

THE MINISTRY OF EDUCATION OF THE REPUBLIC OF AZERBAIJAN

AZERBAIJAN STATE UNIVERSITY OF ECONOMICS

INTERNATIONAL GRADUATE AND DOCTORATE CENTER

MASTER DISSERTATION

ON THE TOPIC

“MEASUREMENT AND MODELLING THE RISK OF LIQUIDITY”

Suleymanova Aytaj Mehman

BAKU- 2021

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**Head of the International Center for
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MASTER DISSERTATION

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Elm andı

Mən, Süleymanova Aytac Mehman qızı and içirəm ki, “Measurement and modelling the risk of liquidity” mövzusunda magistr dissertasiyasını elmi əxlaq normalarına və və istinad qaydalarına tam riayət etməklə və istifadə etdiyim bütün mənbələri ədəbiyyat siyahısında əks etdirməklə yazmışam.

LİKVIDLİK RİSKİNİN ÖLÇÜLMƏSİ VƏ MODELƏŞDİRİLMƏSİ

XÜLASƏ

Tədqiqatın aktuallığı: Likvidlik riski tədqiqatçıların ən çox maraqlandığı məsələlərdən biridir. Uzun illər ərzində bir sıra maliyyə nəzəriyyələrinin və modellərinin hazırlanmasına baxmayaraq likvidlik riskinin ölçülməsi və modelləşdirilməsi ilə bağlı çox az tədqiqat öz nəticəsini vermişdir. Likvidlik riski bank sektorunda vacib risklərdən biri hesab olunur, hansı ki, bankın fəaliyyətinə böyük təsiri vardır.

Tədqiqatın məqsədi: Tədqiqat likvidlik riskinin ölçülməsinə təsir edən amilləri araşdırmaq və nümunəyə Berger və Bowman və Deep və Schaefer metodologiyasını tətbiq etməklə ən yaxşı ölçmə metodunu tapmaq məqsədi daşıyır.

İstifadə olunmuş tədqiqat metodları: Tədqiqat zamanı likvidlik göstəriciləri Berger və Bowman və Deep və Schaefer metodologiyasından istifadə edilmişdir.

Tədqiqatın informasiya bazası: Tədqiqatın informasiya bazasını Azərbaycan banklarının maliyyə statistik göstəriciləri, xarici alimlərin nəşrləri və digər mənbələri təşkil edir.

Tədqiqatın məhdudiyyətləri: Tədqiqatın məhdudiyyətlərinə əsasən bu sahədə olan tədqiqat işlərinin azlığı, statistik məlumatların toplanmasının və araşdırılmasının çətinliyi daxildir.

Tədqiqatın elmi yeniliyi və praktiki nəticələri: Tədqiqat praktiki nəticəsi sığortalı depozitin ümumi depozitə nisbəti, depozit faiz dərəcəsi, aktivlərin gəlirliliyi, problemlı kreditlərin ümumi kreditlərə nisbəti, depozitin ümumi öhdəlik nisbəti, neft qiymətləri, kapital gəliri ölkədəki likvidlik riskinin idarə olunmasına təsir edən əsas amillərdəndir. Tənzimləyici orqanlar və bank sektoruna sərmayə qoyanlar bu göstəricilərə daha çox diqqət yetirməli, bu göstəricilərin dəyişməsinə daha həssas olmalıdırlar. Digər nəticə isə bank həcmının likvidlik riski ilə müsbət əlaqəli olmasıdır. Bu, böyük bankların kiçik banklarla müqayisədə daha yüksək likvidlik riski ilə üzləşdiyini göstərir.

Nəticələrin istifadə olunma biləcəyi sahələr: Nəticələrin istifadə olunma biləcəyi sahələrə əsasən bank və dövlət sektoru daxildir.

Açar sözlər: Likvidliyin ölçülməsi, panel məlumatlarının təhlili, likvidlik riski, Azərbaycan

MEASUREMENT AND MODELLING THE RISK OF LIQUIDITY

SUMMARY

The actuality of the subject: Liquidity risk is one of the most important issues for researchers, but there are few researches done on it. Liquidity risk is one of the most important risks in the banking sector.

Purpose and tasks of the research: Liquidity indicators were used in the research using the Berger and Bowman and Deep and Schaefer methodologies.

Used research methods: In the research liquidity indicators were used with using the Berger and Bowman and Deep and Schaefer methodologies.

The information base of the research: The information base of the research consists of financial statistics of Azerbaijani banks, publications of foreign scientists and other sources.

Restrictions of research: The limitations of the study include the lack of research in this area, and the difficulty of collecting and researching statistical data.

The novelty and practical results of investigation: The main factors influencing the management of liquidity risk in the country, the ratio of insured deposits to total deposits, deposit interest rates, return on assets, the ratio of problem loans to total loans, total deposit liabilities, oil prices, capital gains. Regulators and investors in the banking sector need to pay more attention to these indicators and be more sensitive to changes. As a result, the size of the bank may be positively correlated with liquidity risk. This put large banks at higher liquidity risk than small banks.

Scientific-practical significance of results: Banking and public sectors.

Keywords: Liquidity measurement, panel data analysis, liquidity risk, Azerbaijan

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INTRODUCTION

Relevance of the research topic: The events experienced in the activities of the financial sector, which is an indispensable part of the economy, closely affect all sectors of the country's economy. A vivid example of this is that the financial crisis that started in the US markets in 2007 later gained a global dimension through trade and credit channels and affected the countries of the world. The bankruptcy of giant institutions or their acquisition by other institutions during the global crisis has revealed how important liquidity risk management is. Following the last global crisis, Basel III regulations were made and the basis for sound liquidity risk management criteria was laid. Today, investors take into account the liquidity indicators while making their evaluations about the financial institution.

Statement of the problem and learning level: One of the most crucial challenges for researchers is liquidity risk. Despite the development of a number of financial theories and models over many years, little study on measuring and modeling liquidity risk has been done. One of the most significant hazards in the banking industry is liquidity risk, which has a considerable impact on the bank's operations.

Purposes and objectives of the research: Azerbaijan economy, which was rapidly integrated with the world economy like other developing countries, was naturally adversely affected by the financial crisis. This study was carried out with the aim of investigating the relationship between the important factors affecting the liquidity risk, which is an indicator of the solvency of Azerbaijani commercial and state banks, and determining the possible causes.

Object and subject of the research: The aim of the study is to find the best method for measuring liquidity among various methods

Research methods: In this study, liquidity indicators were created using the methodology of Berger and Bowman and Deep and Schaefer for forty-three commercial and state banks operating in Azerbaijan. With the liquidity indicators obtained, the ratio of insured deposits to total deposits, capital adequacy, deposit

interest rate, return on assets, ratio of non-performing loans to total loans relationships between the ratio of loans to loans, return on equity, loan interest rate, deposit total liability ratio, policy interest rate and exchange rate, and oil price variables were investigated. Bank size variable is calculated by taking the logarithm of the assets in accordance with the literature and used in the model as a control variable.

Research database: The research database includes financial statistics of Azerbaijani banks, publications of foreign scientists and other sources.

Research limitations: The limitations of the study include the lack of research in this area, and the difficulty of collecting and researching statistical data.

Scientific novelty of the research: The ratio of insured deposit to total deposit, deposit interest rate, return on assets, ratio of non-performing loans to total loans, deposit total liability ratio, oil prices, and return on equity are among the important factors affecting liquidity risk management in the country, according to the study's findings. These findings suggest that regulators and those who invest in the banking sector should pay more attention to these indicators, be more sensitive to changes in these indicators, and use this information to guide their investment decisions. Another significant finding of the study is that the size of the bank is positively related to liquidity risk. Large banks, on the other hand, incur a bigger liquidity risk than smaller banks.

Scientific and practical significance of the results: In this investigation where board information examination is utilized, the liquidity move coefficient determined utilizing Deep and Schaefer's strategy and the proportion of protected store to add up to store, store financing cost, return on resources, proportion of non-performing credits to add up to advances, store complete liabilities proportion, oil costs and bank size are measurably as significant connections were obtained.

CHAPTER I. CONCEPT AND MEANING OF LIQUIDITY RISK

1.1 Types of liquidity risk and relationship between liquidity risks

For what reason is liquidity risk the executives so significant? During the new monetary emergency, albeit numerous banks had posted sufficient degrees of capital, they actually experienced challenges since they neglected to deal with their liquidity appropriately. Post-emergency, the greater expense of liquidity, bigger subsidizing spreads, higher instability and decreased market certainty are driving monetary foundations to distribute more assets to improving their liquidity risk the board capacities.

One should start breaking down risks with the origination of risk in its broadest sense. Despite the fact that a ton of creators give somewhat differing meanings of risk, for the most part risk can be thought to be a declaration of a plausible occasion as a worth. Risk is the apparent misfortune that is frequently estimated by the chance of horrible decision, which is communicated as likelihood. A financial expert may consider this to be as a proportion that demonstrates a potential loss of benefit and the event of misfortunes (<http://www.bis.org/publ/bcbs188.htm>, 2010).

G. Kancerevyčius noticed that risk happens when the probabilities of potential outcomes are known, vulnerability emerges when the probabilities of various potential outcomes are not known. This is the thing that recognizes risk from vulnerability.

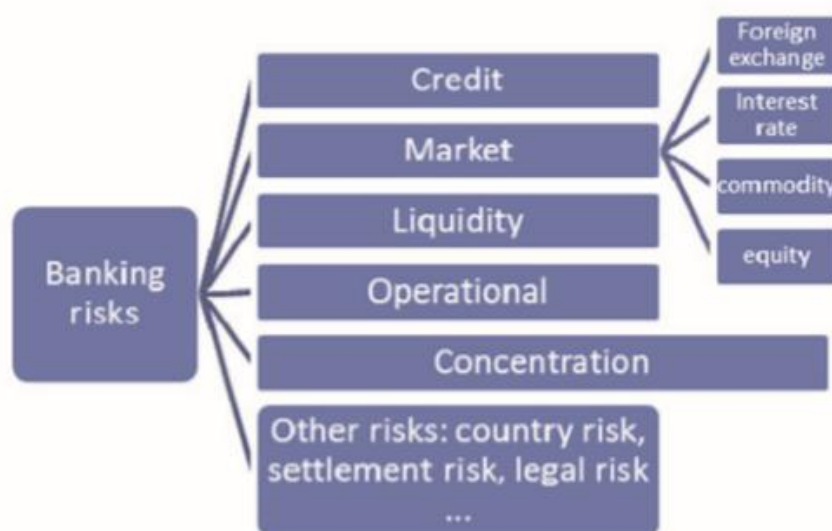
In this way, in light of a scholarly examination, one can deduce that risk is a likelihood, which shows that real productivity will contrast from the one that has been arranged. The higher this likelihood is, the higher risk is confronted. Nonetheless, we can't see risk just as a pointer of significant misfortunes. Tolerating extra risks may prompt additional benefit, and the higher the risk, the higher benefit can be anticipated. All in all, the significance of risk in economy can be seen both as a likelihood of misfortunes and a chance to work under dubious conditions and make higher pay by tolerating a more serious level of risk.

By delivering its administrations to general society, a business bank produces

added an incentive for its investors. This requires dealing with the assets accessible and any risks that may emerge in the best manner conceivable. Banks handle monetary assets endowed to them by store holders and contribute the cash endeavoring to procure the greatest benefit realistic at a satisfactory degree of risk (Valvonis V., 2009). A wide range of techniques exist to deal with each sort of risk. With regards to dealing with its risks, a business bank needs to combine risk the executives, making a uniform interaction since all risks and techniques to oversee it are interrelated.

There are three primary sorts of risks that can be recognized: market risk, credit risk and operational risk (Crouhy M., Galai D., Mark R. 2007). This arrangement of bank risks summarize the risks that banks cause, yet it doesn't accept one of the critical kinds of risks that a bank faces, which is liquidity risk. A. Gaulia and I. Mačerinskienė further extend the arrangement of risk as set up in the Basel rules of capital sufficiency by adding liquidity risk.

Figure 1: Types of banking risks



Source: Compiled by author

Six chief kinds of risk recognized, for example, credit risk, loan cost risk, market risk, liquidity risk, operational risk and unfamiliar trade risk (J. Bessis 2008). Creators of the current banks risk is reflected in Figure 1. The researcher has added

different kinds of risks to the ones referenced previously. Different risks may concern country risk, guideline risk, etc.

As indicated by the arrangement of banking risks presented by unfamiliar financial experts, market risk can be for the most part said to comprise of three lesser risks: stock value risk, loan fee risk and unfamiliar trade risk. Six sorts of risks are distinguished. These are credit risk, liquidity risk, market risk, operational risk, notoriety risk and legitimacy risk. These risks go connected at the hip with capital risk, which is seen as a risk that the financial backer will lose all or part of their assets.

Thus, a business bank is influenced by a wealth of various risks. Numerous creators distinguish different risks that business banks face, yet the distinctions among them are not fundamental.

Liquidity risk is perhaps the most basic risks that banks run. Sufficient administration of liquidity may limit the likelihood that major issues will emerge in future. Indeed, the issue of liquidity isn't restricted to only one bank. A low liquidity proportion in one monetary establishment could influence the whole framework. It is liquidity risk that may assume the complete part on account of an insolvency of a bank. During a period of monetary downturn, the liquidity of a bank is an assurance for the bank's monetary strength (Brunnermeier K., 2009, Lasse H., 2009).

Liquidity is the capacity of a bank to subsidize expansions in resources and meet commitments really, without causing unsuitable misfortunes. The basic job of banks in the development change of transient stores into long haul advances makes banks characteristically powerless against liquidity risk, both of an organization explicit nature and that which influences markets overall. For all intents and purposes each monetary exchange or responsibility has suggestions for a bank's liquidity. Compelling liquidity risk the board guarantees a bank's capacity to meet income commitments, which are questionable as they are influenced by outer occasions and other specialists' conduct.

The European Central Bank characterizes liquidity risk as the capacity of a bank to back expansions in resources and meet installment commitments when due.

Be that as it may, this definition doesn't mirror the degree of liquidity accurately. This degree is significant with regards to unanticipated use of credit offices, withdrawal of stores, untimely reimbursements of advances or potentially installments of interest.

Liquidity characterized as reference of banking terms as the capacity of an establishment to meet its commitments (Fitch T. P., 2006). In banking, this term stands to incorporate the capacity of a bank to fulfill the needs of store holders who wish to pull out their assets and to fulfill the necessities of willing borrowers.

Banks are an imperative piece of the worldwide economy, and the substance of banking is assetliability the board, liquidity, hole and financing risk the executives too. Liquidity risk is the risk that a financial business will have inadequate assets to meet its monetary responsibilities in a convenient way. The too key components of liquidity risk are transient income risk and long haul subsidizing risk. The drawn out financing risk incorporates the risk that advances might be accessible when the business requires them or at satisfactory expense. All financial organizations need to oversee liquidity risk to guarantee that they stay dissolvable.

Market and financing liquidity risks compound each other as it is hard to sell when different financial backers face subsidizing issues and it is hard to get financing when the security is difficult to sell. Liquidity risk likewise will in general intensify different risks. On the off chance that an exchanging association has a situation in an illiquid resource, its restricted capacity to sell that position at short notification will intensify its market risk. Assume a firm has counterbalancing incomes with two distinctive counterparties on a given day. In the event that the counterparty that owes it an installment defaults, the firm should raise cash from different sources to make its installment. Should it be not able to do as such, it also will default. Here, liquidity risk is intensifying credit risk.

Likewise, liquidity risk must be overseen notwithstanding business sector, credit and different risks. In light of its propensity to intensify different risks, it is troublesome or difficult to disengage liquidity risk. In everything except the most basic of conditions, thorough measurements of liquidity risk don't exist. Certain

methods of resource responsibility the board can be applied to surveying liquidity risk. A straightforward test for liquidity risk is to see future net incomes on a step by step premise. Any day that has a sizeable negative net income is of concern. Such an investigation can be enhanced with pressure testing. See net incomes on an everyday premise accepting that a significant counterparty defaults.

Risk is estimated by the likelihood of an irregular factor acknowledging uniquely in contrast to its gauge and is a threat signal. What's more, the size of the peril is resolved as an element of the risk. Here, on the off chance that the incident factor is considered as liquidity determination, the chance of illiquidity causes liquidity risk. As this likelihood builds, the liquidity risk increments. Liquidity risk is perhaps the most significant and greatest risks looked by monetary establishments and mediators in monetary business sectors.

National Bank Liquidity Risk: It is unimaginable to expect to make a definition for this risk. The primary justification this is the wide spread of the possibility that the Central Bank liquidity risk doesn't exist. Since the Central Bank can generally give financing, it never faces an absence of liquidity. The Central Bank, which is the wellspring of the financial base and the imposing business model of liquidity guarantee, can appropriate the liquidity asset (it will dispense with the liquidity lack or excess) to adjust the liquidity interest in the financial framework when it considers significant. The Central Bank can possibly confront liquidity risk when there is no interest for homegrown cash. This is just conceivable if assets from the national bank can't be gotten. The present circumstance may emerge in instances of excessive inflation or cash emergency. Notwithstanding, since such situation is viewed as inconceivable in created modern states, it isn't referenced in the writing. It ought to be noted immediately that the Central Bank as a liquidity underwriter may confront misfortunes. Notwithstanding, these misfortunes won't mirror the liquidity risk. Such misfortunes may incorporate certain risks to the national bank: credit risk identified with insurance esteem, money related strategy risks (bogus sign risks), monetary destabilizing risks (moral peril in regards to crisis liquidity support during emergency periods). Be that as it may, these risks don't influence the liquidity

supplier capacity of the national bank.

Market Liquidity Risk: These kinds of risks are identified with exchanging at reasonable costs. This risk is the deliberate and non-diversifiable segment of liquidity risk. This has two significant impacts. This risk shows liquidity risk similitudes across business sectors, and market liquidity risk has frequently been viewed as an expense or premium in resource valuing writing. It has been seen that it decidedly influences the cost of an asset. The higher the exceptional, the more noteworthy the liquidity risk on the lookout. Essentially dynamic valuation models by and large measure liquidity risk with the covariance between the liquidity measurement and market incomes.

In light of the meaning of the Banking Regulation and Supervision Agency, the market liquidity risk is the likelihood of misfortune if the monetary organization can't take an interest in the market appropriately, the shallow market structure in certain items and can't close its situations at the fitting cost and in a brief timeframe because of the portions and obstructions happening in the monetary business sectors.

Liquidity risk is regularly low and stable. Liquidity risk is seldom the justification its ascent is the descending liquidity development, which is brought about by the fortifying of the market and subsidizing liquidity. The impacts of market liquidity risk are additionally significant regarding monetary strength. Undoubtedly, singular liquidity risk (one or a couple of bank disappointments) can be a valuable instrument to advance the monetary circumstance in certain pieces of the framework. Be that as it may, market liquidity risk overall it can cause genuine results for the framework. This risk can disturb monetary steadiness and asset assignment and, subsequently, lead to emergencies.

Financing Liquidity Risk: Although such risks have verifiably assumed a significant part in all financial emergencies, their significance has expanded considerably more after August 2007. The breakdown of the interbank markets and the phenomenal degrees of intercession by national banks worldwide have uncovered that the worldwide credit emergency conveys the hints of a subsidizing liquidity emergency.

In view of the meaning of the Banking Regulation and Supervision Agency, the liquidity risk identified with financing is "the failure of fluid assets to meet their liabilities because of anomalies in incomes and income lopsided characteristics relying upon development".

The European Central Bank characterized the subsidizing liquidity risk as the risk looked by the bank because of its inability to satisfy its commitments after some time. This definition depends relying on the prerequisite that cash inflows and cash stock in various periods are not exactly or equivalent to cash surges.

$$\mathbf{Money\ Out} \leq \mathbf{Money\ Entry} + \mathbf{Money\ Stock}$$

On the off chance that there is an unevenness (cash surge is more prominent than the amount of cash inflow and cash stock), the liquidity request is met by the offer of resources, getting from interbank markets, financing by the national bank and stores.

Liquidity accessible from interbank and resource markets is a significant wellspring of banks' financing supply, clarifying a solid cooperation among subsidizing and market liquidity.

The connections between national bank liquidity, subsidizing liquidity and market liquidity presents in two situations (Nikolau K., 2012). The primary situation relates to the times of security and the liquidity risk is low in the positive conjuncture and there is a solid communication between liquidity types. The present circumstance guarantees the progression of the asset stream and guarantees the strength of the monetary framework. As per the subsequent situation, negative conjuncture and high liquidity risk cause frail communication between kinds of liquidity. It is shown what communications between three sorts of liquidity mean for liquidity risk. In reality, solid connections between liquidities exist in the midst of emergency just as in typical occasions.

In the midst of emergency, these ties, despite what is generally expected, destabilize the monetary framework. The creator centers around interbank and resource markets with two transmission channels. Change of unsystematic liquidity

risk (peculiar liquidity risk) to add up to liquidity risk can happen through interbank market appropriation channels. Interbank associations make an infectious impact in the current framework. Illiquidity spreads from one bank to all banks, bringing about the consumption of liquidity in the monetary framework. The present circumstance builds the liquidity reserve needs of the banks and the inability to address this issue by the national bank in a convenient way causes emergencies in the financial area. Data deviation and absence of individual liquidity in flawed business sectors lead to the illiquidity in the interbank market.

Liquidity risk emerges from coordination mistakes between contributors, banks and financial backers. With the genuine debilitating of the interbank liquidity channels, the liquidity risk will be moved to the resource market, since banks need to offer their resources at limited costs to acquire liquidity. This will bring about a decline in resource costs and an absence of liquidity on the lookout. The disease impact happens through bank monetary records. Banks are the most fluid resource. They need to rebuild their portfolios by giving need and selling others at the liquidation cost. In this manner, new costs in the market will fall beneath the essential costs of the resource.

The national bank just meets the liquidity required by the monetary framework by keeping the market unbiased as far as liquidity. Liquidity streams from units with abundance liquidity to advertise entertainers with inadequate liquidity. The national bank, which is the absolute liquidity supplier, screens the liquidity interest on the lookout and manages the financial arrangement as indicated by the liquidity sum. This interaction proceeds until liquidity measures are controlled on the lookout.

The connection among market and financing liquidity isn't unidirectional. In the market-to-advertise framework, the market and liquidity risks are commonly intuitive. In the event that the market cost of a resource falls underneath the genuine worth of that resource, the present circumstance will be thought about straightforwardly the banks' monetary records inside the structure of the market change framework. For this situation, banks need to earnestly rebuild their monetary

records and sell their resources at a lower value, both to meet the prerequisites of capital guidelines and to meet their liabilities. This interaction will bring about the abatement in the liquidity of the banks and the liquidity risk arriving at perilous levels.

Brunnermeir and Pederson set up a model that joins resource market liquidity to financial backer subsidizing liquidity. Expressing that financial backers give liquidity to the market, characteristic financial backers' exercises to simplicity of getting to subsidizing liquidity (Brunnermeir M. K. and Pederson L. H., 2009). For this, the capital market needs to meet the insurance consummation prerequisite in a convenient way. Alternately, the financial backer's subsidizing liquidity resource relies upon the market liquidity. Subsequently, the two sorts of liquidity will change comparable to one another.

As indicated, two adjusts are conceivable in capital business sectors. The creators originally managed the liquidity of the capital market. The liquidity plenitude, great economic situations, simple admittance to subsidizing by examiners and their exercises in the market further increment the degree of liquidity. Theorists increment market liquidity by facilitating value unpredictability. Examiners money their exchanges through collateralized acquiring. Market players control the worth at risk by changing the edges. As the edges in the market can change each period, examiners can confront the subsidizing liquidity risk emerging from high edges or misfortunes in current positions. Furthermore, the absence of liquidity in the capital market and the significant requirement for insurance finish and the trouble in acquiring financing openings for theorists will bit by bit diminish the liquidity on the lookout. The association among subsidizing and market liquidity will fuel the illiquidity and cause market misfortunes. At the end of the day, little misfortunes of theorists will prompt a persistent lessening in market liquidity. The delicacy of market liquidity relies upon the degree of capital of theorists. On the off chance that the capital degree of theorists diminishes, the market should change to a little liquidity/high edge balance.

The 1998 Russian emergency is the most clear illustration of liquidity

delicacy. Since moderately little stuns have a major effect. Contrasted with the stock and security markets of the United States of America (USA), Russia, which has a generally little capitalization, has caused incredible vacillations on the planet markets. Particularly in the midst of emergency, other vendor banks, for example, the exercise that monetary organizations ought to learn is that risk openness across monetary foundations is comparable. Deciding these connections in successful risk the board keeps the risk from expanding and focusing.

It is characterized the distinction of market liquidity between exchange cost and principal worth and financing liquidity as the shadow cost of theorists (Brunnermeir M. K. and Pederson L. H., 2009). The creators investigated the connection between the subsidizing liquidity risk pointer and the European Central Bank market liquidity file utilizing a basic straight relapse model. The examination shows that there is a negative connection among market and subsidizing liquidity. It was seen that if the liquidity in the market diminished during the emergency, the financing liquidity risk expanded. At the end of the day, high subsidizing liquidity risk implies high market liquidity risk.

As indicated edge misfortune (edge winding) emerges because of the great edge necessity being tainted with the liquidity inadequacy of the market. For this situation, the enormous positions held by examiners are contrarily associated with the interest stun from clients. The financing stun builds the liquidity inadequacy, expanding the misfortunes of theorists in their present positions and creating additional value decline by constraining them to sell. Distinctive liquidity stuns have a by and large more noteworthy impact.

At the point when mutual funds or speculation banks buy a security, they can utilize protections as guarantee and acquire against it. The distinction between the cost and guarantee worth of the security, called edge or hair style, is financed by the financial backer's own capital. Subsequently, in short and long positions, the all out (edge) is resolved not to surpass the financial backer's capital.

1.2.

1.3. Liquidity risk management in banking: principles and practices

Liquidity risk is a sort of monetary risk that influences every single monetary organization and the solidness of the monetary framework in general. Liquidity risk is a typical piece of banking. The development change of transient stores into long haul credits in financial makes banks naturally powerless against liquidity risk, both of an establishment explicit nature and that which influences markets in general (Basel Committee on Banking Supervision, 2008b, p.1). Basically every monetary exchange or responsibility has suggestions for a bank's liquidity.

In this exploration field Italian researchers have assumed a part of precursors. It was featured the relationship and solid association among resource and risk side of banking. Such reliance is described by a subjective and quantitative change that plan to coordinate with savers' inclinations with borrowers' inclinations. Therefore, this resource obligation change causes liquidity risk in banking. Saraceno and Caprara perceived that the main issue in bank the board is the liquidity risk. It infers the quest for a harmony among resources and liabilities with the limitation of keeping a monetary balance. Characterized bank liquidity as the capacity to whenever pursuit a harmony between in-incomes and out-incomes in the most prudent manner. He likewise perceived the significance to subject liquidity risk to proper board and senior administration oversight. Saraceno's meaning of liquidity risk and its administrative ramifications is surprisingly steady with present day hypothesis of money and current ways to deal with oversee liquidity risk in banking. He featured the significance of the 'time' – the quest for a liquidity balance whenever – and the essential meaning of having an 'coordinated way to deal with' liquidity risk that empowers banks to build up a resource and obligation the board see.

Monetary advancement and developing intricacy of monetary instruments, development of monetary business sectors, expanding globalization of monetary frameworks, resource securitisation and the extending of begin to-disseminate model in the monetary intermediation industry, the moving of banking towards more unstable wellsprings of financing (principally discount capital business sectors) and the advancement of the microstructure of installments framework and capital

business sectors, immensely affect the nature and attributes of liquidity risk in banking (Bessis J., 2009).

It is fundamental that banks have an exhaustive risk the executives cycle set up that adequately recognizes, measures, screens and controls liquidity risk openings. Sound risk the board rehearses are crucial for the reasonable activity of banks. A sound interaction might be separated into four stages. The first is the ID and comprehension of liquidity risk. The subsequent advance is the investigation and the ID of the drivers of the liquidity risk in banking. The third step is the estimating of the liquidity risk, utilizing various models and approaches. A bank needs to adjust between the expense of utilizing a model and the advantages as far as quality and dependability of risk measures. The last advance is the administration of liquidity risk, to decrease or dispense with the monetary and monetary effect of the liquidity confounding.

As it is noted before, monetary hypothesis and practice require an efficient way to deal with gauge and oversee liquidity risk in financial that powers to at the same time see income projections of resources and liabilities. The Basel Committee on Banking Supervision likewise requires a foundational approach with clear authoritative guidelines. The Basel Committee on Banking Supervision distributed the standards for the administration and oversight of liquidity risk in banking. These standards are orchestrated around five center articles (key, administration, estimation and the board, public exposure, job of directors) as follows:

- duty regarding the sound administration of liquidity risk
- explanation of a liquidity risk resilience that is fitting for bank's business technique and part in the monetary framework
- advancement of a procedure, strategies and practices to oversee liquidity risk as per the risk resilience and to guarantee that banks keep up adequate liquidity
- fuse of liquidity expenses, advantages and risks in the interior evaluating, execution estimation and new item endorsement measure execution of sound cycle to distinguish, measure, screen and control liquidity risk
- screen and control of liquidity risk openings and financing needs

- foundation of a financing technique that gives viable broadening in the sources and tenor of subsidizing
- the executives of intraday liquidity positions and risks to meet installment and settlement commitments on a convenient premise under both typical and focused on conditions
- the executives of security positions, separating among burdened and unhampered resources
- the board of pressure tests to change liquidity risk procedures, approaches and positions • course of action of a conventional possibility financing plan that sets out the methodologies for tending to liquidity shortages in crisis circumstances
- support of a pad of unhampered, excellent fluid resources for be held as protection against a scope of liquidity stress situations
- data divulgence that empowers market members to make an educated judgment about the adequacy regarding banks' liquidity risk the executives system and liquidity position
- exhaustive evaluation of a bank's general liquidity risk the board system and liquidity position (it is performed by administrators)
- observing of inner reports, prudential reports and market data (it is performed by chiefs)
- intercession of directors to require compelling and convenient healing activity by a bank to address inadequacies in its liquidity risk the board cycles or liquidity position
- successful participation among directors and public specialists in regards to the management and oversight of liquidity risk the executives.

The above standards for the administration and oversight of liquidity risk in banking give key hierarchical components of a powerful structure for liquidity risk the board:

- foundation of procedure, approaches and practices
- board and senior administration oversight (e.g., assurance of risk capacity to bear liquidity risk the executives; distinguishing proof of sufficient cycles and estimation

frameworks to accurately recognize, measure, screen and control liquidity risk; ID of design and structure of intermittent reports on liquidity risk)

- utilization of liquidity risk the board instruments, for example, stress tests, risk limits (e.g., development holes, volume of overnight subsidizing corresponding to add up to resources, fluid resources and transient liabilities, convergence of liquidity sources), income determining, early admonition signals (e.g., increment of resources financed by unstable financing, decrease in the bank's stock value, demand for extra security in the interbank market, decrease in the credit extensions), possibility subsidizing plans
- support of top notch fluid resources for meet unexpected liquidity needs
- reception of a deliberate methodology by the foundation of a resource and liabilities the executives advisory group (Almco) that is made out of delegates of all bank business zones that influence liquidity risk and is liable for the improvement of liquidity risk the board approaches
- foundation of liquidity risk the board units liable for: distinguishing liquidity risk sources, observing liquidity risk profiles, controlling and moderating liquidity risk, creating liquidity alternate courses of action; creating rules for liquidity risk the executives in the everyday activity of banks.

The Basel Committee on Banking Supervision stressed the development from a static to a unique point of view in estimating, observing and controlling liquidity risk in banking. Notwithstanding a fundamental composed liquidity strategy for overseeing liquidity, endorsed by the board, banks need to build up and report a possibility financing plan, to restrict the broadness and span of liquidity stuns. It is a more powerful liquidity plan that plainly sets out methodologies for meeting crisis liquidity needs and evaluate compromises between elective systems. It contains a system for overseeing liquidity and a rundown of unforeseen liquidity sources that can be utilized in crisis circumstances to manage liquidity alarm (European Central Bank, 2008). The possibility subsidizing plan diagrams an interaction to evaluate the liquidity sources accessible under season of pressure, improving banks' capacity to manage unsurprising and capricious monetary and monetary occasions. Especially,

it recognizes the wellsprings of liquidity, the cutoff points and part of each subsidizing source and the request to utilize the liquidity sources if there should arise an occurrence of outrageous situations. To begin with, the possibility financing plan distinguishes potential liquidity deficiency and afterward directs liquidity stress tests on a gauging premise (diverse pressure situations). These situations and key presumptions are inspected and refreshed yearly to mirror the changing institutional and economic situations. To sum things up, a possibility financing plan ought to:

- assess all potential wellsprings of liquidity reserves, their expenses and adaptability
- diagram various pressure occasion situation
- distinguish liquidity suppliers and liquidity offices
- distinguish lines of obligation if there should arise an occurrence of liquidity crisis circumstances
- design need orders in which liquidity sources can be utilized
- look at an assortment of potential procedures that may be considered if there should arise an occurrence of liquidity stresses
- decide a compelling detailing framework and early admonition markers
- diagram the execution interaction in banking.

A liquidity emergency is a high effect and a low likelihood occasion. In this manner, the capacity to act in time is fundamental to limit the conceivably problematic results of a liquidity emergency. The examination of the pressure tests will frame an important device to distinguish the normal outcomes and to characterize the most reasonable activities in a specific liquidity emergency situation. An arrangement of liquidity early notice pointers is essential to constantly screen circumstances of liquidity stress, which may, among others, be started by market, industry or explicit occasions. The arrangement of liquidity early notice pointers should uphold the administration choices in the event of liquidity crumbling or focused on circumstances.

CHAPTER II. REGULATION METHODS OF LIQUIDITY IN COMMERCIAL BANKS

2.1. Modelling and managing liquidity risk

A large part of the current emergency can be followed to models that neglected to enough reflect risk, both in lodging expenses and complex monetary instruments. Regardless of whether chronicled home value information had never recorded changes like those acknowledged as of late, information from different air pockets, from tulip bulbs on, might have been utilized. It was not satisfactory that lodging was in an air pocket, yet bubble situations ought to have been in the models. Those model issues should be, and are being, tended to, however here the emphasis is on liquidity risk.

Notwithstanding the basic messes, liquidity up can be amplified by market value interruptions, and these impacts ought to be remembered for risk models. Such demonstrating needs to propose a system. Morris and Shin model "liquidity dark openings" as emerging from value developments and normal exchanging techniques of transient financial backers: "liquidity dark openings have the component that they appear to build up speed from the endogenous reactions of the market members themselves. Maybe like a typhoon, they seem to assemble more energy as they create. Part of the clarification for the endogenous criticism component lies in the possibility that the motivating forces confronting brokers go through changes when costs change. Market pain can benefit from itself. At the point when resource costs fall, a few brokers may draw near to their misfortune restricts and are initiated to sell. Yet, this auctioning pressure sets off additional descending tension on resource costs, which incites a further round of selling, etc. Portfolio protection dependent on unique supporting guidelines is maybe the most popular illustration of such criticism."

Surely, market disturbances originated before the boundless utilization of dynamic supporting, however not perceiving such systems can exaggerate the security these techniques give, and result in more dependence on them and a

misrepresentation of the truth of the risk of expanding influence. Dynamic supporting procedures should be refreshed to incorporate the likelihood that the called-for exchanges can't be finished as recommended.

Normal ERM displaying underlines the risks to resource and responsibility esteems, yet the current emergency has clarified that liquidity risk can possibly forcefully sabotage an organization's monetary situation well beyond value risks. Future ERM displaying should address liquidity risk just as the current cost and worth risks.

Essential liquidity risk is the opportunity of not having the subsidizes accessible to pay liabilities due. However, being compelled to post guarantee could be another kind of liquidity risk, regardless of whether that security is actually a resource. All the more comprehensively talking, acknowledging misfortunes in view of constrained offer of youthful resources, and even loss of venture openings because of money requirements, could be incorporated under the rubric of liquidity risk. With an extreme market disturbance, liquidity issues can be exacerbated when ordinarily fluid resources become illiquid. These prospects would all be able to be reflected in model situations.

Liquidity the board shares includes practically speaking with capital administration. Keeping a supply of fluid resources can give a liquidity pad. Likewise coordinating with incomes of resources and liabilities, or if nothing else some part of them, can help oversee liquidity risk. Possibility financing plans are a valuable piece of liquidity risk the executives also, where less fluid resources are to be utilized as advance insurance. Nonetheless, this system may neglect to work under a market disturbance except if credit extensions are gotten ahead of time, as even collateralized advances may get inaccessible. Determining the liquidity of different resources and liabilities in the model definition and developing them over the long run can join liquidity into risk situations. For example, Das and Hanouna talk about a couple of proportions of liquidity.

Property-obligation guarantors use reinsurance as an expense effective substitute for capital, yet in a troublesome occasion, reinsurance costs and

accessibility can change forcefully. The board of this risk could incorporate having unexpected capital sources set up, just as including reinsurance terms that can expand inclusion, like extra rein proclamations. Again powerful displaying ought to incorporate the chance of such liquidity issues emerging.

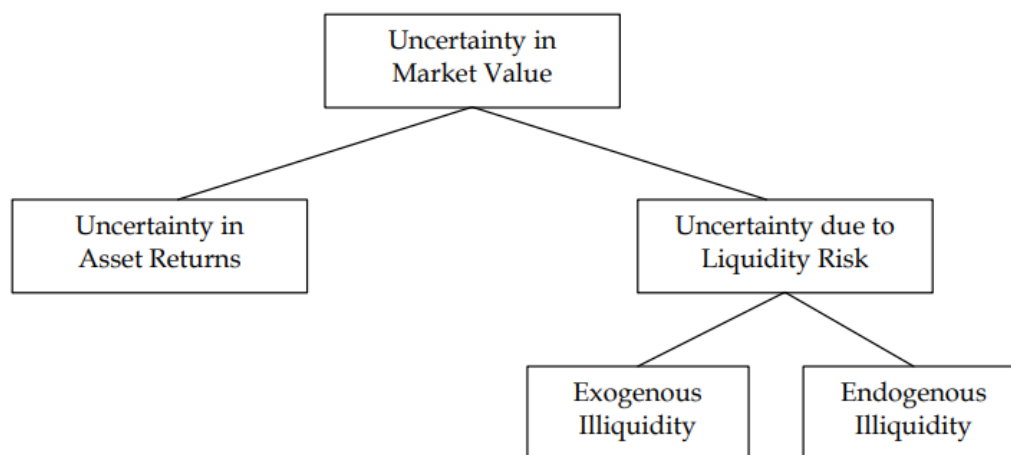
Demonstrating liquidity risk can begin with pressure tests. The current market is one illustration of a pressure situation. An assembly of unfavorable resource, obligation and credit accessibility circumstances can be hypothesized and the incomes projected alongside the worth changes. Probabilistic situation age requires assigning probabilities to the pressure situations and remembering them for a bigger reproduction. Having a model that predicts periodic market disengagements, like Morris and Shin's, can help consolidate liquidity occasions in the situations. Surely, there is a cooperation between value developments and liquidity developments that can be considered. Such displaying can evaluate the effect of liquidity risk on capital ampleness. A contributor to the issue is perceiving cockeyed sheet cash needs that can emerge in a market disturbance, like insurance necessities, installed alternatives, discounts because of appraisals minimize, and so on This additionally accentuates the utility of dynamic ERM models—models that incorporate reaction procedures to different occasions. Dynamic ERM models can likewise profit by the casing work of timetable reproduction, where occasions are reenacted arranged by event and time stepped (Kreps D., 2009). What is currently significant in models is to have situations and reactions consider the likelihood that different players are following similar procedures; fluid resources may become illiquid; wobbly sheet responsibilities may be set off, and so forth Models for these prospects and the collaboration of cost and liquidity are showing up in distributed hypothesis, yet making certain about sensible probabilities for liquidity and relating valuing occasions could be a space of examination for quite a while to come.

We conventionally characterize hazard as vulnerability about future results. Market hazard is basically worried about depicting vulnerability about costs or returns because of market developments. Estimation of market hazard in this manner implies depicting and displaying the return conveyance of the significant danger

factors or instruments. Customary market hazard the board under typical conditions normally manages the dispersion of portfolio esteem changes through the circulation of exchanging returns. These exchanging returns depend on mid-cost, and henceforth the market hazard is truly in a "unadulterated" structure: hazard in a romanticized market with no "contact" in acquiring the reasonable cost. Nonetheless, numerous business sectors have an extra liquidity part that emerges from merchants not understanding the mid-cost while exchanging a position either rapidly or when the market is moving against them, but instead that they understand the mid-value short some spread. Stamping to advertise thusly yields an underestimation of the genuine danger in such business sectors, on the grounds that the acknowledged worth upon liquidation can stray altogether from the market mid-cost. We contend that the deviation of this liquidation cost from the mid-cost, likewise alluded to as the market effect or liquidation cost, and the unpredictability of this expense are significant parts to demonstrate to catch the genuine degree of in general danger.

We thoughtfully split vulnerability in market worth of a resource, for example its general market hazard, into two sections: vulnerability that emerges from resource returns, which can be considered as an unadulterated market hazard segment, and vulnerability because of liquidity hazard. Ordinary VaR approaches like JP Morgan's Risk Metrics center around catching danger because of vulnerability in resource returns however overlook vulnerability because of liquidity hazard. The liquidity hazard segment is worried about the vulnerability of liquidation costs. Figure 2 sums up our market hazard scientific classification.

Figure 2: Taxonomy of market risk

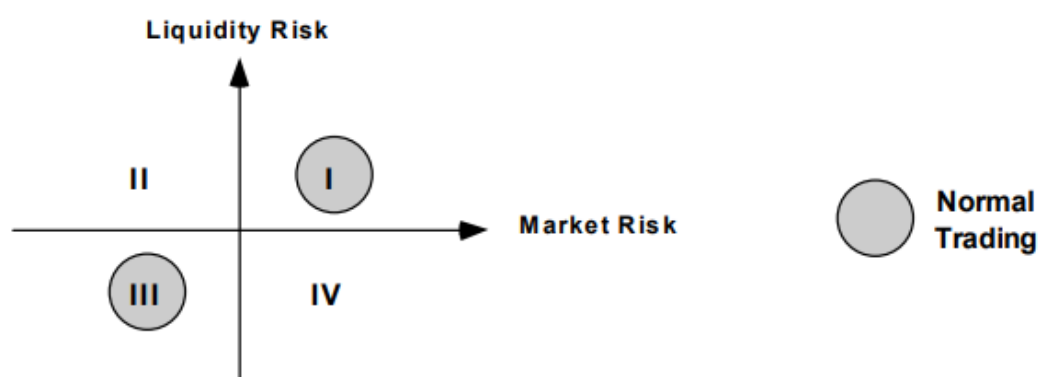


Source: Compiled by author

Theoretically, we can communicate these thoughts as a market/liquidity hazard plane or Risk Cross (Figure 3 underneath) which thinks about the joint effect of the two sorts of hazard. Most business sectors and exchanging circumstances fall into districts I and III; we see that market hazard and liquidity hazard segments are related by and large.

For example, FX subordinate items in developing business sectors have high market and liquidity hazards and in this way fall into locale I. The spot markets for most G-7 monetary standards then again will fall into locale III because of the generally low market and liquidity chances included. Most ordinary exchanging action happens in these two locales and is dependent upon exogenous liquidity hazard, which alludes to liquidity vacillations driven by factors past singular merchants' control. We recognize this from endogenous liquidity hazard, which alludes to liquidity variances driven by singular activities, like an endeavor to loosen up an extremely huge position. A merchant standing firm on a huge footing in a generally steady market, for instance, may wind up in locale II.

Figure 3: Normal Trading on the Market Risk Cross



Source: Compiled by author

The danger cross is obviously a disentanglement of a more perplexing connection among business sectors and position sizes, including both exogenous and endogenous parts of liquidity hazard. Moving along the liquidity hub, specifically, should be possible either by getting across business sectors (i.e., expanding exogenous illiquidity), say from G-7 to arising, or inside a market by just expanding one's position size (i.e., expanding endogenous illiquidity).

Exogenous illiquidity is the aftereffect of market attributes; it isn't unexpected to all market players and unaffected by the activities of any one member (in spite of the fact that it very well may be influenced by the joint activity of all or practically all market members as occurred in a few business sectors in the mid year of 1998). The market for fluid protections, like G7 monetary standards, is ordinarily described by hefty exchanging volumes, steady and little bid-ask spreads, steady and undeniable degrees of statement depth. Liquidity expenses might be irrelevant for such positions when stamping to advertise gives a legitimate liquidation esteem. Interestingly, markets in arising monetary forms or meagerly exchanged garbage securities are illiquid and are portrayed by high volatilities of spread, quote profundity and exchanging volume.

Endogenous illiquidity, conversely, is explicit to one's situation on the lookout, shifts across market members, and the openness of any one member is influenced by her activities. It is basically determined by the size of the position: the

bigger the size, the more prominent the endogenous illiquidity. A decent method to comprehend the ramifications of the position size is to consider the connection between the liquidation cost and the all out position size held.

Market sway models, for example, one created by BARRA evaluate the above connection between the exchange cost and exchange size. On the off chance that the market request to purchase/sell is more modest than the volume accessible in the market at the statement, at that point the request executes at the statement. For this situation the market sway cost, characterized as the expense of prompt execution, will be half of the bid-ask spread. In our system, such a position just has exogenous liquidity hazard and no endogenous danger. On the off chance that the size of the request surpasses the statement profundity, the expense of market effect will be higher than the half-spread. The distinction between the complete market effect and half-spread is known as the steady market cost, and comprises the endogenous liquidity segment in our structure. Endogenous liquidity hazard can be especially significant in circumstances when regularly fungible market positions stop to be fungible; a genuine model would be the point at which the least expensive to convey obligation of a prospects contract switches.

Quantitative strategies for displaying endogenous liquidity hazard have as of late been proposed by Jarrow and Subramanian, Chriss and Almgren, and Bertsimas and Lo, among others. Jarrow and Subramanian, for instance, consider ideal liquidation of a venture portfolio over a fixed skyline. They portray the expenses and advantages of square deal versus moderate liquidation, and they propose a liquidity acclimation to the standard VaR measure. The change, notwithstanding, requires information on the connection between the exchange size and both the amount rebate and the execution slack. Obviously, there is no promptly accessible information hotspot for evaluating those connections, which compels one to depend on emotional assessments.

2.2. Funding and market liquidity risk in banking: an overview of measurement methodologies

Banks face two kinds of liquidity risk: financing risk and market liquidity risk. The financing liquidity risk distinguishes the way that a bank can't productively adapt to any normal or sudden money surges. It is the inadequacy of a bank to fulfill its own commitments instantly. The development change opens a bank to the financing liquidity risk. I distinguish the full scope of financing liquidity risk as follows:

- Liquidity crisscrossing risk: sum and development befuddle between cash inflows and money outpourings. Resource and obligation development befuddle produces loan cost risk as well as liquidity risk.
- Liquidity possibility risk: future occasions may compel banks to require more liquidity than they anticipated.
- Margin call liquidity risk: higher edge approaches the subordinates markets increment financing liquidity risk as money surges rise.
- Intraday liquidity risk: powerlessness to confront intraday installments and insurance prerequisites.

In this viewpoint of investigation the wellsprings of liquidity can be summed up as follows: holding of fluid resources, capacity to exchange exchanging positions, discount and retail stores, credit extensions and the capacity to acquire at short notification, securitization, national bank getting.

The exchanging or market liquidity risk recognizes the circumstance wherein a bank will influence altogether the cost of a monetary resource when it chooses to sell a sizable measure of resources, attributable to the low exchanging volume or restricted profundity of the monetary business sectors. A monetary instrument has great market liquidity when it very well may be traded effectively and rapidly on the lookout. The market liquidity risk emerges when this condition isn't fulfilled attributable to inside or outside causes.

The two kinds of liquidity risk are interconnected on the grounds that the need of monetary assets to confront startling money surges may compel a bank to sell a

lot of monetary resources in its portfolios. It might cause a fall in value on account of the restricted capacity of monetary business sectors to retain a lot of resources. To quantify the effect of subsidizing liquidity risk in banking the monetary writing and practice has created three distinct methodologies: stock, income and crossover approach.

The main methodology is a stock-based methodology. This methodology is not difficult to process and screen. This is the conventional way to deal with liquidity risk evaluation taken by numerous banks. Through the parting of resources and liabilities into promptly attractive resources (or cashable resources), unstable liabilities and reeling sheet responsibilities to loan, it is feasible to appraise the capacity of a bank to withstand liquidity deficiencies (cash capital position):

Cash Capital Position = readily marketable assets – volatile liabilities – commitments to lend.

The attractive resources are largely resources in the bank's asset report that can rapidly be changed over into cash (e.g., cash, transient stores, momentary credit lines, unrestricted protections less hair style). Unpredictable liabilities incorporate discount financing and unstable segment of client stores. It doesn't consider medium to long haul subsidizing, capital and stable bit of client stores. The shaky sheet responsibilities to loan address unavoidable responsibilities to concede advances upon demand. Table 1 shows a bank's accounting report structure when it is embraced a stock-based methodology.

The money capital position addresses a portion of attractive resources that are not consumed by unpredictable liabilities and responsibilities to loan. On the off chance that the money capital position is > 0 it implies that the bank has a positive edge of monetary assets to adapt to unstable liabilities and responsibilities to loan. It estimates the supply of monetary resources that can quickly be sold to confront liquidity stuns in banking. All in all, to ensure a suitable bank's accounting report structure as for liquidity risk it is important that steady liabilities reserve illiquid resources and unstable liabilities store attractive resources. A more far reaching meaning of the money capital position incorporates the consistently accessible acknowledge lines as follows:

Money Capital Position= promptly attractive resources unpredictable liabilities – responsibilities to lend+ consistently accessible credit lines.

In any case, in a reasonable way banks don't entirely the consistently accessible credit lines on the grounds that in the midst of emergency loan specialists undoubtedly really like to interfere with loaning responsibilities.

Table 1: Stock-based approach: a bank's balance sheet structure

<i>Assets</i>	<i>Liabilities</i>
Cash	Short-term deposits
Loans (<i>cashable</i>):	Customer deposits:
Loans and interbank facilities easily cashable	Volatile portion
Securities (<i>unencumbered</i>):	Total volatile liabilities
Not used as collateral	Customer deposits:
Less haircut	Stable portion
Total cashable assets	Medium and long term funding
Loans (<i>others</i>):	Other long term funds
Credit lines not easily cashable	Capital
Maturity loans	Total liabilities
Securities (<i>others</i>):	Steadily available credit lines
Used as collateral	
Not cashable nor accepted as collateral	
Haircut	
Fixed financial assets	
Fixed real assets	
Goodwill	
Total assets	
Commitments to lend	

Source: compiled by the author

Another critical consequence of the stock methodology is the drawn out subsidizing proportion. It is a proportion that contrasts resources and liabilities and a development > 'n' a long time:

Long term funding ratio = assets with a maturity > 'n' years/liabilities with a

maturity > 'n'.

The drawn out financing proportion recognizes the level of resources with a development > 'n' a long time which is being subsidized with liabilities with a development > 'n' a long time or with capital.

For the most part, banks have a drawn out subsidizing proportion under 1 due to the development change (or development befuddling) of the monetary intermediation. In the event that the worth of the drawn out subsidizing proportion diminishes over the long run, it will demonstrate an expansion of the development befuddling of the resource and risk structure. It very well may be a negative sign as far as a broadening of a bank's composition to the liquidity financing risk.

Last yields of the stock methodology are the liquidity proportions and the hold liquidity stocks. Liquidity proportions are controlled by contrasting the worth of fluid save with absolute resources. The save liquidity stock is the measure of the stores that can be recognized into two principle classifications: essential and auxiliary stores. Essential stores are exceptionally fluid and incorporate money, clearing accounts adjusts, profoundly fluid protections, short-term interbank offices and repurchase arrangements. Optional stores are less fluid resources and incorporate currency market instruments, depositories securities, momentary business papers.

The overall size and arrangement of the essential and auxiliary stores will rely upon the development construction, nature and attributes of resources and liabilities, the level of expansion and specialization of banking, the administrative liquidity prerequisites, the discount and retail subsidizing base, the expenses of keeping up lower-acquiring holds, the capital situation of the bank, the monetary advancement, the turn of events and broadening of monetary business sectors and instruments, the accessibility of currency market instruments and credit lines from national banks.

Despite its effortlessness, the stock-based methodology is influenced by numerous constraints. As a matter of first importance, the suppositions about the attractiveness of resources and the unpredictability of liabilities. The partition among fluid and illiquid resources and the detachment among unstable and stable liabilities,

is profoundly influenced by improving on presumptions (e.g., just unhampered protections, not utilized as insurance against credits or subsidiaries, can be remembered for the cashable resources. The ostensible worth must be scaled down by a hair style that relies upon conceivable misfortune comparative with the market cost). Applicable variables are not just the authoritative development of resources and liabilities, yet additionally the implanted choices in the resources and liabilities (flexibility in bank items). The stock methodology is a 'paired' approach. In all actuality there are a wide range of levels of liquidity of resources and solidness of liabilities.

Besides, the stock methodology does exclude the consistently accessible credit lines. Sometimes a bank depends on submitted credit extensions. What's more, the methodology doesn't consider long haul liabilities with a momentary skyline. Momentarily, the stock-based methodology isn't forward looking. To improve the assessment of bank's work to liquidity risk it is important to desert the double rationale of the stock-based approach and embrace a 'confound based' or 'income based' approach. In light of bank's past experience, bank's assumptions and legally binding developments of bank's resources and liabilities, the confound approach ascertains incomes of resources and liabilities across various development cans. In this methodology the liquidity risk is estimated considering the incomes created by bank's resources and liabilities. Liquidity risk depends not just on the last development of resources and liabilities, yet additionally on the development of each middle of the road income. Specifically, the new methodology analyzes the normal money inflows (identified with advances, protections, money and reciprocals) with the normal money surges (identified with client stores, other subsidizing sources, securities and responsibilities to loan) through various homogeneous development cans (or development stepping stools).

The critical aftereffects of the income based methodology are two sorts of liquidity holes: peripheral liquidity hole and total liquidity hole. The minor liquidity hole is the net unbalance between cash inflows and money outpourings identified with each time can. The net liquidity holes are estimated considering the normal

development of resources and liabilities, rather than their repricing periods. The total liquidity hole is the amount of minor liquidity holes of each development can.

The income based methodology can gauge the effect of liquidity variances utilizing occasional holes that are reliable with the design, nature and attributes of bank's resources and liabilities. The development skyline is part into more limited time-cans. It is a valuable answer for defeat the issues of the stock-based methodology. The computation of various liquidity holes for various time spans or cans improves the assessment of the effect of liquidity risk in banking.

Positive total liquidity holes imply that a bank can cover predictable money surges with anticipated inflows. At the end of the day, cash inflows are sufficiently huge to cover cash surges. Unexpectedly, negative aggregate liquidity holes signal a potential liquidity deficiency later on. The overabundance or deficiency of assets in each time container, estimated by an income bungle or liquidity hole, is a beginning stage to quantify and assess the bank's future liquidity conditions. Table 2 shows a bank's asset report structure when it is embraced an income based methodology.

The two unique methodologies (stock methodology and income approach) are corresponding ways to deal with liquidity risk in banking. The first measures the openness to liquidity risk regarding cash capital position and long haul subsidizing proportions. The subsequent methodology measures the openness to liquidity risk regarding liquidity holes and expected incomes changes of resources, liabilities and reeling sheet positions. The income based methodology is influenced by a significant restriction. Incomes of protections (unhampered resources) are characterized by authoritative development without in regards to the way that they can be utilized as insurance to acquire advances (even temporarily). To defeat such sort of restriction it is important to adjust the design of expected incomes to consider the part of unrestricted protections in confronting a liquidity lack (unhampered protections might be moved or given as security). The altered income based methodology (known as 'crossover approach') changes the income approach considering the unhampered resources that can be sold or vowed as security to get assets through

collateralised advances or repurchase activities (repos). Potential incomes of monetary resources, coming from the deal or use as guarantee, are added to expected incomes. The development of models (stock-approach, income approach and crossover approach) makes it conceivable to accomplish more noteworthy precision in assessing the proportions of liquidity risk in banking. Besides, income based methodologies (income and mixture draws near) are influenced by certain constraints concerning the calculation of incomes and the arrangement of incomes into various time containers. The outcomes as far as liquidity holes are influenced by the suspicions to assign the normal money inflows and money outpourings to the diverse time containers. The principle working on presumptions are: normal development of resources and liabilities; anticipated clients' conduct; expected vacillations of at sight advances and at sight stores; inserted choices in resources and liabilities. Vulnerability about incomes of bank's resources, liabilities and reeling sheets positions, can concern the sum, the real development or both (sum and timing). To consider such impediments it very well may be valuable:

a. To model vulnerability, addressing potential impacts of inserted choices in resources and liabilities (for instance: securities with call or put arrangements, cap or floor financing costs, credits which give borrowers the option to prepay balances, stores which give contributors the option to pull out assets whenever). The conduct of bank's clients' belongings vulnerability identified with the activity of inserted choices in credit/charge contracts. A potential arrangement could be the utilization of reproduction and conduct models in which numerous situations are consolidated.

b. To reenact various situations that give various outcomes as far as money inflows, cash outpourings and liquidity holes. It additionally infers the assessment of the impacts of awful situations on bank's liquidity position (stress test) to more readily survey how the liquidity holes would change in most pessimistic scenario situations and assess the capacity of liquidity stores to cover liquidity stuns. A bank may utilize various ways to deal with lead the reenactment works out (verifiable methodology, factual methodology, judgment-based methodology). A bank may likewise mimic distinctive risk factors (e.g., stun on stores, stun on monetary

business sectors, rating minimize) independently or mutually, accepting a particular emergency situation, a foundational risk situation, or a mix of both.

As I called attention to before, the second kind of liquidity risk is the exchanging or market liquidity risk. This sort of liquidity risk might be brought about by outer risk factors (e.g., attributes of monetary business sectors) or by inside risk factors (e.g., size and design of bank's protections portfolios). The liquidity exchanging risk or market liquidity risk is a 'value risk' for those monetary resources whose exchanging volume is low or doesn't exist. It is emphatically connected to the capacity of monetary business sectors to ingest huge size of exchanges without critical value sway.

The level of liquidity of a monetary resource is influenced by numerous variables, for example, size, recurrence and design of monetary exchanges, number and nature of market members, significance of exchanges costs, data imbalance, sum and nature of value data, exchanged volumes and the reliability of the backer. The cost got for a monetary resource relies chiefly upon: midmarket value; what amount is to be sold; how rapidly it is to be sold; the miniature design of the market and the full scale financial conditions.

In this viewpoint of examination, the exchange cost approach is a most utilized strategy to gauge the exchanging or market liquidity risk. It expects that the expense to exchange the monetary resources in typical economic situations inside a specific time is an element of the size of the situation in the monetary instrument and the bid-ask spread ($[\text{bid cost} - \text{ask price}] \times \text{mid-market cost}$). In the event that a monetary position can be effortlessly exchanged ordinary economic situations, exchange expenses can be approximated as a component of current or expected bid-ask spread:

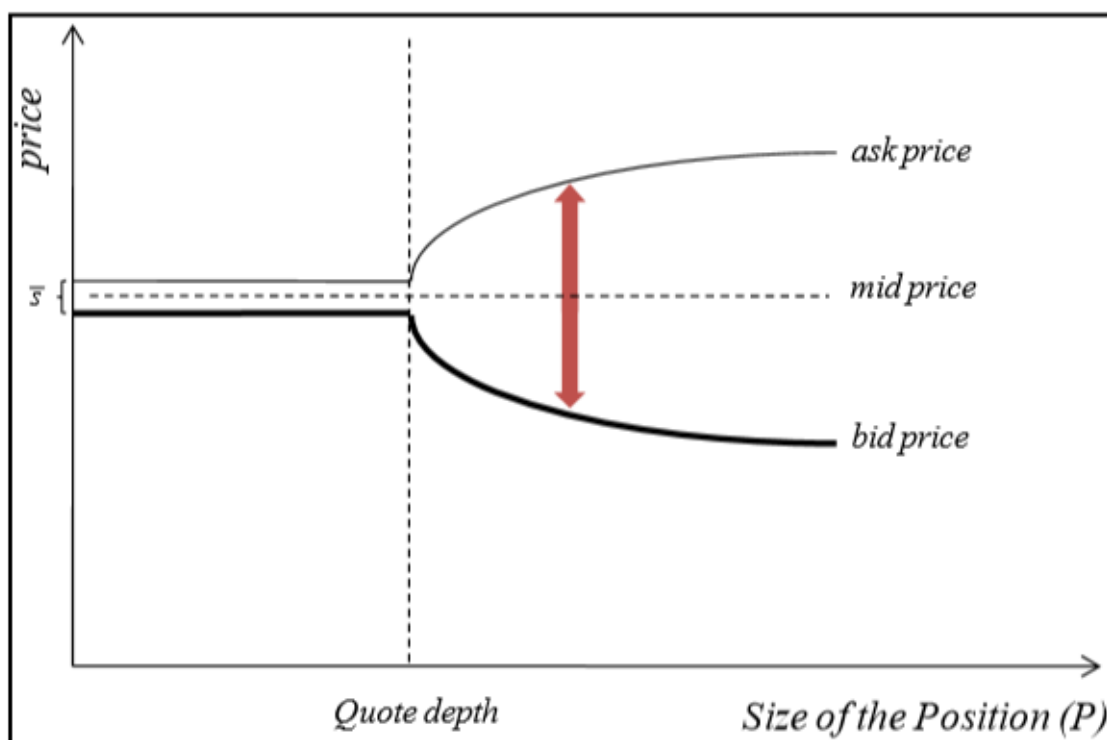
Liquidity market risk = $[(\text{bid} - \text{ask spread}) * \text{position in the instrument}] / 2$

The bid-request spread increments with the size from the monetary position and diminishes with the size of the market. At the point when the amount of the monetary resources for exchange expands, the bid-ask spread is required to increment. Subsequently, the bid-ask spread reductions when the market size

(market profundity) increments. It infers that portfolio expansion in banking doesn't really decrease liquidity market risk. Standing firm on numerous little footings instead of a couple of huge positions will in general involve less liquidity risk (Hull J., 2012, p.450).

In focused on economic situations it is important to quantify the liquidity market risk considering the mean and standard deviation of the bid-ask spread for the monetary position held by the bank. At the end of the day, to assess the expense of liquidation of monetary resources when there is vulnerability on market sway it is important to compute the offered ask spread conveyance inside a specific time span. The bid-ask spread appropriation is generally not ordinarily dispersed. It will in general change over the long run. Likewise, the expense of liquidation of monetary positions (exchange costs) is additionally a diminishing capacity of the time span accepted for the resource liquidation. Figure 4 shows the bid-request spread as a capacity from exchange size and market profundity.

Figure 4: Bid-ask spread as a function of transaction size and market depth



Source: Resti A. and Sironi A. 2007

All in all, the new monetary strife has accentuated the significance of the liquidity risk to the financial matters and the board of monetary foundations. Liquidity risk estimation systems are at a beginning phase of improvement in the banking and monetary industry. In any case, monetary advancement, guideline, banking management and internationalization of the monetary business will drive the improvement of such procedures soon.

The issuance of carrier store testaments (debatable CDs) by New York banks and the improvement of auxiliary business sectors are among the significant components that energize liquidity risk the executives in 1961. The globalization of world exchange and the increment in worldwide exchange volumes made the interest for liquidity rise. Changing financial conditions after 1960 and the improvement of the world business uncovered another liquidity the executives approach.

As an initial step, banks met the monetary assets they required from the dynamic piece of the accounting report. New methodologies were required distinctly to satisfy the developing credit need. The developing advance necessity and the failure to satisfy this need from interest stores brought about an expansion in loan fees. Undoubtedly, banks' rising credit needs from one viewpoint, and then again, have confronted twofold pressing factor with the decrease of their colossal interest stores.

In accordance with these turns of events, another and current liquidity risk the board was required not exclusively to meet the diminishing store assets yet in addition to meet the subsidizing needs. There was presently a specific expense of cash, and the banks productively used these assets relied upon keeping a specific spread between the peripheral expense of the supports got and the profit from the subsidizes given. Actually, monetary organizations have created numerous liquidity instruments to meet their liquidity prerequisites from the liabilities side of the accounting report. These monetary (aloof) instruments are as per the following:

- Short-term borrowings between monetary foundations
- Transferable \ Non-adaptable huge store testaments (CD's)
- Repurchase arrangements (RP's-repo exchanges)

- Repurchase arrangements (invert repo)
- Treasury bills
- Short-term depository ensured testaments
- Money market instruments, for example, securities and bank acknowledgments

The Bank funds conceivable store withdrawals with minimal misfortune with a very much planned liquidity risk the executives, and it likewise meets the credit prerequisites of the monetary market.

The components comprising liquidity can be recorded under 4 headings:

- Deposits-supported resources that can be changed over to fluid right away
- Immediately attractive resources with insignificant risk of misfortune
- Bank's operational money inflow
- Additional getting limit

It tends to be said that the subsidizes it has gathered during its action structure the liquidity premise of the monetary establishment. The new stores will adjust the stores removed from the bank. Notwithstanding, the bank ought not lose its capacity to make new advances, on the grounds that these credits structure the construction of banking. Banks can utilize the stores they need to close the asset shortage. Then again, the assets held by monetary establishments have a high chance expense. Consequently, banks will try not to keep up inordinate stores. Aside from the utilization of stores, the bank can get liquidity from the resources or liabilities of the monetary record.

- Within the extent of resource the executives approach, monetary organizations sell their resources. As such, banks will pick the most proper blend between fluid resources and exceptional yield resources. Resource the board is the distribution of assets from various sources among different speculations. Protections, cash resources and advances are the premise of these resources.

- Within the extent of obligation the board, monetary foundations acquire the liquidity they need by getting. A decent risk structure relies upon the finances the

bank has. For a bank, stores, credits from various establishments, assets from different public and global capital and currency markets address wellsprings of aloof assets.

It is significant for banks to deal with the "cash position" in both a short and an extensive stretch of time. As a benefit making association, the bank needs to acknowledge any stores it is offered and pay request stores to clients. In spite of the way that advances are not a lawful commitment of the bank, the bank loses its clients except if it measures the advance. The finances held by banks ought not be bigger or more modest than needed, both the liquidity shortage and the liquidity wealth can prompt unfortunate outcomes. As a matter of first importance, the absence of fluid assets in banks may make them neglect to cover their obligations that are expected. Then again, viable administration of liquidity risk assists with managing the vulnerability in income to the bank. The executives of liquidity risk is of foremost significance, as a liquidity shortfall in a solitary monetary foundation can have framework wide impacts. Also, albeit the bank closes the liquidity guideline period with fluid subsidizes bigger than required, the bank will endure a misfortune. My save money with abundance supports will have a high chance expense. The justification this is that since these assets are not contributed, the chance to benefit from them is lost. To meet the short and long haul objectives of banks, they ought to consider discretionary and non-discretionary washes in their equilibrium bed covers. Under typical conditions, changes yet to be determined sheet that the bank can't handle or have little impact are ordered as non-optional changes. Optional asset report things are as per the following:

- Bank stores (barring huge store authentications)
- Bank advances
- Bank value Cash resources at the phase of assortment
- Required saves.

Despite what might be expected, changes over which the bank has huge command throughout a brief timeframe are called optional asset report changes. Nonetheless, optional changes that occur essentially are important for the day by day

experience of the monetary establishment. It is among the discretionary changes:

- Inter-monetary borrowings
- Transferable huge store testaments
- US-dollar stores (Eurodollar)
- Repurchase arrangements (repo exchanges)
- Other transient currency market instruments

Having arrived at its occasional top in credit needs, the bank can utilize obligation protections, for example, client stores or repo to back this need. Repurchase arrangements endorsed with various clients are generally refreshed consistently and require significant composition. As the time spent to get reserves expands, the expenses related with repo exchanges additionally increment. Be that as it may, store endorsements have a place with concurrences with fixed expenses. Along these lines, the bank will in general back the credit extension, which requires a few days, through repo arrangements. At the end of the day, banks will in general fund the occasional and repeating credit development by utilizing obligation protections, term advances long haul instruments.

A vital factor deciding the bank's portfolio conduct is future loan cost assumptions. The future decrease in loan fees will build the expense of long haul monetary instruments. For this situation, the bank would like to stay away from generally long haul responsibility because of the great loan cost of the store endorsement. All things being equal, the bank will like to utilize momentary monetary instruments, for example, repo to exploit the normal low loan fees later on. Actually, it will utilize longer term instruments, for example, bank store endorsements during times of increasing loan fees.

Lucchetta estimated bank liquidity in an examination covering 5066 banks for the business sectors of European nations. In the investigation, the connection between bank liquidity and credit development and interbank loan cost factors has been inspected. In the examination, uneven board information investigation was applied and adverse outcomes with bank liquidity and credit development variable and positive outcomes with interbank loan fee were gotten.

Fecht, F., Nyborg, K. G., and Rocholl, J. in 2009 tried the connection between the liquidity cost to be paid by banks and the size of the bank utilizing week after week information utilizing board information relapse examination. In the examination, a critical relationship has been resolved between liquidity cost and bank size. Enormous banks pay less to get liquidity, as indicated by the outcomes. This finding is clarified by the creators as enormous banks have better admittance to interbank markets. This impact showed itself considerably additional during times of expanded lopsided characteristics in liquidity positions. Along these lines, exact discoveries have shown that little size banks are more delicate to liquidity squeeze.

Bourke communicated the variables influencing bank productivity with straight conditions. The creator assessed these conditions utilizing the board relapse model. Interior and outside factors are utilized among the elements influencing bank benefit in the investigation. Bank-explicit factors like capital proportions, liquidity proportions, homegrown uses, and large scale factors, for example, expansion and financing costs, having a place with Europe, America and Australia, are incorporated. The examination inferred that there is a positive connection between the banks' liquidity and bank size between 1973-1981.

Pasiouras and Kosmidou researched the factors influencing the productivity of unfamiliar and neighborhood monetary establishments working in 15 European nations between 1995-2001, and a positive relationship was found between liquidity hazard and bank resource benefit. The creators expressed that as this finding was in opposition to assumptions, the connection among productivity and liquidity stayed questionable for UK banks and further exploration was required.

Shen et al. tried the variables influencing the liquidity risk of 12 created nations (Australia, Canada, France, Germany, Italy, Japan, Luxembourg, the Netherlands, Sweden, Taiwan, the United Kingdom and the United States of America) utilizing lopsided board information investigation. To research the reasons for liquidity risk, Shen et al. Acquired an aggregate of 14360 perceptions utilizing yearly information covering the period 1994-2006. It was seen that the quantity of monetary foundations diminished because of bank consolidations and acquisitions

all through the period. In this investigation, bank-explicit factors, administrative and administrative faker factors and macroeconomic factors are utilized as the clarifications of liquidity risk. Bank size, okay resources, risky resources, and outside financing were utilized among the bank explicit factors. A positive and critical relationship has been found between bank size and liquidity risk. This is evidence that enormous banks will in general loan more and face challenges. The financing shortfall proportion of huge banks is higher than little banks, recommending that banks face liquidity risk. Shen et. Shen et al. showed that it is a significant exogenous variable that influences bank execution and that these impacts contrast in various monetary frameworks. Liquidity risk is adversely connected with bank execution in market-based monetary framework, yet decidedly connected with bank execution in bank-based monetary framework. In this manner, in the bank-based monetary framework, banks will close their financing hole by acquiring. As the responsibility of the bank expands, the loan bosses will lose their trust in the bank and apply a higher risk premium. This will expand the subsidizing cost of the bank and antagonistically influence its exhibition. As per the creators, successful liquidity the executives is accomplished by keeping fluid resources on the dynamic side of the monetary record and by giving adequate enhanced financing assets on the liabilities side.

Deep and Schaefer tried the elements influencing the liquidity hazard of 200 American banks utilizing board information examination. Illustrative factors, for example, advance danger proportion, the proportion of wobbly sheet advances to add up to credits, and the proportion of guaranteed stores to add up to stores were utilized in the examination. The credit hazard variable was estimated by the unpredictability of high-hazard advances and, then again, return on resources. As per the aftereffects of the examination, the credit hazard variable suffers a heart attack and adverse consequence on the liquidity change. Relapse results show that a 1 percent expansion in the advance arrangement of dangerous resources will diminish the liquidity proportion by 0.24 percent. The proportion of wobbly sheet credits to add up to advances was discovered to be emphatically and essentially

connected with the reliant variable. As such, the expansion of this variable will bring about an increment in the bank liquidity hazard. In this examination, it has been reasoned that the store isn't guaranteed and doesn't bring about any adjustment of liquidity.

Berger and Bouwman tracked down a huge connection between the size of banks and their liquidity hazard in their investigation of US banks somewhere in the range of 1993 and 2003. Berger and Bowman found that for US markets, huge banks create more liquidity than little banks, and accordingly face more prominent liquidity hazard.

Aspachs et al. tried the elements influencing bank liquidity with board information relapse examination in his investigation including 57 banks for the UK monetary market. In this investigation, two elective proportions for liquidity hazard have been created. The primary liquidity proportion is estimated by the portion of fluid resources in the bank's complete resources and the second liquidity proportion is estimated by the proportion of fluid resources for stores. Practically speaking, utilizing quarter information of banks covering the years 1985-2003, the connection between bank liquidity and expansion in credits, transient financing costs, bank size, likelihood of getting liquidity from conclusive moneylender exchanges (Tobin's Q), premium edge factors have been dissected. Results for the two proportions don't contrast significantly. In the examination, a negative relationship was found with bank liquidity and Tobin's Q. The justification this is that the liquidity stores of the bank decline when the chance of getting liquidity from the last moneylender exchanges increments. The negative and huge connection between momentary loan costs and liquidity demonstrates that UK banks will in general hold abundance liquidity when financing costs are low. In the investigation, a negative relationship with the liquidity variable, credit development and premium edges, and a positive relationship with the bank size was acquired. As indicated by the exact outcomes, while huge banks will in general hold greater liquidity, the expanding advance rate diminishes the liquidity of the bank.

Kashyap tried the connection between the US money related transmission

system and bank credit supply utilizing 1976-1993 between quarter information of every safeguarded bank. Central bank open market tasks can influence banks' credit supply. For instance, the national bank can lessen the advance inventory of banks by expanding the expense of capital. In the investigation, banks are ordered as little, medium and huge as indicated by the size of their resources. As indicated by the consequences of the investigation, illiquid and little banks were more influenced by the Federal Reserve open market activities for the period appeared in the USA.

CHAPTER III. USED METHODOLOGIES AND EMPIRICAL RESULTS

3.1. Methodology

There are many studies on risk management in international markets. However, studies on liquidity risk management in banks are limited. This is due to the liquidity risk management being relatively new and up-to-date since the beginning of the 2007-2008 financial crisis. With the limited international studies, there is no institutional and empirical model in the field of liquidity risk management in the Azerbaijani banking sector.

Deep and Schaefer measured the liquidity risk with the liquidity conversion gap. The study covers the largest financial institutions of the USA and the years 1997-2001. The study reveals that the liquidity conversion of American commercial banks is around 20%. According to Deep and Schaefer, this ratio shows that the liquidity transformation of the USA is at a low level.

Nikolau presents the connections between central bank liquidity, funding liquidity and market liquidity under two different scenarios. The first scenario corresponds to periods of stability. In the positive case, the liquidity risk is low and there is a strong interaction between liquidity types. This situation ensures the continuity of the fund flow and ensures the stability of the financial system. According to the second scenario, that is, in the adverse case, high liquidity risk causes weak interaction between liquidity types. Nikolau shows how the interaction between the three types of liquidity affects liquidity risk. Strong links between liquidities exist in times of crisis as well as in normal periods.

Brunnermeir and Pedersen created a model that links asset market liquidity to investors' funding liquidity. Stating that investors provide liquidity to the market, Brunnermeir and Pedersen attribute their activities to the convenience of accessing funding liquidity. For this, the capital market must meet the collateral completion requirement on time. On the contrary, the investor's funding liquidity asset depends on the market liquidity. Hence, both types of liquidity will vary in relation to each other.

Berger and Bouwman applied a new model to measure the liquidity of banks and tested this model on all US financial institutions between 1993 and 2003. According to Berger and Bouwman, the bank's liquidity production in the US banking sector has increased every year and in 2003 it was realized as USD 2.8 trillion. One of the results of the analysis is that big banks generate more liquidity than small banks and therefore face more liquidity risk.

Fecht F., Nyborg, K. G., and Rocholl, J. measured the price banks pay to obtain liquidity using data at the individual bank level in 2009. Brunnermeier divided the funding liquidity risk associated with the liabilities of the balance sheet into three risks. These are: debt rollover, margin funding and withdrawal risks.

Shen et al. used two alternative ratios as a measure of liquidity risk; the ratio of net loans to short-term loans and the financing deficit ratio. It was determined that the results for both ratios were almost the same.

Drehmann and Nikolau estimated the liquidity funding risk based on central bank auctions using data from 877 European financial institutions in the period 2005-2007. According to Brunnermeier, the important factor in the formation of liquidity risk is the bank liquidity mismatch.

26 commercial banks operating in Azerbaijan between 2007 and 2015 were included in the sample. 3-month (quarterly) data of these banks are found to be usable. To include only eligible banks in the sample, the following constraints are used:

- Banks with zero deposits are excluded from the analysis.
- Banks that do not have loans are excluded from the analysis.
- Banks with zero or negative equity are excluded from the analysis.

Liquidity risk of the Azerbaijani financial sector was measured by methods developed by Berger and Bouwman and Deep and Schaefer. Using these methods, two separate ratios representing the dependent variable for liquidity risk are calculated.

The aim of this study is to measure the liquidity risk in the financial sector of Azerbaijan with methods developed by Berger and Bouwman and Deep and

Schaefer.

3.2. Overall disclosure patterns

Deep and Schaefer measure the liquidity transformation by dividing the difference between liquid liabilities and liquid assets by total assets, and they call this indicator the Liquidity Conversion Coefficient (LCC). LCC shows how much of the asset is financed with liquid liabilities and varies between +1 and -1. The fact that the ration is equal to or close to +1 value means that the bank converts all deposits into illiquid assets. The fact that the LCC value is close to 0 indicates that the bank cannot realize the maturity conversion, that is, it creates liquid assets with a single deposit. A negative ration means that the bank has less deposits and more liquid assets. The LCC is calculated using the following equation, and the values obtained vary between -1 and +1.

$$\text{LCC} = (\text{Total deposit} - \text{Liquid assets}) / \text{total assets}$$

Table 2: Balance Sheet Items Used in Calculation of Liquidity Conversion Coefficient

Liquid Assets	Cash and similar, balances of deposit institutions, securities, short-term loans (maturity up to 1 year)
Liquid Liabilities	Time deposits, commercial, demand deposits (with a maturity less than 1 year), debts with a maturity less than 1 year

Source: Deep A. and Schaefer G., 2004.

Table 3 includes LCC statistics of all banks. According to these indicators, the liquidity conversion degree of financial institutions is determined to be high. Based on the Berger and Bouwman method, financial institutions are classified according to their gross total assets as large, medium and small. Banks with total assets up to 80 million Manat are classified as small banks, banks with total assets between 80-100 million Manat medium-sized and banks with total assets greater than 100 million Manat are classified as large banks.

The LCC average and median of large banks were determined as 0.41 and 0.40, respectively. The average LCC and median degrees of the middle banks were determined as 0.49 and 0.39, respectively. It is calculated as 0.39 on average for all banks. This result means that banks convert 39% of their liquid deposits to illiquid assets for each Manat 6 assets they hold.

Values close to +1 value, which is the full liquidity conversion, were obtained for large and medium banks. As can be seen from these figures, Azerbaijani banks are mostly financed by liquid deposits and hold illiquid loans. Thus, banks transferred a significant amount of liquidity to the economy.

Table 3: Statistics on the Liquidity Transformation Gap

	Mean	Median	Standard Deviation
Big Banks	0.41	0.40	0.27
Medium Banks	0.49	0.39	0.40
All Banks	0.39	0.36	0.33

Source: Compiled by the author

Another method that measures liquidity risk was developed by Berger and Bouwman. The model created by Berger and Bouwman measures how effectively US banks manage liquidity risk before, during and after the 2008 crisis. With this approach, liquidity production is measured in three stages. In the first stage, assets, equity and off-balance sheet liabilities are classified as liquid, illiquid and semi-liquid. In the second stage, weights are given to the items classified in the first stage. In the third stage, total liquidity is measured by combining these items. Liquidity formation is measured by maturity and category. Loans are classified according to the category in the first method and according to the maturity structure in the second method. Results obtained with two different methods do not differ much.

Figure 5: Bank Liquidity Production Stages

All items are weighted at certain rates	All items are classified as liquid, non-liquid and semi-liquid	Liquidity formation is measured in the banking system
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Source: Compiled by the author

According to Figure 5, at the first stage, all balance sheet and off-balance sheet items are categorized as liquid, illiquid and semi-liquid. Asset classification is made depending on the ease, cost and speed of disposing of bank liabilities in order to obtain liquid funds. On the other hand, the classification of liabilities and equity is made depending on the ease, cost and speed of customers to obtain liquid funds from banks.

The weights of assets, liabilities and off-balance sheet items are determined in accordance with the liquidity creation theory. According to this theory, when the bank transforms its illiquid liabilities into liquid assets, it generates liquidity in the balance sheet. If illiquid liabilities are used for financing liquid assets, liquid is withdrawn from the market.

Negative weights are applied to liquid assets, illiquid liabilities and equity. In other words, even though balance sheet items generate liquidity in the economy, they are multiplied by positive weights. In the opposite case, that in the economy, although liquidity is consumed, it is multiplied by negative weights. For example, when illiquid liabilities such as equity or subordinated debt are used to finance liquid assets, liquidity is withdrawn from the market. If banks convert USD 1 illiquid assets to USD 1 liquid liabilities, they are produced in 1 USD liquid. Similarly, if financial institutions convert USD 1 liquid assets to USD 1 illiquid liabilities, then USD 1 liquidity is withdrawn from the market. Based on these restrictions, Berger and Bouwman weighed the illiquid assets and liquid liabilities with a ratio of $\frac{1}{2}$, while liquid assets and illiquid liabilities were weighted with $-$. In other words, as weights are given to both assets and liabilities, liquidity weights are determined as. Thus $\frac{1}{2} + \$ 1 + \frac{1}{2} * \$ 1 = \$ 1$ liquidity formation occurs when a liquid liability such as demand deposit is used to finance illiquid assets such as commercial loans. In this

case, maximum liquidity (\$ 1) is produced. Similarly, liquidity generation equals - $yükümlülük * \$ 1 + - \frac{1}{2} * \$ 1 = - \$ 1$ when 1 USD of illiquid liabilities or equity is used to finance liquid assets of 1 USD. In this case, a maximum liquidity withdrawal occurs. According to the liquidity formation theory, liquidity is not created in the system when financial institutions use liquid liabilities (for example, demand deposits) to finance liquid assets (for example, securities) or illiquid liabilities and equity to finance illiquid assets (agricultural production). In this case, banks hold balance sheet items that have the same liquidity or as much as they give to the market. That is, zero weight applies to all semi-liquid assets. For example, financing a residential mortgage with time deposits will generate zero liquidity. The reason for this is that these two instruments are sold by the bank and the ease, speed and cost of obtaining these funds by the depositors are the same. Weights are applied similarly to off-balance sheet items. For example, weighting of $\frac{1}{2}$ is applied to letters of credit and unused commitments and $-\frac{1}{2}$ weighting is applied to net participation shares and derivatives.

LCC statistics of Azerbaijani banks calculated by Berger and Bouwman method are included in Table 3. These indicators show that the liquidity conversion degree of financial institutions is high on average.

Table 4: Azerbaijan Banking Sector Liquidity Production for 2007-2015 period

Year	Liquidity volume	The ratio of total liquidity to gross total assets	The ratio of total liquidity to equity
2007/03	330,472	0.02	0.49
2007/12	(665,082)	(0.1357)	0.65
2008	(841,312)	(0.0951)	0.51
2009	(1,240,523)	(0.1390)	0.61
2010	(1,765,767)	(0.1647)	0.73
2011	1,512,397	0.0826	0.45
2012	2,393,901	0.1472	1.01
2013	2,832,942	0.1511	0.97
2014	5,353,770	0.2478	1.51
2015/03	4,955,664	0.2141	1.42
2015/06	5,015,047	0.2145	1.37

Source: Compiled by author

Table 5: Variables Used in the Analysis

Variables	Used Ratio
Liquidity ratio (Lr)	Total Liquidity Amount measured with BB technique
LCC and Shaefer technique (2004)	Liquidity conversion coefficient measured by Deep
Equity Profitability(EP)	$EP = \text{Net Profit} / \text{Equity}$
Capital Adequacy(CA)	$CA = \text{Capital} / \text{Risk weighted assets}$
Deposit Interest Rate(DİR)	Obtained from the website of the Central Bank.
Deposit Total Liabilities(DTL)	Deposits / Total Liabilities
Net Interest Margin(NİM)	Interest Income / Average Income Assets
Policy Interest Rate	Obtained from the website of the Central Bank
Asset Profitability(AP)	Net Profit / Total Assets
Exchange rate	Obtained from the website of the Central Bank.
Oil Price	Obtained from the website of the Central Bank. The change of oil prices has been obtained.

Source: Compiled by author

Liquidity production calculated using the Berger and Bouwman method has increased since 2011. After 2011, banks transferred a significant amount of liquidity to the market. It is noteworthy that the liquidity produced during the crisis period was negative. Negative figures mean that banks keep illiquid debt and liquid assets on their balance sheets.

Various variables that can affect liquidity risk have been used in academic

studies. In this study, two dependent (Lr and LCC) and fifteen explanatory variables were used and the variables used in the analyzes compiled by the authors are shown in Table 4. Dependent variables are determined using the two alternative methods mentioned above.

Since more than one bank and period were analyzed, it was decided to use Panel Data Analysis as a statistical method and was used to estimate the relationship between banks' liquidity ratios and bank-specific variables and macro variables in the 2007-2015 period. Descriptive statistics for dependent and independent variables are presented in Table 6.

Table 6: Descriptive Statistics for Dependent and Independent Variables

Variable	Observation	Mean	St. Deviation	Minimum	Maximum
LCC	1233	0.34	0.30	-1.11	1.68
LR	1233	-0.10	0.99	-13	14.27
NIM	1233	0.19	1.33	-1.12	28.49
EP	1233	0.14	0.30	-0.97	3.17
CA	1233	0.50	0.45	0.01	4.82
AP	1233	0.54	0.25	0.00	1.30
DTL	1233	0.35	0.21	0.00	1.56
Er	1233	0.81	0.06	0.77	1.05
PIR	1233	0.05	1.17	0.02	0.15
OP	1233	4.45	0.29	3.68	4.88
DIR	1233	7.85	1.39	5.00	10.58

Source: Compiled by author

As can be seen from the correlation matrix table, correlations between the explanatory variables used in the models were found to be weak. The correlation between Return on Assets and Insured Deposits / Total Deposits was high (0.8813).

Generalized Moments Method (GMM) is a method developed for autocorrelation and high correlation cases.

Breusch-Pagan test statistics indicate that not all models can be pooled and the classical model is not suitable, so the random effects model is suitable.

According to the results of Breusch-Pagan statistics, it is seen that the random model is valid in the models established between the liquidity ratio and the variables specific to the banks, and no choice was made between the two models. Therefore, with Breusch-Pagan test statistics, F Score tests are no longer required for the selection of fixed or random approach. Random effects model was used according to Hausman test statistics results.

Findings regarding the model are presented in Table 10. Two liquidity ratios were calculated in the study. According to partial regression results, significant relationships have been identified in Liquidity Conversion Coefficient models.

Table 7: Summary Table of Empirical Findings

Panel Regression Equation	Probability value	Significant Variable	Meaningless Variable
LDK-NFM-SMTM-BB	0.0000	Smtm(+), Bb(+)	Nfm
LDK-SY-MFO-BB	0.0000	Mfo(+), Bb(+)	Sy
LDK-AK-SKTK-BB	0.0000	Ak(+), Sktk(+), Bb(+)	–
LDK-BDKTK-MTP-BB	0.0000	Mtp(+), Bb(+)	Bdktk
LDK-PFO-OK-KFO-BB	0.0000	Bb(+)	Ok, Kfo, Pfo
LDK-PF-BB	0.0000	PF(+), BB(+)	–
LDK-ER-BB	0.0000	Bb(+)	ER
LR-NFM-SMTM-BB	0.9501	-	Model Nonsense
LR-SY-MFO-BB	0.8529	-	Model Nonsense
LR-AK-SKTK-BB	0.9239	-	Model Nonsense
LR-BDKTK-MTP-BB	0.9065	-	Model Nonsense
LR-PFO-OK-KFO-BB	0.0026	Ok(+)	Pfo, Kfo, Bb
LR-PF-BB	0.4720	-	Model Nonsense
LR-ER-BB	0.9119	-	Model Nonsense

Source: Compiled by author

It is seen that liquidity ratio models calculated by Berger and Bowman method are meaningless. No statistically significant relationship was found between the independent variables selected for the Azerbaijani financial market and the liquidity ratio.

According to the analysis results, there is a significant relationship between the bank size (BB) variable and the liquidity risk (Table 8). There is a positive

relationship between bank size and liquidity transferred to the market. Because big banks transfer more liquidity to the market with higher liquid asset level. This increases the liquidity risk for large banks. With the findings obtained in international studies, the same results were obtained in the studies conducted by Dinger and Deep and Schaefer for the USA.

Table 8: Liquidity Conversion Coefficient and Net Interest Margin and the Ratio of Insured Deposits to Total Deposits Panel Data Random Effects Model Test Statistics Results

Probability F-statistic = 0.0000 Adjusted R-squared = 0.4036				
	Coefficient	Standard Error	t-Statistics	Probability, P> t
Nim	-0.001176	0.003188	-0.378204	0.7053
Idtd	0.135144	0.018103	7.465136	0.0000
BB	0.627043	0.028204	22.23209	0.0000
Constant	0.000861	0.003702	0.232580	0.8161

Source: Compiled by author

No statistically significant results were obtained for the net interest margin ratio (Nim) (Table 8). The findings obtained for this variable differ from other studies.

According to the analysis result, the ratio of insured deposit to total deposit (Idtd) is one of the important factors affecting the liquidity risk management in the country (Table 8). The law on insuring deposits was adopted in Azerbaijan in 2007, and the expansion of the deposit base of financial institutions and the increase of liquidity has been realized. The variable of the ratio of insured deposit to total deposit was used only in the study of Deep and Schaefer. The results obtained in this study and the study of Deep and Schaefer give different results. In the study, it

has been concluded that insuring or not insuring the deposit has no effect on liquidity.

It has been observed that the capital adequacy ratio (Ca) is not a significant variable for the Azerbaijani banking sector (Table 9).

**Table 9: Liquidity Conversion Coefficient and Capital Adequacy Deposit Interest Rate
Panel Data Random Effects Model Test Statistics Results**

Probability F-statistic = 0.0000 Adjusted R-squared = 0.3824				
	Coefficient	Resistive Standard Error	t-Statistics	Probability, P> t
Sy	-0.008541	0.008395	-1.017456	0.3091
Di	0.008002	0.002700	2.963350	0.0031
BB	0.703597	0.026845	26.20930	0.0000
Constant	-0.057532	0.021903	-0.187853	0.0087

Source: Compiled by author

A statistically significant and positive relationship was found between the liquidity conversion coefficient and the deposit interest rate (Di) for banks in Azerbaijan (Table 9). The increase in deposit interest rates has resulted in the continuous expansion of the deposit base. On the other hand, the expansion of the deposit base caused banks to go to liquidity production and to face more liquidity risk. This result is compatible with the studies of Moore, Lakštutienė and Krušinskas and Ganic, M..

In the study, a significant and positive relationship was found between return on assets ratio (ROA) and liquidity conversion coefficient (Table 10). It points out that the banks with high return on assets in Azerbaijan will have higher liquidity and will realize high liquidity transformation.

Table 10: Liquidity Conversion Coefficient, Return on Assets and Ratio of Non-performing Loans to Total Loans Panel Data Random Effects Model Test Statistics Results

Probability F-statistic = 0.0000 Adjusted R-squared = 0.5745				
	Coefficient	Resistive Standard Error	t-Statistics	Probability, P> t
ROA	0.709266	0.030667	23.12804	0.0000
Sktk	0.030939	0.012655	2.444861	0.0146
BB	0.278462	0.029027	9.593121	0.0000
Constant	0.000580	0.003171	0.183034	0.8548

Source: Compiled by author

For the banks included in the study in Azerbaijan, a statistically significant and positive relationship was observed between the liquidity conversion coefficient and the ratio of non-performing loans to total loans (Sktk) (Table 13). The increase in this ratio is one of the factors that increase the liquidity risk. This finding is consistent with the studies of Arif and Anees (2012) conducted in Pakistan and Ganic, M. conducted for Bosnia and Herzegovina.

A statistically significant relationship could not be found between the liquidity conversion coefficient and the ratio of off-balance sheet loans to total loans (Os1tl). This result is consistent with the study of Deep and Schaefer (Table 11).

**Table 11: Liquidity Conversion Coefficient, Ratio of Off-Balance Sheet Items to Total Items and Total Liabilities Ratio of Deposits Panel Data Analysis Random Effects Model
Test Statistics Results**

Probability F-statistic = 0.0000 Adjusted R-squared = 0.3803				
	Coefficient	Resistive Standard Error	t-Statistics	Probability, P> t
Osctl	-0.000479	0.000917	-0.522278	0.6016
Dtl	0.054085	0.018064	2.994064	0.0028
BB	0.704313	0.026483	26.59443	0.0000
Constant	-0.017813	0.007413	-2.402976	0.2426

Source: Compiled by author

In the study, it was seen that the deposit / total liability ratio (Dtl) had a significant and positive effect on the liquidity conversion coefficient (Table 14). The increase in deposits within total liabilities in the Azerbaijani banking sector is one of the factors that increase the liquidity transformation.

It has been concluded that the policy interest rate (Pi) does not cause a change on liquidity in Azerbaijan (Table 12)

Table 12: Liquidity Conversion Coefficient, Policy Interest Rate, Equity Profitability, Loan Interest Rate Panel Data Analysis Random Effects Model Test Statistics Results

Probability F-statistic = 0.0000 Adjusted R-squared = 0.3759				
	Coefficient	Resistive Standard Error	t-Statistics	Probability, P> t
Pi	-0.098764	0.100655	0.981211	0.3267
ROE	-0.005590	0.012588	-0.444085	0.6571
Li	-0.000876	0.002000	-0.438142	0.8146
BB	0.707635	0.026947	26.26002	0.0000
Constant	0.021582	0.032327	0.667597	0.5045

Source: Compiled by author

Return on equity ratio (ROE) is not an important variable in terms of liquidity management according to the findings. Statistically significant relationships between return on equity and liquidity were not found (Table 12).

There is no statistically significant relationship between liquidity conversion coefficient and loan interest rate (Li) (Table 12).

Oil prices (OP) are not among the variables that explain the liquidity risk in the literature. However, since it is an important variable for Azerbaijan, it is included in the statistical analysis of the study. Azerbaijan is a country with developed oil industry. Oil and natural gas constitute 90 percent of the country's exports. As expected, oil prices were found to have a significant and positive effect on liquidity risk (Table 13).

**Table 13: Liquidity Conversion Coefficient, Oil Prices and Bank Size Panel Data Analysis
Random Effects Model Test Statistics Results**

Probability F-statistic = 0.0000				
Adjusted R-squared = 0.3783				
	Coefficient	Resistive Standard Error	t-Statistics	Probability, P> t
Op	0.026289	0.012867	2.043133	0.0413
BB	0.708129	0.026473	26.74904	0.0000
Constant	-0.116189	0.057522	-2.019883	0.0436

Source: Compiled by author

Currency variable does not affect bank liquidity (Table 14). Only the recent changes in the exchange rate have adversely affected the banking sector. After the last devaluation of Azerbaijan Manat, there is a problem in the repayment of dollar-denominated loans in the banking sector.

Table 14: Liquidity Conversion Coefficient, Exchange Rate and Bank Size Panel Data Analysis Random Effects Model Test Statistics Results

Probability F-statistic = 0.0000				
Adjusted R-squared = 0.4006				
	Coefficient	Resistive Standard Error	t-Statistics	Probability, P> t
Er	-0.077516	0.059351	-1.306071	0.1918
BB	0.743273	0.027250	27.27582	0.0000
Constant	0.001881	0.003932	0.478398	0.6325

Source: Compiled by author

CONCLUSION AND RECOMMENDATIONS

The importance of financial institutions to be more serious about liquidity management has started to be better understood all over the world, especially after the 2008 financial crisis in international markets and the bankruptcy of banks. The crisis that started in the US housing markets in 2007 turned into an uncontrollable liquidity crisis in 2008. The liquidity crisis had a systematic character and affected all world markets.

Risk management deficiencies and management flaws stemming from the financial system were among the weak sides of the US financial system. The reduction of loan interest rates in the USA, the liberalization of the financial sector, the rapid spread of structured products have led to the formation of a speculative financial system with excessive lending characteristics. The crisis in the USA has emerged as a result of the banks giving out mortgage-based housing loans without control and their financialization with risky investments. US investment banks securitized mortgage loans and unchecked them to other countries. With the expansion of financial institutions' loans, the volume of bad loans also increased. As a result, the credit risks that US banks bear in their balance sheets were transferred to the financial sectors of other countries. During the crisis, banks' bad loans increased significantly, causing the credit quality to deteriorate. Financial institutions that could not make their payments due to the problems experienced in the return of mortgage loans went bankrupt. This crisis, which emerges as a “mortgage crisis”, is mostly related to excessive borrowing of banks and risk management errors.

The financial crisis of 2008 affected the developed economies more. The fact that structured products were not transferred to emerging financial markets resulted in the banks of these countries being relatively less affected by the crisis. Since this crisis has a global character, it has also affected developing economies. Therefore, proper management of liquidity is also important for emerging markets such as Azerbaijan.

This study was conducted with the aim of investigating the existence of the relationship between the important factors that are indicators of the solvency of Azerbaijani commercial and state banks and that affect the liquidity risk and to determine the possible causes. In addition, in this study, it is aimed to highlight the important factors that reduce and increase the liquidity risk and to reach the optimum liquid assets that result in lowering the liquidity risk. However, in this study, the effect of the 2008 global crisis and the monetary expansion implemented by the US Federal Reserve on liquidity was investigated and the liquidity situation before and after the crisis was compared.

Since this study is one of the first studies on the Azerbaijani banking sector and risk management, it is thought that it will greatly contribute to the literature and policy makers. In this study, the methodologies of Berger and Bowman, Deep and Schaefer were used to measure the liquidity of the US markets to measure the liquidity risk.

Berger and Bowman methodology measures bank liquidity in three stages. In the first stage, all bank assets, equity, and off-balance sheet liabilities are classified as illiquid, liquid and semi-liquid. In the second stage, certain weights are given to the items classified in the first stage. In the third stage, the total liquidity is measured by combining the items classified in the first stage and weighted in the second stage.

According to the liquidity indicator developed using the Berger and Bowman methodology, it was observed that the liquidity production in the banking sector in Azerbaijan was negative during the financial crisis period. This shows that banks tend to accumulate more liquidity during the crisis period and they face liquidity shortage. In other words, during the crisis period banks could not fulfill the role of creating liquidity and could not convert illiquid assets into liquid liabilities. A liquidity risk indicator is obtained by dividing the total liquidity calculated with the Berger and Bowman methodology by total assets.

The other dependent variable is the liquidity conversion coefficient created by following the methodology of Deep and Schaefer. The methodology of Deep and Schaefer measures the liquidity of the bank by dividing the difference between liquid

liabilities and liquid assets into total assets. This ratio is the liquidity conversion coefficient and this ratio varies between +1 and -1. The fact that the ratio is equal to or close to +1 value means that the bank converts all its deposits into illiquid assets (the bank is assumed to be financed only by deposits). By converting all its deposits into long term assets, the bank realizes a "complete" maturity conversion. The fact that the value of LDK is close to 0 indicates that the bank cannot realize the maturity conversion, that is, it creates liquid assets with a single deposit. A negative ratio means that the bank has less deposits and more liquid assets. In this case, banks will make a negative maturity transformation by withdrawing the liquidity in the market. The high value of this ratio means that the bank will face high liquidity risk.

Bank-specific and macro variables were used as independent variables. These variables are included in the model as they are important factors in the bank's liquidity risk management. Explanatory variables: ratio of insured deposit to total deposit, capital adequacy, deposit interest rate, return on assets, ratio of non-balance sheet loans to total loans, ratio of off-balance sheet loans to total loans, return on equity, loan interest rate, deposit total liability ratio, policy interest rate, exchange rate, oil prices are variable. When the literature studies are searched, it is seen that some explanatory factors are used as control variables. The main reason for this is to eliminate the effect of the explanatory variable and prevent the endogeneity in the model. In this way, the bank size variable is calculated by taking the logarithm of the assets and used in the model as the control variable. In order to test the reliability of this assumption, it was aimed to reach strong and meaningful findings about the existence or absence of relations as well as their direction and size by using econometric methods.

In all models, a panel consisting of 26 cross sections and 30 periods was created for 26 banks. Within the framework of these analyzes, models have been established between liquidity ratio and bank-specific factors and macroeconomic indicators. In these models, it has been examined how much the change in bank-specific factors causes a change on the liquidity risk.

According to the results obtained as a result of the econometric analysis made,

statistically significant results could not be obtained in all models established for the liquidity ratio developed by Berger and Bowman methodology in the Azerbaijani banking sector. This ratio is included in the model as the dependent variable. Factors affecting this ratio were investigated by panel data analysis. According to the panel data test results, it has been determined that there is no significant relationship between the liquidity ratio and all models established. The meaningless models show that this ratio is not related to the factors related to the Azerbaijani banking sector. Since the results are meaningless, it is not necessary to interpret them.

According to the results obtained as a result of the econometric analysis, statistically significant results were obtained in all models established for the liquidity transfer coefficient developed with Deep and Schaefer methodology in the Azerbaijani banking sector.

Among the important findings obtained as a result of the study, the ratio of insured deposit to total deposit, deposit interest rate, return on assets, ratio of non-performing loans to total loans, deposit total liability ratio, oil prices, return on equity are among the important factors affecting the liquidity risk management in the country. These findings provide information that both the regulatory authority and those who invest in the banking sector should pay more attention to these indicators, be more sensitive to the change of these indicators and guide their investment decisions in this way.

Another important finding obtained as a result of the study is that bank size is positively associated with liquidity risk. This reveals that large banks face higher liquidity risk compared to smaller banks.

As is known, as a result of the devaluation in the country as of the end of 2015, Manat lost 50 percent of its value against the dollar. Changes in the exchange rate left the financial sector in a very difficult position. As of 2015 and 2016, the rapid flight from Manat and dollarization process continues in the country. The central bank raised the policy interest rates to 5.06 percent. This resulted in the banking sector raising loan interest rates to 18.77 percent. With such decisions taken by the Central Bank, it is aimed to save on foreign exchange reserves. Only the banking

sector is negatively affected by the decisions made by the Central Bank. Today, there is a problem in the banking sector in repaying loans borrowed in dollars. At the same time, the process of withdrawal of deposits by the public has been accelerated. Banks borrowed large volumes from foreign countries and the foreign debt of the banking sector amounted to 7 billion Manats. Devaluation of the Azerbaijani Manat creates problems in the payment of financial institutions' debts. The fact that foreign debts are in dollars on the basis of the weakening of manat makes the repayment of the debt more difficult.

It is thought that extending the implementation period in future studies and including the changes in 2016 in the analysis may yield different results for Azerbaijani financial markets. In addition, it can be investigated how banks will manage the liquidity risk in the difficult conditions during the oil crisis and which factors are more important.

Finally, it is thought that the calculation of new liquidity coefficients, selection of the appropriate liquidity indicators for the financial markets of the country, and comparison of the results with emerging and developed markets will be important for measuring the effectiveness of liquidity risk management in the Azerbaijani financial sector. It is believed that the findings and analytical interpretations to be obtained will direct the financial market of Azerbaijan and thus contribute to the markets and be beneficial.

The issue of liquidity management began to be better understood after the 2008 global crisis and the bankruptcy of banks in paperback markets. The crisis in the US housing circles in 2007, and in 2008 the uncontrollable liquidity crisis has passed. Since the liquidity crisis has a systematic character, it has taken all the world markets. Although there is a question about liquidity in the international banking system, there is very little work on this issue in the Azerbaijani banking sector. In these studies, the factors affecting liquidity are aimed. The methodology of Deep and Schaefer and Berger and Bouwman of these transactions wanted to look at the liquidity risk management from a different perspective. The Liquidity Conversion Coefficients of Derin and Schaefer were calculated and the liquidity risky of the

Azerbaijan Banking sector was analyzed.

It is thought that extending the implementation period in future studies and adding other variables used in the literature to the analysis may yield meaningful results. In addition, it is thought that the monetary policies of the USA (FED) and the European Central Bank (ECB) in 2021 and 2022 may have significant consequences on the liquidity of the banks. In this respect, the content of the development of liquidity factors will be beneficial after the decisions sent by the FED and ECB.

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