**Abstract:** Banks are ‘risk machines’: they take risks, they transform them, and they embed them in banking products and services. The risk environment has changed drastically. Banking failures have been numerous in the past. Banks try to minimize their losses by managing risks with risk measurements for supporting decisions in the process we discussed above. Current risks are tomorrow’s potential losses. Risk measurement is a conceptual and practical challenge, which probably explains why risk management suffered from a lack of credible measures. This article is an attempt to identify key risks and analyzing measures for reducing exposure to bad influence as much as possible.

**Key words:** Risk Management, Types of Risk, Risk Measures

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**Introduction:**

**The Changing Bank Environment**

In the past decade, rapid innovations in financial markets and the internationalization of financial flows have changed the face of banking almost beyond recognition. Technological progress and deregulation have both provided new opportunities for and increased competitive pressures among banks and non-banks alike.

The field of risk management has undergone an enormous change in the last 30 years and pace of change is accelerating.

The growth in international financial markets and a greater diversity of financial instruments have allowed banks wider access to funds. At the same time, markets have expanded, and opportunities to design new products and provide more services have arisen. While the pace of these changes appears to be quicker in some countries than in others, banks everywhere are generally becoming more involved in developing new instruments, products, and services, and techniques.

Traditional banking practice—based on the receipt of deposits and the granting of loans—is today only one part of typical banks’ business, and is often its least profitable.

Banks make money in one of two ways: providing services to customers and taking risks. For example, retail banks take in customers’ deposits, and provide them with the services of check clearance and safe storage. Retail banks also take risks by giving out personal loans and taking the risk that some of loans may not be repaid. The bank is willing to...
take that risk if it is able to charge the customers a high rate of interest.

Of a bank takes more risk it can expect to make more money, but greater risk also increases the danger that the bank could lose badly and be forced out of business.

Banks must run their operations with two goals in mind: to generate profit and to stay in business. Banks therefore try to ensure that their risk taking is informed and prudent. The control of that gambling is the business of risk management.

Banks need a sense of caution in a liberal credit environment, but they also need the courage and wisdom to take reasonable risks when credit tight. Financial institutions succeed as long as the risks they assume are prudent and within defined parameters of portfolio objectives. This means policies and procedures must ensure that exposures are properly identified, monitored, and controlled, and that loan pricing, terms, and other safeguards against nonperformance or default are commensurate with the levels of risk that banks assume.

Bank failures are the result of lax credit standards, ineffectual portfolio risk policies, risks assumed beyond limits of banks capital, misreading performance barometers and neglecting technological upgradations (both system wide and specific), loan exposure, and ineffective risk rating systems.

The primary function of risk management is to ensure that the total risk being taken is matched to the banks capacity for absorbing losses in case things go wrong. A second reason for understanding risk is to help bankers direct the scarce resource of capital to the opportunities that are expected to create the maximum return with the minimum risk.

Risk management is the discipline that clearly shows management the risks and returns of every major strategic decision at both the institutional level and transaction level. Moreover, the risk management discipline shows how to change strategy in order to bring the risk return trade-off into line with the best long and short-term interests of the institution.

Financial risks are also subject to complex interdependencies that may significantly increase a banks overall risk profile. For example, a bank engaged in the foreign currency business is normally exposed to currency risk, but will also be exposed to additional liquidity and interest rate risk if the bank carries open positions or mismatches in its forward book.

Operational risks are related to a banks overall organization and functioning of internal systems, including computer-related and other technologies, compliance with bank policies and procedures, and measures against mismanagement and fraud. Business risk are associated with a banks business environment, including macroeconomic and policy concerns, legal and regulatory factors, and overall financial sector infrastructure and payment system. Event risks include all types of exogenous risks which, if they were to materialize, could jeopardize a banks operations or undermine its financial condition and capital adequacy.

1. Risk and financial institutions

What exactly is risk? How much risk does the bank have? Is it too much? If it is too much, how do we decrease it? How much does it cost to reduce the exposure? Do we profit from the risk exposure? If so, is the amount of profit worth the risk? It is noteworthy that it is difficult to give a single, short, simple answer to any one of these questions.

Many people see banks and other financial services companies as conservative risk-averse organizations. Nothing could be further from truth. Banks and insurance companies are in the business of managing and pricing risk. In essence they seek opportunities where the market price for accepting risk is higher than their own assessment of its likely cost.

Just therin risk has always been used somewhat casually to mean the chance that events will not unfold the way we expect. Every banker knows what that means. If we make a loan, there is some risk that the borrower will not pay us back. We call that credit risk.

The future is uncertain. But risk is not the same as uncertainty. Some uncertain out-
comes are risky while others are not. Risk is the possibility that an uncertain outcome or event might have an undesirable consequence. In the extreme, the most undesirable consequence is bank failure. Of course, bank failure is just one possible undesirable consequence and not all possibilities are equally probable.

Banks, thrifts, and credit unions are primarily financial intermediaries. Banks—and we use this term to describe all financial intermediaries—rent money from depositors who want it back on demand or at maturity dates rarely more than a few years in the future. Bankers then lend or invest that money in a variety of assets with maturities as long as 30 years. Economists call the latter activity “maturity transformation”. In the process of performing these basic functions, a bank takes credit risk because it has an obligation to repay the depositors regardless of whether or not its own loans are repaid. The maturity transformation process exposes banks to liquidity risk. Also, banks accept interest rate risk because the timing and size of changes in the rates that they receive from their assets rarely match the timing and size of rate for their liabilities (Matz 2004, pp. 1-1; 1-15).

In other words, what we have just defined as credit risk, liquidity risk, and interest rate risk are inherent in the core economic function of banks as financial intermediaries. And, while those are often seen as the three most important risks, they are not the only risks faced by financial institutions.

The risks that banks undertake can be looked at many different ways. Inconveniently, different observers tend to define and name the risks inherent in the business of banking somewhat differently.

Banking risks are defined as adverse on profitability of several distinct sources of uncertainty. Risk measurement requires capturing the source of the uncertainty and the magnitude of its potential adverse effect on profitability. Profitability refers to both accounting and mark-to-market measures.

Banks are subjected to wide array of risks of their operations, as illustrated by Figure 1.

In general, banking risks fall into four categories: financial, operational, business, and event risks. Financial risks in turn comprise two types of risk. Pure risks—including liquidity, credit, and solvency risks—can result in loss for a bank if they are not properly managed.
Speculative risks, based on financial arbitrage, can result in a profit if the arbitrage is correct, or a loss if it is incorrect. The main categories of speculative risk are interest rate, currency, and market.

1.2 Credit risk

Credit risk is the first of all risks in term of importance. Default risk, a major source of loss, is the risk that customers default, meaning that they fail to comply with their obligations to service debt. Default triggers or partial loss of any amount lent to the counterparty. Credit risk is also the risk of a decline in the credit standing of an obligor of the issuer of bond or stock. Such deterioration does not imply default, but it does imply that the probability of default increases. In the market universe, a deterioration of the credit standing of a borrower does materialize into a loss because it triggers an upward move of the required market yield to compensate the higher risk and triggers a value decline. “Issuer” risk designates the obligors credit risk, to make it distinct from the specific risk of a particular issue, among several of the same issuer, depending on the nature of the instrument and its credit mitigants. The view of credit risk differs for the banking portfolio and the trading portfolio (Allen 2003, p. 75).

Credit risk is critical since the default of a small number of important customers can generate large losses, potentially leading to insolvency. There are various default events: delay in payment obligations, restructuring of debt obligations due to a major deterioration of the credit standing of the borrower, bankruptcies. Restructuring is very close to default because it results from the view that the borrower will not face payment obligations unless its funding structure changes. Plain defaults imply that the non-payment will be permanent. Bankruptcies, possibly liquidation of the firm or merging with an acquiring firm, are possible outcomes. They all trigger significant losses, standing of a borrower does materialize into a loss because it triggers an upward move of the required market yield to compensate

the higher risk and triggers a value decline. Credit risk is a factor in every business. It exists whenever payment or performance to a contractual agreement by another organization is expected, and it is the likelihood of a loss arising from default or failure of another organization.

Credit risk and the methods to manage it depend to certain extent on the size and complexity of exposures. Financial institutions, such as banks, investment dealers, trust companies, and credit unions, typically have significant credit exposure due to their emphasis on lending and trading. Credit or counterparty risk-defined as the chance that a debtor or financial instrument issuer will not be able to pay interest or repay the principal according to the terms specified in a credit agreement— is an inherent part of banking. Credit risk means that payments may be delayed or ultimately not paid at all, which can in turn cause cashflow problems and affect a bank’s liquidity. Despite innovation in the financial services sector, credit risk is still the major single cause of bank failures. The reason is that more than 80 percent of banks balance sheet generally relates to this aspect of risk management. The three main types of credit risk are follows:

- personal or consumer risk
- corporate or company risk
- sovereign or county risk

Because of potentially dire effects of credit risk, it is important to perform a comprehensive evaluation of a bank’s capacity to assess, administer, supervise, enforce, and recover loans, advances, guarantees, and other credit instruments. An overall credit risk management review will include an evaluation of credit risk management policies and practices of a bank. This evaluation should also determine the adequacy of financial information received, from a borrower or the issuer of a financial instrument, which has been used by a bank as the basis for investing in such financial instruments or the extension of credit, and the period assessment of its inherently changing risk.
Poor economic conditions and high interest rates contribute to the likelihood of default for many organizations. Credit or counterparty failure is also more likely when an organization has accumulated large losses, owes many other organizations creditors or counterparties have financial difficulty or have failed.

1.2 Interest rate risk

The potential that changes in market rates of interest will reduce earnings and/or capital. The risk that changes in prevailing interest rates will adversely affect assets, liabilities, capital, income, and/or expense at different amounts. Interest rate risk has four components:

- basis risk,
- mismatch risk,
- option risk and
- yield curve risk.

1.2.1 Basis risk

The risk of rates for some instruments changing more or less than rates for other instruments. Basis risk is the risk of adverse consequence resulting from unequal changes in the difference - the spread- between two or more rates for different instruments with the same maturity. Banks, especially consumer-oriented banks, typically incur basis risk because the rates paid on their liabilities are determined differently than the rates received from their assets.

Basis risk is not trivial. In fact, basis risk typically comprises an estimated 2 to 50 percent of the losses to earnings or capital from typical changes in interest rates. This very wide range in the estimated importance of basis risk is attributable to two factors. First, the relative impact is considerably smaller during periods when interest rates change by very large amounts. For this reason, it is unfortunate that most of the attention given to IRR in most banks - both by those who measure it and those who manage it – is devoted to repricing or mismatch risk. Second, basis risk is much larger in some banks, especially retail banks, than in others.

Unfortunately, one of the most common tools used to measure interest risk is smaller financial institutions-gap analysis-does not readily capture basis risk. Regulators are increasingly focusing on basis risk, however.

1.2.2 Mismatch risk

The risk of rates moving up or down; also called duration, gap, or repricing risk. Mismatch risk is the most familiar form of interest rate risk. It is the risk of adverse consequence from a change in interest rates that arises because of differences in the timing of when those interest rate changes affect an institution's assets and liabilities.

It is commonly assumed that almost all IRR takes the form of mismatch risk. This is a serious misconception. Experts estimate that less than half of all interest rate risk results from yield curve or mismatch risk.

Gap or mismatch analysis measures the sensitivity of an exposure, asset, or portfolio to market rate or price changes by considering the mismatch between assets and liabilities.

When there is mismatch between assets and liabilities, or cash inflows and cash outflows, there is exposure and an opportunity for loss.

1.2.3 Option risk

The risk that rate changes prompt changes in the amount or maturity of instruments. Technically, embedded options are put or call options given or sold to holders of financial instruments. In banking these are more familiarly known as borrower options to prepay loans and depositor options to make deposits, withdrawals, and early redemptions. Option risk arises whenever bank products give customers the right, but not the obligation, to alter the quantity or timing of cash...
flows. The risk of embedded options can be seen in residential mortgages. Most bank residential mortgage loans give borrowers the right to prepay the loans in whole or in part at any time. These loans prepay rapidly during periods when prevailing interest rates have fallen below loan rates. When prevailing interest rates have above loan rates, these loans prepay very slowly, if at all. Option risk is not an insignificant component of IRR either. Embedded option risk is estimated to compromise 20 to 25 percent of all interest risk in average banks.

1.2.4 Yield Curve Risk

The risk of short-term rates changing by more or less than the change in long-term rates. Also called yield curve twist risk, yield curve risk is the risk of adverse consequences resulting from unequal changes in the spread between two or more rates for different maturities for the same instrument. For a bank as a whole, yield curve twist risk is estimated to compromise 5 to 10 percent of total interest risk.

1.3 Market risk

Market risk is the risk of adverse deviations of the mark-to-market value of trading portfolio, due to market movements, during the period required to liquidate the transactions.

Market risks refers to risks arising from adverse movements in market price or rate, for example, interest rates, foreign exchange rates, or equity prices. Traditionally, management and regulators focused strictly on credit risk. In recent years, another group of assets have come under scrutiny - assets typically traded in financial markets (Glanz 2003, pp. 4; 388).

Liquidation involves asset and market liquidity risks. Price volatility is not the same in high-liquidity and poor-liquidity situations. When liquidity is high, the adverse deviations of prices are much lower than in a poor-liquidity environment, within a given horizon. 'Pure' market risk, generated by changes of market parameters (interest rates, equity indexes, exchange rates), differs from market liquidity risk. This interaction raises important issues. What is the 'normal' volatility of market parameters under fair liquidity situations? How sensitive are the prices to liquidity crises? The liquidity issue becomes critical in emerging markets. Prices in emerging markets often diverge considerably from a theoretical 'fair value'.

Market risk does not refer to market losses due to causes other than market movements, loosely defined as inclusive of liquidity risk. Any deficiency in the monitoring of the market portfolio might result in market values deviating by any magnitude until liquidation finally occurs. In the meantime, the potential deviations can exceed by far any deviation that could occur within a short liquidation period. This risk is an operational risk, not a market risk.

In order to define the potential adverse deviation, a methodology is required to identify what could be a 'maximum' adverse deviation of the portfolio market value. This is the VaR methodology. The market risk VaR technique aims at capturing downside deviations of prices during a preset period for liquidating assets, considering the changes in the market parameters. Controlling market risk means keeping the variations of the value of a given portfolio within given boundary values trough actions on limits, which are upper bounds imposed on risks, and hedging for isolating the portfolio from the uncontrollable market movements.

1.4 Liquidity risk

Liquidity risk refers to multiple dimensions: inability to raise funds at normal cost, market liquidity risk, asset liquidity risk.

Funding risk depends on how risky the market perceives the issuer and its funding policy to be. The cost of funds depends on the banks credit standing. If the perception of the credit standing deteriorates, funding becomes
more costly. The problem extends beyond pure liquidity issues. The cost of funding is a critical profitability driver. The credit standing of the bank influences this cost, making the rating a critical factor for a bank.

The liquidity of market relates to liquidity crunches because of lack of volume. Prices become highly volatile, sometimes embedding high discounts from par, when counterparties are unwilling to trade. Funding risk materializes as much higher cost of funds, although the cause lies more with the market than the specific bank. Market liquidity risk materializes as an impaired ability to raise money at reasonable cost (Horcher 2005, pp. 9; 47; 205).

Asset liquidity risk results from lack of liquidity related to the nature of assets rather than the market liquidity. Holding a pool of liquid assets acts as a cushion against fluctuating market liquidity, because liquid assets allow meeting short-term obligations without recourse to external funding. This is rationale for banks to hold a sufficient fraction of their balance sheet of liquid assets, which is a regulatory rule. The 'liquidity ratio' of banks makes it mandatory to hold more short-term assets than short-term liabilities, in order to meet short-run obligations. In order to fulfill this role, liquid assets should mature in the short-term because market prices of long-term assets are more volatile, possibly triggering substantial losses in the event of sale.

Liquidity risk might become a major risk for the banking portfolio. Extreme lack of liquidity results in bankruptcy, making liquidity risk a fatal risk. However, extreme conditions are often the outcome of other risks. Important unexpected losses raise doubts with respect to the future of the organization and liquidity issues. When a commercial bank gets into trouble, depositors 'run' to get their money back. Lenders refrain from further lending to the troubled institution. Massive withdrawals of funds or the closing of credit lines by other institutions are direct outcomes of such situations. A brutal liquidity crisis follows, which might end up in bankruptcy.

1.5 Operational risk

Operational risk is risk of direct or indirect loss resulting from inadequate or failed internal processes, people and systems or from external events. In essence, operational risk is an 'event risk'. There is a wide range of events potentially triggering losses. Operational risks appear at different levels

- People,
- Processes,
- Technical and
- Information technology.

'People' risk designates human errors, lack of expertise and fraud, including lack of compliance with existing procedures and policies.

Process risk scope includes:

- Inadequate procedures and controls for reporting, monitoring and decision making;
- Inadequate procedures on processing information, such as errors in booking transactions and failure to scrutinize legal documentation;
- Organizational deficiencies;
- Risk surveillance and excess limits: management deficiencies in risk monitoring, such as not providing the right incentives to report risks, or not abiding by the procedures and policies in force;
- Errors in the recording process of transactions;
- The technical deficiencies of the information system or the risk measures (Van Deventer et al. 2005, pp. 5; 47; 75).

Technical risks relate to model errors, implementation and the absence of adequate tools for measuring risks. Technology risks relate to deficiencies of the information system and system failure.

1.6 Foreign exchange risk

The currency risk is that of incurring losses due to changes in the exchange rates. Vari-
ations in earnings result from the indexation of revenues and charges to exchange rates, or of changes of the values of assets and liabilities denominated in foreign currencies.

Foreign exchange risk is a classical field of international finance, so that we can rely on traditional techniques there without expanding them.

The rearrangement of business processes to reduce risk a form of internal hedging. It may involve effort but can be a viable means to reduce exposure and risk. Dependig on the approach to foreign exchange risk, an organization might undertake internal hedging approaches where aviable and supplement with derivates for some or all of the remaining exposure.

The conversion risk resuls from the need to convert all foreign currency-denominated transactions into a base reference currency. This risk does exist, beyond accounting conversion in a single currency, if the capital base that protects the bank from losses is in local currency. A credit loss in a foreign country might result in magnified losses in local currency if the local currency depreciates relative to the currency of the foreign exposure.

1.7 Other risks

1.7.1 Country risk

Country risk is , loosely speaking, the risk of a ‘crisis’ in country. There are many risks related to local crises, includung:

- Sovereign risk, whish is the risk of default of sovereign issuers, such as central banks or government sponsored banks. The risk of default often refers to that of debt restructuring for countries;
- A deteration of economic conditions;
- A deteration of the value of the local foreign currency in terms of the banks base currency;
- the impossibility of transferring funds from the country, either because there are legal restrictions imposed locally or because the currency is not convertible any more;
- A market crisis triggering large losses for those holding exposures in the lokal markets;

1.7.2 Performance risk

Performance risk exist when the transac- tion risk depends more on how the borrower performs for specific projects or operations than on its overall credit standing.

Performance risk appears natably whn dwaling with commodities. As long as delivery of commodities occurs, what the borrower does has little importance. Performance risk is ‘transactional’ because it relates to specific transaction.

2.1 Risk measures and probability distributions

Risk management relies on quantitave mesures of risks. There are varios risk measures. All aim at capturing the variation of a given target variable, such as earnings, mar- ket value or losses due to default, generated by uncertany. Quantitative indicators of risks fall into three types:

- Sensitivity, which captures the deviation of a target variable due to a unit movement of single market parametar (for instance, an interest rate shift of 1%). Sensitivities are often market-risk-related because they relate value changes to market parameters, whish are value drivers. The interest rate gap is the sensitivity of the interest margin of the banking portfolio to forfeit move of the yield curve. Sensitivities are variations due to forfeit moves underlying parameters driving the value of target vari- ables;
- Volatility, whish captures the variations around the average of any random parameter or target variable, both upside and downside. Unlike forfeit movements, volatility charac- terizes the varying instability of any uncertain parameters, wich forfeit changes ignore. Volatility mesaures the disperzion around its mean of any random parameter or of target variables, such as losses for credit risk;
- Downside mesaures of risk, whish fokus
on adverse deviations only. They characterize the 'worst-case' deviations of a target variable such as earnings, market values or credit losses, with probabilities for all potential values. Downside risk measures require modelling to have probability distributions of target variables. The 'Value at Risk' (VaR) is a downside risk measure. It is adverse deviation of a target variable, such as the value of transation, not exceeded in more than a preset fraction of all possible future outcomes. Downside risk is the most comprehensive measure of risk (Marrison 2002, p. 15).

Also very important for measuring risk is the relationship between capital, risk and default. The difference between value of assets minus the value of liabilities is called capital.

While the concept of assets and liabilities is fairly straightforward, the real-life interplay between the two is somewhat complex, as the value each can change daily.

This affects available capital, which impacts the bank’s ability to pay its debts. For analyzing and managing banking risk are interesting three parameters:

- ROE (return on equity) = Final Equity – Initial Equity / Initial Equity.
- RAROC (Risk-Adjusted Return on Capital) = ENP / EC.

RAROC is the expected net risk-adjusted profit (ENP) divided by the economic capital (EC) that is required to support the transaction.

In reality, there are an infinite number of possible outcomes for the asset value. We represent the distribution of these possible outcomes with a probability density function.

**Introduction to probability distributions**

In reality, there are an infinite number of possible outcomes for the asset value. We represent the distribution of these possible outcomes with a probability density function. Figure 2 shows a typical probability density function for credit losses. Along the x-axis is the value of the assets. The height of the function in the y-axis gives the probability of any given loss occurring. From this distribution we can see the probability of the asset value falling below the debt value. The probability of this happening is the area in the tail. The probability distribution for the second case, with extra equity, looks like Figure 3 with very low probability of default. The probability distribution for the third case, with extra risk, looks like Figure 4. Notice that the shape of the distribution on Figure 4 has changed as the risk of the assets changes.
Extra uncertainty increases the probability of default.

Conclusion

Risk management has been a challenge for as long as there have been markets and price fluctuations and risks arise from an exposure to financial markets, its transactions with others, and reliance on processes, systems, and people.

An independent risk oversight function gives management a level of comfort and answers the question "Who is looking after risk management".

Many bankers profess their commitment toward shareholder value concepts. However, unless they truly analyze the implications of their strategies on market value of equity and overall bank volatility risk, a healthy dose of skepticism is warranted.

The 80/20 rule pays large dividends. This is golden rule. It has served to attention focused on the "forest", rather than become mired in the "twigs", of analytical complexity and detail.

Market signals are useful for pricing risk. The cost of capital, the hurdle ROE, the borrowing spread over Treasuries, and many other "risk pricing" dimensions can be derived from available market information.

There is no free lunch in economy. Higher returns are usually associated with increased risk. However, it is always worthwhile to explore any available diversification opportunities.

Be consistent in all evaluations. It is terribly hypocritical to monitor the riskiness of the market value of equity for ALCO purposes, but to have all internal incentives based on some type earnings measure.

Teams play fair if the game is fair. If the criteria used to judge performance are arbitrary, unclear, or unfair, politics and internal competition can be very destructive.

Everything depends on everything else.

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