



Asset-Liability Management and Liquidity Trap (Case Study: Credit Institute for Development)

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ABSTRACT

An increase in the ability to timely meet commitments which will be due in the near future is a prerequisite for the survival of banks. Hence, the correct and optimal management of liquidity is an important affair that banks should perform. The present study aimed mainly to test the management of asset-liability and liquidity trap in the Credit Institute for Development. The research is applied in terms of the method and survey in terms of the type. The key ratios in the prediction of liquidity trap were identified through interviews with the experts in the area of asset-liability management. Then, a researcher-made comparison (paired) questionnaire was used through the ISM technique to investigate the relationships of these ratios. Finally, the conceptual model was extracted and the degree of influence of the variables was determined by the power of influence and the power of dependence. The indicators of asset-liability management were raised as the independent variable, and the financial ratios related to liquidity trap as the dependent variable. The Ginger's causality test was used to assess the hypotheses and perform the statistical analysis, applying the Eviews software. The research results revealed that the immediate ratios of cash funds to volatile deposits, cash assets to short-term debts, volatile deposits to total deposits, macro deposits to total deposits, demand deposits to total deposits, liquidity coverage, and loan to deposit are most closely related to the prediction of liquidity trap. In addition, among the indicators of asset-liability management, the ratios of capital adequacy, VaR, and cash and current debt to current assets had a significant effect on the liquidity trap of the Credit Institute for Development.

Keywords:

liquidity trap, asset-liability, financial ratios, ISM, the Credit Institute for Development.



1. Introduction

Asset and Liability Management (ALM) is a strategic management tool for managing interest rate and liquidity risk in banks and credit institutions. In other words, Asset Liability Management (ALM) is the process of finding optimal policies for long term investors which need to meet future obligations. The management of assets and liabilities includes the process of managing and controlling the non-compliance of assets and liabilities for various reasons, including liquidity issues, liquidity, or changes in the rates of bank profits. Since management of assets and liabilities is a main function of financial management of banks, therefore, they use ALM techniques to increase their profitability through monitoring risk and minimize losses due to their transactions. These techniques target the volume, composition, maturity, rate of sensitivity, quality, and liquidity of assets and liabilities to achieve a predetermined risk-to-return ratio. In fact, the objective of ALM is to strengthen the quality and quantity of assets by considering the risk associated with assets and liabilities for future management (Monetary and Bank Research Institute, 2013). Financial analysis is a responsibility of the financial director and refers to the correct understanding of the performance and past status of the company, which allows future planning to maximize shareholder wealth. The financial analysis process includes three domains: financial accounting, analysis from the investor's perspective, and management economics. In the field of financial accounting, they determine profit, value added, and taxes. In the field of analysis from the investor's perspective, it is based on the investor analysis through comparative financial information and market analysis. In the field of management economics, it focuses on economic activities, effectiveness, maximization of shareholders' wealth, and value creation. In fact, a financial analyst goes to the frontier of identifying the status quo. By developing organizational tasks and rapid increase in costs and their link to the general status of communities, it is necessary to improve systems of planning, control and management of resources and expenditures, and to clarify operational, financial, and administrative processes in order to enable decision makers have access to sufficient valuable information about operations, performance outcomes, and financial and non-financial resources of activities to maximize shareholder wealth. Given the

agile business space in the third millennium, merely obtaining information will not lead to wealth and value creation, rather, this information should be used to create knowledge, wisdom, and discernment in the decision makers (Makuyi *et al.*, 2016).

The whole subject of assets liabilities management is an area of banking that has undergone drastic change. Strong capital does not guarantee liquidity in all situations, there can be panics and sudden increase in the demand for liquidity (Paul, 2009).

The new Basel III accord aims to address liquidity risk in banks through the Liquidity coverage ratio (a liquidity requirement) and the Net stable funding ratio (a restriction on maturity mismatch that limits the volume of refinancing coming due each period. (Basel Committee 2010). Basel III has introduced new banks requirement both on the capital and on the liquidity risk. These changes will have big impact on banks, because they are required to hold a level of capital and liquidity higher than in the past, this will inevitably have also an impact on the liquidity creation function performed by banks (Horvát, et al, 2012).

Matching is defined as „the distribution of the term of assets in relation to the term of the liabilities in such a way as to reduce the possibility of loss arising from a change in interest rates (Redington, 1952). Immunization is the process of making investments in a manner which will protect the existing business from a change in the interest rates. In his paper, Redington concluded that the results of the actuary can be absolute under certain circumstances, with the primary condition being that the duration of the payments going out of the company be equal to the duration of the cash being received by the company. It was his opinion that if this criterion be met, the assets and liabilities would then be equally affected by changes in the market interest rate. Duration was introduced by Macaulay back in 1938 and still remains a critical tool for Asset Liability Management. Despite its wide usage immunization has some very pertinent limitations. For a perfectly immunized portfolio, the following are the conditions; Present value of Assets = Present value of Liability Duration of Assets = Duration of Liability Convexity of Assets > Convexity of Liabilities According to Cain and Treussard (2007), immunization is the act of establishing a position such that the value of the position is insensitive to small changes in some specified parameter and this normally enables strategic managers to meet their target profit.

The term is most commonly used to describe a liability and supporting portfolio such that the net or surplus market value of the position is immune to small changes in interest rates. This term could readily be applied to any business where its profits or values have been protected from changes in the price of an input or output.

Making decision about the maturity of assets and liabilities is one of the most important decision areas in a bank. The difference between borrow and loan rates is, in essence, the profit earned by the bank. The obvious risk arising from this strategy is that the level of short-term rates increases over the duration of the loan, therefore, when the loan is refinanced, the bank will incur less profit or net loss. Managing this risk is the main task of the ALM committee. Liquidity is another risk factor. From the perspective of banking and treasury, the term "liquidity" refers to liquidity related to financing or proximity and access to cash funds. Cash is the most liquid asset. Banks suffer several interdependent liquidity risks, including the risk of inability to pay deposits to depositors on demand, the inability to raise funds in the market at reasonable rates, and inadequate funds for loan

Baum (1996) defines Asset Liability management (ALM) as the practice of managing a business so that decisions and actions taken with respects to assets and liabilities are coordinated in order to ensure effective utilization of company's resources to increase its profitability. ALM is conducted primarily at an overview, balance sheet level (Choundhry, 2011). Thus, ALM involves the management of the total balance sheet dynamics and it involves quantification of risks and conscious decision making with regard to asset liability structure in order to maximize the interest earnings within the framework of perceived risks. The main objective of ALM is not to eradicate or eliminate risk, but to manage it in a way that the volatility of net interest income is minimized in the short run and economic value of the bank is protected in the long run. The ALM function involves controlling the volatility of net income, net interest margin, capital adequacy, liquidity risk and ensuring an appropriate balance between growth and risk.

The whole subject of assets liabilities management is an area of banking that has undergone drastic change. Strong capital does not guarantee liquidity in all situations, there can be panics and sudden increase in the demand for liquidity (Paul, 2009). However, it is

the job of the central banks to help in those circumstances. A strong capital base in the banking system and in all its components is likely to limit future liquidity shocks management, this is a provoking idea for the management of the financial institutions to think about and act. However, how and when to act are the questions which led to asset liability management; a management tool to monitor and manage various aspects of risks associated with the balance sheet management, including the management of exposure of the financial institutions.

The Asset liability management in the recent years has become a tool of integrated analysis of assets and liabilities so to value not only the interest rate risk but the liquidity risk, solvency risk, firm strategies and asset allocation as well. The landscape of asset liability management for the financial sector is ever changing and the scope of asset liability management activities has widened. Banking institutions have adopted Asset liability management strategies to address key risks such as; interest rate risks, liquidity risk and foreign exchange risk. A sound ALM process integrates strategic, profitability, and net worth planning with risk management. This process often includes an Asset Liability Committee (ALCO), which has the central purpose of attaining goals established by the short and long-term strategic plans without taking on undue risk.

Asset liability management practice is concerned with managing interest rate and liquidity risks and this is the ALM desk within the treasury department. Interest rate risk exists in two strands. The first strand is that the risk of changes in asset liability value due to changes in interest rates. Such changes impacts the cash flows of assets and liabilities, or rather their present value, because financial instruments are valued with reference to market interest rates. The second strand is associated with optionality, which arises with products such as early redeemable loans. The other type of risk managed by ALM is the liquidity risk, which refers to the liquidity of markets and the ease with which assets can be translated to cash (Choundhry, 2011).

1.1. Liquidity Risk

According to Wellink (2008), "The extreme liquidity conditions and resulting difficulties that persist today are vivid illustrations of the critical importance of market liquidity to the banking sector,

these events emphasized the links between market and funding liquidity, the interrelationship between funding liquidity risk and credit risk, and the fact that liquidity is a key determinant of banking sector soundness."

The main role of banks in the financial market is to create liquidity and transform risk (Berger, & Bowman, 2009). Banks use short-term debt to invest in long-term assets (Diamond and Dybvig, 1983). This function creates liquidity risk and therefore a bank unable to roll over maturing debt can fail despite of being solvent. Majority of recent bank liquidity crises in developed economies were caused by increased uncertainty over a bank's solvency and played out primarily in wholesale funding markets (Huang & Ratnovski, 2011).

Liquidity is a significant determinant of financial distress, because without liquidity a bank cannot meet the deposit withdrawals and satisfy customer loans. The objective of liquidity management thus is to ensure that banks are able to meet in full all their financial obligations as they fall due. In December 2006, the Basel Committee on Banking Supervision established the working group on Liquidity to review liquidity supervision practices in member countries. The working group's mandate was to take stock of liquidity supervision across member countries. This included an evaluation of the type of approaches and tools used by supervisors to evaluate liquidity risk and banks' management of liquidity risks arising from financial market developments.

The new Basel III accord aims to address liquidity risk in banks through the Liquidity coverage ratio (a liquidity requirement) and the Net stable funding ratio (a restriction on maturity mismatch that limits the volume of refinancing coming due each period. (Basel Committee 2010). Basel III has introduced new banks requirement both on the capital and on the liquidity risk. These changes will have big impact on banks, because they are required to hold a level of capital and liquidity higher than in the past, this will inevitably have also an impact on the liquidity creation function performed by banks (Horvát, et al, 2012).

1.2. Effect of Asset Liability Management on Liquidity Risk

Asset liability management plays a critical role in weaving together the distinct business lines in a bank.

The management of both the liquidity and balance sheet are crucial to the existence of a financial institution and sustenance of its day to day operations. It is also essential for seamless growth of the balance sheet in a profitable way. Typically, the Asset liability management function seeks to generate daily gaps on short-term ladders and ensures that cumulative gaps operate within pre-set limits. However, managing liquidity gaps alone is not adequate. A well-managed liquidity function will include liquidity contingency plan, liquid asset buffers and setting liquidity policies and limits in tune with level of risk that the management believes is acceptable and manageable (Oracle White Paper, 2011).

In recent times, even large multinational financial institutions were in a deep liquidity crisis and in dire need of external intervention for survival. The practical importance of asset liability management and liquidity management had been somewhat underestimated. Even managers of large institutions, regulators, and observers glimpsed how well reputed firms and trusted institutions folded up and were not able to find a way out of the deep liquidity crisis (Oracle white paper, 2011). This resulted in regulators attributing high importance to new measures and practices needed to ensure a sound liquidity management system. Regulators have enhanced and in some geographies revamped the regulatory oversight on asset liability management and liquidity management (Oracle white paper, 2011).

Over the past couple of decades, the financial system has evolved a more effective approach of liquidity management. Due to financial innovation, commercial banks have moved from an "originate to hold" model to an "originate to distribute" model. Banks now rely more on financial markets for their funding. This has allowed the alleviating of borrowing constraints in the economy, as growth in lending could be partially disconnected from growth in bank deposits. But financial institutions were probably overconfident in their Asset liability management techniques, which became increasingly sophisticated. In times of stress, it appears more difficult than anticipated for financial institutions to adjust their Asset liability management quickly. Therefore, there is probably a limit to the optimization of asset liability management, and this is a message for the future (Jean, 2008).

Through correct Asset liability management - liquidity, profitability and solvency of banks can be ensured and at the same time banks can manage and reduce risks such as credit risk, liquidity risk, interest rate risk, currency risk etc. The liabilities of a bank have distinct categories of varying cost, depending upon the tenor and the maturity pattern. Likewise, the assets comprise different categories with varying yield rates depending upon the maturity and risk factors. Therefore, the major aim of Asset liability management is the matching of the liabilities and assets in terms of maturity, cost and yield rates. The maturity mismatches and disproportionate changes in the levels of asset and liabilities cause both liquidity risk and interest rate risk.

The term asset-liability management (ALM) has expanded in economics since the mid-1970s. ALM includes a set of tools and techniques that guarantee value creation for shareholders and control of risks (Eco-innovation, 2008). ALM is a risk assessment and risk management process that is planned for achieving financial goals. This process involves planning, directing, and controlling the flow, level, and combination of the funds earned, the costs, and revenues of the company, and is combined with financial risk control and achieving financial goals. This approach focuses on minimizing different risks by placing the appropriate combination of assets and liabilities in order to meet the company's goals. The key idea in ALM is to make strategic investment decisions in a stepwise manner and consistent with the use of cash funds in fulfilling the company's obligations (Habibi, 2002). ALM can be defined as reconstruction of the two sides of the balance sheet to achieve reasonable profitability, minimize interest rate risk, and provide sufficient liquidity (EcoNowin, 2008). In general, ALM includes a set of management tools designed to address the risks that organizations face; *i.e.*, those risks that reduce the profitability and efficiency of financial institutions. In fact, ALM represents the relationship between risk and return. Therefore, ALM discusses about risk-taking using innovative ways to achieve optimal rewards and always begins by analyzing the balance sheet and examining its internal and external items. Successful ALM in an organization requires identification, assessment, and control of the company's main risks. In this regard, the most important issues which target level should be extracted include asset returns, stock

returns, leverage ratio, and risk-adjusted capital ratio. ALM examines issues and techniques raised in this field and the uncertainties that the company faces. This uncertainty is divided into internal and external groups. Internal uncertainties are related to the flow of funds and external uncertainties to the economic conditions, capital market, demographic conditions, and so on. Internal uncertainties can be reflected by designing future cash flows and allocation of a parameter for these factors in the model, and external uncertainties through the scenario of random variables in mathematical models.

ALM is essentially one of the activities of risk management and capital management. Although in banks, most daily activities are done at the committee level, decisions and directions are made at the highest level of the bank. The risks that the banking environment faces are multidimensional and mainly include interest rate risk, liquidity risk, credit risk, and operational risk. Interest rate risk is a type of market risk. Risks associated with fluctuations in interest rates and liquidity levels are risks that lead to reversal fluctuations in income levels due to changes in market rates and bank financing costs. In other words, banks' income levels are heavily sensitive to fluctuations in interest rates and the cost of providing funds in the wholesale market. ALM includes a set of techniques that are used to manage interest rate risk and liquidity risk, and is linked to the bank's balance sheet structure, which is heavily influenced by legal and funding constraints and profitability objectives.

2. Literature Review

Banks are exposed to very different potential risks, including those related to the technological and financial structure, which affect also their credit, and those that result from the institutional and social environment. These risks are not mutually exclusive and they overlap making their isolation and detection difficult (Musakwa, 2013).

Subrahmanyam Ganti (Dr.) has observed in article "Asset Liability Management for Banks in a Deregulated Environment" that Asset Liability Management (ALM) is a philosophy under which banks can target asset growth by adjusting liabilities to suit their needs. The focus of ALM should be the bank profitability and long term operating viability. The author has contended that a large size bank using interest sensitive funds should aim at an equally

interest sensitive asset structure to ensure a stable flow of net interest income whereas a small sized bank with a predominantly retail deposit mix of fixed nature needs to aim at fixed-rate earning assets. Banks with sufficient liquidity and safety built into their asset and liability structure can easily withstand the financial turbulences created by deregulation and disintermediation.

Sinkey Joseph (Jr.) referred to Asset Liability Management (ALM) as coordinated management of a bank's balance sheet to allow for alternative interest-rate and Liquidity Scenarios. The total variable of ALM in the short run is Net Interest Income (Nil) or its ratio form Net Interest Margin ($NIM = \frac{NII}{\text{Earning Assets}}$). This accounting approach determines the change in a bank's Nil as the product of unexpected changes in interest rates and its dollar gap (i.e. the difference between rate sensitive assets (RSAs) and rate-sensitive liabilities (RSLs)). Thus $Nil = Ar \times GAP$. In contrast, the economic model of ALM focuses on the sensitivity of the market value of a bank's equity to unexpected changes in interest rates.

Kosmidou Kyriaki and Zopounidis have stated that Asset Liability Management is an important dimension of risk management, where the exposure to various risks is minimised while maintaining the appropriate combination of asset and liability, in order to satisfy goals of the firm or the financial institution. The authors have discussed in brief models that were developed regarding the optimal management of the assets of the firms, the risk, the return and the liquidity namely Stochastic programming, Decision Rules, Capital growth and Stochastic control. Advantages and disadvantages related to above mentioned four approaches have also been brought out by the authors. In another chapter entitled "Review of the asset liability management techniques" the authors have discussed at length various Asset Liability Management techniques / models such as Deterministic Models, Multi objective linear programming Models, Stochastic Models, Chance constrained Programming Models, Sequential Decision Theoretic Approach, Dynamic Programming, Stochastic linear Programming, Simulation Models.

Harrington R noted that "Modern asset and Liability Management involves, continually, monitoring the existing position of a bank, assessing how this differs from what is desirable, and undertaking transactions to move the bank towards the

desired position. The objective is to sustain and, where possible enhance, profitability, while controlling and limiting the different risk inherent in present day banking, as well as complying with the constraints of monetary policy and supervision.

Dattatreya Ravi E observed in his article that "Financial Institutions Provide a valuable service by assuming intermediation risk of various types including liquidity, credit and interest rate risks. Given the recent volatility of interest rates, the major intermediation risk is interest risk. ALM is a systematic approach that attempts to provide a degree of protection to the institution. ALM consists of necessary framework to define, measure, monitor, modify and manage interest risk.

Vij Madhu in her article "Asset Liability Management in Indian Banks" has observed that the importance of managing the asset-liability mix in the Indian financial markets has emerged from the increasing volatility in the domestic interest rates as well as foreign exchange rates that has evolved after liberalisation. This deregulated interest rate environment has brought pressure on the management of banks to maintain a good balance among spreads, profitability and long-term viability. Over the last few years there has been an intense competition and banks and financial institutions have been required to take up strategic planning as an exercise for asset liability management in order to survive and grow in the ever increasing competitive and risky environment.

Chowdhari Prasad and K.S. Srinivasa Rao in their paper have attempted to undertake SWOT analysis and other appropriate statistical techniques to rank 30 private sector banks using four parameters - efficiency, financial strength, profitability and size and scale. The authors have carried out Analysis of variance (ANOVA) for each of these four parameters using F-test as a parametric case. They have found that private banks are professional, dedicated and efficient. They have strong financials and comply with capital adequacy requirements and prudential norms. Their major weaknesses identified are confinement to limited area, limited number of branches, higher employee turnover ratio, etc. However, with high level of autonomy and faster decision making processes, cost effective services they have capacity to perform better in future. The authors have cautioned private sector banks, mergers and takeover threat from other

large banks and entry of foreign banks as possible areas of threat.

Lonkar M.V in his article “Risk Based Supervision and Changing role of Auditors” has noted that Banks in the process of financial intermediation are confronted with various kinds of financial and nonfinancial risk viz. credit, interest rate, foreign exchange rate, liquidity, equity price, commodity price, legal, regulatory, reputational, operational, etc. These risks are highly interdependent and events that affect one area of risk can have ramifications for a range of other risk categories. The Reserve Bank of India (RBI) has issued discussion papers on Risk Based Supervision (RBS) and Prompt Corrective Action (PCA) Framework. The earlier supervision process of RBI is based on CAMELS (Capital adequacy, Asset quality, Management, Earning, Liquidity, Systems and control) (applicable to all domestic banks) and CALCS (Capital adequacy, Asset quality, Liquidity, Compliance and Systems.) (applicable to Indian operations of banks incorporated outside India) approach where capital adequacy, asset quality, management aspects, earnings liquidity were considered.

The Reserve Bank of India is now embarking on the path to Risk Based Supervision (RBS), which would be introduced in phases beginning from 2003. The RBS model consists of:

- development of risk profile for each bank
- designing a customised supervisory action plan for each bank based on the risk profile.
- Delineating the scope and extend of supervision to target high risk areas and areas of supervisory concern, and strengthening quality assurance and enforcement functions to maintain objectivity and neutrality in application of supervisory standards.

Gupta S.C in the article entitled “Risk -the New Strategic Imperative in Financial Management” has defined Risk as the possibility of suffering loss”, is the fundamental element that influences financial behaviour. Progressive liberalisation, globalisation, introduction of a wide range of products and services, improvement in technology and communication have profoundly impacted the operating environment of financial systems in general and the banking sector in particular. The Balance sheets of banks have undergone significant changes. Risks faced by banks

have multiplied posing challenges to not only the banks but also to the supervisors and regulators. To respond to these challenges, emphasis of banks has changed from the simplistic ‘profit oriented’ management of risk / return management. Various supervisory initiatives have also been taken to induce better operating standards and greater transparency and sensitivity towards risk management in banks. Risk Management has become the new strategic imperative.

Toby Adolffras J in his article “Extent of Nigerian Banks’ compliance with Basel Sound Liquidity Management Practices” carried out empirical investigation in 21 Nigerian banks and confirmed that there has been a significant difference between actual practices and standard liquidity management practices at 5 percent level of significance. There has also been observed a significantly positive relationship between compliance level and banks’ liquidity profile. The author contended that liquidity and solvency problems interact and one could cause the other. Given monetary policy constraints, banks that comply with sound liquidity management practices anticipate and manage shortfalls intelligently through proper contingency planning.

Arzu Tektas in his article “Asset and liability management in financial crisis” carried out An efficient asset liability management requires maximizing banks’ profit as well as controlling and lowering various risks. This multi-objective decision problem aims to reach goals such as maximization of liquidity, revenue, capital adequacy, and market share subject to financial, legal requirements and institutional policies. This paper models asset and liability management (ALM) in order to show how different managerial strategies affect the financial wellbeing of banks during crisis.

Lina Novickytė in her article “Assessment of Banks Asset and Liability Management: Problems and Perspectives (Case of Lithuania)” has shown Asset and liability management is one of the most important risk management measures at a bank. It is one of most important tool for decision making that sets out to maximize stakeholder value. Nevertheless it is important to track the external factors of the asset and liability management in the market to remain in the long term and to prepare for negative effects. Banking sector analysis could be the instrument to measure the sustainability of the country’s financial sector. This paper showed Lithuanian banking sector asset and

liability management activity and make assumptions of how sustainable the sector are during the different business cycle stages and how banks can manage their risks according to business cycles. The analysis revealed that banks tend to take more risk over time. The cycles of bank assets and liability are not identical to the cycles of business activity level, therefore it is seen that banks manage their assets and liability and attempt to influence their activity and profitability. The results indicate why the banks tend to enhance their risk levels before and during the financial crisis.

Ciobotea Adina and Oaca Sorina Cristina in “Assets and Liabilities Management – Concept and Optimal Organization” carried out Asset-liability management (ALM) is a term whose meaning has evolved. It is used in slightly different ways in different contexts. ALM was pioneered by financial institutions, but corporations now also apply ALM techniques. In banking, asset and liability management is the practice of managing risks that arise due to mismatches between the assets and liabilities (debts and assets) of the bank. This can also be seen in insurance. Banks face several risks such as the liquidity risk, interest rate risk, credit risk and operational risk. Asset Liability management (ALM) is a strategic management tool to manage interest rate risk and liquidity risk faced by banks, other financial services companies and corporations. ALM is defined as “the process of decision making to control risks of existence, stability and growth of a system through the dynamic balances of its assets and liabilities.”

Kanhaiya Singh (Dr) in asset liability management in dynamic approach has shown In India asset liability mismatch in balance sheet of commercial banks posed serious challenges as the banks were following the traditional methods of recording assets and liabilities at the book value. The liberalization process in the economy coupled with multifaceted global developments exposed banks for various kinds of risks viz. interest rate risk, liquidity risk, exchange risk, operational risk etc. which have direct impact on their operations, profitability and efficiency to compete with. The Central Bank of the country focused and advised banks for taking concrete steps in minimizing the mismatch in the asset-liability composition. There had been many positive impacts of various strategies followed by banks in the last one decade. This paper is an attempt to analyze the impact of measures and strategies banks undertook to manage

the composition of asset-liability and its impact on their performance in general and profitability in particular

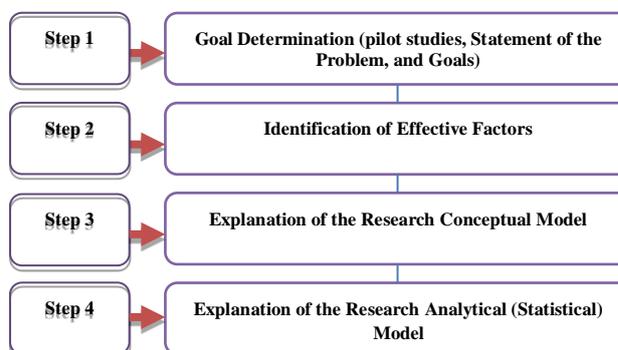
Klaassen was the first to show how arbitrage opportunities can bias the optimal solution of a bond selection investment problem with liability. The arbitrage opportunities issue related to the generation of a scenario tree for asset returns has been then considered by other authors.

Geyer, Hanke, and Weissensteiner investigate the theoretical relationships between the mean vector and the covariance matrix specifications of the statistical model for asset returns and the existence of arbitrage opportunities.

Consiglio, Carollo and Zenios and Staino and Russo proposed two similar moment matching tree generation approaches which directly consider the problem of avoiding arbitrage opportunities.

3. Methodology

A method should always be employed step by step in a study in order to achieve a goal. Figure (1) indicates the steps taken in this study.



3.1. Goal Determination

In the first step, the research goal should be determined. The goal of this study was to design and codify a liquidity trap model at Iranian banks. In fact, researchers sought to explain a liquidity trap model at Iranian banks by adopting a mixed (qualitative-quantitative) method and relying on theoretical foundations and relevant key concepts. As a result, knowledge development can be facilitated in the research area.

3.2. Identification of Effective Factors

In this step, it is necessary to extract indices, components, and factors affecting the illiquidity trap at Iranian banks. For this purpose, the qualitative data analysis method was employed for identifying and coding components and factors affecting the liquidity trap at Iranian banks in accordance with the theoretical literature, empirical studies of the subject, surveys, and interviews with banking experts. A large amount of data was generated in a qualitative study, regardless of the data type. Such data were collected through individual or group interviews, field notes, narrative methods (quotation), talks on the Internet, direct observation, or methods used to restore social phenomena such as videos, images, and footages.

It should be noted that manuscripts, notes, and images contain raw research data. They cannot present any information on the research results. Therefore, an appropriate data analysis method should be employed to combine the information obtained from different sources in the form of a continuous description. A widely-used analysis technique of qualitative research is thematic analysis. It is a method of identifying, analyzing, and reporting existing patterns in qualitative data. Thematic analysis is a process of analyzing text data. It converts dispersed and diverse data into rich and detailed data. It is not merely a specific qualitative method. It is a process which can be used in most of the qualitative method. There are many techniques of thematic analysis, each of which follow specific processes. In this manuscript, a stepwise process and statistical population were presented for thematic analysis by combining the methods proposed by King and Horrocks. In this section, the process of thematic analysis is introduced in three phases, six steps, and twenty actions. Table (1) shows these phases and steps.

Accordingly, it should be noted that although thematic analysis has many advantages, it is not free of disadvantages. A flaw of this analysis method is observed in comparison with other qualitative methods. For instance, thematic analysis does not offer any solutions for the classification of extracted themes and components. It does not clarify the mutual relationships between components, either. Therefore, the interpretive structural equation modeling approach can be adopted to fix such problems and enrich the

conceptual model extracted from thematic analysis. Data analysis is discussed in the next section.

4. Results

The questionnaires were analyzed after they were collected. The analysis was conducted in descriptive (demographic) and inference formats. The inference analysis was meant to test the research hypotheses. For this purpose, the partial least squares approach (confirmatory factor analysis) was employed.

The confirmatory factor analysis is mainly aimed at determining the power of a predefined factor model by using a set of observed data. In fact, an initial theory is taken into account to select the relevant variables and indices first. Then factor analysis techniques are used. In other words, the confirmatory factor analysis seeks two main goals in structural equation modeling:

- Estimating the parameters of a factor load corresponding model, the matrix of variance and covariance in factors, and the error of residual variance in observable variables.
- Evaluating the fitness of theoretical model based on factors

Chart (1) shows the structural equation modeling diagram used to evaluate the statistical explanatory power of the model.

Quantitative Analysis

Financial ratios and relevant procedures are used as the asset-debt quantitative analysis instruments. In this study, certain ratios of measurable data were used to define the combination of assets and debts and analyze how they changed.

Capital Adequacy Ratio

CAR is one of the ratios used to evaluate the healthy performance and financial stability of banks and financial institutes. Banks should have sufficient capitals to cover the risks resulting from their activities. They should be careful that potential harms do not affect investors. For this purpose, they should possess the minimum capital to cover the operational risks. The minimum capital is nearly 8% of the balanced assets to the risk (the risk of every asset with respect to the nature of that asset and relevant risk).

$$CAR = \frac{\text{Tier 1 capital} + \text{Tier 2 capital}}{\text{Risk weighted assets}}$$

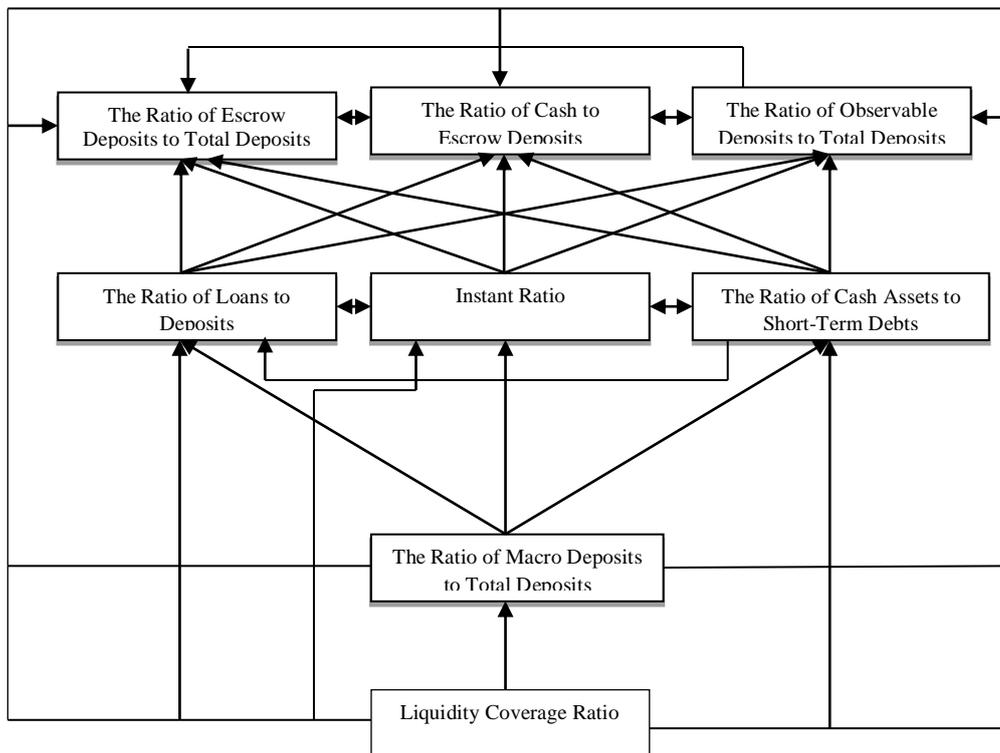


Chart (1). SEM Diagram (Evaluating the Statistical Explanatory Power of the Liquidity Trap Model)
(the conceptual framework for research (source: the researcher))

Value at Risk

VaR is a widely-used index in financial topics. At a certain confidence level, it is expected that the asset does not experience a loss exceeding VaR for a certain period of time in the future.

VaR is mainly calculated by using the normal probability density function of asset changes. First, critical changes (R_{cutoff}) is calculated. With a probability of $(1-\alpha)$, the upcoming changes of a future day will not be more negative than critical changes; therefore, no more loss will be experienced:

$$R_{cutoff} = \mu - z_{\alpha} \cdot \sigma$$

VaR is obtained from the coefficient of critical changes in the current value of the asset portfolio (p_0):
 $VaR = p_0 \cdot R_{cutoff}$

Gap Ratio: It indicates the ratio of interest-rate-sensitive assets to interest-rate-sensitive debts.

Cash Ratio: It indicates the ratio of total security bonds and funds to current assets/debts.

The Ratio of Total Debts to Total Assets: This ratio is used to calculate a percentage of assets provided by debts. Regarding business units, this ratio is used as an index to determine financial risk. In other words, every budget deficit makes a company resort to loans to supply a larger part of resources. Then the company will be more likely to lack the ability to repay loans (Peyno, 2007).

Ratio of Current Debts: It includes the ratio of current debts to shareholders' equity, total assets, and total debts. The ratios of current debts indicate the weights of short-term accruals in different aspects of balance sheets at a company. The lower these ratios are, the lighter the short-term debts are (Banks, 2005).

4.1. Interpretation of Results (Case Study)

Hypothesis testing provides a basis for taking ideas or theories that someone initially develops about the economy or investing or markets, and then deciding whether these ideas are true or false. More precisely, hypothesis testing helps decide whether the tested ideas are probably true or probably false as the

conclusions made with the hypothesis-testing process are never made with 100% confidence - which we found in the sampling and estimating process: we have degrees of confidence - e.g. 95% or 99% - but not absolute certainty. Hypothesis testing is often associated with the procedure for acquiring and developing knowledge known as the scientific method. Hypothesis testing is similar in some respects to the estimation processes presented in the previous section. Indeed, the field of statistical inference, where conclusions on a population are drawn from observing subsets of the larger group, is generally divided into two groups: estimation and hypothesis testing. With estimation, the focus was on answering (with a degree of confidence) the value of a parameter, or else a range within which the parameter most likely falls. Think of estimating as working from general to specific. With hypothesis testing, the focus is shifted: we start by making a statement about the parameter's value, and then the question becomes whether the statement is true or not true. In other words, it starts with a specific value and works the other way to make a general statement. A null hypothesis is a type of hypothesis used in statistics that proposes that no statistical significance exists in a set of given observations. The null hypothesis attempts to show that no variation exists between variables or that a single variable is no different than its mean. It is presumed to be true until statistical evidence nullifies it for an alternative hypothesis.

A type II error is a statistical term used within the context of hypothesis testing that describes the error that occurs when one accepts a null hypothesis that is actually false. The error rejects the alternative hypothesis, even though it does not occur due to chance. A type II error fails to reject, or accepts, the null hypothesis, although the alternative hypothesis is the true state of nature.

4.1.1. Preliminary Concepts of Statistics (Procedure for a hypothesis testing)

- ✓ State the null (H_0) and alternative (H_a) hypothesis
- ✓ Specify a significance level α
- ✓ Specify the test statistic under H_0
- ✓ Specify the decision rule for rejecting H_0
- ✓ Compute the test statistic based on the sample data
- ¾ Draw conclusions

4.1.2. Preliminary Concepts of Statistics (Type I and II errors)

- Type I error: reject H_0 when it is true
 $P(\text{Type I error}) = P(\text{Reject } H_0 \mid H_0 \text{ is true}) = \alpha$
- Type II error: fail to reject H_0 when it is false
 $P(\text{Type II error}) = P(\text{Fail to reject } H_0 \mid H_0 \text{ is false}) = \beta$
 $P(\text{Reject } H_0 \mid H_0 \text{ is false}) = 1 - \beta = \text{Power of the Test}$

In this research:

H0: ALM indicators have a significant effect on banks' trap liquidity

H1: ALM indicators have not a significant effect on banks' trap liquidity

- ✓ In Equation 1, the loan-to-deposit dependent variable is influenced by the variables of capital adequacy, Value at Risk (VaR), gap ratio, current assets/(cash-in-hand + securities) = cash ratio, current liabilities/(cash-in-hand + securities) = cash ratio, current liabilities to current assets, current liabilities to assets, and the ratio of facilities to large deposits. These variables have a significant and different effect.

- The capital adequacy, shown by I, increases the loan-to-deposit ratio; so that an increase in capital adequacy would be associated with 0.46 units increase in the loan-to-deposit ratio. The VaR ratio, which is calculated as 1.96 times the assets, reduces the loan-to-deposit ratio in the Tose-eh Financial and Credit Institution; because the increase in assets would be associated with the increase in the bank's services and, consequently, the increase in the amount of deposits. With increasing deposit, the amount of facilities also increases; but the loan-to-deposit ratio decreases; because the amount of facilities does not increase as much as the amount of deposits; and therefore they leave a negative effect.

- The increase in the gap ratio, which is calculated using the interest sensitive assets/interest sensitive liabilities method, reduces the loan-to-deposit ratio.

- Current assets/(cash-in-hand + securities) = cash ratio increases the loan-to-deposit ratio in the bank.

- ✓ The existence of a cash ratio, obtained from the current liabilities / (cash-in-hand/securities) method, also has a positive effect on the loan-to-

deposit ratio. The current liabilities variable has a negative impact on the loan-to-deposit ratio. The ratio of current liabilities to assets has a positive and significant effect, and the variable of facilities to large deposits ratio has a negative effect on the loan-to-deposit ratio.

- ✓ In equation (2), the Liquidity Coverage Ratio (LCR) is a dependent variable which is affected by the variables of capital adequacy, VaR, the gap ratio; $\text{current assets}/(\text{cash-in-hand} + \text{securities}) = \text{cash ratio}$, $\text{current liabilities}/(\text{cash-in-hand} + \text{securities}) = \text{cash ratio}$, $\text{current liabilities to current assets}$, $\text{current liabilities to assets}$, $\text{ratio of facilities to large deposits}$. The variable of capital adequacy ratio has a positive effect on liquidity coverage. The impact of other variables is as follows: VaR ratios and gap ratio have a negative effect, and the cash ratio and current liabilities to current assets ratio have a positive effect, and the ratio of facilities to large deposits has a negative effect on the liquidity coverage ratio.
- ✓ In Equation 3, the ratio of volatile deposits to total deposits is influenced by the ratio of capital adequacy, VaR, the gap ratio; $\text{current assets}/(\text{cash-in-hand} + \text{securities}) = \text{cash ratio}$, $\text{current liabilities}/(\text{cash-in-hand} + \text{securities}) = \text{cash ratio}$, and $\text{current liabilities to current assets ratio}$.
- ✓ Equations 4 and 5 (the ratio of liquid assets to short-term liabilities and the quick ratio) are affected by the variables of capital adequacy ratio, VaR, the gap ratio; $\text{current assets}/(\text{cash-in-hand} + \text{securities}) = \text{cash ratio}$, $\text{current liabilities}/(\text{cash-in-hand} + \text{securities}) = \text{cash ratio}$, $\text{current liabilities to current assets}$, as detailed in the table.
- ✓ Equation 6, the ratio of large deposits to total deposits also influenced by the ratio of capital adequacy, $\text{current assets}/(\text{cash-in-hand} + \text{securities}) = \text{cash ratio}$, $\text{current liabilities}/(\text{cash-in-hand} + \text{securities}) = \text{cash ratio}$, and $\text{current liabilities to current assets ratio}$. All of these variables have had a significant effect on the whole equation.
- ✓ In Equation 7, the ratio of demand deposits to total deposits is also affected by VaR, $\text{current assets}/(\text{cash-in-hand} + \text{securities}) = \text{cash ratio}$, $\text{current liabilities}/(\text{cash-in-hand} + \text{securities}) = \text{cash ratio}$, $\text{current liabilities to current assets ratio}$, $\text{current liabilities to assets}$, and $\text{facilities to large}$

deposits ratio , which is consistent with the previous research.

- ✓ In Equation 8, the cash ratio to volatile deposits is influenced by the [variables of] capital adequacy, VaR, $\text{current assets}/(\text{cash-in-hand} + \text{securities}) = \text{cash ratio}$, $\text{current liabilities}/(\text{cash-in-hand} + \text{securities}) = \text{cash ratio}$, and $\text{current liabilities to current assets ratio}$.

Table (2) shows these results.

4.1.3. Granger Causality Test

According to the estimated equations, the explanatory variables can explain almost 99% of the dependant variables, which is indicative of the high validity and reliability of the study as well. According to Granger causality test, the current assets to “cash deposits + securities” ratio has a one-way causal relationship with capital adequacy. In other words, based on this relationship, the cash ratio shall result in capital adequacy.

- ✓ There is a one-way causal relationship between capital adequacy and $\text{current debts}/(\text{cash deposits} + \text{securities})$ ratio. These two relationships are indicative of the fact that the cash ratio affects the cash ratio #2 through the capital adequacy channel.
- ✓ There is a one-way causal relationship from current debts to current assets, and then to capital adequacy.
- ✓ There is a one-way causal relationship from liquidity coverage to capital adequacy.
- ✓ There is a one-way causal relationship from capital adequacy to large deposits / total deposits ratio.
- ✓ There is a one-way causal relationship from VaR ratio to loan / deposit ratio.
- ✓ There is a one-way causal relationship from VaR to current debt / assets ratio.
- ✓ There is a one-way relationship from gap ratio to sight deposits / total deposits ratio.
- ✓ There is a one-way causal relationship from cash ratio ($\text{current debts}/(\text{cash deposits} + \text{securities})$) to gap ratio.

Regarding the other variables, if the probability value is smaller than 0.05, the hypothesis written on the right side is rejected and the causal relationship shall apply. (Annex 1)

5. Discussion and Conclusions

Since survival of the banks depends certainly on their ability of increasing the liquidity and fulfilling

their commitments timely, the liquidity management is one of the most important skills of a bank. Proper liquidity management prevents serious problems that may happen to the banks. Indeed, considering the fact that lack of liquidity in a bank can cause extensive problems in the system, importance of liquidity for a bank is beyond any other issues. Therefore, the liquidity analysis not only makes the bank manager monitor status of the liquidity constantly, but also makes him find out how to meet the cash requirements under various scenarios, including critical conditions. Indeed, liquidity management in a bank consists of analyzing of the bank's liquidity status in the past, forecasting the future needs, studying the methods of attracting the resources, and designing structure of the assets (especially estimating the bad debts). Liquidity coverage ratio, loans to deposits ratio, cash deposits to short-term debts ratio, sight deposits to total deposits ratio, large deposits to total deposits ratio, run-off deposits to total deposits ratio, cash deposits to run-off deposits ratio, and quick ratio are the most important factor affecting a bank's liquidity.

It must be noted that results of the estimated model are indicative of compliance of the findings with some of the local and overseas studies in this field. Some of the studies that comply with the theoretic results and estimated results of the present study are as follows:

Pedram et al (2008) carried out a study to forecast the liquidity trend of the banks, aiming to determine the liquidity gap. They concluded that deposits and amount of the loans provided by the banks are amongst the important factors affecting liquidity of the banking system. They explained that when the loans and facilities provided by a bank exceed the deposits, the bank shall face liquidity problems, and that there is a positive relationship between these two. This result complies with results of the present study, which are indicative of a positive relationship between the liquidity trap and loans-to-deposits ratio. Yazdanpanah and Shakib Haji Agha (2010) stated in their study that maturity of the assets and debts as well as monitoring the loans-to-deposits ratio are amongst the important liquidity growth factors, and the banks with higher loans-to-deposits ratio are more likely to face the liquidity trap; because when the loans and facilities provided to the customers exceed the total deposits, the bank shall be less likely to meet the cash requirements. This complies with results of the present study (the positive relationship between loans-to-

deposits ratio and liquidity trap. Hanifi and Ramanipoor (2012) studied the factors affecting the liquidity in the banking industry. Results of their study show that the sight deposits and miscellaneous deposits have a significant negative effect on the liquidity trap. There is also a significant relationship between miscellaneous deposits and liquidity trap. There is a significant positive relationship between facilities provided to the customers and the liquidity trap. Meanwhile, sight deposits and miscellaneous facilities have a significant positive effect on the liquidity trap. According to Hanifi and Rahmanipoor's results, there is a positive relationship between sight deposits to total deposits ratio and liquidity risk (the bank's inability of fulfilling its commitments); because if the banks face a sudden deposit run-off (sight deposits), they might have to cash their less valued assets. This shall result in devaluation of the assets and lack of liquidity. Results of the present study, which are indicative of a positive relationship between sight assets to total assets ratio and the liquidity trap, comply with Hanifi and Rahmanipoor's findings. Chalaki et al (2015) also concluded in their study that changes of investments and run-off deposits to total deposits ratio have a significant positive effect on liquidity of the banks. This result complies with findings of the present study; because the higher run-off deposits (including current and saving accounts) to total deposits ratio is, the bank would be more likely to face the liquidity trap. Mehrara and Bohulvand (2017) have also achieved a number of results in regard to the effective factors of liquidity trap in the banks. Their results confirm that debt-to-asset ratio, long-term investment deposits ratio, capital to assets ratio, and deposits composition are the most effective variables in the liquidity risk pattern of the Iranian banks; so that the higher debt to assets ratio of a bank is, the more its liquidity risk would be; and the higher long-term investment deposits ratio is, the less the liquidity risk would be. They believe that a major risk that threatens the banking system is the liquidity risk, which is usually caused by inefficient liquidity management. In the banking activities, usually the maturity period of the facilities is longer than that of the deposits or debts, and such discord of remittance and collection dates affects the banks' ability of fulfilling commitments and consequently damages their reputation; and failing to make proper decisions may result in their bankruptcy. On the other hand,

maintaining the excess liquidity limits the bank's use of productive assets and existing investment opportunities, which shall disassociate the depositors and shareholders. Therefore the liquidity risk management is an inevitable and critical requirement of efficiency and profitability of the banking system. In the present study there is a negative relationship between cash assets to short-term debts ratio and the liquidity trap; so that increased cash assets to short-term debts ratio shall reduce the probability of facing liquidity trap. This complies with the results and findings of Mehrara and Bohlulvand.

In total, the result is that assumption H0 is accepted. It means that ALM indicators have a significant effect on banks' trap liquidity. Basically there are 3 ALM indicators (Capital adequacy, current liabilities to current assets, the cash ratio) have the most significant effect on getting to liquidity trap.

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