Journal of Money and Economy
Vol. 13, No. 1, Winter 2018
pp. 107-123

Effect of Asset and Liability Management on Liquidity Risk of Iranian Banks

Azam Ahmadyan[1] **Mahshid Shahchera**[2]

Received: 28 Apr 2019 Approved: 31 Aug 2019

In financial markets, the main component of risk management is liquidity risk. Asset and Liability Management (ALM) strategy is concerned with managing all risks. Asset and liability management seeks to manage liquidity risk, which refers to both the liquidity of markets and which assets can be translated into cash. The liquidity is importantly affected by the management of banks' balance sheets. This paper contributes to the discussion by focusing on liquidity and asset and liability management by providing a theoretical framework to examine how the ALM could be reduced the liquidity risk in banking. We investigate the effect of ALM indicators on liquidity risk. We measure liquidity risk, and ALM with indicators approach, using financial statement in 2006-2018 and panel data approach. The results indicate that if asset and liability management improves, liquidity risk decrease and if the ratio of capital adequacy increases, the bank can better cover liquidity risk, and so increasing in capital adequacy will reduce liquidity risk. Deposit per shareholders increases the liquidity risk of banks. Interest rate increases liquidity risk. When profitability increases, liquidity risk will increase. The relation between liquidity risk and profitability is positive.

Keywords: Asset and Liability Management, Liquidity Risk, Macroeconomic Indicators.
JEL Classification: C21, G23

1 Introduction

Asset and liability management (ALM) includes the best investment of assets and future liabilities. The aim of ALM is the valuation of risks and benefits for assets and liabilities. The traditional view of managing risks, focus on risk's type and survey the level of risk but the new technics study the financial risks. Strategies on ALM focus on assets and liabilities for implementing, monitoring, and revising financial objectives to controlling risks. Although, increasing of risks, improve the possibility that bank's assets will not cover its

[1] Banking Department, Monetary and Banking Research Institution, Iran; azam_ahmadyan@yahoo.com (Corresponding Author)
[2] Banking Department, Monetary and Banking Research Institution, Iran; mahshidshahchera@yahoo.com

short-term obligations, ALM is usually accompanied from a long-term perspective. (Choudhry, 2007)

ALM survey gap in assets and liabilities, the sensitivity of balance sheet to change of prices and interest rate and could help to proper reactions and response to risks and fluctuation of the economic environment. Thus liquidity gap that shows risk could recognize liquidity mismatch in balance sheets. Banks manage liquidity risk that creates for any reason by this technique. Therefore, banks hold a large part of assets in the different liquid formation and provide liquidity requirement through a liquid asset while the needs of banks must be provided through funding.

Then there is a linkage between liquidity risk and asset and liability management. Liquidity risk may be calculated by liquid asset and cash-flow matching. The liquid asset focuses on a liquid section in the balance sheet that banks use in their portfolios. These measure emphases on pools of assets and secured facilities. Liquidity relates to cash flow matching and mismatch of assets and liabilities, also asset and liabilities management.

Liquidity risk management is so complex that it may cause different consequences in banking. Liquidity risk could be arising from different sources that this effect on banking liquidity risk management — Source of liquidity risk related to the business decision of managers and policymakers of banks. Banks managers utilize decisions based on a combination of historical data of markets and events.

In recent years, Iranian banks have confronted a lack of liquidity and an increase in the cost of asset and liability management. The Government pressure to provide loan and to decrease the interest rates has caused no balance between assets and liabilities of banks. So this has led to banks failing to manage their assets and liabilities, thereby increasing liquidity risk. As for the importance of this issue, in this paper, we investigate, the relationship between asset and liability management and liquidity risk.

This paper has some tips that set it apart from other studies. In this paper, based on the empirical literature on liquidity risk criteria, a hybrid benchmark for liquidity risk is designed. Then the banks of Iran are ranked according to the combination of liquidity risk. As the first rank bank is a bank that has the lowest liquidity risk and has the best liquidity risk management, the bank with the 5th rank has the highest liquidity risk and the worst liquidity risk management. Finally, considering the importance of the effect of Asset management and Liability management on liquidity risk, this effect has been investigated from three aspects of the effect of asset management, Liability

management and Asset - Liability management on liquidity risk, and the results have been compared.

The organization of the paper is as follows. Section 2 provides a review of the existing literature of this study. Section 3 explains the importance of asset and liability management. Section 4 provides a detailed description of the variables that affect our analysis. The final section surveys the empirical methodology and key findings of this study and provides concluding comments.

2 Literature Review

The purpose of Hunjra et al. (2017), was to determine the gap between the assets and the liabilities of Islamic and conventional banks. It also finds the impact of liquidity risk, capital adequacy, management efficiency, operating cost, and transaction size on net interest margin for Conventional Banks (CBS) and net profit margin for Islamic Banks (IBs) in Pakistan, Malaysia, Bahrain, and UAE. Short-term and long-term assets and liabilities gap are further emphasized in this study. Data were extracted from the financial statements of both types of banks for the period of 2008-2014. This study finds that there is a negative short-term gap for both types of banks, while the long-term gap for both types of banks is positive. Results show that the operating cost is an important factor which affects the profit margins and progress quality of the management of banks. Finally, the overall results show that CBS have better assets and liabilities structure of profitable assets at low-cost liabilities.

The specific objectives of Mamati et al. (2017), was to examine the effect of liquidity stress testing on liquidity risk of microfinance banks in Kenya. They wanted to determine the effect of loan to deposit ratio on liquidity risk of microfinance banks in Kenya, to determine the effect of return on assets on liquidity risk of microfinance banks in Kenya, and to determine the effect of return on equity on liquidity risk of microfinance banks in Kenya. The findings were significant to the microfinance banks for effective asset liabilities management and policy formulation. The results of the regression analysis indicate that there is a great positive correlation between liquidity risk and liquidity stress testing, and significant negative relationship between loan to deposit ratio, Return on Asset and Return on Equity. The findings of the analysis conclude that the independent variables affect the dependent variable (Liquidity risk).

Hong et al. (2014) examined the impact of liquidity risk measures using the Net stable funding ratio and liquidity coverage ratio in the model using panel data from US banks for the period 2001 to 2011. This survey shows that

liquidity risk is the main reason for crisis and point out new liquidity requirements under the Basel III is important for controlling risk. Sharara (2014) survey the constraint of liquidity and its effect on ALM strategies in Zimbabwe. Results showed the relationship between liquidity shortage and vulnerable in the financial market is strong, and ALM creates the capacity of cash holding in banking. Liquidity risk was subjected to profitability. ALM absorbs risk and shocks that banks fact it. Also, Sharara (2014) indicate that ALM is the main role in the monitoring of liquidity risk.

Guthua (2013) investigated the effect of Asset Liability Management on the liquidity risk on the commercial banks in Kenya. The results of the regression analysis show that there is a significant positive relationship between independent variables (return on equity, capital adequacy, loan to deposit ratio, return on assets, total assets, asset-liability management policies, liquidity stress testing, and contingency funding plan) and the dependent variable, i.e. liquidity risk of commercial banks. The findings of the analysis conclude that independent variables affect the liquidity risk of commercial banks in Kenya.

Ratnovski (2013) use a model in which banks can manage liquidity risk. Result Showed Higher liquidity protects banks against small liquidity shocks, and greater transparency guards large liquidity shocks. The author suggests, the government can choose effective and supportable rules and regulations for liquidity buffers, but cannot impose transparency. Thus, government liquidity regulation results in reduced amounts of active liquidity management. Banks hold high liquidity buffers by law but reduce their costly transparency efforts.

Harvey (2013) emphasis on ALM strategies detects the risks in the United States. This study indicates that there is a positive relationship between asset and liability management and financial performance. According to the evidence, asset and liability management improves profitability and performance.

Rosen and Zenios (2006) indicate the importance of asset and liability management. This study states that liquidity risk changes the financial statement and effect on profitability. Asset liability management could be controlling this risk and increase risk acceptable of banks. These strategies in ALM help to manage risk better. Rogers (2005) survey the relationship between asset and liability management and profitability in Scotland banking system. ALM controlling could be increased performance in commercial banks. Vulnerabilities of the financial sector could be influenced by ALM strategies.

Muranaga and Ohsawa (2002) survey the relationship between ALM strategies and risks. This study focuses on suitable strategies for controlling risks management.

Ahmadyan (2018), using the existing theoretical and empirical literature, and applying a DSGE model, the impact of macroeconomic variables on asset and liability management is modeled. The kernel distribution function is used to extract the critical threshold of the target macro variables. This function allows the researcher to determine the thresholds according to their variable process. The results of the survey show that, in recession and decline in GDP, asset and liability management costs are rising more than the price index increases.

Omrani and Naji Azimi, (2016), try to define various objectives with the focus on determining the optimal amount of cash and liquidity risk, and, based on that, optimally manage assets and liabilities. Considering the determination of multiple objectives and limitations in the banking system and the experience of past years, the model used in this paper is fuzzy idealized, fuzzy programming model with fuzzy restrictions. The proposed paper model is capable of presenting optimal values for each item of the balance sheet for the coming years according to the conditions of previous years. There are nine aspirations and more than thirty fuzzy limitations in the model to achieve the final answer. The goals of the paper are: to maximize profits, to limit the ratio of facilities to deposits, to increase the bank's share of deposits, increase the amount of balance sheet items, increase the amount of different assets to total assets, observance of restrictions, the adequacy of capital, the reduction in the volume of investment in tangible fixed assets, the greater the claims of the Central Bank of the amount of debt to it, and the greater the claims of banks and credit institutions of the amount of debt to them. Hierarchical analysis method has also been used to achieve the importance of each of these aspirations. In the end, the results of the research are compared in both fatal and fuzzy models, and the improvement of the results in a fuzzy state is visible to the definitive state.

Ahmadyan and Shahchera (2014) suggest a micro funded framework that can evaluate the role of asset and liability management in the banking sector in business cycles through a DSGE model. In this paper, they use a Bayesian method to estimate parameters and use national account and balance sheet data from 1981 to 2013. Results show that tightening monetary policy decreases the cost of ALM. On the other hand, raising required reserve requirement increases the cost of asset and liability management; technology shock leads to a decrease of asset and liability management cost, and the costs of ALM

affects the interest rate. Then, the increase in the cost of ALM leads to an increase in interest rate.

3 The Importance of Asset-Liability Management (ALM)

ALM strategies suggest a long-term position for investing assets and covering liabilities in the time.ALM strategies create better planning for future uncertainties; and, ideally, improve efficiency and performance from the integration of asset and liability management (Yuliya Romanyuk, 2010).

Brennan, Schwartz, and Lagnado (1997), Mulvey (2001), Rosen and Zenios (2006), Kosmidou and Zopounidis (2008), and Mulvey and Vladimirou (1989) indicate the importance of ALM in banking and introduce the methods that could improve the banking business models.

Asset-liability management is the authorizing the maturity shapes of assets and liabilities. It associates the methods of asset management, liability management, and spread management into a consistent process leading to combined management of the total balance sheet.

Susie Fair (2003) describes ALM is the process of assessing balance sheet risk and making prudent decisions. ALM process joins in profiting committee and creates the best decisions for banks. According to Patrick Totty (2003), ALM decreases balance sheet risk by predicting how earnings and other key performance benchmarks response in alternative interest-rate environments and economic conditions. ALM helps the bank to manage its assets and liabilities efficiently with special focus on profitability, capital adequacy, liquidity, and risk factors in a dynamic and competitive economic environment. Asset-liability management is a set of interrelationships that must be identified, coordinated, and managed as an integrated system (Moynihan, Purushothaman, Mcleod, and Nichols, 2002).

Banks create liquidity as maturity transformation, also known as time intermediation. In other words, they demand deposits and other short-term resources and lend them in the form of longer maturity. (Elliott, 2014) Maturity transformation is useful for banking to provide liquidity. Banks, as the main intermediate, create liquidity. In particular, deposits are “sticky”. Demand deposits can theoretically all be remote in a single day. Therefore, banks can create liquidity by the mismatch. Attention is drawn to the fact that banking crisis may also arise.

Management and controlling of liquid assets is an important role in liquidity risk management. Banks may also face additional liquidity requirements from activities and businesses that create more instability and volatility. Lending activities also change their liquidity needs; banks may

deliver credit to firms and financial institutions. Banks with more deposits need adequate cash to reduce the possibility of liquidity risks. Finally, the type of banks' activities and performance impact on their liquidity needs.

Banks need to have sufficient liquid assets that can be converted easily and quickly into cash with little or no loss of value. This leads to bank to prefer different share concentrations if it focuses only on the risk-return tradeoff.

Management of liquid assets is determined importantly by its internal liquidity risk management framework, which depends on the business model and individualized liquidity needs. Although the financial statement of banks shows, there are relatively share of reserve balances to meet liquidity needs. Investment banks may also face additional intraday liquidity needs from dealer-intermediated activities and businesses such as prime brokerage services and derivatives trading. Banks' commercial lending activities also design their liquidity needs; banks may provide credit to nonfinancial firms and financial institutions that involve relatively quick funding.

Banks could have a sound process for identifying, measuring, monitoring and controlling liquidity risk. Then, banks need a funding strategy that makes effective portfolios in the sources of funding. Banks should actively manage their collateral positions, differentiating between encumbered and unencumbered assets.

Since the Financial Crisis in 2008, the business of banks is seriously argued. Especially, Regulators focus on reducing systemic and economic risk coming from the banking sector. The Regulators are severely limiting the capability of bank management and bank owners to define their business models. The relationship between business model and ALM strategies is more important for assessing risk.

The main purpose of ALM is to limit and manage risks of balance sheet. Management requires regarding restrictions and assessment of revenue. Then, the liquidity is importantly affected by the management of banks' balance sheets.

This paper contributes to the discussion by focusing on liquidity and asset-liability management by providing a theoretical framework to examine how the ALM could be reduced the liquidity risk in banking.

4 Model

This study is based on the assessment of ALM on liquidity risk in the banking system in the period from 2006 to 2018. Financial data obtained from banking database and macroeconomic statements from the Database of Central Bank

of Iran. This model estimated panel data for 30 banks[1] (private and state banks) in the Iranian banking system. In our study, the data includes active banks in the Iranian banking system throughout 2006-2018. This financial information is retrieved from the Central Bank dataset.

According to the importance of liquidity in Iran's banking system, the relationship between liquidity risk and ALM is surveyed. Namely, this paper investigates which ALM determinant has the highest dependency on the dependent variable (liquidity risk). Also, this concept has by using statistical methods such as ANOVA Analysis and multiple regression analysis in measuring the individual and combined effects of the variables on the dependent variable.

To measure the liquidity risk, we use two steps. First, individual risk criteria are calculated for liquidity risk, and then the calculated criteria are combined. As a point of Madhi (2017), this paper has been used liquidity risk indicators. Liquid asset to total asset measures the ability of a bank to absorb liquidity shocks. A high ratio means a high ability to absorb shocks. Liquid assets to short term liabilities measure the ability of a bank to cope with a high demand for short term liquidity. A high ratio means that the bank is liquid at short-term. Liquid assets to deposits used to measure a bank's liquidity in case that bank cannot borrow from other banks.

The more liquid asset means that the bank can control and manage liquidity risk. Loan to total assets measures the share of loans in total assets. It shows the percentage of the bank's assets related to illiquid loans. When this ratio is high, it means that the bank is less liquid. Loans to deposit plus short term liabilities indicate the relationship of illiquid assets and liquid liabilities. When this ratio is high, it means that the bank is less liquid. Bank's loans –customer deposits to total assets- indicate liquidity risk exposure. Define as the difference between the bank's loans and customer deposits; the financing gap is divided by total assets. The variables used in this article are presented in Table 1.this table shows all of the variables that use the models.

[1] Eghtesad Novin, Ansar, Parsian, Pasargad, Ayande, Day, sarmaye, Sina, Saman, Shahr, Karafarin, Iran zamin, Hekmate Iranian, Ghavamin, Ghardeshgari, Khavarmine, Tejarat, Saderat, Mellat, Refah, Sepah, Melli, Post Bank, Gharz ol Hasaneh Mehr, Gharz ol Hasane Resalat, Sanat va Madan, Kashavarzi, Maskan, Tose Saderat, Tose Taavon.

Table 1
Definitions of the Variables

	indicators	Symbol
liquidity risk	Liquid asset to total asset	Lr1
	Liquid assets to Short term Liabilities	Lr2
	Liquid assets to deposits	Lr3
	Loan to total assets	Lr4
	Loans to (deposit+ short term liabilities)	Lr5
	(Bank's loans –customer deposits) to Total assets	Lr6
Combined liquidity risk	Rank between 1,…5. 1 is the Bank with minimum liquidity risk, and five is the Bank with maximum liquidity risk	LRM
Performance	Capital adequacy	Perform1
	Deposit per shareholders	Perform2
Profitability	Return on asset	Pro1
	Net interest margin	Pro2
Macroeconomic	Loan interest rate	Eco1
Asset and Liability Management	Total asset per shareholders	AM
	Total Liability per shareholders	LM
	Asset sensitive to interest rate over liability sensitive to interest rate	ALM

Source: Research Findings

The following steps, this research calculate the measure of the **combined liquidity risk ratio**. First, each liquidity risk ratio is normalized using the minimum and maximum ratios.

$$\left(\frac{a_i - L}{U - L}\right) \tag{1}$$

Where, a_i , L and U are Liquidity risk ratio, minimum, and maximum of them. Then, to derive an indicator for the combined liquidity risk, the sum of these normalized indices is calculated.

$$CS_i = \sum \left(\frac{a_i - L}{U - L}\right) \tag{2}$$

That CS_i is combined of the liquidity risk ratio. The amount $CS_i$is between zero and one. Zero is the worst situation, and one is the best situation in this criterion (Prasad. K.V.N & G. Ravinder, 2012). Table 2, Shows this ranking.

Table 2
Ranking

Rank	Criterion
1	$0.8 < CS_i < 1$
2	$0.6 < CS_i < 0.8$
3	$0.4 < CS_i < 0.6$
4	$0.2 < CS_i < 0.4$
5	$0 < CS_i < 0.2$

Source: Research Findings

Table 3
Unit Root Tests of the Variables

variables	PP-Fisher, Chi-square	ADF- Fisher, Chi-Square	Im, Pesaran and Shin W-Stat	Levin, Lin& Chu
Lr1	178.970	139.379	-9.53440	-43.6453
	(0.000)	(0.000)	(0.000)	(0.000)
Lr2	197.122	199.969	-20.7459	-70.0078
	(0.000)	(0.000)	(0.000)	(0.000)
Lr3	173.837	186.723	-25.2855	-105.302
	(0.000)	(0.0001)	(0.000)	(0.000)
Lr4	108.493	115.415	-4.56118	-8.98685
	(0.0001)	(0.000)	(0.000)	(0.000)
Lr5	140.018	121.349	-8.91144	-53.7281
	(0.000)	(0.000)	(0.000)	(0.000)
Lr6	137.121	104.016	-4.45454	-18.5166
	(0.000)	(0.0004)	(0.000)	(0.000)
Perform1	149.147	128.446	-9.14455	-40.8735
	(0.000)	(0.000)	(0.000)	(0.000)
Perform2	220.262	146.337	-7.42976	-19.5453
	(0.000)	(0.000)	(0.000)	(0.000)
ALM	224.847	174.033	-10.3530	-21.5598
	(0.000)	(0.000)	(0.000)	(0.000)
Al	188.525	118.787	-5.43675	-11.8011
	(0.000)	(0.000)	(0.000)	(0.000)
Am	210.440	141.045	-7.32268	-18.4565
	(0.000)	(0.000)	(0.000)	(0.000)
Eco1	168.227	152.477	-6.10099	-14.9188
	(0.000)	(0.000)	(0.000)	(0.000)
Pro1	150.301	119.026	-8.69073	-48.8577
	(0.000)	(0.000)	(0.000)	(0.000)
Pro2	139.867	110.147	-7.79212	-46.7623
	(0.000)	(0.0001)	(0.000)	(0.000)

Source: Research Findings

Banks that are ranked 1 and 2, these banks are low risk and have good liquidity risk management. If the rank of banks is 3, these banks are medium risk and have average liquidity risk management and Banks with 4 and 5 ratings, these banks are high risk and have poor liquidity risk management.

The results of the unit root test are shown in Table 3. This paper uses the four unit root test statistics, PP-Fisher, ADF- Fisher, Im, Pesaran and Shin W-Stat, Levin, Lin& Chu.

The results show that all of the variables are static at the level and Inference and significance at the level of 5%. Statistical analysis of variables is presented.

Table 4
Descriptive Statistics (Lr)

	Lr1	Lr2	Lr3	Lr4	Lr5	Lr6
Mean	18.37782	287.9284	70.82426	93.53301	122.3219	-11.46677
Median	14.10592	130.2846	22.60062	99.24519	119.0124	-19.87357
Maximum	92.21803	7378.904	4801.990	136.1833	894.4176	96.64822
Minimum	1.591581	6.074725	1.886783	0.000000	0.000000	-111.7168
Std.Dev.	12.87878	686.4756	354.3637	27.08281	66.10246	38.46401
Skewness	2.091861	7.430714	12.33342	-1.208920	8.156108	0.695349
Kurtosis	9.890152	68.91375	163.3300	4.241713	95.95896	3.896581
Jarque-Bera	533.3588	37475.02	215995.4	60.64153	73115.37	22.47360
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.000013
Sum	3620.430	56721.90	13952.38	18426.00	3620.430	56721.90
Sum Sq. Dev.	32509.14	92364761	24612428	143761.8	32509.14	92364761
Observations	197	197	197	197	197	197
Cross sections	30	30	30	30	30	30

Source: Research Findings

In table 4 and 5, the Descriptive Statistics of variables is shown. Iranian banks have an average of 18.37 percent in Liquid asset to total asset. The average of Liquid assets to deposit is 70.82 percent. The liquidity risk indexes respectively are distributed in leptokurtic (K=9.8, 68.91, 163.33, 4.24, 95.95 and 3.8) manner and some positively skewed (S=2.09, 7.43, 12.33, -1.20, 8.15 and 0.69). If skewness is negative, the data are negatively skewed or skewed left, meaning that the left tail is longer. If the skewness of distribution is zero, data are perfectly symmetrical. If skewness is less than −1 or greater than +1, the distribution is highly skewed. The Jaque-Bera test supports that the liquidity risk is not normally distributed (JB=533.35, 37475.02, 215995, 60.64153, 73115, 37, and 22.47360). This distribution further shows that half of the Iranian banks had liquidity risk index that is higher than 14.10, 130.28,

22.60, 99.24, 119.01, and 19.87 percent. Data show that while some banks have less than 10 percent liquidity risk index, others have as high as 111.71 percent.

Table 5 shows Asset and liability management indicators. The stat of Jarque-Bera and p-value shows that we reject null hypnotists and conclude the data is not normally distributed.

The mean of capital adequacy ratio (perform1), have 10.62 percent. It indicates that Iranian banks are well-capitalized and have a high capacity to withstand shocks that could be caused by loan defaults. While half of the Iranian banks have higher than 6.67 percent capital adequacy ratio, some have less than 1 capital adequacy ratio (minimum of 0.12), implying the insufficiency of capital. Also, their shareholders have yet to infuse the required capital to cover the bank's capital deficiency or prepare a capital build-up plan acceptable to the banking sector program.

The Jarque-Bera test shows deposit per shareholders was likewise not normally distributed (JB=503564), with a Kurtosis=220 and positively skewed distribution (S=14).

Table 5
Descriptive Statistics of Variables

	AM	**LM**	**ALM**	**PERFORM1**	**PERFORM2**	**Pro1**	**Pro2**	**Eco1**
Mean	1923.8	1832.38	116.0584	10.62457	1522.047	1.5046	2.2199	15.0
Median	1472.7	1344.80	87.93266	6.679907	1039.884	0.9806	1.3307	14.0
Maximum	83092.6	82992.6	3092.233	67.84395	80586.59	13.682	50.0092	21.00
Minimum	150.0	126.000	175.0000	0.120348	3.146479	-3.577	-4.9349	12.00
Std. Dev.	5337.2	5337.64	205.6300	10.50491	5167.800	2.004	4.2425	3.322
Skewness	14.184	14.17736	12.60748	2.452756	14.43927	2.0727	6.6633	0.953
Kurtosis	215.73	215.5800	179.2679	9.682526	220.9639	10.243	69.145	2.371
Jarque-Bera	479795.	479106.6	327630.4	575.5317	503564.7	719.7	47045.2	50.42
Probability	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sum	458096.	458096.2	28782.47	2135.539	380511.7	373.14	550.541	45000
Sum Sq. Dev.	7.09e9	7.09e+9	10444072	22070.63	7.65e+09	992.6	4445.889	3300
Observations	250	250	248	201	250	248	248	300
Cross sections	30	30	30	30	30	30	30	30

Source: Research Findings

Moreover, profitability, measured in terms of ROA (pro1), is fairly low at 1.41 percent. ROA is likewise not normally distributed as indicated by the Jarque-Bera test (JB=1235.72), with a leptokurtic (K=14.16) and positively skewed distribution (S=2.38), indicating that half of the Iranian banks have

ROA higher than 1.03 percent. Data shows that some banks have as high as 13.68 percent ROA, while others have even less than zero.

Net interest margin (pro2) averaged at 2.21 percent; it was highly leptokurtic (K=69.14). The maximum Net interest margin is 50 percent. The distribution was highly negatively skewed (S6.66), with half of the Iranian banks having net interest margin higher than 1.3 percent. Similarly, the distribution is not normal, as indicated by the Jarque-Bera test (JB=47045).

The mean of loan interest rate (Eco1) is 15 percent. The loan interest rate in Iran is less than 12 percent; this show banking system supplies credit in low-cost. Half of the Iranian banks have higher than 14 percent loan interest rate. Some have less than 12 percent implying some banks reduced their interest revenue. In Iran, inflation is more than the loan interest rate, this situation decreases the interest revenue of the banking system, but this interest rate is high for producing section and the cost of producing increase.

In this section, we expand the analysis and estimate models with panel data (2006-2018), to this concept, we recognize characteristics which may not be constant over time (heterogeneity) and reduce bias in the estimated parameters. Using Eviews 9, a panel data model is estimated, and the required tests are performed. The results of Limer test are shown in Table 5. The F-limer test is used to recognizing the pooled and panel data estimation. The probability of statistic shows the panel data can be used.

Table 5
F-Limer Test

Chi-square	**F- stat**
119.367099	4.505873
(0.0000)	(0.0000)

Source: Research Findings

Hausman's test is used to select the methods of random effects or fixed effects. The results show that the model should be estimated by the random-effects method.

Table 6
Hausman Test

Test Summary	**F- stat**
Cross-section random	6.006720
	(0.5390)

Source: Research Findings

The structure of the model is shown in formula (1):

$$y_{it} = C + \sum_{t=2006}^{2017} \beta_i x_{it} + e \quad (3)$$

in which y_{it} are dependent variables, and this variable denotes liquidity risk. β_i is the coefficient of the explanatory x variables. $x_{it}$are independent variables. C is the value of the intercept. e is the error term assumed to have zero mean and independent across the time period. In estimation (1), an independent variable related to asset and liability management is ALM (Asset sensitive to interest rate over liability sensitive to the interest rate). In estimation (2), the independent variable is AM (Asset per shareholders) and in estimation (3), the independent variable is LM (Liability per shareholders).

Table 7
Results of the Model

Indicators	Estimation(1)	Estimation (2)	Estimation (3)
C	4.484080	4.518741	4.29925
	(11.48356)	(11.48680)	(11.32733)
ALM	-0.002429	…….	…….
	(-1.315309)		
Al	…….	-0.0001333	…….
		(-2.311862)	
Am	…….	…….	-0.000146
			(-2.573894)
Perform1	-0.005612	-0.004288	-0.004100
	(-3.539396)	(-4.145936)	(-4.027738)
Perform2	0.000150	0.016084	0.000153
	(2.26478)	(1.110220)	(2.309706)
Eco1	-0.067340	-0.069932	-0.064723
	(-3.459079)	(-3.529068)	(-3.340027)
Pro1	-0.265741	-0.220680	-2.208196
	(-2.670249)	(-2.395712)	(-2.271616)
Pro2	-0.092121	-0.080441	-0.076845
	(-2.037144)	(-2.259764)	(-2.173461)
R-sq	0.78	0.79	0.69
D. W.	1.84	1.81	1.71

Source: Research Findings

According to the results, there is a negative relationship between liquidity risk and asset and liability management. The better management can make better controlling in liquidity risk. Asset liability management is concerned with strategic balance sheet management involving risks caused by changes in the interest rates, exchange rates, and the liquidity position of the bank. The

significance of ALM to the financial sector is further highlighted due to the dramatic changes that have occurred in recent years in the assets (uses of funds) and liabilities (sources of funds) of banks. There is a vast shift in the borrowers' profile, the industry profile and the exposure limits the same as, interest rate structure for deposits and advances, and so on. This has been accompanied by increased volatility of markets, diversification of bank product profiles, and intensified competition between banks on a global scale, all adding to the risk exposure of banks. Thus, banks increasingly need to match the maturities of the assets and liabilities, balancing the objectives of profitability, liquidity, and risk. This concept increases the need for implementing asset liability management in banks.

Perform1 is capital adequacy that indicates the measure of health in the banking system. If the bank increases the ratio of capital adequacy, it can make better covering and controlling liquidity risk, and so increasing in capital adequacy will reduce liquidity risk. Perform2 variable indicates deposit per shareholders. Whatever the deposit is more than equity, the bank has more unstable resources and less risk-taking capability. It increases the Liquidity risk of banks.

Eco1 variable is the interest rate of lending. The higher interest rates create more willing for attracting deposits and supply credits, and due to the difference in the maturity of deposits and credits, the risk of liquidity of banks increases.

Pro1 and pro2 consider as profitability index. Return on the asset and net interest margin show the profitability measure that we use in this model. The more profitability indicates the more asset incoming. Because assets incoming is mainly assets with long-term maturity, if they increase, although raising profitability, also increases the liquidity risk in banks.

5 Conclusions

Effective asset-liability management is especially important for deposit-taking institutions since the variety of liabilities for them is, by definition, more complex than non-deposit-taking institutions.

A sound asset-liability management strategy enables organizations to minimize the risks inherent in the balance sheet by matching the currencies and terms of assets and liabilities as closely as possible in line with the organization's risk appetite. When terms and currencies of assets and liabilities are perfectly matched, there is no financial risk (note that this does not eliminate other risks—especially credit and operational risks). In practice, it is hard to match these terms exactly, so it is important to measure the

mismatch and set ceilings, or limits, on the amount of risk with which the organization is comfortable.

In this paper, we focus on the effect of asset and liability management index on liquidity risk. Liquidity risk, as defined here, is not the same as cash flow management. Cash flow management concentrates on daily cash flow needs per branch or field office for loan disbursement, operating costs, etc. Liquidity management focuses on liquidity risk indexes.

To investigate the effect of asset and liability management on liquidity risk, the financial statements of Iran's banking system for the period 2006-2018 have been used. Results indicate that asset and liability management indicators have a significant and negative effect on liquidity risk. The more banks succeed in managing assets and liabilities, the better it can be accountable for deposit withdrawals, and liquidity risk decrease. These results are similar to Hunjra et al. (2017), Hong et al., (2014), and other papers that we survey in the literature review.

The liquidity is importantly affected by the management of banks' balance sheets. This paper contributes to the discussion by focusing on liquidity and asset-liability management by providing a theoretical framework to examine how the asset-liability management could reduce the liquidity risk in banking.

References

Ahmadyan, A. (2018). Effect of Macroeconomic on Asset and Liability Management. *Quarterly Journal of Islamic Finance and Banking Studies*, Vol. 4, Issue 9, 141-172, (In Persian).

Ahmadyan, A., & Shahchera, S. (2014). A Model of Asset and Liability Management and Monetary Shocks (DSGE Model). *Journal of Money and Economy*, Vol. 9, No.1 Winter 2014

Brennan, M. J., E. S. Schwartz, and R. Lagnado. (1997). Strategic Asset Allocation. *Journal of Economic Dynamics and Control,* 21, 1377–1403.

Choudhry, M. (2007). *Bank Asset and Liability Management: Strategy, Trading Analysis*. John Wiley & Sons.

Guthua, A. M. (2013). *The Effect of Asset Liability Management on the Liquidity Risk of Commercial Banks in Kenya*, research report, University of Nairobi.

Harvey, A., (2013). Asset Liability Management and Financial performance in America. *International Review of Business Research Papers*, 2(2), 45-58.

Hong, H., Huang, J., & Wu, D. (2014). The Information Content of Basel III Liquidity Risk Measures. *Journal of Financial Stability*, 91-111.

Hunjra, A. I.; Faisal, F., Abdeen, Z., Kamal, A., & Ghufran, M. (2017). The Asset and Liabilities Gap Management of Conventional and Islamic Banks: An Empirical Study of Pakistan, UAE, Malaysia, and Bahrain. *Journal of Islamic Business and Management*, Vol. 7; Issue. 2, 266-282.

IMF. (2006). *Financial Soundness Indicators*, compilation guide, Publication Services, Washington DC, U.S.A.

Kebede, E. (2014). *The Impact of National Bank Regulation on Banks Performance: Evidence from the private banks of Ethiopia*. Master of Business Administration in Finance Thesis, Addis Ababa University.

Kosmidou, K. and Zopounidis, C. (2008),. Measurement of Bank Performance in Greece. South Eastern Europe *Journal of Economics*, 6, 79-95.

Mamati, M. W., Ayuma, C., & Mwirigi, P. K. (2017). Effect of Asset Liability Management on Liquidity Risk of Micro-Finance Banks in Kenya. *International Journal of Economics, Commerce, and Management*. Vol. V, Issue 10, October 2017.

Moynihan, G. P., McLeod, M., & Nichols, G. (2002). DSSALM: A Decision Support System for Asset and Liability Management, *Decis. Support Syst*. 33(1), 23-38.

Mulvey, J. M. (2001). Introduction to Financial Optimization: Mathematical Programming Special Issue. *Mathematical Programming*, 89, 205–16.

Mulvey, J. M., & Vladimirou, H. (1989). Stochastic Network Optimization Models for Investment Planning. *Annals of Operations Research*, 20, 187–217.

Muranaga, J., & Ohsawa, M. (2002). *Measurement of Liquidity Risk in the Context of Market Risk Calculation*. Working Paper, Institute for Monetary and Economic Studies, Bank of Japan, Tokyo.

Omrani, M., & Naji Azaimi, Z. (2016). Modeling Of Asset Management and Debt Management with Liquidity Risk Management Approach; (FGP) In the Banking System Using Fuzzy Ideal Planning Model, Case Study: Mellat Bank. *Journal of Economic Modeling Research,* No, 25.

Ratnovski, L. (2013). Liquidity and Transparency in Bank Risk Management. *Journal of Financial Intermediation*, 22(3). 422-439.

Risk-Based Capital Requirements Regulations (2016). *Lesotho Government Gazette*, Vol. 61, No.49.

Rosen, D., & Zenios, S. A. (2006). Enterprise-Wide Asset and Liability Management. In *Handbook of Asset and Liability Management*, Volume 1: Theory and Methodology, Chapter 1, edited by S. A. Zenios and W. T. Ziemba. Amsterdam: Elsevier.

Sharara, P. (2014). *Modeling the Effects of Asset Liability Management on the Liquidity Risk of Commercial Banks in Zimbabwe (2009-2013)*. Research proposal submitted in partial fulfillment of the requirement for the award of the degree of financial engineering of Harare Institute of Technology.

Totty, P. (2003). Demystifying ALM. *Credit Union Magazine*, August.