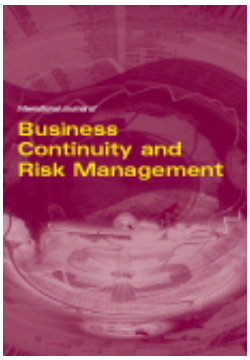

International Journal of Business Continuity and Risk Management

ISSN online: 1758-2172 - ISSN print: 1758-2164
https://www.inderscience.com/ijbcrm

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DOI: 10.1504/IJBCRM.2023.10055478

Article History:

Received:	25 September 2021
Last revised:	05 April 2022
Accepted:	10 June 2022
Published online:	17 April 2023

Assessing the factors affecting the liquidity risk in Jordanian commercial banks: a panel data analysis

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Abstract: One of the main purposes of banks' risk management is to control credit and liquidity risk which are the main sources of risk. This research explores factors affecting liquidity risk of commercial banks operating in Jordan, spanning from 2003 through 2017. The sample of the study includes all commercial banks by employing pooled OLS and panel 2SLS econometric techniques. Findings of the study show that bank size, return on assets (ROA), capital adequacy ratio (CAR), risk, non-performing loans (NPL), T-equality and T-liability have a positive impact on liquidity risk. While return on equity (ROE) shows the negative and significant impact on the liquidity risk. This study suggests that authorities should trace and monitor the determined internal factors that have a negative impact on the liquidity of banks to minimise bank run chances.

Keywords: liquidity risk; commercial bank; Jordan; return on assets; ROA; capital adequacy ratio; CAR; panel data.

Reference to this paper should be made as follows: Alrwashdeh, N.N.F., Ahmed, R., Danish, M.H. and Shah, Q. (2023) 'Assessing the factors affecting the liquidity risk in Jordanian commercial banks: a panel data analysis', *Int. J. Business Continuity and Risk Management*, Vol. 13, No. 1, pp.84–99.

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1 Introduction

The efficiency of the banking system is critical for economic stability and development (Halling and Hayden, 2006). In everyday lives, both financial and non-financial sectors face 'risk', and individuals equate risk with losses and harm to either recover or failure or devastation in full. When we examine the business area, we realise that each company is taking protective measures to move into the risk control sector. In the field of business, we will find that each company takes protective measures to leap into the field of risk-use. We do so either by being limited by the organisation's capacity or by being absolute risks. A bank's liquidity can be used to determine if the bank is in good health, moderately healthy or unhealthy.

Risk and uncertainty are analysed in various business environments, and extensive examination in organisational functions, such as managerial decision taking (Yates and Stone, 1992; Shapira, 1995). Risk has been defined as "to what extent it is uncertain, whether the decision would possibly have positive and/or disappointing consequences" (Sitkin and Pablo, 1992). Risk is often correlated with negative outcomes (McNamara

and Bromiley, 1999). Though there are also some beneficial possibilities, people typically equate risk with failure or injury. Risk applies to the probability of universal route deviations. Such discrepancies reduce the interest and lead to unpleasant circumstances. A commonly accepted approach is risk classification as credit, sector and operational (Lam, 2001).

A wider meaning for the word 'risk' has quickly become the standard for many corporations, non-profit organisations, and government agencies alike, in recent studies. Enterprise risk as it is called, is the probability that the predicted results do not match the actual results. The extent to which the outcomes of a company's corporate strategy deviate from those specified in its corporate objectives, or the extent to which they fail to reach these objectives, is referred to as enterprise risk (Dickinson, 2001). In this perspective risk has two characteristics, namely uncertainty characteristics and risk acceptance by an organisation as it participates in its activities. Enterprise risk typically varies with the business line, company nature, political and economic problems, and other variables. It is the aggregate risk resulting from the risk of industry, financial risk, and the risk of enterprise.

Risk management has undergone major shifts in recent decades. It has emerged into the corporate world as a separate discipline in the 1990s. The idea of managing risk is not so innovative, as managing risk strategies such as a mitigation of risk by health, hazardous education, and quality control; other risk financing; as well as long-standing protection such as self-insurance plus captive insurance (Doherty, 2000). The today's risk is the potential losses of tomorrow. They are, however, not as evident as real profits and costs. Risk measurement is both a conceptual and a practical challenge, which explains why risk management has been plagued by a dearth of reliable measures (Bessis, 2011). Recognition of risk management as a separate management role brings with it several advantages, for example, it provides better quality data for decision making, risk management discussions can create more positive working relationships with their key personnel, budget can be estimated accurately, it encourages the firm to protect from its threat, etc. Inclusion of risk management as a technique in the common role of management helps to improve efficiency (Suranarayana, 2003). Usually, financial institutions use two specific risk control approaches. Another strategy requires the definition of threats individually and separate treatment of each. The other supports risk management by becoming well-diversified. The Basel Banking Supervision Committee adopted a risk definition: "Risk of failure occurring from ineffective or unproductive internal techniques, individuals as well as structures or external outcomes." Basel Committee on Banking Supervision defines liquidity risk as "emerges from a bank's incapacity to accommodate decline in liabilities and debt or fund growth in assets."

Allen et al. (2008) proposes that by diversifying and smoothing volatility over time, banks play a significant role in spreading the risk in the economy. The fixed nature of the claims that they issue, however, can cause financial system fragility. Banks have a significant role to play in supplying funding for businesses and helping them expand the economy. Risk management in banking therefore allocates the whole setting of risk management procedures and versions that permit banks to implement risk-grounded guidelines and practices.

The basic preconditions to implement risk management in banks are to quantify, in addition to analyse the different kinds of risks posed in banks, and then track those risks back to regulated risk drivers. Nonetheless, once we know the extent of the risks to remain under control then what they represent in the form of upcoming value lost,

jumping to market instruments to mitigate risks without sufficient awareness of experiences to the several risks is worthless. Therefore, the problem of risk management is not as straightforward as it might seem at first.

Jordan's banking sector has been one of the best performing sectors of the Jordanian economy since 1948. As a result, it is given a special role in Jordan's financial system, the banking sector has played an active role in terms of economic development and growth, in the provision of credit facilities for the household and business sectors, allowing the economy to continue an upward trajectory growth trend. Jordan banking sector comprises of 25 through a network of 786 branches and 83 representative offices in 2015. The banking sector is an important part of the Jordanian economy, accounting for 18.82% of gross domestic product (GDP) in 2015, up from 3.85% in 2003. It is commonly regarded as a profitable business for both domestic and foreign investors, with a return on assets (ROA) of 1.3% in 2015 compared to 0.7% in 2003, and a return on equity (ROE) of 10.3% in 2015 compared to 9.9% in 2003.

Banks are widely known to experience various types of risk, ranging from interest rate risk to credit risk. Therefore, understanding risks and their impact on bank performance is critical to all banks which also apply to Jordanian banks since banks in Jordan are themselves exposed to different types of risks and because of the important role that Jordanian banks play in the financial system and the real economy. Therefore, if these bank specific risks are not properly managed, they may have untold repercussions for the real economy. It is worth noting that the banking sector in Jordan does not have a functioning credit risk management system to be able to anticipate future risks that might affect the system. As a result, serious events have risen due to such inadequacy. Poor or insufficient liquidity can lead to loss of the confidence of depositors, which can also lead to a loss of the status of banking institutions. It is therefore very necessary for banks to maintain a proper level of liquidity (Shah et al., 2018). Therefore, identifying the major type of risks faced by Jordanian banks should assist in helping the central bank of Jordan's reform policies in the direction of mitigating these risks while also maintaining the stability of the banking system.

So far, no research in the Jordanian background has been conducted on the liquidity risk. Therefore, this study focuses on evaluating the factors that affect liquidity risk in Jordanian commercial banks. This study might be the unique which identify the factors that affect liquidity risk of banks. Findings of the study would be beneficial for all the stakeholders, for example for the banking industry itself, the central bank of Jordan and the overall economy.

2 Literature review

As discussed earlier, different types of risk that are faced in banks and other private institutions during transactions in daily operations. It has resulted, after a lot of surveys, that risk management has allowed organisations to cause failures or downfall (Wiseman and Bromiley, 1991; McNamara and Bromiley, 1999). The main goal for risk management is to maintain a balance between the power and the loss. For a decade, all the theory regarding this activity and the strategies used to sustain and monitor has been addressed in detail in less developed countries.

Some of the studies reported that the chief risk officer (CRO) plays a very vital role in keeping the company out of risk management, as the CRO while interacting directly with the boards of directors and providing them with reliable reports that lead the organisation towards growth and succession (Daud et al., 2010). Such banks have (less or negative) capital returns and asset returns since the recession, although they have high or low ROE in traditional corporate governance, because the CRO has no clear contact with the boards of directors.

Zaleha et al. (2011) had focused on the accounting management and risk management partnership and find that they are both interrelated. The relationship goes to both sides as it depends on the business' approach. The survey findings indicated that the study of financial versions is detected in order to subsidise mostly to managing the risk, even the people who were asked about the relationship agreed that these two are the key features for an organisation's running. The interviewees also stated, mark by the survey outcomes, that financial control, budgeting, and strategic arrangement played an important part in risk management.

Cummins et al. (2009) studied the connection between risk-management practices besides intermediation either they collaborated with each other, or they became two separate practices. For research purposes, US financial institutions have been extensively studied with property-liabilities insurers as to how they can use the intermediation activities (i.e., financial and insurer intermediation) along with cost reduction. Following the observation, it was shown that some insurers had the versatility to work on reducing their costs while getting the extension that kept them away from risk management and focusing on various activities that improved economic performance.

Al-Tamimi and Al-Mazrooei (2007) pursued another goal of observing different types of risks taken at UAE banks. After the observation, it was noticed that banks are taking various types of risk that are correlated to risk management. When a survey was conducted to conclude on risk types, it was found that three kinds of risk challenged by UAE well-paid banks are distant exchange risks, chased by credit risk, and then operational risk. Similarly, UAE banks are very effective in managing risk, the most significant variables in risk management activities are risk recognition and risk control and analysis. Lastly, the results showed that there was a substantial gap risk assessment and analysis between the UAE national, international banks and risk management and control. In addition to liquidity ratio, Shen et al. (2009) used substitute liquidity risk procedures and investigated the causes of liquidity risk (sources of liquidity risk model), by means of an unstable dataset of 12 progressive markets to commercial banks over the period of 1994–2006. Liquidity risk has been revealed to be the first determinant of bank performance. Moreover, they discover that liquidity risk may decrease bank productivity (return on average properties and return on typical equity) due to advanced fund cost but enhance the net interest limits for the bank. In addition, they classify countries as bank-based or the financial system of marketplace and reveal the liquidity risk of market-based monetary system is negatively connected to bank demonstration.

Ahmed et al. (2011) analysed the level of company's liquidity risk determinants of Islamic banks of Pakistan from the four years between 2006 to 2009. Results indicate that leverage, solidity, and phase are main factors of liquidity risk for the Islamic banks of Pakistan. However, the findings also indicate that the bank size and profitability variables are not strong predictors of liquidity risk of Pakistan's Islamic banks. Mennawi and Ahmed (2020) analysed the liquidity risk with a sample of 25 Sudanese Islamic banks during the period of 2012 to 2016. Study depicts that investment and bank size are

positively related to liquidity risk. In another study of Sodanese banking sector, Mennawi and Ahmed (2020) explores that short-term securities and cash to total assets are negatively and significantly related to liquidity risk while deposits and non-performing loans (NPL) are positively related to liquidity risk.

Aydemir and Guloglu (2017) examined the impact of credit and liquidity risks on banks' spreads during business cycles in emerging markets. Their findings showed that credit risk was more important than liquidity risk in explaining bank spreads and that the spread effects of credit and liquidity risks vary over the business cycle. Using annual data of banks in 12 advanced economies during the period 1994–2006, Chen et al. (2018) employed alternative liquidity risk measures besides liquidity ratio and examined the main drivers of liquidity risk while also using a set of control variables consisting of bank-specific, supervisory and macroeconomic characteristics. The finding indicates that liquidity risk reduced profitability due to the higher cost of funds but increased banks' net interest margins.

Shamas et al. (2018) used panel data analysis to analyse the liquidity risk factors of seven Islamic banks in Bahrain during a five-year period (2007–2011). According to the findings of the study, Islamic banks' liquidity risk is positively associated to their profitability (ROA). In contrast, credit risk (NPL) and capital adequacy ratio (CAR) effect liquidity risk negatively and significantly, whereas bank size had a negative but small impact. Mazreku et al. (2019) explored the factors that affect the liquidity risk of Balkan banking sector and find that capital adequacy, profitability and deposits positively related to LR while NPL are negatively related to liquidity risk of banking sector. On contrary, a study in Vietnam by Tran et al. (2019) also finds the positive relationship between loan size and liquidity risk. Finally, Asadollahi et al. (2021) reveal that the findings revealed that decreasing legal deposits and NPL while enhancing deposit attraction has an impact on a bank's liquidity risk.

Based on previous literature reviewed, the aim of this study is to examine the liquidity determinants in risk management in the banking sector of Jordan. It is going to look specifically at the operation of commercial bank in Jordan. The next section will highlight the data used and the analytical techniques to be used to achieve the objectives of this research.

3 Model and methods

3.1 Models specification

The liquidity risk of banks can be affected by numerous factors. In the previous literature, various factors are identified as influencing liquidity risk of banks. The present study is conducted to investigate the internal factors that influence liquidity risk of commercial banks operating in Jordan. The variables included in the study are 'total equity', 'total liabilities', 'CAR', 'ROE', 'risk-weighted assets' (Risk), 'net income', 'NPL', 'ROA' and bank size. Few studies which have used these factors to identify the liquidity of banks are Shen et al. (2009), Alman and Oehler (2010), Ahmed et al. (2011), Purbaningsih and Fatimah (2014) and Kimathi et al. (2015). The following model is specified for the purpose of analysis:

$$LIQ_{it} = \beta_0 + \beta_1 Size_{it} + \beta_2 ROA_{it} + \beta_3 ROE_{it} + \beta_4 CAR_{it} + \beta_5 T.LOAN_{it} + \beta_6 RISK_{it} + \beta_7 NPL_{it} + \beta_8 T.EQUI_{it} + \beta_9 T.LIAB_{it} + \beta_{10} N.INC_{it} + \mu_{it} \quad (1)$$

In the above model, liquidity (*LIQ*) is a dependent variable and size, *ROA*, *ROE*, *CAR*, *T.LOAN*, *RISK*, *NPL*, *T.EQU*, *T.LIAB*, and *N.INC* are independent variables. β_1, β_2, …, β_{10} in model are coefficients of the variables, μ in the equation is error terms, *i* and *t* represent cross-sectional and time aspects of the variables. Table 1 presents a summary of variables description along with their sources.

Table 1 Measures of variables

Symbol	*Variable*	*Proxies*	*Source*
LIQ	Liquidity risk	Cash to total assets	Kosmidou et al. (2005)
CAR	Capital adequacy ratio	Tier 1 capital + Tier 2 capital / risk-weighted assets	Žuk-Butkuvienė et al. (2014)
ROE	Return on equity	Earnings available for common stockholders / common stock equity	Kimathi et al. (2015)
NPL	Non-performing loans	Non-performing loans	Vodová (2011)
ROA	Return on assets	Asset utilisation ratio = operating income / total assets	Shamas et al. (2018), Chen et al. (2018)
SIZE	Size of the bank	The logarithm of total assets	Mennawi and Ahmed (2020)
NPL	Non-performing loans	Non-performing loans	Widyarti et al. (2022)
T-equity	Total equity	Total equity	Vodová (2011)
T-liability	Total liabilities	Total liabilities	Vodová (2011)
Net income	Net income	Net income	Vodová (2011)
T-loan	Total loans	Total loans	Vodová (2011)

3.2 Data

The whole banking sector of Jordan is considered to analyse the internal factors of banks liquidity risk. This study uses the sample of 13 commercial banks of Jordan for the period of 2003 to 2017. Financial statistics are composed from the Jordanian banks to evaluate and estimate liquidity of risk management. Data is collected from Amman Stock Exchange (ASE), annual reports of banks, and Jordanian central banks. In this analysis, liquidity risk in dependent's variable, is stated as the proportion of cash to total assets. This proportion calculates the portion of the assets reserved by a bank in currency or marketable securities.

3.3 Methodology

As nature of the data utilised is basically panel, therefore, for the estimation of the panel data, there are two extensively used models in literature such as fixed effects (FEs) and random effects (REs) modelling techniques. FE method is appropriate if there is serial correlation between explanatory variables and the error term of the model. On the other

hand, RE model procedure is more appropriate in the absence of serial correlation between the explanatory variables and the error term. Though, in case of panel data, there are always possibilities that error term and explanatory variables may be related strongly. In this case, the FE would be preferred over RE modelling. Still, the decision pertaining to choosing between the RE and FE modelling is carried out using the Hausman test. The results of the Hausman (1978) test reported suggest using the RE model instead of the FE model.

Once the decision is made to choose RE modelling procedure, next step is to choose between pooled model and RE model. For this purpose, the OLS estimation technique is applied, the F method is used between the pooled and RE method. If the choice is RE model, GMM estimation technique would be better to estimate the model of dynamic REs. Choice between pooled OLS and RE suggests using pooled OLS as Breusch and Pagan Lagrange-multiplier test fails to reject null-hypothesis. To check the robustness of results, we have deployed multiple techniques of panel data (FE, RE, pooled OLS and GMM). The main difference between RE and FE is that RE estimates are produced using GLS method while assuming that the unobserved heterogeneity is uncorrelated with the regressors (Gujarati and Porter, 2009). In addition, our analysis uses the instrumental variable technique. In this paper, we used 2SLS to get rid of the endogeneity problem. For pooled, set, and RE we used 2SLS. To analyse and compare the effect of independent variables with the dependent variable, descriptive, correlations and regression analysis are employed by using Stata 15.

4 Results and discussion

In this section, we analyse the outcomes of the Jordanian commercial banks' liquidity risk determinants for the period of 2003 to 2017. The outcomes from pooled OLS, FE, RE, and the dynamic models (2SLS) and GMM are summarised in Tables 4 and 5. The outcomes of statistical descriptive study and correlation matrix are presented in Tables 2 and 3, respectively.

Table 2 Descriptive statistics

Variables	*Obs.*	*Mean*	*Std. dev.*	*Min.*	*Max.*
LIQ	180	13.1974	6.9491	0.4652	59.4487
Size	180	9.2095	0.4731	8.0327	10.4126
ROA	179	1.4373	0.6513	–0.1700	4.9700
ROE	179	10.3731	5.1995	–1.4500	39.8400
CAR	159	17.7547	4.6093	10.9000	36.7100
T-loan	180	45.2639	10.0965	0.2785	60.2790
RWA	135	63.6929	20.7606	0.0630	96.2632
NPL	170	98.2029	220.2920	0.0000	981.0000
T-equity	180	653.7788	264.9932	224.5205	2,529.2970
T-liability	180	86.9245	15.2464	47.4337	281.9875
Net income	180	1.9411	6.6058	–0.1659	89.6229

Table 3 Correlation matrix

	LIQ	*SIZE*	*ROA*	*ROE*	*CAR*	*T-LOAN*	*RISK*	*NPL*	*T-EQUALITY*	*T-LIABILITY*	*NET INCOME*
LIQ	1.0000										
SIZE	0.3947	1.0000									
ROA	0.0353	–0.0234	1.0000								
ROE	0.0786	–0.0709	0.8360	1.0000							
CAR	–0.9160	–0.3010	0.1497	–0.1249	1.0000						
T-LOAN	–0.2571	–0.1149	0.1619	0.0898	–0.1385	1.0000					
RISK	0.0580	–0.0899	0.0391	0.0091	–0.1982	0.1176	1.0000				
NPL	–0.1537	0.0682	–0.1498	–0.1936	–0.0627	0.2410	–0.3978	1.0000			
T-EQUALITY	0.5628	0.1500	–0.1209	0.1934	–0.4719	–0.1784	–0.0477	–0.1653	1.0000		
T-LIABILITY	0.6329	0.1181	0.0142	0.1026	–0.0896	–0.0575	–0.0286	–0.0558	0.7271	1.0000	
NET-INCOME	–0.0609	–0.0977	0.0321	0.0225	–0.0091	–0.0080	0.0540	–0.0452	–0.0139	–0.0022	1.0000

4.1 Descriptive statistics

Descriptive statistics of data are presented in Table 2. The descriptive analysis reveals that the 'LIQ' mean is 13.19 and the std. dev is 6.94, while the mean size of banks is 9.20 and a std. dev. at 0.473 holds that 13.19% of liquidity buffer among Jordan commercial banks. ROA mean is 1.43, and std. dev. is about 0.651. ROE mean is 10.373 and std. dev. is on 5.1999. CAR average is 17.75, and std. dev. is around 4.60. Mean value of T-loan is 45.26 with the std. dev. of 10.096, NPL mean is 98.20 and std. dev. is about 220.29. The T-equity mean is 653.77 with the std. dev. of 265. Furthermore, the mean T-liability is 86.924 and the std. dev. is 15.25. Net income average of 1.941 and std. dev. is about 6,605.

Table 4 Panel data analysis (dependent variable = LIQ)

Models	*Pooled OLS*	*FE*	*RE*	*Dynamic RE*
Coefficients	Estimates	Estimates	Estimates	Estimates
	[Std. error]	[Std. error]	[Std. error]	[Std. error]
	(P-value)	(P-value)	(P-value)	(P-value)
Intercept	–66.87489	–57.47528	–61.50902	–76.76632
	(12.25928)	(11.50952)	(11.97143)	(20.46754)
	0.000	0.000	0.000	0.000
Size	5.845737	5.306038	5.447658	7.866322
	(1.060003)	(0.9924129)	(1.032286)	(2.066774)
	0.000	0.000	0.000	0.000
ROA	3.242554	2.704304	1.762431	1.033549
	(1.812745)	(1.77133)	(1.815024)	(2.507763)
	0.076	0.130	0.332	0.680
ROE	–0.2961238	–0.2672281	–0.1245151	–0.1033712
	(0.231398)	(0.2248889)	(0.2302963)	(0.2902704)
	0.203	0.237	0.589	0.722
CAR	0.4833513	0.2125151	0.3044691	–0.0090045
	(0.1206262)	(0.1245617)	(0.1299365)	(0.1612928)
	0.000	0.091	0.019	0.955
T loan	–0.082362	–0.1207349	–0.1105488	–0.1002673
	(0.0525623)	(0.0506651)	(0.0515935)	(0.0656989)
	0.120	0.019	0.032	0.127
Risk	0.0739706	0.0509104	0.0589593	0.0377706
	(0.0228322)	(0.0227607)	(0.022584)	(0.0411647)
	0.002	0.027	0.009	0.359
NPL	0.0024273	0.0035667	0.0009431	0.0001742
	(0.0020613)	(0.0030386)	(0.0020481)	(0.0041372)
	0.241	0.243	0.645	0.966

Note: VIF = 2.50, Durbin-Watson = 1.941545, Hausman = 0.3549 and LM = 1.000.

Table 4 Panel data analysis (dependent variable = LIQ) (continued)

Models	*Pooled OLS*	*FE*	*RE*	*Dynamic RE*
T equity	0.0219975	0.0111011	0.0117055	0.0044366
	(0.0023274)	(0.0039056)	(0.0039958)	(0.0055813)
	0.000	0.005	0.003	0.427
T-liability	0.1302565	0.126136	0.1237466	0.1778562
	(0.0400281)	(0.0388944)	(0.0397103)	(0.0535373)
	0.001	0.002	0.002	0.001
Net income	–0.020395	–0.0790124	–0.0259748	0.0913563
	(0.0512129)	(0.0486121)	(0.0495228)	(0.3575292)
	0.619	0.107	0.600	0.789
Lag term				0.0185188
				(0.0618421)
				0.765
R^2	0.5614	0.5737	0.5937	
Adjusted R^2	0.5293			
F-test	0.0018	0.0047		

Note: VIF = 2.50, Durbin-Watson = 1.941545, Hausman = 0.3549 and LM = 1.000.

4.2 Correlation matrix

The correlation analysis in Table 3 revealed that risk management indicators and the independent variables are positively correlated with liquidity risk, while CAR, TLOAN, RISK, NPL and net income are negatively related to liquidity risk. Bank size, ROA, ROE, RISK, T-equality, and T-liability are positively related with liquidity risk in the banking sector of Jordan. The highest correlation is between T-liability and liquidity of banks, that is 0.63. Evidence of strong correlation amongst the variables taken into the study is not found.

4.3 Regression results

The regression outcomes of the balanced panel data are presented in Table 4. Further, to check the robustness, results of FE, RE and dynamic RE models are also presented in Table 4. Durbin-Watson's value in close to 2 which means there is no problem of autocorrelation. F-test among pooled OLS and model of FE, F-test declares to us that the pooled model is suitable. Test of Hausman is used between random effecting model and FE signifying that the model of RE is appropriate. The test of LM is used for choice between pooled model and the RE model, representing that OLS has been pooled accordingly. The advantage of pooled OLS is that it will provide the results which are 'best linear unbiased estimation' (Zulfikar, 2019). The VIF value indicates there is no problem of multicollinearity in the data.

Table 5 Panel 2SLS estimation results

Models	*Common effect model*	*Fixed effect model*	*Random effect model*
Coefficients	Estimates	Estimates	Estimates
	[Std. error]	[Std. error]	[Std. error]
	(P-value)	(P-value)	(P-value)
Intercept	–71.83231	–66.76282	–71.83231
	(12.88688)	(12.84613)	(13.53308)
	0.000	0.000	0.000
SIZE	6.163763	5.918621	6.163763
	(1.078537)	(1.071251)	(1.132619)
	0.000	0.000	0.000
ROA	–0.1829021	1.345084	–0.1829021
	(2.375865)	(2.39635)	(2.495002)
	0.939	0.575	0.942
ROE	0.0833395	–0.1172794	0.0833395
	(0.3069547)	(0.3117603)	(0.3223468)
	0.786	0.707	0.796
CAR	0.3818477	0.2883076	0.3818477
	(0.1317939)	(0.1335699)	(0.1384026)
	0.004	0.031	0.006
T loan	–0.0559761	–0.0747949	–0.0559761
	(0.0607707)	(0.0623279)	(0.063818)
	0.357	0.230	0.380
Risk	0.0654493	0.0584195	0.0654493
	(0.02239)	(0.0237067)	(0.0235128)
	0.003	0.014	0.005
NPL	0.0006392	0.0034467	0.0006392
	(0.0020064)	(0.0030544)	(0.002107)
	0.750	0.259	0.765
T-equality	0.0110232	0.0109972	0.0110232
	(0.004589)	(0.004649)	(0.0048191)
	0.016	0.018	0.022
T-liability	0.127138	0.1259979	0.127138
	(0.0426976)	(0.043455)	(0.0448387)
	0.003	0.004	0.005
Net income	–0.0218348	–0.0747477	–0.0218348
	(0.0466318)	(0.0479282)	(0.0489701)
	0.640	0.119	0.656
R^2	0.6173	0.5965	0.6173
Wald test	191.47	1,329.41	173.62

Note: Durbin-Watson = 1.98 and Hausman = 0.9548.

This study carries out to explore the factors of liquidity risk in the banking sector of Jordan. For this purpose, factors like ROA, ROE, CAR, T-EQUITY, T-LOAN, NPL, BANK SIZE and income regressed over liquidity risk in Table 4. Panel results show that bank size significantly causes an increase in liquidity risk by 5.85% at 1% level of significance ($p < 0.01$), showing the effective performance of banks. The results could be described through the huge amount of fund that large banks can hold in addition to the high capital that holds by the Jordanian commercial banks which increasing the liquidity risk as a result to the huge amount of credit that they offer. These results are consistent with the study of Chen et al. (2018), who found positive relationship between bank size and liquidity performance in Tunisia. ROA also positively and significantly associated with liquidity risk at 10% level of significance ($p < 0.1$). Results of the study show that 1% increase in ROA also results in growth of liquidity risk by 3.24% in value. This suggests that the commercial banks of Jordan follow a traditional strategy for the management of liquidity risk by sustaining adequate money reserves to meet Jordan's central bank requirements. Our results are consistent with prior studies of Bourke (1989), Kosmidou et al. (2005) and Jedidia and Hamza (2015), who estimated a positive connection between ROA and liquidity risk. Result is anticipated as 'high-risk to high return, low risk to low return'. But ROE has no significant relationship with 'liquidity risk' ($p > 0.1$) but negative sign indicates that the lower ROE, the more liquid risk the bank has. As a result, the connection between productivity and liquidity risk can be a major factor for potential investors, which means that the influence of banks' liquidity risk cannot be negligible when considering profit motives.

CAR also positively and significantly affects the liquidity risk of banks. As, 1% increase in CAR induces 0.48% increase in the liquidity risk ($p < 0.01$). The positive relationship may be clarified by the high ratio of the CAR reached at 21% (the Basel Committee minimum is 8% and the commercial bank of Jordan is 12%) representing the well-capitalised banks. This reform would improve the adequacy of capital and liquidity risk management, through the introduction of stricter risk assessment procedures in lending institutions and the creation of tighter prudential standards for banks in order to strengthen their capital (Žuk-Butkuvienė et al., 2014). Moreover, high rate of CAR allows banks to create more room for liquidity risk (Mazreku et al., 2019). Risk is positively and significantly associated with banks liquidity at 1% level of significance and causes 0.07% point increase in a liquidity among commercial banks of Jordan. The results shed light on the efficiency of the portfolio of Jordanian banks that offer an indication of the expansion in risky assets that explain the negative association. In addition, T-loans do not have any significant impact on liquidity risk in the commercial banks of Jordan. However, positive sign indicates that it leads to increase in the liquidity risk of the Jordanian commercial bank which can be explained by the high level of capital retained by the business. Similarly, NPL also has no effect on LR ($p > 0.1$), but positive sign indicates that increase in NPL may cause more liquidity risk. The results confirm the correlation between risk and liquidity risk, we may understand that by raising the risk assets of the Jordanian banking portfolio, the NPL ratio will increase because of the Jordanian bank 's high liquidity risk level, it is worth noting that Basel's minimum liquidity ratio is 100%, while in the Jordanian bank it reaches 150%. Results of our study are consistent with the Vodová (2011) who finds positive impact of NPL on liquidity in Czech commercial banks.

Results of this study also depict that T-equity also cause an increase in the liquidity risk by 2% which determine the good financial leverage of a bank. Finally, net income has no significant relation with banks liquidity risk in Jordan. But negative sign depicts that increase in net income of banks may reduce liquidity risk ($\beta = -0.02$, $p > 0.1$). The result could be explained by the high volume of deposits received particularly after the Arab Spring to the Jordanian industry, and the income produced by the portfolio of risky assets.

We may determine the significance and non-significance of the parameters, based on the likelihood value. If the possible value is a smaller amount than 0.05 then the parameter's estimation which is significant, but if the possible value is greater than 0.05 then the parameter's estimation is insignificant. In OLS model, R-square can capture 56% variability of our model which should be considered the best fit model as F-test value is also significant at 1% level of confidence.

5 Conclusions

This paper examines the liquidity risk determinants of the commercial banks in Jordan over the time of 2003–2017 using annual data collected from ASE, Jordanian commercial banks, and the annual reports of each bank. The analysis employed panel methodology to study the impact of bank-definite variables at the liquidity risk of Jordanian commercial bank. The findings show that bank size, ROA, CAR, risk, NPL, T-equity and T-liability have a positive impact on liquidity risk. While ROE shows the negative and significant impact on the liquidity risk of the commercial banks of Jordan during the study period. Whereas, loans and net income has no significant impact on the liquidity risk.

Findings of the study would be beneficial for all the relevant stakeholders, for example for the banking industry itself, the central bank of Jordan and the overall economy. It is suggested that authorities should trace and monitor the determined internal factors that have a negative impact on the liquidity of banks to minimise bank run chances. This study somehow sheds light on the important liquidity risk determinants in the Jordanian banking industry that help regulators, managers, and researchers concentrate more on those variables to strengthen the liquidity risk role of banks. This study recommends researchers to investigate whether liquidity problems in Jordan are same for each type of banks or whether liquidity has created any challenges and ripple effects for the domestic economy.

References

Ahmed, N., Zulfqar, A. and Imran, H.N. (2011) 'Liquidity risk and Islamic banks: evidence from Pakistan', *Interdisciplinary Journal of Research in Business*, Vol. 1, No. 9, pp.99–102.

Allen, F., Carletti, E. and Gu, X. (2008) 'The roles of banks in financial systems', *Oxford Handbook of Banking*, pp.32–57, Oxford University Press, Oxford.

Alman, M. and Oehler, A. (2010) *Liquidity Transformation Factors of Islamic Banks: An Empirical Analysis*, Bamberg University, Bamberg.

Al-Tamimi, H.A.H. and Al-Mazrooei, F.M. (2007) 'Banks' risk management: a comparison study of UAE national and foreign banks', *The Journal of Risk Finance*, Vol. 8, No. 4, pp.394–409 [online] https://doi.org/10.1108/15265940710777333.

Asadollahi, S.Y., Taherabadi, A.A., Shahveisi, F. and Khairollahi, F. (2021) 'Modeling liquidity risk management in banking using system dynamics approach', *Advances in Mathematical Finance and Applications*, Vol. 6, No. 3, pp.1–22.

Aydemir, R. and Guloglu, B. (2017) 'How do banks determine their spreads under credit and liquidity risks during business cycles?', *Journal of International Financial Markets, Institutions and Money*, Vol. 46, pp.147–157 [online] https://doi.org/10.1016/j.intfin.2016.08.001.

Bessis, J. (2011) *Risk Management in Banking*, John Wiley & Sons, New York, NY, USA, DOI: http://196.190.117.157:8080/xmlui/bitstream/handle/123456789/30504/155.Jo%C3%ABl%20Bessis.pdf?sequence=1.

Bourke, P. (1989) 'Concentration and other determinants of bank profitability in Europe', *Journal of Banking and Finance*, Vol. 13, No. 1, pp.65–80.

Chen, Y.K., Shen, C.H., Kao, L. and Yeh, C.Y. (2018) 'Bank liquidity risk and performance', *Review of Pacific Basin Financial Markets and Policies*, Vol. 21, No. 1, p.1850007.

Cummins, J.D., Georges, D., Robert, G.A. and Hakim, N. (2009) 'The efficiency of insurance firms with endogenous risk management and financial intermediation activities', *J. Prod. Anal.*, Vol. 32, pp.145–159 [online] https://doi.org/10.1007/s11123-009-0131-0.

Daud, W.N.W.D., Yazid, A.S. and Hussin, M.R. (2010) 'The effect of chief risk officer (CRO) on enterprise risk management (ERM) practices: evidence from Malaysia', *International Business & Economics Research Journal (IBER)*, Vol. 9, No. 11, pp.55–64.

Dickinson, G. (2001) 'Enterprise risk management: its origins and conceptual foundation. The Geneva papers on risk and insurance', *Issues and Practice*, Vol. 26, No. 3, pp.360–366.

Doherty, N.A. (2000) 'Innovation in corporate risk management: the case of catastrophe risk', in *Handbook of Insurance*, pp.503–539, Springer, Dordrecht.

Gujarati, D. and Porter, D. (2009) *Essentials of Econometrics*, 4th ed., SAGE Publications, McGraw Hill.

Halling, M. and Hayden, E. (2006) 'Bank failure prediction: a two-step survival time approach', *C.R.E.D.I.T. Conference*, Austrian National Bank, Vienna, p.31.

Hausman, J.A. (1978) 'Specification tests in econometrics', *Econometrica: Journal of the Econometric Society*, Vol. 46, pp.1251–1271.

Jedidia, K.B. and Hamza, H. (2015) 'Determinants of liquidity risk in Islamic banks: a panel study', *Islamic Management and Business*, Vol. 2, No. 2, pp.137–146.

Kimathi, A., Mugo, R., Njeje, D. and Otieno, K. (2015) 'Factors affecting liquidity risk management practices in microfinance institutions in Kenya', *Journal of Economics and Sustainable Development*, Vol. 6, No. 4, pp.78–90.

Kosmidou, K., Tanna, S. and Pasiouras, F. (2005) 'Determinants of profitability of domestic UK commercial banks: panel evidence from the period 1995–2002', in *Money Macro and Finance (MMF) Research Group Conference*, June, Vol. 45, pp.1–27.

Lam, J. (2001) *Risk Management – The CRO is Here to Stay*, Prentice-Hall, New York, NY.

Mazreku, I., Morina, F., Misiri, V., Spiteri, J.V. and Grima, S. (2019) 'Exploring the liquidity risk factors in the Balkan Region banking system', *European Research Studies Journal*, Vol. 22, No. 1, pp.96–108

McNamara, G. and Bromiley, P. (1999) 'Risk and return in organizational decision making', *Academy of Management Journal*, Vol. 42, No. 3, pp.330–339.

Mennawi, A.N.A. and Ahmed, A.A. (2020) 'The determinants of liquidity risk in Islamic banks: a case of Sudanese banking sector', *International Journal of Islamic Banking and Finance Research*, Vol. 4, No. 1, pp.38–49.

Purbaningsih, R.Y.P. and Fatimah, N. (2014) 'The effect of liquidity risk and non performing financing (NPF) ratio to commercial Sharia bank profitability in Indonesia', *LTA*, Vol. 60, No. 80, p.100.

Shah, S.Q.A., Khan, I. and Shah, M.T.S.S.A. (2018) 'Factors affecting liquidity of banks: empirical evidence from the banking sector of Pakistan', *Colombo Business Journal*, Vol. 9, No. 1, pp.1–18.

Shamas, G., Zainol, Z. and Zainol, Z. (2018) 'The impact of bank's determinants on liquidity risk: evidence from Islamic banks in Bahrain', *Journal of Business & Management (COES&RJ-JBM)*, Vol. 6, No. 1, pp.1–22.

Shapira, Z. (1995) *Risk Taking: A Managerial Perspective*, Russell Sage Foundation.

Shen, C.H., Chen, Y.K., Kao, L.F. and Yeh, C.Y. (2009) *Bank Liquidity Risk and Performance*, Department of Finance, National University of Kaohsiung, Taiwan.

Sitkin, S.B. and Pablo, A.L. (1992) 'Reconceptualizing the determinants of risk behavior', *Academy of Management Review*, Vol. 17, No. 1, pp.9–38.

Suranarayana, A. (2003) *Risk Management Models: A Primer*, ICFAI Press, New Delhi.

Tran, T.T., Nguyen, Y.T. and Long, T. (2019) 'The determinants of liquidity risk of commercial banks in Vietnam', *Banks and Bank Systems*, Vol. 14, No. 1, p.94.

Vodová, P. (2011) 'Liquidity of Czech commercial banks and its determinants', *International Journal of Mathematical Models and Methods in Applied Sciences*, Vol. 5, No. 6, pp.1060–1067.

Widyarti, E.T., Widyakto, A. and Suhardjo, Y. (2022) 'Analysis of the effect of non-performing loan, return on assets, return on equity and size on banking liquidity risk (case study on conventional banks registered in IDX period 2016–2020)', *Jurnal Dinamika Management (JDM)*, Vol. 13, No. 1, pp.78–86.

Wiseman, R.M. and Bromiley, P. (1991) 'Risk-return associations: paradox or artifact? An empirically tested explanation', *Strategic Management Journal*, Vol. 12, No. 3, pp.231–241.

Yates, J.F. and Stone, E.R. (1992) 'The risk construct', in Yates, J. (Ed.): *Risk Taking Behavior*. pp.1–25, Wiley, New York.

Zaleha, A.R.S., Rahim, A.R.A. and Khairuzzaman, W.I.W. (2011) 'Management accounting and risk management in Malaysian financial institutions: an exploratory study', *Managerial Auditing Journal*, Vol. 26, No. 7, pp.566–585 [online] https://doi.org/10.1108/02686901111151314.

Žuk-Butkuvienė, A., Vaitulevičienė, D. and Staroselskaja, J. (2014) 'Capital adequacy (solvency) and liquidity risk management: analysis, evaluation, and possibilities for improvement', *Ekonomika*, Vol. 93, No. 2, pp.59–76.

Zulfikar, R. (2019) *Estimation Model and Selection Method of Panel Data Regression: An Overview of Common Effect, Fixed Effect, and Random Effect Model*, INA-Rxiv 9qe2b, Center for Open Science [online] file:///C:/Users/Hassan%20Danish/Downloads/Regression%20Analysis%20of%20Panel%20Data%20(1).pdf.