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LIQUIDITY RISK MANAGEMENT IN THE BANKING BOOK: A PRACTICAL FRAMEWORK APPROACH TO BASEL III REGULATIONS

A dissertation presented

by

PIERRE CELESTIN NKOU MANANGA

Dissertation submitted in partial fulfilment of the requirements

for the degree of Master of Management in Finance & Investment

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FACULTY OF COMMERCE LAW AND MANAGEMENT

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Month Year

October 2012

DECLARATION

I, **Pierre Celestin Nkou Mananga,** declare that the research work contained in this dissertation is my own work, except where otherwise indicated and acknowledged. The dissertation is submitted in partial completion of Master degree of Management in Finance & Investment at the University of the Witwatersrand, Johannesburg. This dissertation has not, either in whole or in part, been submitted for a degree or diploma at any other university.

Signature……

At……..

Date……

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A dissertation presented

by

PIERRE CELESTIN NKOU MANANGA

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Prof KALU OJAH

DEDICATION

This thesis is dedicated to the shining star in my life, my adorable and most beautiful partner, **Shooheima Champion,** and to our extremely smart and beautiful daughters, **Chloé, Elle and Clémentine** For their everlasting love, support and encouragement throughout my studies at Wits Business School.

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Firstly, I would like to thank God, the father of Jesus Christ, for the life, health and wisdom which He bestowed on me during the course of this project. To my mother, Mbala Georgette Clementine, my thanks for her love and support throughout my existence. You taught me that being physically disabled was no obstacle to shooting for the stars and reaching for my goals and that education was my only ticket out of poverty – thank you.

I would like to offer my wholehearted thanks to Professor Kalu Ojah who endeavoured to set up the Master's degree in Finance and Investment at the Wits Business School and who supported me throughout my education at the Wits Business School.

To all my friends, thank you for standing by me. Your encouragement and understanding were vital to my completing this enterprise. Also your friendship makes my life an interesting journey.
This thesis is only the beginning of many more to come.

ABSTRACT

The recent market turmoil caused by the subprime crisis highlighted the fact that **an inappropriate liquidity risk management process** may strongly affect the capacity of banks to maintain their financial equilibrium and economic performance under stress conditions. In addition, it has been observed that the most significant challenge facing banks when they are adopting new regulations such as Basel I, Basel II and now Basel III is the imminent threat of imbalances between the interests of the shareholders and those of the regulator (Chabanel, 2011). This thesis proposes a **framework on liquidity risk management** in the banking book that a bank may adopt so as to improve the way in it could **manage the anticipated changes within tits regulatory environment.**

Keywords: *Basel II and III, liquidity and liquidity risk, funding risk, market liquidity, contractual maturity, behavioural maturity, liquidity cost, fund transfer pricing (FTP), stress testing and contingency plans, liquidity management principles*

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CHAPTER 1

1. UNDERSTANDING LIQUDITY: WHAT IS LIQUIDITY?

1.1 Introduction

As was highlighted by the recent banking crisis and the severe recession that ensued, and despite the fact that many banks had reported adequate regulatory levels of capital, banks nevertheless experienced adverse operating conditions as a result of **inadequate liquidity risk management frameworks**. In response to the **higher cost of liquidity**, larger funding spread, diminished market confidence and increased regulatory imperatives, many financial intermediaries, and especially banks, are hastening to embark on various programmes to strengthen their approach to liquidity risk management. Liquidity risk management is a synthesis of the sum of the risks that a bank may face as a result of the fact that liquidity risks materialise at the level of the balance sheet structure (Carrel, 2009).

According to SWIFT (2011), there is an additional imperative to improve the liquidity risk management capabilities of banks.

> "Liquidity risk is now included in the scope of Pillar II of the Internal Capital Adequacy Assessment Process (ICAAP), and it requires quantitative measures and reporting, complemented by improved monitoring and controls."

Policymakers are advocating fundamental reforms to change the way in which banks were previously regulated and supervised. Prudential measures are being mandated which focus not only on preventing, but at least mitigating, further liquidity crises and, most importantly, avoiding the necessity of governments and taxpayers being forced into unprecedented bailouts to contain the effects of the crisis.

Unlike other financial intermediaries, for example, insurance firms which are more concerned with risk transformation, the core activity of banks is maturity transformation, which may be explained in terms of the collection of deposits (short-term liabilities) in order to finance loans (long-term assets). However, this very maturity transformation activity creates a structural mismatch in the balance sheets of banks, leading to the birth of liquidity risk. Thus, **liquidity risk is inherent in the banking book**. That is, the likelihood that the mismatch between the timings of cash inflows and outflows might imperil prospective gains of bank largely long term assets, and thus jeopardizes bank's sustainability. An additional consequence of bank's maturity transformation is high leveraging of the banking industry such that banks intrinsically work on short term deposits and other short term funding sources thus enhancing the potential impact of any liquidity problem, both at a bank's specific and systemic crisis.

At its most elementary level, liquidity management is facile and comprises an optimal mix of positive and negative cash flows with investments or other funding sources. The level of liquidity risk in a bank is decided by whether or not this optimal combination has been achieved. In theory, a bank could eliminate the liquidity risk in its banking book by matching the cash flow of its assets and liabilities. However, such an approach is impossible from a market perspective as well as being highly impractical. For most banks, deposits constitute the major share of their liabilities and the majority of these deposits are redeemable on call. In addition, the maturity of banks' liabilities are ambiguous and, thus, difficult to match (Buehler & Santomero, 2008).
In other words, no bank is able to afford to hold enough liquid assets, contingent funding lines or sufficient liability duration to eliminate liquidity mismatch risk. Apart from the cost, supply/demand constraints within the local and international money and capital markets make it practically impossible for banks to eliminate liquidity mismatch risk. Thus, in view of the cost/market constraints no bank is able to eliminate the risk of "extreme liquidity stress events" and, at best, banks may plan for moderate to high stress events and hope that this will contribute to their avoiding more extreme liquidity problems. Central banks and regulators, often referred to as lenders of last resort, play a vital role in facilitating liquidity transfer and ensuring financial stability, particularly in view of the fact that banks are not able to eliminate the risks of extreme liquidity events and also that it is prohibitively expensive and practically impossible to eliminate liquidity risk in the banking book.

Accordingly, it is essential that a sound and adequate liquidity risk management framework be adopted by banks to mitigate the effect of an unanticipated liquidity squeeze. Accordingly, this thesis proposes a liquidity risk management framework based on Basel II principles while taking account of the recent Basel III regime. The researcher does, however, acknowledge the fact that such a framework is highly organisation specific. Nevertheless, while there is no universal, correct solution to liquidity risk management, certain generic, best practice principles are recommended although their integration into a bank liquidity risk management strategy will depend greatly on several individual circumstances.
The remainder of this thesis is structured as follows: Chapter 2 discusses the definition of liquidity and liquidity risk while chapter3 identifies the causes of a liquidity crisis. Chapter 4 is devoted to the liquidity management principles while chapter 5 extends the liquidity management principles by exploring the difficult subject of liquidity cost and pricing and the associated fund transfer pricing framework (FTP). Chapter 6 presents the conclusion to the current study and lays a foundation on possible areas of research.

CHAPTER 2

2. DEFINITION OF LIQUIDITY RISK

2.1 Definitions

It is almost impossible, if not difficult, to measure liquidity and liquidity risk without a proper definition of the two terms. Liquidity, as will be demonstrated, is an elusive concept with the meaning and general understanding of liquidity varying considerably. This statement is borne out by the fact that the empirical documentation of liquidity is not limited to one type of liquidity only. However, this thesis focuses on the following main types of liquidity:

- Market liquidity
- Funding liquidity
- Accounting liquidity
- Central bank liquidity

There are frequent references to both market and funding liquidity and their respective risks in the documentation of the Basel Committee of Banking Supervision (BCBS) and such references pertain to the liquidity analysis of the financial system as whole. According to Nikolaou (2009), the concept of central bank liquidity and its risks[1] is thoroughly explained while the concept of accounting liquidity is found mainly in books on financial accounting.

What is liquidity? How are the types of liquidity related? Is there even a link between the types of liquidity? These are the questions that this section will endeavour to answer.

Since the recent financial meltdown, during which governments and taxpayers were forced to intervene on a large and unprecedented scale to avoid the collapse of the financial system, the concept of liquidity has become the focal point of regulators, financial institutions and academics. Nevertheless, a uniform definition as well as an understanding of the notion of liquidity is still lacking. According to Crockett (2008), *"Liquidity is an elusive notion. It is easier to recognize than to define."*

[1] This section borrows intensively from Nikolaou (2009). Nikolaou lays out the path to a structural approach to understanding liquidity, liquidity risk, funding liquidity and market liquidity.

From an economic perspective, Williamson (2008) defines liquidity as the facility in terms of which an economic agent may exchange his/her existing wealth either for cash or for goods and services. From a practical perspective, liquidity refers to how inexpensively and quickly one may convert an asset into cash (About.com Economics, 2012). On closer inspection and from an intuitive angle, both of these definitions allude to the time, immediacy and flow concept which may be mathematically expressed as follows:

$$\text{outflows}_t - \text{inflows}_t \leq \text{warehouse liquidity}_t$$

In developing the framework in this study, liquidity will be referred to as the free flow, at a specific time, of cash or near cash instruments among the actors within the financial system. The next section will, according to the types of liquidity listed above, offer a definition of liquidity.

2.2 Accounting Liquidity

Accounting liquidity, which is used mainly by credit analysts to assay the ability of a firm to satisfy its debt obligation, may be broadly defined as an aptitude assessment of a company's balance sheet strength as regards meeting its obligations as and when they fall due. Accounting liquidity is expressed as follows, as a ratio (short-term solvency ratios) of current liabilities:

$$\text{current ratio} = \frac{\text{current assets}}{\text{current liabilities}}$$

The current ratio is an indication of a company's coverage of its current liabilities by its current assets. For example, if the ratio is 2:1, the company will be able to realise half of the values stated in the balance sheet in liquidating its current assets and still have sufficient funds to service all its current liabilities.

$$\text{acid-test ratio} = \frac{\text{current assets - inventories}}{\text{current liabilities}}$$

The acid-test ratio or, as it is commonly known the quick ratio, is obtained by subtracting prepayments and inventories from current assets and then dividing the net number by the current liabilities. The quick ratio measures the ability of a company to meet current liabilities from liquid and most marketable assets.

$$\text{operating cash flow ratio} = \frac{\text{operating cashflow}}{\text{current liabilities}}$$

The operating cash flow ratio is obtained by dividing the operating cash flow by current liabilities. This demonstrates the ability of a firm to service its liquid liabilities (current debt) from liquid assets (current income), rather than through asset liquidation.

These ratios have major weaknesses, however, and are of limited use as regards liquidity risk management. In addition, they ignore the composition of both current assets and current liabilities.

2.3 Market Liquidity

Financial practitioners appear to have finally reached consensus on the concept of market liquidity, although the concept was first introduced by **Keynes in 1930**. A number of researchers recently defined market liquidity as an asset's ability to be traded promptly without significant price movement and at a price close to its value, that is, no sizeable haircut may have to be incurred to achieve immediacy. Recent empirical studies such as Chordia, Sarkar, & Subrahmanyam (2003), Vermaelen (1981) and Brunnermeier & Pedersen (2009) have highlighted the salient features of market liquidity which can be summarised as follows:

- Market liquidity is strongly correlated with both market dynamics and market volatility.
- Market liquidity is susceptible to "flight to quality" and may, therefore, dry up unexpectedly.
- Market liquidity is the same for all traded securities.

In addition, Deutshe Bundesbank (2008) points out those market participants endogenously determine transaction costs by their supply and demand behaviour. Furthermore, transaction costs are a key determinant of market liquidity and are usually subdivided into the following four essential components:

- The tightness of the market, which is calculated using bid-offer spread and which determines the price of unwinding a position at short notice.
- The depth of the market, which is closely related to the notion of liquidity or liquid market. This is an evaluation of which transaction volume may be realised instantaneously without distressing prices.
- The resiliency of the market, which refers to the velocity at which market prices return to equilibrium after a sizable transaction.
- The notion of immediacy, which is the measure of time from the initiation of a market transaction to its completion.

More importantly, Yi-Mien, Shwu-Jen, & Min-Shen (2012) argue that: *"Market liquidity and market liquidity risk have no significant association with information asymmetry."*

However, from a market participant perspective, information asymmetries coalesced with fear will increase transaction costs and negatively affect market liquidity. Deutshe Bundesbank (2008) established that a strong correlation exists between market liquidity and funding liquidity, and that *"a reduction in market*

liquidity can adversely impact funding liquidity, particularly when transaction costs increase and market liquidity falls in stress situations, the funding of banks becomes more expensive."

From a banking book perspective, the area of market liquidity with which this study is more concerned is the **interbank market**[2] as well as the **asset market**[3] where securities are traded. These two categories are the main source of a bank's funding liquidity.

2.4 Funding Liquidity

Drehmann & Nikolaou (2010) define funding liquidity as *"the ability to settle obligations with immediacy. Consequently, a bank is illiquid if it is unable to settle obligations."* In its principle underpinning sound liquidity risk management and supervision, the Basel Committee on Banking Supervision outlines funding liquidity as the ability to repay or refinance liabilities, unwind and settle trades as they mature. The International Monetary Fund (IMF) through its Global Financial Stability Report (October 2010) also incorporated the notion of solvency in its definition of funding liquidity risk. Although solvent, funding liquidity refers to the ability of an institution to raise funding and to make agreed-upon payments timeously.

It must be noted that all these definition are complementary. In addition, it is essential to point out that funding liquidity is neither an amount nor a ratio and that, on the contrary, it conveys the degree to which an institution is capable of fulfilling its respective commitments. It is important to understand these concepts in order to understand the consequential nature of liquidity risk better.

2.5 Central Bank Liquidity

Central bank institutions such as the South African Reserve Bank, the Bank of England and the US Federal Reserve are charged with achieving and maintaining price stability and public confidence through the regulation of the size of a nation's base money or M-zero (M0), which is, in turn, closely related to the supply of cash and reserves in the economy, the availability and cost of credit and the foreign-exchange value of the nation's currency (Britannica Online Enciclopedia, 2012).

Central bank liquidity refers primarily to the competency of the central bank to supply the liquidity needed to the economy (Nikolaou, 2009a). The central bank actively manages interest rates; acts as a lender of last resort and sets regulatory principles and reserve requirements for the banking sector, all of which in turn transmit the monetary policy of the central bank to the economy.

---

[2] Money market created by the short-term funding needs of banks, which borrows from banks with surplus funds. The interest rate charged on these loans is the interbank rate.

[3] Asset markets include OTC, exchanges and open market operations.

From an operational perspective and as part of its efforts to drain out or supply liquidity and influence the level of interest rates in the economy, the central bank conducts open market operations (OMO) which comprises an auction sale or purchase to banks of government debt instruments (bonds, treasury bills, debentures) government debt instruments purchased by banks are classified in the balance sheet as liquid or marketable assets. These assets (liquid and marketable) are repurchased on a weekly basis by the central bank in the "repo market" to inject liquidity in the financial system. Additionally, banks trade these assets in the financial market in the form of collateral transactions to meet various liquidity requirements in their balance sheet.

The point of what we a making is that Central Banks provide or drain liquidity in the financial system by issuing financial instruments such a Treasury Bill and debentures and buying them back through the repo market in addition, for example in South Africa, banks and as per the Basel Committee on Banking Supervision, banks are obligated to hold a percentage of marketable and liquid assets to total deposits as a sort of deposit insurance in the event of a bank run.

2.6 Liquidity Risk

Before delving into the concept of liquidity risk and associated management principles, we have attempted to present liquidity in a simple and intuitive way without mentioning risk. We remind ourselves that **liquidity** as provided by different actors in the financial market **is a flow concept** an unhindered flow of cash which is heavily dependent on time. Liquidity lives in the present as a binary concept: you are either liquid or not. Whereas liquidity risk is mostly concern with the future it is an anticipated state of the maturity mismatch of current assets and liabilities. At a basic level, care should be taken not to confuse liquidity and capital as capital could be illiquid. Liquidity risk materialises at the illiquidity position of bank as illustrated by GARP (2007): Even though a bank could be well-capitalised, to be illiquid (as opposed to be liquid) means to need more time as funds are coming (but not quickly enough) or assets may be sold (but not immediately without incurring a haircut or a loss).

In general, risk refers to the probability of an occurrence of expected and/or unexpected undesirable outcome (tail events in the probability distribution). Nevertheless, liquidity risk undertaking by banks remains an essential factor in an efficient global economy. Liquidity risk enterprise by banks (mismatch between short term liabilities and long term assets) adds value but only up to some point which is regrettably ambiguous or not known (Bardenhewer & Schnider, 2011).

Liquidity risk is a major and intrinsic part of the banking business model and it is not possible for banks to shy away from it. In order to meet the demands of both depositors and borrowers simultaneously, banks convert short-term deposits into long-term loans with this activity being known as maturity transformation. However, this maturity transformation activity exposes banks to the following three major risks, firstly, credit risk as banks are contractually obligated to repay the depositor's capital plus interest regardless of whether or not its own loans are cash positive; secondly, banks also take on interest rate risk as a result of timing

differences between the change in asset and liabilities rates; and finally, as a result of maturity transformation banks assume an extensive degree of liquidity risk Matz (2004a) which is depicted pictorially in figure 2.1

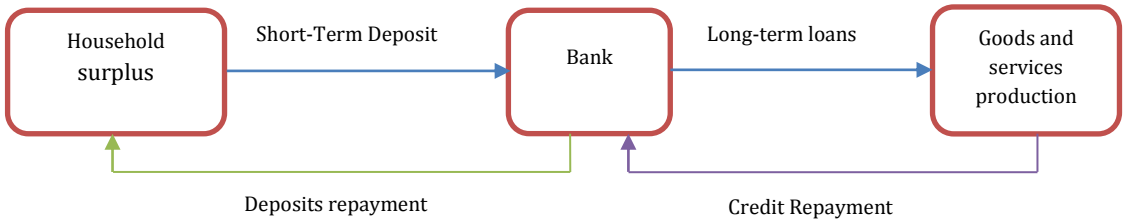


Figure 2.1: Maturity transformation

The nature of maturity transformation means that, structurally, banks invest significantly in both illiquid assets and in deposits which are highly liquid liabilities. If borrowers were unable to secure long-term funding to support long-term investments, there would be limited investment in support of economic growth. This makes liquidity risk a complex operational risk. This state of affairs arises from both anticipated and unanticipated risks, namely, tail risks that are highly consequential with their own intrinsic characteristics that may be exacerbated by market distress, counterparty failures, systemic risks and internal imbalances or as a result of the coalesced effects of those shocks see figure 2.2. Carrel (2009) maintains that *"liquidity risk cannot be hedged with a process but through a culture of risk management that aims at routinizing the unexpected."*

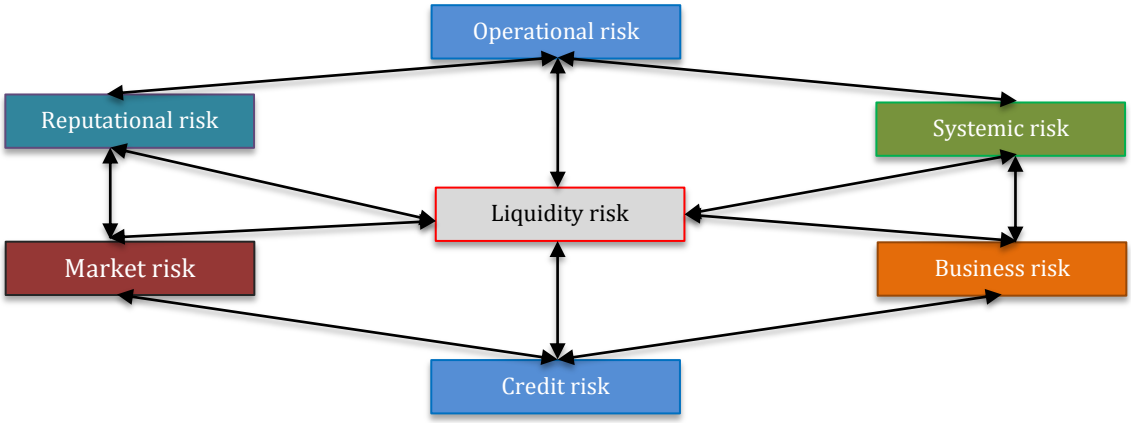


Figure 2.2: Liquidity risk as a consequential risk[4]

[4] Adapted from Bartetzky (2008) and Duttweiler (2009)

2.7 Market Liquidity Risk

Market liquidity risk has to do with a funding problem in both the money and the capital markets and is the risk that an institution may not be able either to fulfil its obligations (i.e. collateral, margin requirements) or to trade financial instruments at prevailing mark to market prices as a result of a market disruption or a lack of market liquidity. Market risk liquidity arises from the lack of marketability of a financial contract that may not be bought (entry) or sold (exit) immediately without incurring a significant haircut. Nikolaou (2009) maintains that market liquidity risk is the systematic, non-diversifiable element of liquidity risk while Vento & La Ganga(2009) note that market liquidity risk is the risk that a financial institution such a bank will be unable to easily offset or close out a position without considerably affecting the market price because of deficient market depth or market disruption. The consequences of market (systemic) liquidity risk have the following manifestations:

i. Money and capital market disruption

Money and capital market disruption is associated mainly with the concept of **"flight to quality"**, in terms of which there is a build-up of liquidity in some markets, a decreased level of liquidity in other markets and a preference for holding onto highly liquid assets. This phenomenon may be either short or long term until equilibrium is restored, depending on certain factors.

ii. Payment system disruption

Banks are intimately interconnected (i.e. interbank connection). However, the interbank payment system may become illiquid after major disruption stemming from changes in participants' behaviour, as well as gridlocks in operations (clearing and settlements) that, in turn, reduce liquidity in the financial market.

iii. Macroeconomic crisis (credit crunch or asset price bubble)

A credit crunch, as witnessed with the recent financial crisis, is typically associated with banks hoarding cash and not being willing to extend loans and advances in anticipation of a decline in the value of collaterals which banks use to secure loans from qualifying borrowers. This, in turn, impacts on the ability of these borrowers to refinance their debt. At the other extreme, a credit crunch in an overheated economy is caused by unsustainable high asset prices, resulting in a major correction or price collapse.

iv. Contagion by association

Gropp & Vesala (2004) maintain that shocks which initially affect one or a few banks only may be significant both domestically and across borders, and may spread throughout the economy by way of contagion. Contagion develops from interbank exposures as a result of which the probability increases of a number of banks simultaneously experiencing a tail event. Allen & Babus (2007) investigated the intertwined nature of the global market and concluded that that it is difficult to anticipate the consequences that may be attributed

to an interconnected financial system. Furthermore, what was primarily perceived as misfortune specific to the United States as a result of the subprime mortgage market quickly magnified and spilt over to both global money and capital markets. As the markets declined steeply, banks began hoarding cash and became unwilling to lend money to each other. The result was a drying up of short-term lending as interbank lending rates rose sharply. The credit crunch ultimately triggered bank runs in the both the United Kingdom and the United States of America and then spread globally like a contagious disease.

2.8 Funding Liquidity Risk

According to Vento & La Ganga (2009), funding liquidity risk is the risk that a financial institution, although well-capitalised or solvent, would not be able to maintain a constant equilibrium between its cash inflows and outflows or would be able to do so only at excessive cost over a short period of time. Furthermore, the joint forum of the Basel Committee (cited in Vento & La Ganga (2009)) defines funding liquidity risk as "*the risk that the firm will not be able to efficiently meet both expected and unexpected current and future cash flow and collateral needs without affecting either daily operations or the financial condition of the firm*".

Drehmann & Nikolaou (2010) first defined funding liquidity as *"the ability to settle obligations with immediacy"* and then subsequently as follows: *"funding liquidity risk is driven by the possibility that over a specific horizon the bank will become unable to settle obligations with immediacy."*

What is interesting in Drehmann & Nikolaou (2010) approach is that they have established that funding liquidity risk possesses two major characteristics, namely:

- Future random inflows and outflows of cash
- Future random prices of liquidity obtained from varied sources

However, more importantly to our understanding of funding liquidity and funding liquidity risk, they argue that funding liquidity should be viewed as a binary concept (i.e. a bank's ability or inability to settle obligations) at a particular point in time and that, as opposed to funding liquidity, funding liquidity risk is an unlimited forward-looking concept as it pertains to the probability distribution of future outcomes.

According to Drehmann & Nikolaou (2010), funding liquidity risk and market liquidity risk bear a close affinity to each other in the sense that funding liquidity risk is subject to occasional spikes from a state of stability. In essence, funding liquidity is plentiful when not needed, but extremely scant when required.

2.9 Central Bank Liquidity Risk

The central bank liquidity risk concept may be defined as the inability of the central bank to perform a crucial role in facilitating liquidity transfer and guaranteeing financial stability, given that banks are not able to eliminate the risks of extreme liquidity stress events. However, such a scenario is highly unlikely in developed economies. Thus, according to Nikolaou (2009b), central bank liquidity risk does not exist. In addition, in view of the fact that the central bank is an extension of a government treasury, it is considered by market participants to be a risk-free institution. The central bank, through its market operations, supplies liquidity-base money when it is required to meet the equilibrium demand for liquidity in the financial system in accordance with its mandate.

In addition, where it becomes evident that the liquidity crisis may deepen beyond the ability of the banks to stabilise the crisis as a result of a bank-specific or systemic crisis, the central bank, in its capacity as the lender of last resort, may provide, at its own discretion, liquidity to distressed institutions. This assistance usually takes the form of temporary condoning of the non-compliance with the required level of prudential liquid asset as well as the prudential cash reserve to facilitate settlements. In addition, Drehmann & Nikolaou (2010) argue that central bank liquidity is essential to avoid illiquidity at banks and the avoidance of illiquidity is expressed in the daily net-liquidity demand (NLD). In other words, the NLD is the net amount of central bank daily liquidity needed by banks to meet their obligations when they fall due. The NLD is expressed mathematically as follows:

$$\text{NLD}_t = \text{contractual outflows}_t - (\text{contractual inflows}_t + \text{central bank liquidity}_t)$$

CHAPTER 3

3. POTENTIAL CAUSES OF A LIQUIDITY CRISIS[5]

Diamond & Dybvig (1983) developed a model of bank runs and liquidity crises which is widely considered today by academics as the most influential in the field. They demonstrated that the bank's business model in terms of which daily activity involved accepting inherently illiquid assets (i.e. mortgages) and offering liquid liabilities (i.e. deposits) made banks susceptible to bank runs. They also provided an insight into the mechanics of demand deposits and liquidity.

Assuming there is zero or little correlation among depositors; Diamond & Dybvig (1983) assert that demand deposit contracts provide much needed liquidity to banks. In addition to liquidity, the pooling of deposit contracts provides a superior risk sharing and diversification among depositors. However, in the case of a depositor panic, liquidity could be eroded, immediately giving rise to a self-fulfilling frenzy among depositors as "herd behaviour" becomes evident with first withdrawals being followed by withdrawals by those depositors who would have in the first place preferred to leave their deposits put had they not been anxious about the potential bank failure. Thus, a liquidity crisis may be avoided provided that confidence in the financial institution is maintained. In the Diamond & Dybvig (1983) model, the fundamental ground for depositors' withdrawals is a shift in expectations. In other words, a run on a bank or a liquidity crisis materialises because bank's assets, which are liquid but unsecure, are not sufficient to cover the nominally fixed liability (i.e., demand deposits), and, as a result, depositors withdraw their money to reduce the anticipated losses.

However, it is not explicitly stated in the Diamond & Dybvig (1983) model that it is not feasible to imagine and to anticipate every possible event that may cause a liquidity crisis. Modern banking activities are extremely complex and liquidity itself has proved to be a consequential risk. As Matz (2011b) explains, from a banking perspective, the fundamental issues in a liquidity crisis may be classified as either **endogenous or exogenous.** Endogenous problems, which are bank specific, are primarily as a result of the poor management of credit risk and, occasionally, operational risk events; whereas exogenous liquidity problems are triggered by market disruptions which are usually the result of payment system disruptions, country rating downgrades and, to some extent, surprises. For the purpose of this thesis, in line with the terminology of Basel III, endogenous and exogenous liquidity crises will be identified as follows:

[5] Part of this chapter relies heavily on Nkou Mananga & Daehnke (2007).

i. Bank specific funding disruptions
ii. Systemic crises respectively

3.1 Bank Specific Crisis

A bank specific (idiosyncratic) funding disruption is typified by a loss of confidence in the bank concerned. Bank's liabilities which are mostly in the form of deposits are extremely confidence-sensitive and triggers[6] for unexpected, large-scale loss of depositor's confidence are extremely difficult to predict and it is therefore essential to understand that liquidity events are to be placed in the context of their underlying cause(s). Liquidity events may not be the cause of impending failure but the underlying cause at the time. In a stress and increasingly volatile environment, the possibility of a risk precipitation is compounded. The immediacy, severity and duration of the crisis is highly reliant on particular circumstances and, more often than not, resulting in a panic-driven withdrawal of deposits coalesced with a drawdown under loan commitments (i.e. credit cards and loan overdrafts), as customers fear that their credit facility with the bank will dry up. The following categories in terms of bank-specific crises may be considered:

i. Credit risk events such as the recent subprime crisis, resulting in a substantial financial misfortune.
ii. Market risk event (i.e. unauthorised trading), resulting in a material financial deficit
iii. Reputation risk event as a result of a sudden loss of confidence in the bank which, in turn, results in large cash withdrawals
iv. An inadequate liquidity management process, resulting in an inability to meet obligations as they fall due or to fund asset growth
v. Taxation risk event.
vi. Insurance risk event
vii. Solvency risk event having a material effect on the capital adequacy position of the banks

3.2 Systemic Risk

The concept of "systemic risk" has received little attention from academics up to now despite the fact that the recent severe recession bears all the hallmark of a "systemic risk". Systemic risk is often mistakenly referred to as systematic risk. However, **systemic risk is not the same as systematic risk.** Thus, what is systemic risk? Kaufman & Scott (2003) provides the following partial answer to this question: *"Systemic risk is the risk*

[6] In BJ Fogg's behavior model, triggers are events that incite a particular action. Basically, without a trigger, the target behavior will not happen

or probability of breakdowns in an entire system, as opposed to breakdowns in individual parts or components, and is evidenced by co-movements (correlation) among most or all the parts."

On the other hand, the Bank for International Settlements (2001) defines systemic risk as:

> *"Systemic financial risk is the risk that an event will trigger a loss of economic value or confidence in, and attendant increases in uncertainly [sic] about, a substantial portion of the financial system that is serious enough to quite probably have significant adverse effects on the real economy."*

Dwyer (2009) maintains that Kaufman & Scott's (2003) definition is a more or less incomplete definition of the term *systemic risk,* as it would appear that their definition endeavours not to confuse the event under scrutiny (breakdown) itself and the cause of the event (loss of confidence) despite the fact that the term *breakdown* is still ambiguous today. This study will use the definition of systemic risk offered by Kaufman & Scott (2003).

Armed with the definition of systemic risk, the question now arises as to how we go about recognising it, measuring it and managing it.

3.3 Systemic Risk Measurement

From a central bank perspective, the following two assessment measures for systemic risk may be identified, namely:

i. The Too Big To Fail (TBTF) test
ii. Too Interconnected To Fail (TICTF)

In its analysis of the failure of insurance companies in America, the Property Casualty Insurers Association of America (2009) devised the following categorisation:

The Too Big To Fail Test: This represents the conventional method for assessing the risk in respect of the requisite central bank or treasury intervention. Assessment of this risk is done by measuring the size of an institution as compared to the domestic and foreign marketplace and the market share concentration and using the **Herfindahl-Hirschman Index**[7] as well as the competitive barriers to entry or the ease with which a product may be substituted.

[7] The Herfindahl–Hirschman Index or HHI is a measure of the size of business firms in relation to the industry within which they operate and provides an indication of the degree of competition between them.

Too Interconnected to Fail: The Too Interconnected to Fail (TICTF) assessment has been the key element of the current financial emergency relief decisions taken by the majority of central banks and treasuries. This assessment measures the probability and degree of the medium-term, net negative impact of the broader economy on the ability of a business firm that has failed to conduct its business-as-usual activities. The impact is assessed not only as regards the institution's products and activities, but also as regards to the economic multiplier of all the other commercial activities which are dependent specifically on that institution. The TICTF is also abased on how an institution's business activities are correlated with others (Property Casualty Insurers Association of America, 2009).

From a banking perspective, a number of systemic risks may be observed, each with their own salient features. These systemic risks are as follows:

i. **Contagion by association**

This is mostly concerned by a distress at a number of banks whose exposure is concentrated at the interbank level. Domestic or cross-border shocks may initially affect either one or few similar institutions with the shock then spreading throughout the economy by way of contagion and resembling **falling dominos**. Contagion risk may be easily susceptible to **moral hazard** because the central bank may act in its capacity as a lender of last resort. It is, thus, imperative that, on a consensus basis, the central bank ensure that each domestic bank under its supervision has reduced vulnerabilities, that rigorous stress tests are conducted and that there is contingent funding liquidity available for these systemic scenarios.

ii. **Payment system disruption**

This type of systemic risk refers mainly to disruptions to the interbank payment agreements, either as a result of operational distortions or changes in participant behaviour. However, banks are closely interconnected. The lack of cash or, more simply, illiquidity may stem from blockages in the infrastructure of the payment, clearing and settlement system and this, in turn, may reduce liquidity in the financial market. Despite the fact that the disruption is generally short term bank failure may ensue. Central bank liquidity is generally extended to stressed institutions in order to reduce the systemic impact.

iii. **Money and capital market disruption**

During periods of severe market stress, as a result of their liquidity generating capacity, high quality assets do not suffer from haircuts as compared to lower quality assets. Accordingly, the flight to quality phenomenon occurs when there is a concentration of liquidity in some markets and a decline of liquidity in other markets, coupled with a more than usual higher demand for highly liquid assets.

This phenomenon may also be observed when depositor incentives are threatened with panic withdrawing of deposits ensuing in favour of a "better" institution during a meltdown.

iv. Macroeconomic crises

A credit crunch such as the recent subprime crisis is characterised by lack of trust among banks. During this crisis the interbank markets shut down as banks hoarded cash and were unwilling to extend further credit to quality borrowers. This, in turn, impacted on the ability of these borrowers to service their debts

CHAPTER 4

4. LIQUIDITY RISK MANAGEMENT PRINCIPLES

Liquidity problems may have inauspicious consequences for a bank's earnings and capital and, in extreme conditions, may lead to the collapse of a bank which, in every other respect, is solvent. A liquidity crisis affecting a bank that plays either a minor or a major role in financial intermediation may have systemic consequences for other banks and for the entire banking system. A sound and coherent liquidity risk management principles is, therefore, essential both to the viability of every bank and to the preservation of the overall banking stability. Accordingly, this study aimed to articulate a practical liquidity risk management framework designed to meet both the requirements of the Basel III regulations and the broader requirements of managing and mitigating liquidity risk within a bank.

A sound liquidity management process is required to quantify, measure, monitor and control liquidity exposures. In 1992, the Basel Committee on Banking Supervision (BCBS) first proposed a framework for measuring and managing liquidity based on the maturity ladder and on stress testing. The BCBS approach to managing liquidity risk has since evolved into what is today termed *Basel III*. The liquidity management principles proposed in this thesis bear a close resemblance to those proposed by Basel II. This is accompanied by my own understanding and interpretation. Accordingly, the proposed approach to managing liquidity risk at banks is based on the following three pillars which are closely related:

- Funding risk management pillar
- Stress testing and scenario analysis management pillar
- Liquidity cost management pillar

Funding risk management aims to a stable, cost effective and well-diversified liability base supporting both the bank's business model and the strategy that the bank is pursuing. Stress testing and scenario analysis ensure the survival of a bank within a stress environment and, thus, assume a readiness to cope with the unexpected. Liquidity cost management, on the other hand, ensures a thorough assessment of performance through a funds transfer pricing mechanism.

4.1 Funding Risk Management

4.1.1 Structural Liquidity Mismatch Management

Structural liquidity mismatch exists as a result of maturity transformation activities in the banking book, in terms of which long-term assets, for example mortgages, are funded by short-term liabilities, for example demand deposits. The measure of exposure to liquidity risk in the banking book is assessed using gap analysis (static or dynamic) methodology which comprises an assessment of the mismatch between the liquidity provisions from assets and the liquidity consumptions from liabilities with different time bands on a maturity ladder in a predetermined period, for example, 12 months. The objective of a gap analysis is to evaluate the gap between the liquidity consumed by illiquid assets and volatile liabilities and the liquidity provided by stable deposits and marketable assets. For the purpose of this study, static gap analysis is not recommended as it is an imprecise measurement due to its failure to acknowledge interim cash flows.

The maturity ladder of assets and liabilities, both on balance sheet and off balance sheet, should be formulated in respect to the following:

i. Contractual mismatch between assets and liabilities
ii. Behaviourally adjusted "business-as-usual" mismatch between assets and liabilities

Table 4.1: Structural mismatch: contractual balance sheet using gap analysis[8]

Buckets In billions of ZAR	Total	Next day	2–7 days	8 days to 1 month	2–3 months	4–6 months	7–12 months	> 12 months
Total inflows	**700**	**60**	**75**	**38**	**85**	**70**	**84**	**288**
Home loans	420	50	70	35	65	70	80	50
Credit cards	50	10	5	3	20	0	4	8
Others	230							230
Total outflows	**700**	**505**	**10**	**50**	**0**	**70**	**15**	**50**
Wholesale call	350	350						
Saving account	120	120						
Others	230	35	10	50		70	15	50
Liquidity gap	0	-445	65	-12	85	0	69	238
Cumulative gap		-445	-380	-392	-307	-307	-238	0

On both a contractual and behavioural maturity basis, the contractual mismatch ladder assumes that cash consumption and cash provision behave according to their contracted maturity (identification of liquidity surpluses or deficits). On the other hand, the behavioural adjusted basis factor the likelihood of maturity into the various time bands, based on the product and depositors' behaviour. In developing the behavioural maturity ladder, in instances in which it is not possible to ascertain the maturity of the assets, liabilities and off-balance sheet items, the maturity is elected on a worst-case basis except for products where a worst-case scenario is considered inapplicable(i.e., equity capital, tax provision, contingent liabilities). In terms of worst-case scenarios, assets are classified according to their latest maturity (i.e., greater than 12 months' time bucket) and liabilities at their earliest maturity (i.e., demand or call time bucket).

The bank liquidity position is estimated by calculating the net cumulative mismatch value. This is done by subtracting cash inflows (assets) from cash outflows (liabilities) in each discrete time band and aggregated in each successive time band in order to obtain a cumulative figure. The monitoring of liquidity risk using the behavioural adjusted cash flow statement is made easier by the adoption of maximum limits and guidelines adopted by the risk committee. On a net cumulative basis that is, any cumulative surplus or shortfall is carried

[8] The above table illustrates the structural mismatch balance sheet in terms of which short-term liabilities are used to fund long-term assets on a cumulative basis. This hypothetical balance sheet is liability sensitive as the liabilities exceed the assets.

over to the next maturity time band, preferably daily, the bank's total anticipated cash inflows less its total anticipated cash outflows in each of the following time bands should not transcend the agreed-upon limits.

4.1.2 Key Structural Mismatch Metrics

The short-term contractual maturity mismatch as a percentage of total funding is assessed using the following metrics:

i. Refers to the 0 to 31 day contractual maturity mismatch (the gap between assets and liabilities) as a percentage of total funding.
ii. Reflects the extent to which the bank's short-term contractual liabilities exceed its short-term contractual assets.
iii. Set target in accordance with the structural balance sheet dynamics.

4.1.3 Contractual Profiling Guidelines

It is recommended that the bank redesign its current balance sheet by spreading the balance sheet over appropriate time buckets based on the contractual maturities of all its assets and liabilities. In developing the bank's maturity ladder for all the assets and liabilities in the banking book for the purposes of measuring liquidity, certain balance sheet items may not be considered on the grounds that they are either inconsequential (expressed in absolute terms) or it is not possible to represent them accurately. These items include the following:

i. Fixed assets (land, buildings and equipment which are extremely illiquid)
ii. Accrued interest
iii. Non-performing loans (impairments)
iv. Remittance/credit in transit

4.1.4 Asset Profiling

i. Inflows

The general rule for assets is that they are subsumed in the maturity ladder according to their contractual maturity profile, preferably latest or tardy.

ii. Liquid Assets

Liquid assets are subsumed in the maturity ladder at their latest mark-to-market value less a calculated discount/haircut according to the operating market depth in order to reflect possible fire sale conditions. The magnitudes of the discount factor are country specific and are higher for illiquid or volatile markets.

iii. Committed Facilities

These securities, which are generally provided by other banks with an ambiguous drawn-down maturity, should be treated as commitments to lend at some uncertain future date.

4.1.5 Liabilities Profiling

i. Outflows

The general rule for liabilities is that they are subsumed in the maturity ladder according to their contractual maturity profile, preferably earliest or soonest.

ii. Committed Undrawn Facilities

These facilities include overdrafts and commitments which are not due to be met on a specific date and which are unlikely to have to be met in full. A proportion of the outstanding commitments, based on past and forecasted drawdown trends, is included in the sight to call time bucket.

4.1.6 off-Balance Sheet Profiling

Risk that is moved off balance sheet and out of sight may easily be either forgotten or incorrectly measured. Accordingly, it is recommended that contingent liabilities be included in the maturity ladder with the assumption that the condition necessary to trigger an outflow is fulfilled.

4.1.7 Behavioural Profile (Business-as-Usual) Guidelines

In order to measure the liquidity risk inherent in the bank's balance sheet, it is essential that the liquidity attributes (idiosyncrasies) of the various asset and liability classes be profiled accordingly. Certain products exhibit behaviour that is substantially different to the contracted product description. For example, home

loans consistently prepay in excess of their scheduled amortising profile. Furthermore, the maturity date of current accounts is not known with exactitude. The behaviour of such random maturity products is better understood and analysed using stochastic models. These calibrated models are subsequently used to forecast expected customer behaviour, and by that modelling and quantifying the inherent product pool liquidity risk. When analysing the liquidity risk within the banking book or the bank's balance sheet, it is critical to consider the anticipated (business-as-usual) net cash inflows and outflows within different time bands. The behavioural position should be based on stochastic models emulating factual consumer behaviour. In addition, these models need to be calibrated to the most recent data to ensure realistic profiling assumptions. It is recommended that the models and calibration procedures outlined below be reviewed frequently. During a liquidity crisis the main challenge is the rapid erosion of the bank's deposit base. It is, therefore, extremely important to profile the ambiguous (random) maturity liabilities (deposits) using the most conservative behavioural assumptions.

On the assets side of the balance sheet, the probability of eccentric client behaviour during a liquidity crisis is immaterial, and the behavioural assumptions should reflect the real or factual client behaviour during the period of business-as-usual or normal trading activities. The remainder of this section will focus on explaining the behavioural modelling techniques that, in the opinion of the researcher, should be applied to key asset and liability classes in order to derive the banking book **business-as-usual mismatch position**. In other words, the business-as-usual mismatch refers to the "**behaviouralised"** liquidity mismatch of the balance sheet (i.e. all assets and liabilities are spread across the maturity buckets according to their expected day-to-day cash flow profile under normal market conditions). The business-as-usual mismatch is based on a set of assumptions about the cash flow behaviour of the various types of assets and liabilities.

4.1.8 Assets

i. Cash and cash equivalents

It is recommended that notes and coins as well as central bank interest-free deposits be profiled in the sight to one-month maturity bucket

ii. Liquid assets held for prudential requirements

High liquid assets (i.e. treasury bills, debentures and government bonds) should be profiled in the sight to one-month maturity bucket and at mark-to-market value less a haircut to reflect possible fire sale conditions. In a deep liquid market, this haircut is insignificant given the tradability of the instruments. The central bank usually allows the banks, in the event of a liquidity squeeze, to borrow funds against a pledge of liquid assets, provided the operational cash requirements are met.

iii. Investments

These are marketable assets and government securities. Hence, held to maturity instruments are profiled according to their contractual framework while marketable assets are profiled in the demand time bucket less a discount to reflect a possible fire sale situation.

iv. Amortisable assets

Amortisable assets comprise the following:

- **Mortgages, instalment sales and leases**: Prepayments refer to any payments in excess of the scheduled principal payments that are made toward the repayment of the principal Fixed Income Analysis (2007). Contractual principal repayments should be reproduced as per maturity in the appropriate time bucket together with an adjustment for prepayments based on a pre-calculated prepayments rate. The prepayment rate should be calibrated to an actual constant or conditional prepayment rate (CPR). According to Fixed Income Analysis (2007), the conditional prepayment rate (CPR) calculates prepayments as a percentage of the current remaining loan balance expressed as a compound annual rate; for example, an 8% CPR means that 8% of the mortgage pool's payment toward the repayment of principal that is in excess of the scheduled principal payment is expected to prepay over the following year. Fixed Income Analysis (2007) also, demonstrates that empirical, conditional prepayment rates are negatively correlated with interest rate levels.

  Prepayments are determined by comparing the actual principal amount received, as per schedule, with the pre-agreed, periodic, principal payment obtained from the amortisation schedule of the mortgage with the difference being the prepaid principal. According to convention, the prepayment rates are expressed in terms of **single monthly mortality (SMM)**, which is the relative magnitude of the monthly prepayment and the available monthly prepayment amount. The SMM is calculated as follows:

$$\text{SMM}_t = \frac{\text{prepayment in month } t}{\text{beginning mortgage balance for month } t - \text{scheduled principal payment in month } t}$$

  As regards the above formula, suppose that:
  The scheduled principal payment in month 25 is R 35 000 000
  The beginning mortgage balance in month 25 is R 18 000 000 000
  The prepayment in month 25 is R 80 000 000

  The SMM for month 25 is calculated as follows:

$$SMM_{25} = \frac{80{,}000{,}000}{18{,}000{,}000{,}000 - 35{,}000{,}000} = 0.004453 = 0.445\%$$

This result means that, in month 25, 0.445% of the outstanding mortgage balance available to prepay in month 25 is prepaid

On the other hand, if an expected SMM for a given month is calculated, it becomes irrelevant to ascertain what the prepayment for that month would be. However, in practice, prepayment rates are given on an annualised basis rather than monthly. This is achieved by annualising the SMM. This exercise is known as the **conditional prepayment rate (CPR)**[9]

$$\boxed{CPR = 1 - (1 - SMM)^{12}}$$

$$CPR = 1 - (1 - 0.445\%)^{12} = 0.052112 = 5.21\%$$

A CPR of 5.21% means that, in discounting scheduled principal payments, almost 5.21% of the remaining mortgage balance at the beginning of the year will be prepaid by year end.

v. Ambiguous maturity assets

- **Overdrafts and call accounts**

  Contractually, the bank possesses the right, and not the obligation, to demand the settlement of the remaining call and overdraft balances. The profiling approach to the maturity ladder is based on the historic pool behaviour of these accounts. This is a more prudent profiling methodology which corresponds to actual client behaviour.

- **Revolving credit accounts**

  In order to profile revolving credit accounts, the current actual age of individual accounts is compared with the anticipated average repayment term.

vi. Other assets

- **Interbank advances to other banks (local and foreign currencies)**

  Interbank overnight advances should be profiled in the demand time bucket.

[9] It is referred to as a conditional prepayment rate because the prepayments in one year are dependent upon the amount which was available to prepay in the previous year (Fixed Income Analysis, 2007).

- **Preference Share Loans**

  Preference share loans should be profiled according to their contractual maturity.

- **Credit Cards**

  Credit cards may be classified in two categories, namely, budget and straight. Budget is paid off over a period of months while straight is usually settled within a number days after month end, either in full or at minimum repayment amounts. The budget transactions are profiled according to their contracted settlement period while the profiling of the straight transactions is based on the pool attrition rate which is, in turn, based on certain assumptions including the following:

  - Existing card holders continue to expend and repay on an on-going basis.
  - On the net pool basis, principals are returned to the bank as a result of the pool attrition rate (i.e. the rate at which existing customers are settling and closing their accounts).

  The overall card prepayment rate should be based on the combined repayments of both budget and straight transactions:

  - Fixed assets (i.e. buildings and equipment) are generally illiquid and should be profiled in the greater than 12 months' time bucket.

4.1.9 Liabilities

i. Fixed-term liabilities

Fixed term liabilities such as fixed deposits are profiled according to their contracted payment profile.

ii. Ambiguous maturity liabilities

These are maturity liabilities which the bank customer has the right, but not the obligation, to demand that his/her fund be repaid immediately. The contracted maturity may be either demand or call. Ambiguous maturity should be profiled on historic pool volatility levels and growth rate, assuming either linear regression or stochastic pool behaviour.

4.1.10 Ambiguous Maturity Liabilities

It is essential that a bank differentiate between its volatile and its stable deposits. Stable deposits are those deposits that are long term, thus providing stability and predictability to the banking book (long-term fixed deposits), whereas volatile deposits are those deposits that contractually may leave the bank on demand. The volatile deposits, which are also termed ***ambiguous maturity products,*** are those deposits that provide instability to the banking book and are susceptible to leaving the bank at the first sign of trouble. Volatile deposits (i.e. wholesale call, cheque accounts etc.) are often the largest component of the bank-funding base.

From a business-as-usual perspective, it has been found that the volatile deposits are sometimes sticky on a pool basis. In order to measure the stickiness of the volatile deposits, the following models are proposed.

4.1.11 The Models

I. Effective life based on linear regression

In estimating the effective life of an ambiguous maturity product, a simple linear regression analysis may be performed on at least 24 months' worth of historical month-end balances. The least-squares methodology is applied to estimate the slope and the y-intercept, while the linear regression equation is used to extrapolate at which point the time series will reach a zero balance, depending on the slope of the regression line.

If the time series is positive sloping, then the point at which the series reaches a zero value would be in the past. The difference between this calculated historical date (when the series equal zero) and the most current date of actual data is calculated. The result is the number of months between the current actual data point and the zero value date. As a result of the fact that the time series is positive sloping, the time till zero balance from the most recent data series point provides an estimate of the effective life of the product.

However, if the time series is negative sloping, the point at which the series reaches a zero balance would be in the future and the difference between the calculated future date and the current date of the actual data is the number of months between the two measures and an estimate of the effective life of the product.

II. Linear regression equation

The condition expected value of the time series is given by:

$$\boxed{E(Y \mid X_i) = B_1 + B_2 X_i}$$

Mathematically we may write that

$$\boxed{Y_i = B_1 + B_2 X_i + u_i}$$

The above equation is the linear regression line with B_1 and B_2 obtained using the least squares methods. In order to find the zero balances, solve for $Y_i = 0$

III. Effective life based on a geometric Brownian motion

The least square methodology approximates the average life of volatile liabilities whereas the geometric Brownian model provides a means with which to predict cash consumption or the effective life of a volatile product at a given confidence interval. The methodology is based on historic volatility levels and growth rates (positive or negative) with the main assumption being the stochastic behaviour of the month balances of the volatile product. The geometric Brownian motion is used to forecast the outflows at a given confidence level on a normal distribution.

The volatility is obtained by calculating the standard deviation of the percentage change of the deposit pool balance from one month-end to the next resulting in the following equation for the cumulative outflow:

$$\boxed{dS_t = \mu S_t dt + \sigma S_t dW_t}$$

Where constants are given by W_t = wiener process; μ = drift in percentage terms and σ = volatility in percentage terms.

Dividing the above equation by S_t the following new expression is obtained:

$$\boxed{\frac{dS_t}{S_t} = \mu dt + \sigma dW_t}$$

Applying the Ito integral, we obtain:

$$\boxed{\int_0^{\Delta t} \frac{dS_{\Delta t}}{S_{\Delta t}} = \mu \Delta t + \sigma dW_{\Delta t}}$$

Assuming that $W_0 = 0$ and applying the Ito lemma, we obtain the following equation:

$$\boxed{d(\ln S \Delta t) = \frac{dS_{\Delta t}}{S_{\Delta t}} - \frac{1}{2}\sigma^2 dW_{\Delta t} \Rightarrow \ln \frac{S_{\Delta t}}{S_0} = (\mu - \frac{1}{2}\sigma^2)\Delta t + \sigma W_{\Delta t}}$$

Differentiating both sides, we then obtain

$$\frac{dS_t}{S_0} = \mu\Delta t + \sigma Z\sqrt{\Delta t}$$

Where Z is a random score from a standardised normal distribution

Table 4.2: Business-as-usual maturity gap using the stochastic outflow model

Buckets In billions of ZAR	Total	Next day	2–7 days	8 days to 1 month	2–3 months	4–6 months	7–12 months	> 12 months
Total inflows	**700**	**60**	**75**	**38**	**85**	**70**	**84**	**288**
Home loans	420	50	70	35	65	70	80	50
Credit cards	50	10	5	3	20	0	4	8
Others	230							230
Total outflows	**700**	**65**	**54**	**138**	**109**	**169**	**102**	**63**
Wholesale call	350	24	35	70	86	77	58	
Saving account	120	6	9	18	23	22	29	13
Others	230	35	10	50		70	15	50
Liquidity gap	0	-5	21	-100	-24	-99	-18	225
Cumulative gap		-5	16	-84	-108	-207	-225	0

The above table illustrates the benefit of "behaviouralisation". The stochastic model is used to profile both the wholesale call and the saving account. Contractually, the maturity of saving and call accounts is next day. However, using statistical methods, it is possible to prove that the maturity of these ambiguous maturity liabilities may be extended. This has the benefit of reducing the cumulative gap.

4.1.12 Funding Ratios

Despite the fact that gap analysis as well as associated mismatch limits and guidelines are introduced to mitigate the impact of liquidity mismatching, the funding ratios measure the inherent liquidity risk borne from a bank's short-term and long-term balance sheet position. In fact, term ratios monitor the amplitude of term deposits as a percentage of the total deposit bases. These ratios are defined as follows:

i. Short-term funding ratio

The short-term funding ratio as a percentage of total funding liabilities to the public compares short-term, volatile funding ("volatile funding") with total liabilities to the public. The ratio measures the reliance on short-term funding with a maturity of call to 31 days.

It is imperative that the bank monitor its short-term funding ratio on a daily basis as it is preferable to have funding maturing in the greater than 12 month time bucket in the maturity ladder. This, in turn, gives the bank sufficient time to plan for contingencies although it is essential that care be taken not to increase the bank's participation level in the money market shortage, that is, loss of short-term liquidity.

ii. Long-term funding ratio

According to the Committee of European Banking Supervisors (2009), the long-term funding ratio likens long-term liabilities or permanent funding ("core funding") with long-term assets. The ratio measures the magnitude to which core funding is used to create longer-term, illiquid assets and contingencies. Based on the individual components of the ratio – long-term liquid liabilities and long-term illiquid assets - it is possible to evaluate whether and to what proportion any surplus of long-term funding liabilities over long term illiquid assets is available to absorb any unanticipated cash outflow. In other words, the core funding surplus compared to long-term illiquid assets demonstrates the faculty to fund volatile asset positions such as haircuts on assets and other contingencies.

The Committee of European Banking Supervisors (2009) calculates long-term funding ratio as:

(Retail deposits + wholesale funding> 1year + equity instruments)/ (illiquid assets + contingent liabilities)

From a practical perspective, banks prefer their long-term funding (maturity exceeding 180 days) to be significantly higher than the short term funding ratio as this reflects a reliance on long-term deposits. It should be noted, based on the structural dynamics of the balance sheet, that a bank should anticipate its funding requirements and, thereby, set targets for its funding ratios:

$$\frac{(\text{deposits with maturity } > \text{ 180 days})}{(\text{Total deposit base})}$$

Another measure of the long-term funding ratio (LTFR) is based on the cash flow profile emanating from on/off balance sheet items. This measure expresses the amount of assets with maturity of x years funded by liabilities of the same term maturity. The measure is expressed as follows:

$$\text{LTFR} = \frac{\sum_i \text{Outflows}_i (> x \text{ years})}{\sum_i \text{Inflows}_i (> x \text{ years})}$$

The following section examines the Basel Committee on Banking Supervision's (BCBS) suggested liquidity standard for liquidity management for banks under the Basel III framework, namely:

iii. Net stable funding ratio (NSFR)

The introduction of the **net stable funding ratio (NSFR)** by the Basel Committee on Banking Supervision (**BCBS)** was aimed at reducing the extent of liquidity mismatches in the maturity ladder by encouraging the use of long-term funding of assets as opposed to short- term funding of long term assets (e.g. , wholesale call money funding the home loan book).

$$\frac{\text{Available Stable Funding for 1 year}}{\text{Required Amount of Stable Funding for 1 Year}} = \frac{\text{Sources}}{\text{Uses}} \geq 100$$

Matz (2011c) defines the sources of funds as the net amount of a bank's

- preferred equities with remaining maturity of one year or greater
- term deposit with maturity of less than one year that is anticipated to be rolled over for a lengthened period in an "idiosyncratic stress event"
- capital.

On the other hand, the use of funds stems mostly from the net value of assets held and funded by the bank and grossed by required stable funding.

iv. Liquidity coverage ratio (LCR)

In contrast to the net stable funding ratio, according to the Global Financial Stability Report (2011), the LCR is intended to ameliorate the bank's ability to withstand an extreme, short-term (1 month) liquidity squeeze. In short, the LCR may be defined as the ratio of a pool of high quality marketable assets to a measure of a bank's net cash consumption covering a one-month period. Understandably, the ratio should, at minimum, be 100 per cent.

It is assumed that the following is included in cash consumption:

- Drawdown of contingency facility
- One hundred per cent drawdown of interbank borrowing
- Drawdown of all other short-term (1-month) financial securities
- Maintenance of required levels of liquid assets

Minimum levels of prudential liquid assets are deposited with the central bank for prudential requirements purposes. It is also appropriate that a bank hold additional, unencumbered, marketable assets in excess of the minimum prudential requirement in order to cater for volatile depositor withdrawals, drawdowns under committed facilities, drawdowns by margin and collaterals calls.

A liquid asset is an asset that is highly marketable, readily convertible into cash which possesses the characteristics listed below Basel Committee on Banking Supervision (2010):

- The asset is assigned a zero per cent (0%) risk weight under the Basel II standardised approach.
- The asset may be traded or repo in deep markets for cash and vice versa.
- The asset is frequently traded with no haircut.

Fire sale discounts are country specific and must be reflected in the maturity ladder. A quick guideline is the fact that fire sale discounts (haircuts) are higher mostly in the case of illiquid or highly volatile securities markets. Thus, effectively, the aggregate value of liquid assets (free from regulatory requirements) at the closing market prices on the preceding day less a fire-sale discount, must at all times exceeds a set percentage of the total bank's deposit based:

$$\text{LCR} = \frac{\text{Stock of High Quality Liquid Assets}}{\sum_{30\text{ days}} \text{Stressed Net Cash Outflows}}$$

v. Liquidity risk elasticity

Liquidity risk elasticity measures the change in total assets over funding liabilities (stable and volatile) that is related to an increment in the marginal cost of funding (Culp, 2007). The measure is given as follows:

$$\frac{\partial \text{NA}(t)}{\partial \alpha} = \frac{\partial \text{A}(t)}{\partial \alpha} - \lambda \frac{\partial \text{L}(t)}{\partial \alpha}$$

Where $\text{NA}(t) =$ net asset; $\lambda =$ funded position and $\partial\alpha =$ marginal funding

vi. Liquidity adjusted value at risk (LVAR)

Bervas (2006) combines exogenous liquidity risk with value at risk (VAR) to create the liquidity adjusted value at risk (LVAR). Accordingly, LVAR is VAR plus exogenous liquidity cost where the exogenous liquidity cost is the worst anticipated half-spread at a particular confidence interval. On the other hand, Vento & La Ganga (2009) assert that LVAR is the maximum loss arising from "unwanted liquidity developments" which are sometimes effected by unforeseen changes in market variables. However, this maximum loss, as measured by LVAR, should not be exceeded by the calculated probability over a known time period at a given confidence level.

Vento & La Ganga (2009) further reason that, in the LVAR structure, the bank's anticipated liquidity profile should be adjusted to deal effectively with the possible changes in the anticipated cash flow(ACF) and also that the concept of ACF should be understood as the aggregate of two parts, namely:

- the deterministic anticipated cash flow (ACF_D) and
- the volatile anticipated cash flow (ACF_v) .

This results in a cumulated future liquidity position, namely, the forward liquidity exposure (FLE). The rationale is that LVAR encompasses both liquidity risk and the inability to meet either a cash shortage or a cash surplus on a mark-to-market basis. Thus, the following formula should be considered:

$$\boxed{\mathrm{FLE}(t) - \mathrm{LVAR}_q(t) + \mathrm{OR}(t) \geq 0}$$

Where $\mathrm{LVAR}_q(t) =$ liquidity value at risk at q confidence; $\mathrm{OR}(t) =$ bank's own resources to fund shortfall and $\mathrm{FLE}(t) =$ cumulated gap or forward liquidity exposure at t . The bank's own resources are a combination of new non-secured liabilities, central bank liquidity and the liquidity resulting from selling marketable assets. Accordingly, the forward liquidity exposure may be rewritten as follows:

$$\boxed{\mathrm{FLE}(t) = \mathrm{FLE}(0) + \sum_t \mathrm{ACF}(t-1) - \sum_t \mathrm{LVAR}(t-1)}$$

4.1.13 Funding Concentration

In order to ensure that banks do not place unwarranted reliance on any single entity as a funding source, it is essential that banks pursue a properly diversified mix of funding sources. Thus, to achieve this objective, the limits agreed upon by management should be applied to the following:

- Single deposit counterparty consisting of individual and corporate entities should not, at any time, transcend a set limit to total deposit to public.
- Short-term deposits and standby facilities received from any entity should not, at any time, transcend a set limit to total deposit to public.
- The amount of readily available funding sources portfolio less a discount should equal or be set as a benchmark for the value of the top-ten deposits maturing in two weeks' time.

In addition, exposure to specific market sector funding sources should be circumscribed as follows:

- A limit should be set on the funds raised from interbank and financial institutions.
- Additional limits placed on funds raised from corporates, parastatals and government.

Matz (2011d) underlines the importance of understanding that the diversification of funding sources does not always result in a reduction of benefits of material risk and it is essential that the bank understand when and how to apply diversification. As regards a credit risk manager, diversification is the ultimate rule although this does not apply in funding risk management.

An example:[10] A client may deposit R100 in a savings account. Otherwise the same client may deposit R50 in a savings account and R50 in a demand deposit. These two situations give rise to diversification as regards different products (savings and demand deposit) although the risk of losing R100 in deposits has not been reduced.

On the other hand, as Matz (2011e) asserts, the increase in depositors' names does not automatically reduce funding risk and the number of depositors, although different, is not indicative of liquidity risk. Liquidity risk has to do with the type of deposits, whether volatile or not. For their part, volatile deposits are withdrawn quickly at the first sign of distress and the behavioural correlation between the fund providers may converge to a single unit.

Hence, it is essential that the bank always double check its diversification framework as liquidity risk stems from the type of funds provided.

According to Matz (2011e) the effective diversification of liquidity sources may be performed as follows:

- Promote concentrations and not diversification of funds that score higher on a stickiness scale.
- Deter concentration and not diversification of funds that perform poorly on a stickiness scale.
- Diversify funding by counterparty type from counterparties whose performance is average on the stickiness scale.
- Diversify away from short-term concentrated funding.
- Obviate lumpy maturity schedules or the concentration of funds maturities.

4.1.14 Intraday Cash Flow Management

Every bank must oversee and forecast significant cash flows at least one month in advance, including withdrawals and maturities, and also report large outflows. The daily monitoring of cash flows should be an integral aspect of the on-going funding management process and should assist the bank in anticipating large outflows proactively.

[10] Adapted from Matz (2011e)

The cash flow forecast encompasses the following salient benefits (Matz, 2011f):

- Highlights cash flow provision and consumption.
- Assesses the amount of warehouse liquidity.
- Assesses cash flow needs in regard to the warehouse liquidity.
- Constitutes a forward-looking risk measure as opposed to retrospective risk measure.
- Comprehensive risk measure of on and off balance sheet items.
- Eases liquidity cost management.

4.2 Liquidity Risk Management

Should banks be concerned about liquidity risk management when the central bank is ready to step in as a lender of last resort to avoid a possible systemic risk or the "too big to fail concept"? Central banks have used taxpayers' money to inject liquidity into the financial system in order to limit the fallout from a crisis. Accordingly, in order to avoid a repeat of the same delinquencies, regulators have designed a set ratio measurement to evaluate the extent of liquidity risk in a bank's balance sheet. In addition, the dynamics of the recent financial crisis have highlighted the fact that an illiquid (well capitalised) bank may become insolvent extremely quickly while an insolvent bank is, by the same token, illiquid (Goodhart, 2008). It has already been established that maturity transformation is at the heart of liquidity risk and, yet, Basel III still does not have in place a single measure of the extent of maturity transformation equivalent to the VAR measure of market risk. Moreover, central banks are not aware of the extent or the maximum maturity transformation limit a single bank may undertake.

Thus, in the absence of such measures and limits, the central bank should rely on the following:

- Stress testing
- Contingencies plans
- Disclosures

In view of the fact that liquidity risk management is all about attitude and principles, liquidity risk management should be seen as a culture that should be enforced by the central bank at the risk of sanctions.

This section discussed the concept of liquidity risk management that should become a culture for every bank.

4.2.1 Stress Testing and Scenario Analysis[11]

[11] Nkou Mananga, Van der Walt, & Bowes (2008)

Liquidity stress and scenario analysis should be used to gauge a bank's potential vulnerability to extreme, but plausible, adverse conditions. According to the Basel Committee on Banking Supervision (2010), each bank should conduct liquidity stress testing at regular intervals and also maintain associated contingent funding plans to cater for a systemic risk and a bank-specific crisis. Accordingly, each bank should develop a liquidity model designed to meet both the requirements of **specific stress analysis** and the broader requirements of managing and mitigating liquidity risk through scenario analysis under which key assumptions break down. By means of stress testing and scenario analysis, a bank should endeavour to achieve the following objectives:

- Through testing, elect and assess the possible impacts of adverse liquidity scenarios (i.e. what could go wrong? What is the extent of the severity of the crisis? What solvency is at risk?);

- Identify opportunities for rapid and effective responses in a crisis situation (i.e. implement contingency plans to deal with scenario specific stress tests).

- Use the results of the stress test either to set liquidity limits and guidelines or to formulate a funding strategy designed to limit the extent of maturity transformation and, hence, liquidity risk.

- Plan for crisis avoidance or reduced severity of the crisis.

It is essential to realise beforehand that the **need** for liquidity will change according to the scenario being tested and that the **availability** of funding sources will change according to the specific scenario.

4.2.2 *Synopsis of Stress Scenarios*

In terms of identifying possible scenarios, the following three broad-based (high-level) liquidity scenarios have been identified:

- Name in market or bank-specific liquidity crisis
- Operational and seasonal liquidity requirements
- Systemic and cyclical crises

Within these high-level scenarios, six scenarios have been selected for stress analysis from across the continuum of liquidity risk scenarios for the purposes of measuring and managing a bank's liquidity risk. It is, however, recognised that there are several possible lower-order scenarios which may affect the liquidity position of a bank. Nevertheless, it is not necessary to model every possible scenario provided that, to a greater or lesser extent, the scenarios selected represent all other possible scenarios across the continuum in respect of impact.

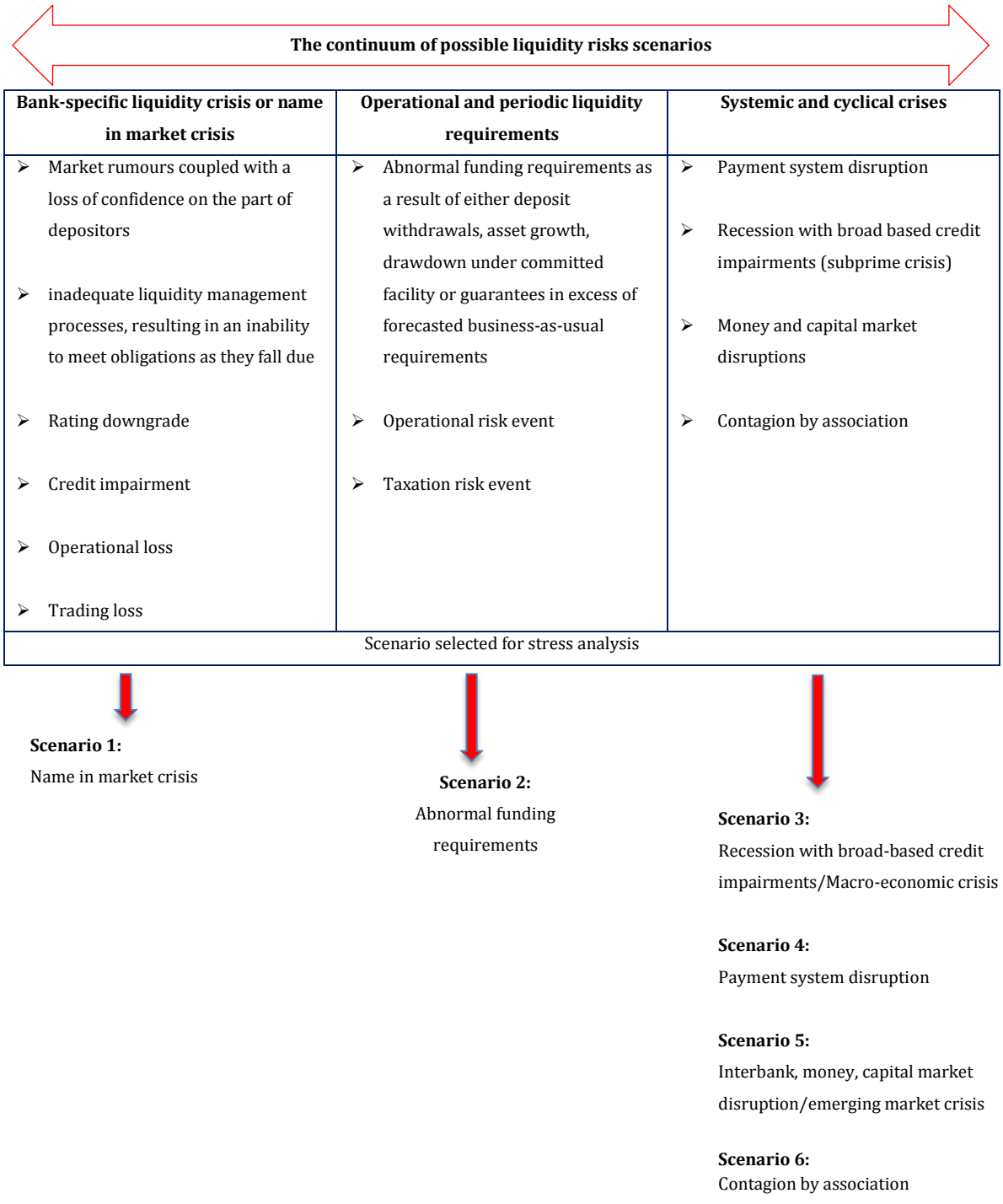


Figure 4.1: Continuum of possible liquidity risk scenarios

Table 4.3 Defining stress scenarios

Scenario Indicator	Scenario Summary	Scenario Commentary
Scenario 1	Name in market crisis	This scenario is characterised by a lack of confidence in the bank. As previously stated, bank deposits (retail or wholesale) are highly confidence-sensitive while triggers for an abrupt large scale loss of depositor confidence is extremely difficult to anticipate
Scenario 2	Abnormal funding requirement	A higher than anticipated asset growth or a higher attrition of the deposit base as a result of withdrawals or drawdown of committed facilities.
Scenario 3	Recession with broad based credit impairments/Macro-economic crisis	The impact of an increased level of potential default rates and drawdown on contingent liabilities. At the other extreme, banks will not extend credit to qualifying borrowers and this, in turn, impacts on the ability of these borrowers to service their debts
Scenario 4	Payment system disruption	This scenario is characterised by an ephemeral failure of the clearing and settlement systems and/or the effect of key payment system not being operational for up to one day
Scenario 5	Interbank, money, capital market disruption/Emerging market crisis	This scenario is characterised by an inability to exit or enter financial markets a will to liquidate trading positions. This is typically associated with a flight to quality where highly liquid assets lose the ability to trade without friction
Scenario 6	Contagion by association	This scenario is characterised by domestic or external shocks which initially affect one or a few institutions only, but with the potentiality to spread throughout the economy by way of contagion.

4.2.3 *Relative Position on the Risk Continuum*[12]

In order to distinguish between high and low risk scenarios, it is necessary to rank each scenario according to the **probability** of occurrence and the **impact** on occurrence while the impact and probability of occurrence are key factors which are used to assess and measure the **liquidity risk** associated with a scenario. By categorising scenarios according to risk, it is then possible to determine which risks require the most diligence in terms of formulating risk mitigation strategies.

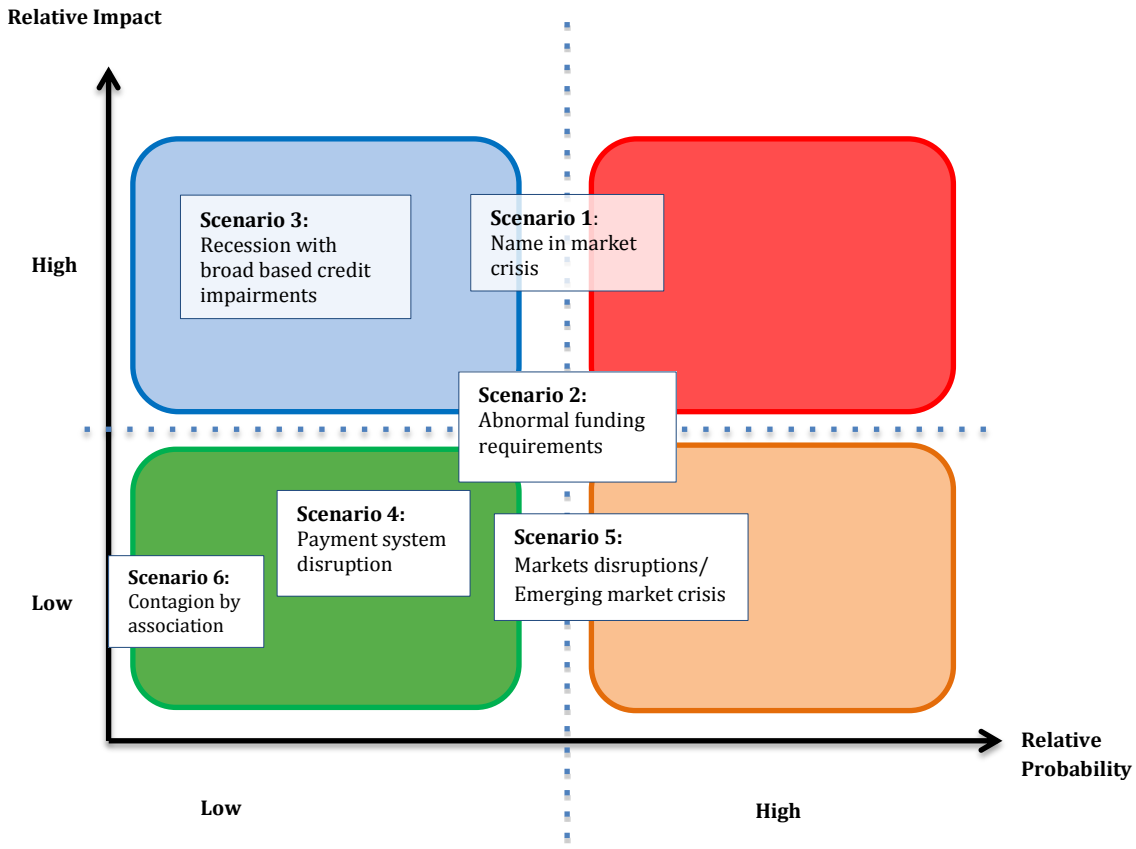


Figure 4.2: Relative impact and probability basis of a qualitative scenario analysis

[12] Nkou Mananga, Van der Walt, & Bowes (2008)

As a result of the lack of reliable historical data, it is difficult to approximate the actual probability and impact of a specific scenario which may occur. In many instances, a common scenario outcome may be the result of a completely different set of circumstances, thus making it difficult to quantify the probability of occurrence (i.e. different factors may lead to the common scenario of recession). Accordingly, a qualitative approach is recommended to identify the **relative probability** rather than the exact probability of occurrence. Therefore, based on a qualitative assessment, the various scenarios have been assigned a probability relative to all the other scenarios.

4.2.4 Qualitative Approach to Scenario Analysis

In order to anticipate the impact of a stress scenario on each asset and liability component in the banking book qualitatively, it is essential that banks stipulate the key principles which would be taken into consideration when predicting the relative impact of one scenario as opposed to another. As regards the bank management, it is recommended that the high attrition of the deposit base during stress events be kept in check. It is, therefore, imperative, before embarking on any qualitative approach, to anticipate the movement of assets and liabilities of the bank from its business-as-usual behaviour to its stress behaviour.

4.2.5 Balance Sheet Assets

As regards to the assets in the balance sheet, during stress events, it is generally assumed that a liquidity squeeze from a bank perspective would not prevent clients from servicing their obligations sufficiently early. In other words, the bank would need to be closed or in the process of being liquidated before the customers would desist from repaying their loans.

4.2.6 Balance Sheet Liabilities

The behavioural adjusted mismatch balance sheet is constructed using the following key indicators;

- Stable indicator of assets and liabilities (i.e. applied to ambiguous maturity products)
- Volatile indicator assets and liabilities (i.e. deposits which are behaviourally long term in nature but contractually overnight)
- Run down indicators
- Refinancing indicator

Table 4.4 Explains the rational and logic behind the stable and volatile concept

Indicators	Business-as-usual	Behaviour under various stress scenarios
Stable and volatile indicators	The stable and volatile indicators are applied to ambiguous maturity liabilities. In other words, liabilities, which are behaviourally long-term in nature, but contractually on call (i.e. cheque accounts). The stable indicator relates to liabilities which have been statistically determined to be sticky whereas the volatile indicator refers to that portion of the deposits which are volatile (quick to be withdrawn)	The level of stable funds will decrease while the level of volatile funds will become higher leading to a higher maturity mismatch between the cash flows of assets and liabilities as deposits are withdrawn more rapidly.
Refinancing indicators	From a business-as-usual perspective, the stable portion of deposits will be refinanced or rolled over into new funding	In adverse conditions, term funding will be refinanced over a shorter term or not refinanced at all
Rundown indicators	The rundown indictor should be applied to stable deposits only, i.e. rather than assume that the stable portion of the deposit is completely permanent, the rundown indicators assume that the stable portion will reduce over time	The stable portion of deposits will run out more rapidly over time, thus leading to a greater gap or mismatch between assets and liabilities

4.2.7 *Withdrawals Under Stress Conditions*

Banking book liabilities are composed of a variety of customers and investors, each manifesting unique behavioural characteristics. It is important to appreciate the propensities of these customers and investors as regards withdrawing their funds once the bank is facing a stress scenario.

The extent to which a customer/investor's deposit remains stable under adverse conditions may be anticipated based on the following criteria (which are graphed in figure 4.3):

- The customer/investor's **dependence on information associated with the bank**
- More importantly, **the customer/investor's relationship with the bank**

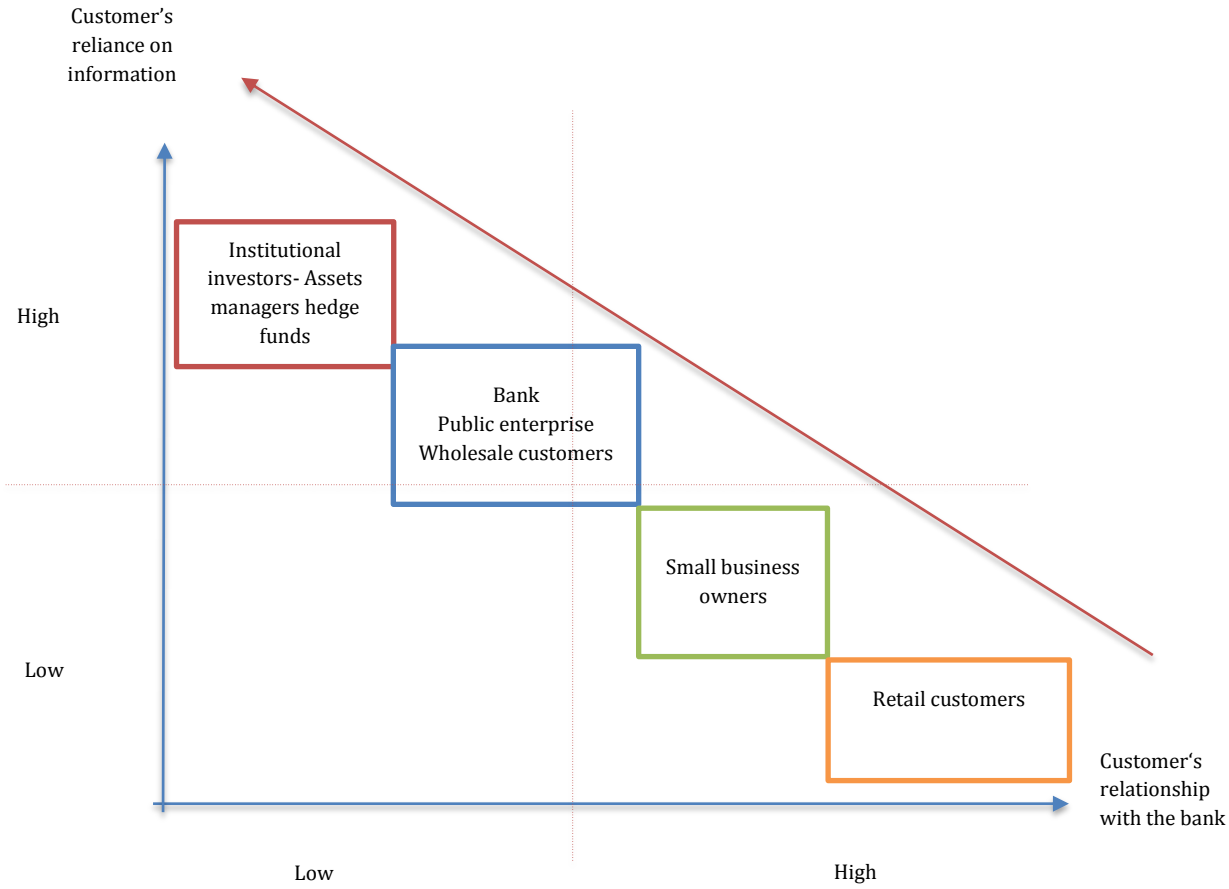


Figure 4.3: **Anticipated behaviour of customers during a stress event**

4.2.8 Contingency Plans[13]

Contingency planning may be defined as the systematic preparation and strategies and approaches to potential future adverse conditions. As indicated by Duttweiler (2009), it is impossible to know beforehand the timing, type, gravity or duration of a stressed condition. Nevertheless, it would seem that, without a properly thought-out contingency plan, the likelihood of surviving a liquidity crisis, either mild or severe, may be severely compromised. Accordingly, it is essential that every bank have in place an action plan or contingency plans that will equip the bank with suitable guidelines, processes and escalating procedures for efficient management of liquidity in a crisis. The capacity to identify and recognise an increase in the likelihood of a liquidity crisis and to immediately and expeditiously implement backup plans in order to augment liquidity should be based on a set of deterioration of early warning indicators and triggers which, on an aggregated liquidity risk profile basis, should be rated at least once a week.

The core strategy during a crisis that will enable a bank to manage liquidity pressures successfully involves the gradual sale of available, unencumbered liquid and marketable assets in excess of the minimum prudential requirements. In addition, cognisance should be taken of the following potential sources of liquidity, which will depend on the sophistication and regulatory constraints of the market:

- The utilisation of secured and unsecured funding lines
- The temporary use of regulatory cash reserves
- The selling of investment securities
- The utilisation of interbank borrowing capacity and central bank repo instruments

In addition to the consumption of available liquidity, mitigating actions also need to be implemented. These may include, but not be limited to, the following:

- The lengthening of the liability profile, particularly deposits
- A slowdown in credit extension, even to qualifying borrowers
- Aggressive pursuit and competitive pricing of deposits
- Maintaining a relationship with liability holders

Where a liquidity crisis deepens beyond the ability of the bank to stabilise the crisis, assistance from the central bank must be sought as the lender of last resort. In the normal course of business, contingency plans should be derived from the result of bank specific stress tests and systemic stress tests. The assumptions of

[13] Daehnke & Nkou Mananga (2007)

the stress scenarios, as well as the associated contingency liquidity sources, should be disclosed on a regular basis.

4.3 Disclosures

This section examines the informational procedure and the usefulness of financial disclosures. One of the most significant aspects of mitigating liquidity risk is "**through the perceptions of depositors.**" From a bank perspective, the following two type of disclosure may be distinguished:

- Public disclosure
- Internal disclosure

4.3.1 Public Disclosure

Public disclosure of information about banks' activities and thus the composition of its balance sheet, the level of liquidity risk in the banking book, the policy and the framework for its management may induce fund providers to monitor banks performances resulting in enhanced confidence in banks. This is upmost important as perceptions of depositors are more important than the bank's true risk. According to Matz (2011g) *"If you have to prove that you are creditworthy, it is too late".* All banks risk taking activities (e.g., Credit risk, Market risk, Liquidity risk, Interest rate risk, Operation risk) should be disclosed in the financial statements.

Public disclosure may enhance the quality of management and prevent the adverse effects of **principal-agent problems**.

4.3.2 Internal Disclosure

Internally, the bank management should be aware of

i. the bank's net aggregate exposure
ii. the bank's compliance to the limits and guidelines which it has set on
    a. funding concentration
    b. funding ratios
    c. structural liquidity mismatch from a contractual and behavioural balance sheet
    d. off-balance sheet items
    e. cash flow forecast and top-ten maturing liabilities over a one-month period
    f. result of stress test and associated contingent liabilities
    g. auditors' reports
    h. Inter-bank market participation.

Chapter 5

5. LIQUIDITY COST AND PRICING

It is highly recommended that banks invest both time and resources in knowing and setting up their target level of liquidity risk exposure. If liquidity were without cost, the target level could be delimited as "as much as we can get." It is; however, clear from the maturity transformation activities, which depositors and funds providers demand the time value of money benefits and, thus, liquidity comes with a cost with these costs imposing real constraints. For almost every liquidity source, banks incur either direct or indirect charges, for example, lower interest returns earned from liquid and marketable assets or the higher costs paid for stable or long term funding. Accordingly, the optimal management of liquidity behoves a delicate balance between the inflow proceeds from the origination of assets and the mismatch between the assets and liabilities (i.e. liquidity risk). Thus, in view of the fact that liquidity is not free, banks should be cognisant of the full cost of liquidity in order to make fully informed decisions about the compromised target amount and the liquidity risk limits (Matz, 2004a).

The current methods for measuring liquidity costs and benefits are fairly varied. It is commonly understood among bankers that liquidity cost is merely the difference between the bank's marginal cost of funds and the swap yield curve. However, the challenge arising from the marginal cost of funds is that this marginal cost of funds encompasses some form of idiosyncrasy. Matz (2004b) states that: *"This month the marginal cost of liquidity might be new medium term notes. Next month, it might be securitizations. Different costs are associated with different marginal sources."* Nevertheless, the use of the difference or gap between the swap curve and the internal funding curve to tease out the liquidity premium is both trivial and intuitive and it is essential that the disadvantages and advantages of using this method be fully understood.

A new concept that has attracted significant academic interest will now be discussed, namely, the concept of f**und transfer pricing (FTP)** with further discussions on the advantages and disadvantages of liquidity cost calculations being presented in the FTP section.

5.1 Fund Transfer Pricing

What is fund transfer pricing (FTP)? Fund transfer pricing is a performance measurement technique that accredits funding cost to loans (assets originations) and funding credit to deposits (liquidity providers). Fund transfer pricing (FTP) is considered the single most important and indispensable factor of any profitability measurement process. FTP may also be defined as a process that measures the contribution to overall profitability of each individual source of funds. The funds transfer pricing process is generally applied to banking as a way of highlighting the areas of strength and weakness within the funding framework of the bank (Investopedia, 2012).

In addition, fund transfer pricing (FTP) is a method used by bankers to measure the profitability of both assets (i.e. loans) and liabilities (i.e. deposits). However, the challenges as regards the banking book from a FTP perspective are twofold:

i. For individual deposits, the interest to be paid and the associated operating expenses are known in advance. Nevertheless, evaluating the return on those deposits is elusive as a result of the fact that deposits are used to finance various types of assets (i.e., home loans, personal and wholesale loans, interbank loans and, perhaps, fixed assets) and;

ii. For individual assets or loans, the interest to be received (net of impairments) is generally known, but not the funding cost. The reason for this state of affairs arises from the fact that banks use various sources of funds (i.e. as wholesale call deposits, savings deposits, term deposits, interbank deposits, subordinated debt and equity) to finance assets.

The FTP methodology is designed to meet the two above mentioned challenges. Banks require a specific fund transfer price to compensate deposits. In addition, banks also require a specific fund transfer price in order to measure the cost of funding loans. Thus, a FTP methodology that takes into account the balance sheet structure and correctly prices assets and liabilities (i.e. deposits and loans) is indispensable as regards the Basel III implementation that insists on a significant buffer of liquidity, the recent global banking crisis and the on-going economic turbulence. Furthermore it is essential that the FTP methodology evaluate performance at business unit level (Dermine, 2011).

Fund transfer pricing methodologies are an integral aspect of both a bank's liquidity management and also its interest rate risk management processes, as it is a mechanism which may be used to centralise the overall interest rate and funding gap of the bank's balance sheet.

5.2 Fund Transfer Pricing Methodologies

As mentioned above, fund transfer price (FTP) aims to calculate a transfer price rate that effectively remunerates the deposits and, by the same token, calculates the transfer price rate that measures the return on loans. A number of techniques have been used, depending on the size and objectives of the organisation; these are in order of accuracy and difficulty of execution. Essentially the assigning of funding rates in an FTP process is narrowed down to the following two approaches, namely, a pool methodology which is easy to implement and a more complicated matched rate transfer price approach. The latter methodology has gained in popularity because of its lack of ambiguity. Transfer rates have a transparent basis and are applied consistently throughout the balance sheet. However, both methodologies factor the maturity and re-pricing characteristics of both asset and liabilities in the banking book in order to assign rates, depending on the funding date and the point on the selected funding curve.

I. Single pool rate methodology

In terms of this methodology, the transfer rate, which is effectively the weighted **average cost of funds** for the bank, is allocated uniformly to all assets (loans) and liabilities (deposits) and there is no distinction between providers of funds and users of funds. All transactions are pooled together with the providers of funds adding to the pool and the users of funds taking from the pool. The single pool rate methodology is very simple as well as easy to understand and to implement. In addition, it does not require massive investment into ALM systems and it is extremely suitable for small banks that have stable funding sources and a stable income source. However, one major drawback of this method is that it does not take into consideration any maturity or risk characteristics of fund (i.e., an overnight call deposit is treated in the same way as a 5 year term deposit).

II. Multiple pool rate methodology

The multiple pool rate methodology is an improvement of the single pool methodology. In terms of this method, the bank's balance sheet is divided into two distinct pools – the pool of loans and the pool of deposits – which take into account the maturity characteristics of assets and liabilities and their respective rate and yield. The transfer price rate is calculated by determining both the weighted average rate of loans and the weighted average rate of deposits. This methodology makes it far easier to monitor the rate of new deposits and loans and to assess the overall profitability of individual transactions.

III. Match rate transfer price methodology (MRTP)

The matched rate methodology (MRTP) ensures that all balance sheet items (off balance sheet included) are priced at exact market rates which accurately reflect both the liquidity risk and contractual features of all the bank's transactions. The key precept in this methodology is to enrich pricing decisions at the business unit level by ascertaining that prices are based on the real value of the cost bank's sources and uses of fund. All transfer prices are based on independent, observable, external benchmarks.

5.3 Determination of Match Rate Transfer Price (MRTP) [14]

Most academic works or relevant literature refer to transfer price although there is very rarely a step by step methodology of how to obtain a transfer price. This section draws heavily on the researcher's experience as a senior liquidity manager at one of the South Africa's main bank. Accordingly, the researcher will detail the way in which he derived the transfer rate based on the matched maturity.

5.4 Liquidity Premium

5.4.1 MRTP Curve – Non-prime Linked Instruments

In order to determine the MRTP curve based on the balance sheet items that re-price at a rate other than the prime lending rate, the MRTP is obtained as the mid of the overnight deposit rate, 1 month to 12 months Jibar rates and, from 12 months onwards, the Swap mid rates. It is significant that all rates are quoted on a bid or ask spread.

It is noted that:

- The Johannesburg Interbank Agreed Rate (JIBAR) rates are inclusive of the liquidity spread and no additional liquidity premium is payable.
- A liquidity premium is added to the swap rates. This has the sole purpose of converting the swap curve to a money market curve

[14] Bowes & Nkou Mananga (2009)

5.4.2 MRTP Curve – Structural Products

Structural products are transfer priced at the structural MRTP rates:

- Interest rate swaps that perfectly hedge the underlying risk position are priced to represent the MRTP rate.
- Additional interest rate swaps must be priced every day, either to replace maturing swaps on the existing position or to hedge new positions.
- As a result of the five-year amortising profile of the representative swap, 1/60 of the profile will mature each month and must be priced. This is equivalent to a five year bullet swap with a notional of 1/60 of the structural position maturing.
- The structural product MRTP rate is ultimately represented by the number of swaps, all with different fixed rates. The weighted average of all these rates represents the MRTP rate.

Pricing liquidity poses a serious challenge to bankers and is one of those necessary evils. According to Matz (2011h), *"damned if you do and damned if you don't."*

If a bank decides to invest in liquidity pricing, they increase the complexity of their day to day operations, they increase bureaucracy and they exacerbate any existing discontent among business units and treasury. However, more importantly, your peers (other banks in the same industry) could misprice liquidity and the pricing bank could lose profitability. If a bank decides not to measure the price of liquidity, the bank may easily fall short of the new Basel regime that insists on buffer liquidity. In addition, the bank's strategic investments and balance sheet management would not be optimal.

CHAPTER 6

6. BASEL III AND LIQUIDITY RISK RULES

Although the recent severe recession started as a credit problem, it manifested swiftly as an acute funding problem, resulting in a liquidity crisis. The key finding arising from the financial meltdown was the exposure of the ineffective and incompetent management of liquidity risk. Bank managers totally underestimated the impact the liquidity crisis would have on their balance sheets, prompting governments to intervene and regulators to revisit regulations pertaining to financial institutions in general and to banks in particular. Basel III was borne out of the severe recession. Basel III is a development of the established Basel II framework and it is an evolution that ushered in a focus on the minimum capital requirements and liquidity ratios of banks rather than a revolutionary overhaul of the liquidity risk management and regulation at banks.

Skoglund (2011) argues that the new liquidity risk regulation at banks emphasises the importance of setting up a proper system for the identification, measurement and management of liquidity risk. As regards the key focus on contingent planning banks are encouraged to maintain:

i. A portfolio of marketable and highly liquid assets that may hedge out liquidity consumption during stressed conditions.
ii. An efficient cost of funding by integrating a fund transfer pricing to mitigate the opportunity cost of raising liquidity buffer.

The "**new regulation for liquidity risk"** may, therefore, be summarised as follows (Skoglund, 2011):

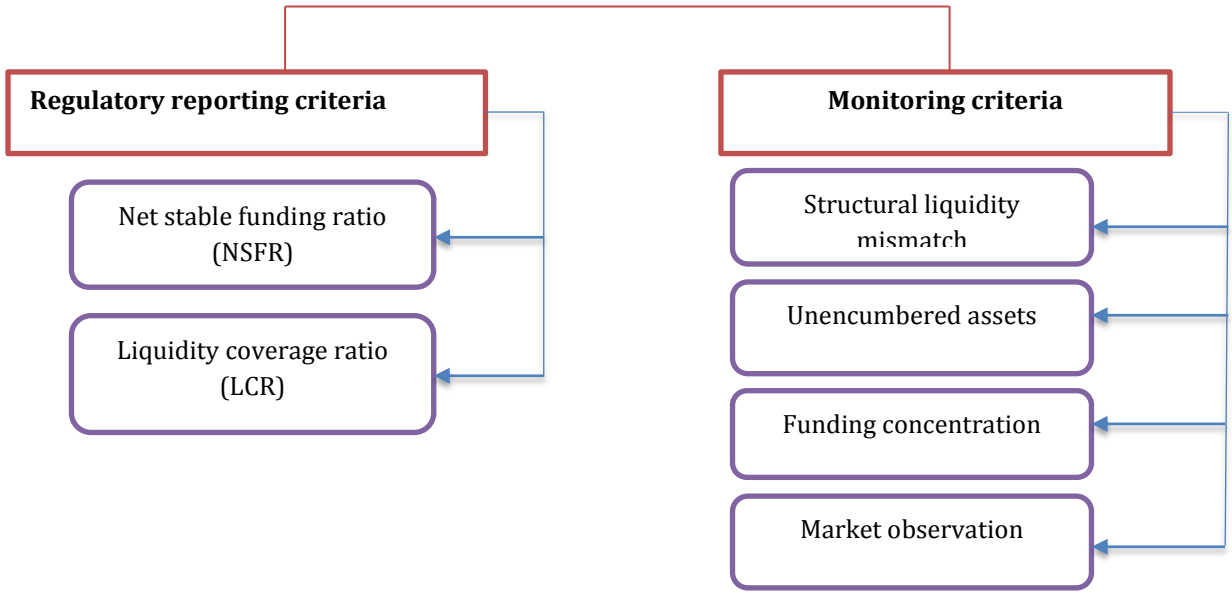


Figure 6.1: New regulation for liquidity risk[15]

Do banks have the choice **not to implement Basel III**, given its challenges and the current recessionary environment? **The answer is clearly NO.** A speedy implementation of Basel III could effectively signal to customers, shareholders and regulators that banks are recovering well from the severe recession. According to Chabanel (2011), Basel III will contribute to a bank's competitive advantage by enhancing management insight into business and creating new opportunities.

As previously mentioned, Basel III may be seen to have evolved from the established concepts of Basel II. However, it must be appreciated that, if the challenges of implementing the new regime of regulatory requirements are not addressed effectively, this may hamper the successful implementation of the Basel III principles.

[15] Basel Committee on Banking Supervision (2010)

6.1 Anticipated Challenges of Basel III[16]

The following list of anticipated challenges arising from Basel III is by no means exhaustive and significant challenges, in order of priority, are listed below.

i. **New culture of risk management with liquidity at the forefront**
   a. The new regulatory regime will change the way in which banks take into account risk management in general and liquidity in particular. Central to the new regulation is the emphasis on the fact that liquidity is not a standalone risk but rather a complex and consequential risk that should be managed at the enterprise level.

ii. **Data management**
   a. Successful compliance with the Basel III requirement in terms of data management will be realised if and only if banks ensure that the repository of all transactional data pertaining to the bank's activities is proper and accurate.

   b. Clean and precise data will enable the bank to calculate liquidity ratio, perform stress testing and allocate capital more efficiently

iii. **Stress testing**
   a. The new regulatory regime requires that stress tests and scenario analysis be performed on a regular basis. This exercise is extremely reliant on both data and the experience of staff as regards identifying the scenario that is the most appropriate to making more sense of the structure of the balance sheet as well as the interpretation of stress results and the contingency measure to be put in place

iv. **Interconnectedness**
   a. Different countries across the globe have interpreted the rules and regulations of Basel III in different ways. It would, however, have been easier if a unified set of rules had been applied to all countries, as this is highly improbable, however, the main challenge lies in the fact that banks, which are interconnected and which actively trade with each other, are not governed by the same set or interpretation of rules.
   b.

[16] Adapted from Chabanel (2011)

6.2 Liquidity Risk Rules

The management of liquidity risk is not highly abstruse. Nevertheless, the intricacy of liquidity risk management originates mainly from the fact that liquidity risk is difficult to measure. How do you measure liquidity risk when it is highly reliant on human psychology, on uncertain future occurrences and on the interconnectedness of the global economy in terms of which adverse conditions in one market may rapidly spread to other markets? In view of the fact that the understanding and measurement of liquidity risk presents serious challenges and also because the prescription to hold an amount of liquid and marketable assets is somewhat vague, Matz (2011i) recommends that liquidity should be viewed in the context of stress testing and scenario analysis and, thus, the following set of rules from should be taken into account before any attempt is made to measure liquidity risk:

Rule 1: Liquidity risk is inescapable.

Matz (2011i) argues that, as a result of maturity transformation which is one of the most important element of a healthy economy, it is not possible either to completely avoid nor entirely hedge liquidity risk. As financial intermediaries, a bank's core activity is to bring together surplus and deficit agents in other words, to transform deposits into loans. The funding liabilities (deposits) of banks are naturally short term whereas the assets (loans) are naturally long term. Accordingly, the liquidity risk resulting from mismatches or gaps between assets and liabilities is completely ineluctable. The most important point of this argument is that risk in general and liquidity risk in particular cannot be avoided but should be managed within acceptable guidelines and limits.

Rule 2: Liquidity risk is not one dimensional, it is multi-faceted.

The meaning of liquidity risk differs greatly among financial market practitioners, be it in the capital market, funding specialist or risk manager. Liquidity risk refers to either the inability to fund obligations when they are due or to raise cash to fund business activities **(funding liquidity risk),** the inability to perform a transaction at will and at the expected mark to market price as a result of a reluctance to effect the transaction on the part of other market players **(market liquidity risk),** the anticipation of future adverse conditions that are naturally low as regards their probability of occurrence but severe in impact **(contingent liquidity risk)** or the fact that liquidity risk is not a standalone risk but may be triggered by other events**(consequential liquidity risk).** *"All of these have to be understood as distinct facets of the same stone."* said (Matz, 2011j).

Rule 3: The complacency of too much liquidity soon disappears during a bank run.

Banks are naturally confidence sensitive. The biggest portion of their funding sources emanate from depositors and short-term creditors. Banks runs may be exacerbated by the maintenance of a sufficiently large gap between the contractual maturity of assets and the contractual maturity of liabilities. Any information indicating that the fortune of a bank is in question may trigger a loss of confidence, thus resulting in the panic withdrawals of funds deposits and a depletion of committed facilities (i.e. credit cards, overdrafts). In addition, the refinancing of deposits becomes almost impossible as maturing term deposits are not rolled over and it becomes difficult to obtain replacement funds. It should be noted that the deposit insurance held at the central bank in term of prudential requirement does not prevent a panic withdrawal when confidence is lost and this, in turn, forces the bank into an anticipated search for liquidity (Matz, 2011k).

- **First corollary**: The notion of *confidence* is an intangible one and could easily be underestimated but the loss of confidence in a bank as empirically proven will generally trigger unprecedented large amount of cash outflows. When depositors (fund providers) lose confidence in a particular bank, the amount of cash at a bank's disposal and the amount of cash a bank can raise in the market is completely irrelevant.
- **Second corollary**: Although intangible, confidence should be promoted actively through a range of internal and external disclosure and proper communication to the public. After all, inasmuch, as liquidity risk management is about managing confidence it is also about managing cash. Therefore, confidence should not be mistaken for the amount of liquid assets and regulatory capital holdings or ratings from rating agencies. Confidence should be built daily through active engagement with fund providers and fund users (Matz, 2011k).
- **Third corollary**: Confidence is easily broken. In most cases, confidence is lost through the spreading of true but entirely incomplete information (Matz, 2011k).

Rule 4: Stress testing and scenario analysis are the language of liquidity risk.

It is highly ineffective and even detrimental to discuss liquidity risk not to mention the management or measurement outside the context of stress testing and scenario analysis. Unanticipated deposit losses are a frequent occurrence in certain scenarios but not in others while available sources of stress funding are readily available in some scenarios but not in others. Liquidity risk manifestations are scenario specific.

- **First corollary:** Liquidity risk is forward-looking. In other words liquidity risk is prospective. Liquidity risk relies on the assumption that future events could yield serious repercussions. As a consequence, retrospective management and backward-looking measurement, budget based upon previous liquidity needs and finally historical ratios are of no or negligible value (Matz, 2011k).

- **Second corollary:** Liquidity risk is consequential. Every genuine or hypothetical liquidity squeezes at the level of the balance sheet has to be appreciated in the context of its underlying cause. "*It is difficult, if not impossible, to find any historical example of a bank getting in trouble because it is illiquid, in other words, liquidity is often the proximate cause of a failure but never the underlying cause*" (Matz, 2011l) .

- **Third corollary:** Reckless and irresponsible liquidity risk measurement and management are easily differentiated from prudent risk measurement and management until the occurrence of a full-blown liquidity crisis (Matz, 2011k).

Rule 5: Too little liquidity may kill a bank unexpectedly, but too much liquidity will kill a bank gradually.

The bank's holdings of marketable and liquid assets should be understood as mitigating factors with the purpose of buying time until available contingent liquidity sources are accessed and not as the solution to a full-blown liquidity crisis. No bank under business-as-usual conditions can afford to hold sufficiently large buffers to survive a prolonged and severe funding strain.

- **First corollary**: Liquidity risk managers must put in place a range of liquidity benchmark and liquidity early warning indicators and triggers that will enable a quick identification of an imminent liquidity crisis (Matz, 2011k).

  Second corollary: Liquidity risk managers must put in place a liquidity contingency plan that provides the bank with an action plan that can be used to empower the liquidity risk manager and the board of directors with appropriate and timely guidelines, processes and escalation procedures for managing liquidity in an escalating volatile environment. More often than not, a liquidity contingency plan is designed from the result of a liquidity stress test exercise (Matz, 2011k).

Rule 6: Cash provision and consumption are fungible.

All liquidity provisions may be divided into three distinct categories (Matz, 2011k):

- Liquidity may be obtained from the sale of assets. Unencumbered liquid assets and marketable assets may easily be converted into needed cash in business-as-usual conditions. In practice, the warehousing of liquid and marketable assets is costly as these assets are usually low yield risk free government securities. And no bank can hold sufficiently large enough liquid and marketable assets to withstand a prolonged liquidity crisis
- Liquidity may be obtained from borrowed money that must be repaid, refinanced or rolled over. Some borrowed funds are sticky, others are volatile and the liquidity manager should be aware and categorise them according to the level of volatility in each of the bank's type of borrowed funds.

- Liquidity may either be available or obtained from a positive gap when cash consumption is less than cash provisions.

Rule 7: Liquidity risk management is a zero sum game for the system as a whole

According to Matz (2011m), all the above seven rules of liquidity risk are ancillary to this rule. A market comprises at least two participants, namely, a buyer and a seller. In the language of game theory, liquidity is a zero sum game and a cash inflow for one party implies a cash outflow for the other party with no new liquidity being created in the system.

Rule 8: Regulation is essential but exiguous

"*No smart group of people can ever design a set of rules that some other group of smart people cannot think of a way to circumvent*" (Matz, 2011n). Both Basel I and II were enlightening. Under these regimes, capital was considered as the panacea of risk management. However, it has been proven that capital consideration as the solution to liquidity risk is a fallacy. Basel III represents a significant improvement on enterprise risk management in general and liquidity risk management in particular although, in reality, it is anticipated that it will also be proven to be inadequate.

Rule 9: From a regulator perspective, the main objective of regulations must be the preservation of confidence in financial intermediaries. The preservation of confidence will be easily achieved by preserving the soundness of financial institutions. However, it is not possible to maintain financial soundness without minimising the incentives for management failures (Matz, 2011n).

Chapter 7

7. CONCLUSION AND FUTHER REMARKS

This thesis commenced by discussing a definition of liquidity and offering an understanding of liquidity risk, while remaining cognisant of the fact that measurement without definition is arduous if not impossible. It was then established that liquidity is neither an amount nor a ratio (e.g. (cook ratio[17])). As reasoned by Duttweiler (2009), liquidity articulates the degree to which a financial intermediary is able to meet its obligations when they fall due while, conversely, illiquidity arises when a financial institution is not able to meet its obligations when they fall due. It may, thus, be said that liquidity represents a qualitative component of the financial strength of a bank.

Secondly, the study discussed the potential causes of a liquidity crisis and established that liquidity risk is the inability or incapacity of a financial institution to meet its financial obligation when they fall due either as a result of a bank specific crisis or a systemic crisis. Most importantly, and throughout the history of liquidity squeezes, the following important concept has emerged: Liquidity risk is consequential and its management requires that it consistently be accounted for across a range of liquidity benchmarks and early warning indicators and triggers which include both market-related indicators (e.g. country rating, funding spread), as well as governance related benchmarks(e.g. liquidity control and oversight, operational risk) with the sole purpose of maintaining a delicate balance between the three internal variables (asset allocations, funding and collateral) within a context of changes and potential shocks which systematically challenge this equilibrium. Misalignments of internal balances (e.g. assets and liabilities equilibrium) with external factors ultimately result in a liquidity squeeze (Carrel, 2009).

Thirdly, the study presented liquidity risk management principles and explored different, but integrative, methods that a bank should consider when managing liquidity risk in its banking book. The arduousness or difficulty encountered in managing liquidity risk is to be found in the fact that there is no single metric with which to assess liquidity risk, for example, Value at Risk (VAR) in market risk or probability of default (PD) in credit risk. The study demonstrated throughout that liquidity risk is not a standalone risk. It may arise from the misapprehension of risks, from the various types of vulnerability which may ensue from a bank's funding

[17] The Cook ratio estimates the amount of capital a bank should hold as a percentage of its total risk adjusted assets. The Cook ratio places all funding (cash provision) from the bank on the same level despite the fact that some funding may be riskier than others.

strategy, or from a bank's structural allocation of its assets and liabilities or from a bank's credit and collateral policies.

The liquidity risk management principles outlined in this study may be divided into two categories, namely, funding management, and stress testing and associated contingency plans. It is believed that the objectives of the liquidity management principles are to ensure both adequate liquidity and the on-going maintenance of sufficient liquidity and an adequate funding base during both business-as-usual times and in distress times despite the fact that the bank in question may be well capitalised. It was argued that stress testing and the associated contingency plans allow the bank to focus on a sound strategy in terms of which costs are kept at minimum level and the interests of various stakeholders (regulators, shareholders, member of the public) are well balanced.

The argument put forward by Matz (2011o) that "we simply cannot discuss liquidity risk – let alone measure it or manage it – outside of the context of scenarios" reinforced the notion that stress testing is a **must** and that it should be carried out on a regular basis and reported to senior management. The study advocated that, in addition to stress testing, simulation exercise should be performed in terms of which *"a run on a bank"* is simulated. Fourthly, the study touched on the broader subject of the performance measurement principle. The study maintained that running costs should be kept in check. This, in turn, led to the introduction of the concept of fund transfer pricing (FTP) and a discussion of the two methods available to determine fund transfer pricing, namely, **the pool rate approach and the matched rate approach**. FTP is a key element of asset origination with the type and quality of assets being determined by the cost and pricing of liquidity in the market.

Fifthly, the study discussed the new Basel III regime and its challenges. Following the severe recession, characterised by a deepening liquidity crisis, the Bank for International Settlements (BIS) proposed thirteen liquidity risk management principles that are applicable to deposit-taking institutions. The objectives of these thirteen principles are to provide guidelines for effective liquidity management see Bank For International Settlements (2008). As already established, Basel III represents a maturation rather than a drastic and far-reaching change in the Basel II framework which had already been implemented by banks. The main additions in Basel III are the liquidity leverage ratios and the enhancement of minimum capital requirements. However, the implementation of Basel III is by no means a trivial matter and the following significant challenges should be fully noted and properly addressed:

- Higher capital requirements
  - Increased quality of tier 1 capital
  - Reduced complexity and superfluous details of Tier 2 capital
  - Eradication of Tier 3 capital
  - Higher capital requirements for trading book positions

    - Limits for capital elements and new adequacy criteria
- Increased risk coverage
    - Increased risk weights for securitisation transactions
- New liquidity standard and leverage ratio
- The combined consequences of the requirements – both for those requirements that are impendent and those requirements that are still under discussion
- Higher regulatory costs imputed to on-going changes in regulatory requirements
- Growing pressure on return of equity (ROE) as a result of increased capital and liquidity costs and increased risk coverage.

The Basel III regime prefaces a *"paradigm shift"* in capital and liquidity standards in financial institutions with the main focus on banks. The new regime was, however, rushed after a short consultation period and, as a result, many elements remain unfinished. Nevertheless, despite all the challenges, it is essential that banks ensure that they engage with the new regime as soon as possible in order to remain profitable and competitive in the post crisis landscape. In addition to the impact of Basel III on banks, the study also discussed what Leonard Matz who is considered by many practitioners as the expert on liquidity risk management terms **the liquidity rules** – rules which could be taken as axioms to enable a better understanding of liquidity and liquidity risk and its entire components which are critical for financial soundness at financial institutions.

Another debate among practitioners, regulators and academics is the fact that some believe that Capital should be treated as a primary mitigant of liquidity risk. This just demonstrates the lack of understanding of the true nature of Liquidity risk. I have endeavour throughout this study to show that Liquidity risk cannot be assessed by using a single risk measure such as VAR in Market risk and PD in Credit risk. It makes no sense to assign Capital to liquidity risk as liquidity is not a silo risk but a consequential risk. On the other hand a portion of Capital in market and liquid asset could boost the require liquidity buffer. But Capital by nature is illiquid and the primary role of Capital is to mitigate unanticipated losses, not cash flow shortcomings. In short, if a bank is experiencing a liquidity strain, it needs cash, not capital. In fact, using capital for loss absorption and to meet on-going obligations will result ultimately in reduced value both from a regulator and depositors perspective.

Return on Capital (ROC) is one of the most important measures of performance and one cannot afford to impair Capital. Unfortunately, I feel that those new Basel III measures, which are the liquidity coverage ratio (LCR) and the net stable funding ratio (NSFR) are short term solution to liquidity risk. They fail to recognise liquidity risk as a Consequential Risk.

Another important aspect in this study is discussion of the fact that the interpretation of the new liquidity regulation and policies, as well as the calibration of liquidity risk, is vulnerable to significant model risk. It is essential that bankers do not obviate **model risk** while the most effective way in which to compensate for the unavoidable errors is to put in place and establish an appropriate governance platform for liquidity risk

measurement and management. Liquidity risk management may be addressed in two ways with these two ways being pursued conjointly. Firstly, there is the ultimate reduction of the probability of a crisis. This may be achieved through the liquidity management principles and the liquidity rules as discussed in this study. Secondly, there is the on-going assessment and maintenance of a liquid buffer against the impact of a crisis (e.g. a buffer of marketable and liquid assets not systemically correlated with the financial industry). In conclusion, it must be borne in mind that there is virtually nothing that may be done in a crisis that was not anticipated prior to the commencement of down trending (Matz, 2011p).

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