrowing
Fed Funds, libor, euro dollar deposits over night

Other Term Funding
Term deposits, FHLB term deposit

Challenges

- Uses > limit of daylight credit resources
- appropriate target bal at day end

Variability of CF patterns

(↑ Volatility)

↓

No advance notice of large cash req.

Impact of Market Forces

Asset Volatile

→ unanticipated margin calls.

Monetary policy influence ability to source funds.

Lack of Real Time Data (Tech Infra)

For Balance expected transaction flows.

Governance Structure of Liquidity RM

Active Risk Management

1. update risk taxonomy
2. Incorporate in firms risk appetite framework.

Integration with Risk Governance

Follow 3 lines of Defence Model

- First line - Treasury
- Second line - Corporate Risk Management
- Third line - Internal audit

Risk Assessment

Identify measure & evaluate settlement risks from existing and potential new products.

Risk Measurement & Monitoring

A. Monitor clients real time cash positions (intraday cr. extended)

⟶ ensure charges passed adequately

B. Real time position monitoring across all PCS activities in all markets & all of their lines of business.

Measures for Understanding Intraday Flow

Total Payment

- Pmt amt
- Time originated
- Time for each processing step
- Payer & Payee
- Pmt system used

↓

Analyze total pmt sent & recd. for Non FI & FI clients. Analyze net liq position at any time

Other Cash Transaction

Transaction level detail captured & capture snapshot of A/C & collateral positions (Net Bal of cash & Securities with FMU)

Settlement Positions

Maintain data on settlement position with FMU

↓

Monitor patterns & correlate with ex - ternal Market Factor.

Time Sensitive Obligations

Monitor volume & patterns.

E.g. Return of repo borrowings margin payments

↓

financial penalties & reputation risk.

Total Intraday Cr lines to Clients

Banks should have data regarding average & peak usage at client portfolio levels. (Agg + Drill down)

Total Intraday Cr lines available & usage

Max amount of Cr. lines avail comm. + uncomm.

Measures for Quantifying & Monitoring Risk Levels

Banks

<u>Largest (Max) O/D</u>
Credit Line.

Track for cash A/C held at CB, FMU & correspondent Bank.

Peak utilization relative to total amount available

<u>Intraday Credit Used</u>
Tier 1 capital

↓

Help, bank to measure relative systematic risk.

Client

<u>Max O/D</u>
Credit Line.

↓

- Pinpointing clients.
- Comparing with industry
- Identify successful indicators to modify client behaviour.

<u>Payment</u>
Throughput

↓

<u>Outgoing pmt</u>
Total pmt

at diff. points of time

↓

- Track volume patterns
- Meet target % deadline
- Identify peak periods

Stress Testing & Scenario Analysis

Stress Testing

Scenarios in which shortfall can happen ← 1. Key Vulnerabilities

2. Responses - potential response & contingency plans

3. Technology infra - data aggregation capability (Modify data with diff set of assumptions)

Vulnerabilities & shortfalls we are exposed to ← 4. Beyond Empirical Results - Brainstorming critical thinking

Scenario Analysis

1. Own Financial Stress (Poor cr portfolio)

2. Counterparty Stress (Failure of FMU. Core Bank)

3. Customer Stress (↑withdrawal in cr lines)

4. Market Wide Credit/Liquidity Stress (Tight Money Market Condition)

Risk Management for FMUs

FMU → Execution eg. New York Stock Exchange

+ Clearing (Central Counter parties eg. Fixed income clearing corporation)

+ Settlement eg. Depository Trust Co.

+ Payment eg. CH interbank pmt system

Monitoring Risk

Not Met

Indirect Member

A. Membership Criteria Size & Credit Worthiness

Met

Direct Member

Advantage

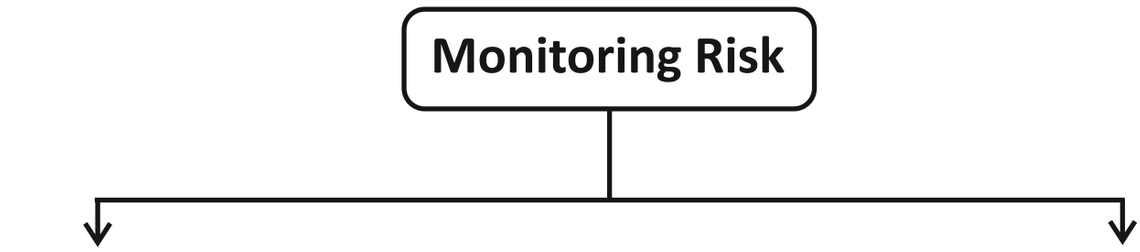
- Easier credit risk analysis

Disadvantage

- Tiering creates risk concentration in small number of settlement banks.

B. Monitoring risk of participant

- Periodic revenue of F.S.
- Monitoring Settlement Positions & margin collateral.
- Introduce Measures for members with potential default risk concern.



C. Facilitating Payment in Failure

Mutualizing of default risk in event of participant failure.

- by establishing guarantee fund.

D. Final Resort

Risk mutualization by involving Central Bank which eventually pass loans to Govt of tax payers.

Tools to Manage Intraday Settlement Risk.

1. **Net Debit Caps** - Constrain size of negative position

2. **Collateral -** Increase Initial and Variation margin

3. **Liquidity Saving Machanism -** Transaction netting, transaction throughput requiremens, Transaction prioritisation capabilities

4. **Settlement Window -** Multiple settlements throughout the day

5. **Contingent Liquidity -** Backup credit lines from Central bank

ALM: - Assets & liabilities as integrated whole.

ALM STRATEGIES

1. ASSET MANAGEMENT STRATEGY

Rel. amts of funds (1. liabilities - deposits & borrowed funds & 2. Equity)

Exogenously determined/ strongly regulated.

Decisions: - ASSETS! Who to grant credit?

At what cost/terms?

2. LIABILITY MANAGEMENT STRATEGY

Fluctuating rates, competition for funds, new sources of funding, mix & cost of deposit/non - deposit liabilities.

Decisions: - LIABILITIES! Lever: - offer rate

3. FUNDS MANAGEMENT STRATEGY

A. Exercise control over volume/ cost/ mix of both assets & liabilities.

B. Ensure that asset management & liability management are consistent.

Max returns, min cost control risk

C. Revenues & costs arise from both sides of balance sheet.

IR RISK: - income statement & balance sheet

(IR Revenues/costs) (Assets/Liab)

Reinvestment risk & Price risk

Interest rates: - price of credit

An equilibrium level

(not monopoly, exogenous, "price takers")

Measurement; - YTM, bank discount rate

Components; - $\tau_{nom} = \tau_{real} + risk\ premium$

(default risk, inflation risk, liquidity risk, call risk, maturity /duration term risk)

YIELD CURVES

Y VS T constantly change level, slope curvature

Slope: upward (rates will Rise. Economy Will expand) / downward (rates will fall Economy will enter recession) /horizontal (rates will stay stable)

Struggling economy ⇒ steepen, gap↑
Economic prosperity ⇒ flatten, gap ↓

Upward: Typical assump^{n} & favorable

POSITIVE MATURITY GAP

UPWARD SLOPING → positive net interest margin

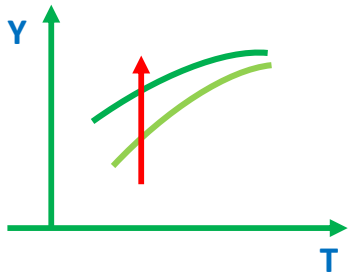
ASIDE: many banks conduct ALM under the guidance of "asset liability Mgmt. committee"

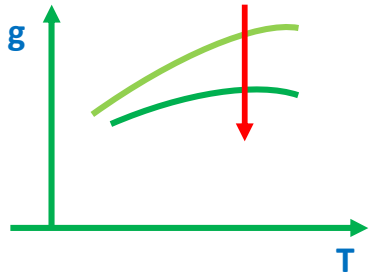
A POSSIBLE GOAL: - insulate profits/ NIM

NII

$$NIM = \frac{II - IE}{Total\ raening\ assets}$$

Assuming positive maturity gap &upward sloping yield curve.





REPRICEABLE ASSET: - short term securities (gov/private) about to mature, short term loans (about to mature), variable rate loans & securities. (cash X, PPE X, LONG term Loans & securities (fixed rate) X).

REPRICEABLE LIABILITY: - CDs about to mature/renew (new rate to be negotiated), floating rate money mkt deposits, short term saving a/c , money market borrowing (Fed funds market).

EXPLAINING CHANGES IN NII

$$NII = r_A \cdot NSA + r_{ISA} \cdot ISA - r_L \cdot NSL - r_{ISL} \cdot ISL$$

$$\Rightarrow \quad \Delta NII = \Delta r_{ISA} \cdot ISA - \Delta r_{ISL} \cdot ISL$$

1. Changes in level of interest rates Δr
2. Changes in slop of interest rates.

   $r_{ISA} - r_{ISL}$
3. Changes in volume of assets.
4. Changes in volume of liabilities.
5. Changes in composition of assets/liabilities (fixed/floating, short maturity/long maturity, yield).

Interest sensitive Gap (IS GAP) = interest - sensitive assets (ISA) - interest sensitive Liabilities (ISL)

REPRICEABLE

$$\text{Relative IS GAP} = \frac{\text{IS GAP}}{\text{size of FI (Assets)}}$$

$$\text{Interest sensitivity Ratio (ISR)} = \frac{ISA}{ISL}$$

1. **POSITIVE GAP/ASSET SENSITIVE**

   IS GAP > 0 Rel. IS GAP > 0 ISR > 1

   ISA – ISL > 0 $\Delta NII = (ISA - ISL)\,\Delta r$

   $\Delta r > 0 \Rightarrow$ NIM↑, NII↑ (vice versa)

   RISK :- $\Delta T < 0$

2. **NEGATIVE GAP/LIABILITY SENSITIVE**

   IS GAP < 0 Rel. IS GAP < 0 ISR < 1

   ISA – ISL < 0

   RISK: $\Delta r > 0 \Rightarrow$ NIM↓, NII↓

GAPPING METHODS

In practice: -

1. Choose a time period/ horizon over which NIM managed.
2. Divide time period into maturity buckets
3. Calculate IS GAP for each bucket & cumulative IS GAP till end of each bucket.

   $\Delta NII = \Delta r$ (Cumulative gap)

INTEREST SENSITIVE GAP MANAGMENT

1. AGGRESSIVE APPROACH

$\Delta r > 0$ expected $\Rightarrow$ Position yourself with IS GAP > 0

$\Delta r < 0$ expected $\Rightarrow$ Position yourself with IS GAP < 0

"creates risk"
"hedge & not forecast"

$$\Delta NII = ISA \cdot \Delta r_{ISA} - ISL \cdot \Delta r_{ISL}$$

imperfectly correlated

Δr_{ISA} & Δr_{ISL} don't move at same speed as rates in open market. Rates on deposits are lagged.

$$\sigma_{short\ term} > \sigma_{long\ term}$$

2. DEFENSIVE APPROACH

Set IS GAP as close to zero to reduce expected volatility of NII.

$$\$Repriceable\ Assets = \$Repriceable\ Liabilities$$

IS GAP = 0 Rel. IS GAP = 0

ISR = 1

ELIMINATE AN IS – GAP

RISK: Fall in rates	RISK: Rise in rates
IS GAP > 0	IS GAP < 0
a. Do nothing.	a. Do nothing.
b. Extend asset maturity / shorter liability maturity.	b. Extend liability maturity / shorter asset maturity.
c. Increase ISL & / or decrease ISA.	c. Increase ISA & / or decrease ISL.

3. WEIGHTED INTEREST – SENSITIVE GAP APPROACH

Current balance sheet: -

Repriceable assets: - ISA_i

Repriceable liabilities: - ISL_i

$IS\ GAP = \sum ISA_i - \sum ISL_i$

$$\Delta NII = ISA \cdot \Delta r_{ISA} - ISL \cdot \Delta r_{ISL}$$

Δr_{ISA} & Δr_{ISL} : Different amts & speeds.

"BASIS RISK "

Weight: - β factor $\Delta r_i = \beta_i \Delta r$

rate set in (e.g. fed open market Funds rate)

Risky, rate volatile investments: -

$\beta_i > 1$

Deposit interest rates / money mkt: borrowings

$\beta_i < 1$

REFIGURED BALANCE SHEET

Assets: - ($IS\ A_i\ \beta_i$)

Liabilities: - ($ISL_i\ \beta_i$)

IS GAP

$\sum ISA_i\ \beta_I - \sum ISA_i\ \beta_i$

DURATION GAP MANAGEMENT

Change in rates: ΔA, ΔL → ΔE (net worth)

DURATION: - value & time weighted measure of maturity.

Average time needed to recover funds committed to an investment.

$$D = \frac{\sum PV(CF_i) * t_i}{\sum PV(CF_i)}$$

Current mkt value/price.

$$\Delta P = -D_{mod} * P * \Delta r$$

High duration ⇒ high interest rate risk

As coupon↑ ⇒ D↓

As maturity↑ ⇒ D ↑

CONVEXITY: second order impact of r

$$C = 1/p \frac{d^2 p}{dr^2} \quad C \uparrow \text{ as } D \uparrow$$

$$C \downarrow \text{ as coupon} \uparrow$$

Greater sensitivity @low interest rates.

$$D_A = \sum W_i D_{A,i} \qquad D_L = \sum W_i D_{L,i}$$

W_i: - $ weights/mkt value-based weights.

Duration GAP = D_A - D_L

Generally E > 0 A – L > 0 L/A < 1

Leverage Adjusted D_A – L/A D_L

Duration Gap:

DURATION OF ENTIRE PORTFOLIO:

$$D = \frac{A}{A-L} \cdot D_A + \left(\frac{-L}{A-L}\right) D_L$$

$$= \frac{A}{A-L}\left(D_A - L/A \; D_L\right)$$

to measure I/R sensitivity Of net worth/Equity.

$$\Delta E = \Delta A - \Delta L$$

$$= -A \cdot D_{mod}, A \cdot \Delta r_A - \left(-L \cdot D_{mod}, L \cdot \Delta r_L\right)$$

Keeping it simple, $\Delta r_A = \Delta r_L = \Delta r$

$$\Delta E = -A\ (D_{\text{mod},A} - \frac{L}{A} D_{\text{mod},L})\Delta r$$

Three crucial factors: -

*SIZE of FI *Lev. Adj. Duration *SIZE of shock

IMPACT OF I/R ON NET WORTH

$D(= D_A - \frac{L}{A} D_L) = 0 \Rightarrow$ no change

$D > 0 \Rightarrow$ Fall if $\Delta r > 0$

$D < 0 \Rightarrow$ Fall if $\Delta r < 0$

maturity Transformation: $D_L < D_A \Rightarrow D > 0$

Possible Action: PORTFOLIO IMMUNIZATION

$D \rightarrow 0$

AN AGGRESSIVE STANCE

Expect ^{n}: $\Delta r > 0$ Reduce D_A & increase D_L

(move towards – ve duration gap)

$\Delta r < 0$ Increase D_A & reduce D_L

(move towards + ve duration gap)

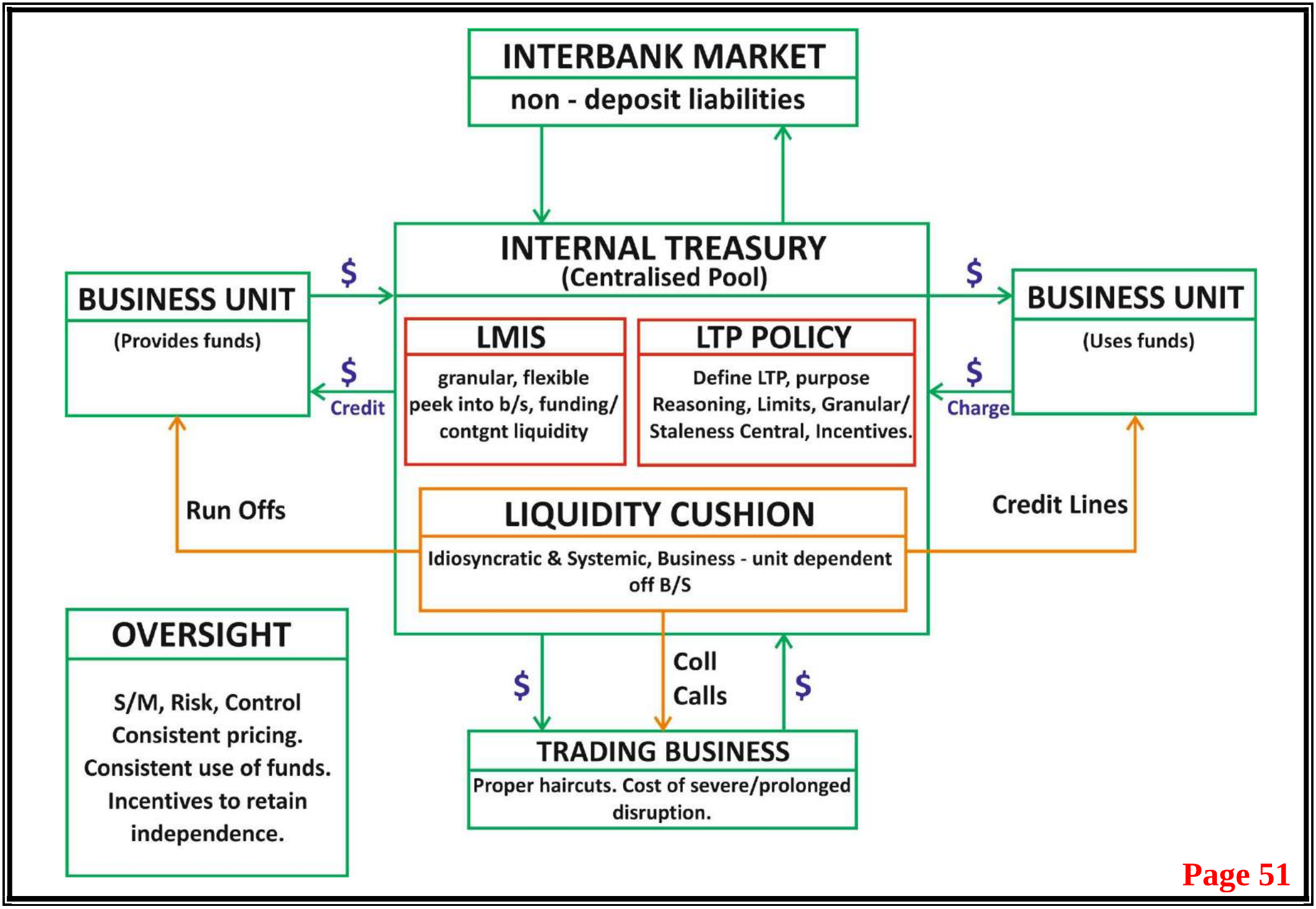
LIMITATIONS

IS GAP MANAGEMENT

- Ignores impact on net worth (equity) via changes in mkt value of A & L
- Choice of planning periods arbitrary. Too wide buckets?
- Repricing time difficult to identify (Current A/C deposits credit lines).
- Not including off balance - sheet items (hedges).

DURATION GAP MANAGEMENT

- Costly exercise locating assets, liab with precise duration. (you can also hedge, at low cost)
- Immunization is a dynamic problem.
- Duration & embedded options (passbook savings a/c, prepayments, defaults).
- Small & parallel Reality: convexity and non-parallel.


INTERBANK MARKET
non - deposit liabilities
INTERNAL TREASURY
(Centralised Pool)
BUSINESS UNIT
(Provides funds)
$
Credit
$
$
BUSINESS UNIT
(Uses funds)
$
Charge
LMIS
granular, flexible peek into b/s, funding/ contgnt liquidity
LTP POLICY
Define LTP, purpose Reasoning, Limits, Granular/ Staleness Central, Incentives.
Run Offs
LIQUIDITY CUSHION
Idiosyncratic & Systemic, Business - unit dependent off B/S
Credit Lines
OVERSIGHT
S/M, Risk, Control
Consistent pricing.
Consistent use of funds.
Incentives to retain independence.
$
Coll Calls
$
TRADING BUSINESS
Proper haircuts. Cost of severe/prolonged disruption.

APPROACHES TO LIQUIDITY TRANSFER PRICING

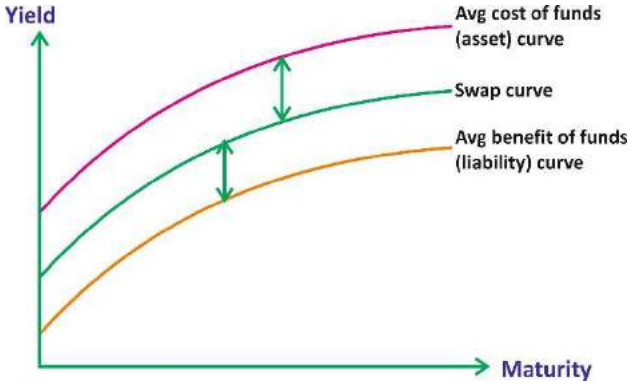
1. **ZERO COST OF FUNDS APPROACH** liquidity = free good, no liquidity risk, no charge & no credit.
   All units work with swap curve ⇒ maturity transformation

LIBOR(≤ 1 yr), IRS (> 1 yr)

Illiquid assets + volatile liabilities.

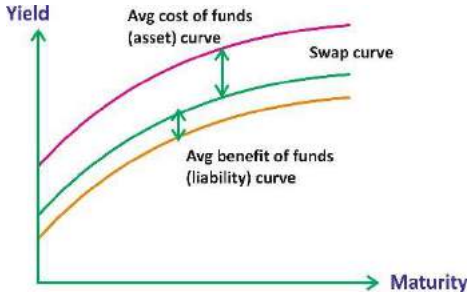
Rationale:- LIBOR/SWAP Spreads were low ≡ compensation for credit risk

2. **POOLED / AVERAGE COST OF FUNDS**
   Average interest expense across all funding sources. (deposits/non-deposits)
   (effective, after reserve requirements)



Simple, but problematic: -

- ❑ Long term assets have higher liq. risk. Long term deposits should be rewarded more
- ❑ Same average rate for cost & benefits of funds.
- ❑ Historical rates & prices, not actual rates & prices. (Average Lags actual mkt cost)



WHY AVERAGE COST?

- ❑ Simple
- ❑ Easily understood & complied with
- ❑ Basic LMIS.
- ❑ Reduces net interest income volatility.

IMPLICATIONS OF POOLED AVERAGE

REMUNERATION + INFORMATION ASYMMETRY ⇒ LONG TERM ASSETS↑

+ POOLED AVERAGE COST

Similarly, liabilities become short term → Maturity Transform ^{n} ↑

ALSO, DISTORTED PROFIT ASSESSMENT

(Average cost lags actual market cost).

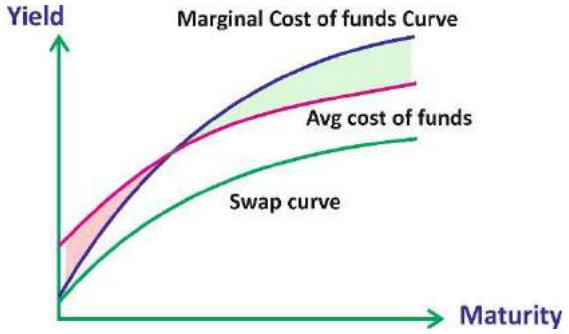
Mispricing & Accumulation of assets at distorted risk adjusted terms.

3. MATCHED MATURITY MARGINAL COST OF FUNDS APPROACH

Fixed rate borrowing costs → Floating rate borrowing costs.

Spread: "Term Liquidity Premium" (credit risk of bank, market Assess premium) (same for costs & benefits)

≡ f (tenor/maturity)



PRICING FUNDING LIQ. RISK : AN EXAMPLE

TERM (IN YEARS)	1	2	3	4	5
TERM LIQ.PREMIUM	1	2	3	6	10
AVERAGE COST	2	2	2	2	2
TERM LIQ. PREMIUM	5	10	18	28	40
AVERAGE COST	8	8	8	8	8

CASE 1: Non - Amortising Bullet loan:

1mn,1 yr vs 5 yr, Term liq vs Avg, Now vs Before

CASE 2: Amortising loans.
5 yr, linearly amortising bullet loan.

Charge (Before) = ——————— =

Tenor-weighted (blended) Term liq. Premium

≡ Funding reqd somewhere between & yrs.

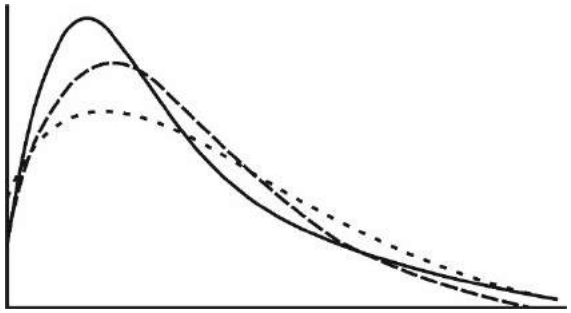
Average cost of funds?

CASE 3: Mortgage (pre - payable)
(Unknown Prepayment timing/amount)

Bundle mortgages into Monthly vintages.

Model repayment history over time check if similar

$$WAL = \sum_{i=1}^{n} \frac{Pi}{P} t_i$$



CASE 4: Deposits: more credit for "sticky"/long tenor.
(more credit to core deposits, less to "hot")

Avg cost: Over compensates short tenors. & undercompensates long tenors.

(no distinct ⁿ b/w Core & hot)

Structural liq risk↑

Demand deposits ≡ O/N Term Liq. Premium (~ Zero, Discourages)

CONTINGENT LIQUIDITY RISK

LIQUIDITY CUSHION: buffer of highly liquid, unencumbered assets to help survive periods of unexpectedly high funding outflows.

Only idiosyncratic scenarios.

Questionable marketability (illiquid, correlated encumbered)

Short term funding of cushion. (funding always, available, S/T disruption) (minimize negative cost of carry, low incentive to attribute back to business).

Poor attribution of cost of carry.

$$\$\ cost\ of\ carry = V * (r_{S/T} - r_f)$$

$$liquidity\ premium = (\$\ cost\ of\ carry) \Big/ Assets$$

FTP = base rate (swap curve) + term liquidity premium + liquidity premium

- ❑ All assets have some risk. (distortions)
- ❑ Risk in liabilities? (run offs)
- ❑ Businesses have different liquidity needs in stress.
- ❑ Not granular enough @ product level.

1. IDENTIFY CONTINGENT COMMITMENTS

- ❑ Retail deposit run – off
- ❑ Wholesale funding run-off
- ❑ Draw downs on lines of credit.
- ❑ Collateral calls on derivatives.
- ❑ Secured funding run - off

2. STRESS TESTING

(idiosyncratic & systemic & combination)

Stress ≡ overall risk tolerance, structural liquidity gap, Complexities of on & off-balance sheet activities.

- ❑ Size: variety of scenarios, net vs inflows
- ❑ Composition: Larger prop. Of cash & G-secs.
- ❑ marketability: relation to stress scenario, survival period, factors: valuation, mkt depth, central bank eligible, bank's rating & participation in mkt)

3. CALCULATE COST OF CARRY

(Ensure haircuts have been applied)

(Apply higher funding costs-it can take longer.)

4. RECOUP COST OF CARRY

@ most granular level (BU/product/trade) based on predicted/expected usage.

$$E.g. \frac{Limit - Drawn\ Amt}{Limit} * \frac{\Pr(drawdown)}{(Drawdown\ factor)} * Cost\ of\ cushion$$