Liquidity Risks Models in Jordanian Commercial Banks

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Abstract

The relatively large size of the commercial banks in Jordan compared to other sectors in the economy as well as the turmoil in the MENA region is the motivation of this study analysed the impact of internal bank factors such as profitability, capital, credit, size and quality of management on liquidity risk for thirteen Jordanian commercial banks while controlling for the regulatory and macroeconomic environment using a panel data model. The econometric results show that profitability has a positive impact on liquidity risk whilst the existence of an efficient management has a negative impact on liquidity risk. Finally, the impact of capital and credit on liquidity risk had an ambiguous effect due to the interactions between the different factors. The breadth of commercial banks' activities in Jordan as regards financing most of the economic sectors in the country through their role as financial intermediaries marks the importance of shielding them from liquidity risks.

Keywords: Liquidity Risk, Commercial Banks, Finance, Risk Management.

Introduction

The Liquidity is the lifeline of all the business undertakings and banks that operate in the dynamic market environment, the inadequate liquidity or poor availability of cash can have a detrimental implication on their survival and sustainability (Dash, et al., 2011). Whereas, the risk that arises before a financial institution when it is not able to meet their obligations is the liquidity risk. In other words, it can be said that when the banks fails to convert the assets into cash without compromising on the capital and income , as a wide range of factors can be used by banks to assess liquidity risks (Chen, et al., 2018). In addition, there is major factors that have been identified by the literature include banks internal factors, regulatory factors, macroeconomic aspects. Furthermore, liquidity risk can have an adverse implication on the performance of financial sector as well as banking institutions in particular, affect the profitability of financial institutions and banks to a great extent. In the highly unpredictable and competitive environment, banks need to careful devise liquidity risk management that can have a major implication on their viability and sustainability (Arif & Anees, 2012). During the last decade in relation to global financial crises and new financial rules, the liquidity risk of banking has taken on such importance and become it be essential to measure, manage, and assess the impact of liquidity risk on the economics of banking (Scannella, 2016).

The impact of the global financial crisis on Jordanian commercial banks was limited due to their low exposure to the global financial system as well as the country's underdeveloped financial market, limiting its access to financial tools to diversify their portfolios. These limits have been imprinted on Jordanian banks' risk appetite as well as their market behaviour. Jordanian banks have often been characterized as being more conservative with an emphasis on the traditional role of banks as financial intermediaries. This is apparent on their income statements as more than 60% of their revenues comes from interest rates on loans (Yaseen, et al., 2015). However, innovation in the financial markets as well as the repercussions of the Arab Spring have impacted Jordanian banks' behaviour and made them more prudent regarding their local market exposures and the quality of their liquid assets as it caused some withdrawals from banks and caused some liquidity shortages at banks.

Jordanian commercial banks size compared to other sectors in the economy promote necessity of authorities to shield this sector from the negative effects of these developments through improving the efficiency by enhancing banks' regulations and developing sound operational risk methodologies in the banking system by charting the guidelines and instructions . The existence of effective framework that mitigates risk and allocate resources more effectively is essential for the banking sector (Choudhry, 2011). This research has addressed the following questions:

Q1: Do Jordanian commercial banks with high profitability ratios face higher liquidity risk?
Q2: Do Jordanian commercial banks with high non-performing loans face higher liquidity risk?

Q3: Do large Jordanian commercial banks face higher liquidity risks?
Q4: Do Jordanian commercial banks with higher capital face lower liquidity risks?
Q5: Do Jordanian commercial banks with higher efficiency face lower liquidity risks?

Literature Review

Theoretical frameworks emerged to facilitate discussion of the role of the banking system in the economy. These have focused on the banking industry within a macroeconomic framework in order to explain macroeconomic phenomena and the dynamic interactions between economic agents' behaviour, commercial banks and money supply. Liquidity risk management theories have highlighted the use of money in day-to-day activity, as a store of value and for speculation purposes (Keynes, 1936). Also, they have set many factors that affect economic agents' choice to hold money at banks such as transactions costs, interest rates (Meltzer, 1963), 'precautionary purposes' (Whalen, 1966), etc. However, these theories have not focused on profit maximisation for commercial banks and how these banks manage their liquidity. Later, some theories emerged to explain how commercial banks operate within the context of ALM (Baumol, 1954). These theories suggested liquidity management strategies. Following the commercial loan theory, banks were focused on short-term, self-liquidating loans to ensure the availability of liquidity to meet their needs. Financing short-term loans allows banks to have high liquid earning assets and be capable of meeting their demand-deposit liabilities. The shift ability theory represented an extension of the previous theoretical literature through recognizing that liquid assets could be used to meet liquidity needs (Klein, 1971) through banks shifting their assets by selling them to more liquid banks in the secondary market before they matured. Banks could have enough liquidity through having readily marketable securities that could be converted to cash in normal conditions (Udoka, 2012). Also, it assumes that assets need not be linked with self-liquidating bills and held in other shiftable open-market assets, such as government securities (Moti, et al., 2012).

The anticipated income theory suggested that borrower's expected income is one of the major determinants for instalment amounts to loan payments. Banks that have high quality management could include a certain amount of loan investments that are expected to be liquidated in line with the abovementioned theories or through a combination of them. In the case of large withdrawals from the banking system, the central banks may intervene through ensuring the availability of liquidity for banks (Prochnow, 1949).

Liability management theory includes commercial banks' ability to fulfil their liquidity needs by borrowing in the capital and money markets (Alshatti, 2015). This requires available sources of liquidity to be matched to expected needs. However, the importance of balance sheet structure for financial institutions' viability in turn stresses the importance of matching assets and liabilities over set time horizons. Banks need to assess the impact of current and potential market conditions on the predictable behaviour for their asset and liability positions and take any necessary steps to meet their unexpected liquidity needs. These theories highlighted many important factors that affect liquidity management and could increase the levels of liquidity risk that may stem from various resources related to day-to day operations with regards to lending and trading activities (Chorafas, 2007). The potential match between both sides of the balance sheet in terms of maturity and sensitivity to interest rates minimises liquidity and interest rate risks (Zawalinska, 1999; Belete, 2013).The survival of banking institutions in the current financial system depends mainly on their ability to meet their contractual obligations by ensuring the fulfilment of their needs of cash, liquid assets and collateral through synchronizing their funding resources in ordinary and crisis conditions (Federal Reserve, D.B.S.R., 1994). The liquidity of an asset depends on its convertibility and speed of conversion to cash with no or little loss (Nader, 2002). Thus, liquidity risk is the uncertainty surrounding the speed and availability of convertibility of an asset in a functional market in which there is active trading in the asset. The potential loss for the institution arises from its inability to meet its obligations when they fall due without incurring high costs.

Accordingly, liquidity risk stems from the inability of firms to raise funds to meet their financing needs, or from their inability to execute transactions at prevailing market prices due to a lack of appetite among other market parties. This risk can adversely affect a bank's earnings and capital. Thus, banks must ensure the availability of funds to face the demands of their depositors and borrowers at an acceptable cost. Liquidity risk is considered one of the main threats for financial institutions and their stability; therefore, liquidity buffers are crucial for liquidity risk management and to insulate these institutions against liquidity shocks (Khan, et al., 2017) However, the vulnerability of the banking system to liquidity risk can be summarized through their main role, which focuses on using short-term funds and transforming them into long-term loans. Employing stress test scenarios for liquidity risk at US commercial banks amid the global financial crisis of 2007-2009, Pagratis et al. (2017) identified key sources of funding vulnerabilities, and concluded that large time deposits are the dominant funding vulnerability, whereas government securities largely support other classes of liquid assets. Consequently, banks should focus on managing their liquidity to enable them to meet their obligations as they fall due without incurring unacceptable

losses (Basel Committee on Banking Supervision, 2008). Many studies have defined liquidity risk as the ability of financial institutions to meet and settle their obligations as they come due (Basel Committee on Banking Supervision, 2008; Chorafas, 2007; Federal Reserve, D.B.S.R., 1994; Drehmann, 2013; Choudhry, 2011; Vento & La Ganga, 2009).

The ability of a bank to meet its obligations depends on the condition of the macroeconomic environment, the financial sector and entity specifics (Choudhry, 2011). Further, liquidity risks stem from various resources related to day-to day operations with regards to lending and trading activities (Chorafas, 2007). Therefore, the inability of these institutions to meet their obligations will render the bank in default (Drehmann, 2013). Accordingly, banks are committed to ensuring the availability of funding to cover expected and contingent future obligations without affecting their day to day operations or financial position, which is known as liquidity risk funding, over a specific horizon with reasonable costs (Basel Committee on Banking Supervision, 2008; Drehmann, 2013; Vento & La Ganga, 2009).

The above-mentioned definitions have illustrated that there are three main sources of liquidity risks that could affect banks, namely: systemic risk, idiosyncratic risk, and technical risk. Systemic risk can be attributed to market-wide risk, and under this category fall all external risk factors to the bank, such as market disturbances, lack of central bank funding or failure of the market mechanism in turning assets into cash. Individual or idiosyncratic risk is attributable to internal factors in the bank such as poor management, the disclosure of high losses or the loss of trust by clients, which reduces the bank's ability to refinance its obligations and attract new ones. The technical risk can be created through the timing of the bank's cash flows, i.e. when liquidity is available at the bank. Commercial banks could have large inflows in distant periods. However, in the short term, banks may have significant outflows that outweigh their liquidity buffers, and this creates mismatches in the cash flows (Adalsteinsson, 2014). Accordingly, banking activities with regards to funds management and maturity transformation is important for the process of liquidity risk (Diamond & Dybvig, 1983; Rajan & Bird, 2003). Mismatches between assets and liabilities' maturities create mismatch gaps, which constitute structural risks that are determined by the nature of funding resources and lending policies. As a result, banks are continually seeking to match their assets' maturities with their short-term and medium-term funding resources. Such dependency presents the taxonomy of liquidity risk (Bessis, 2010; Bonfim & Kim, 2012). To manage liquidity risk, banks tend to maintain liquidity buffers that are comprised of market liquid assets in order to anticipate and meet liquidity demand within a reasonable timeframe. Thus, banks and other deposit-taking institutions tend to benefit from pooling liquidity to a large group of depositors (Diamond & Dybvig, 1983). However, researchers cannot observe banks' exposures to liquidity risk directly, but it is possible to perceive their structure, operations and changes in their liquidity buffers, which allows for the prediction of the manner in which internal and market factors affect their liquidity buffers.

Bank-Specific Factors

Sources of liquidity risk indicate that internal factors that contribute to commercial banks' performance have a major impact on the management of their liquidity (Roman & Sargu, 2015; Zaghdoudi & Hakimi, 2017). For example, some researchers indicated that the internal determinants of banks impact their liquidity risk, regardless of the liquidity risk measure that is adopted or the country in which it is operating. (Wójcik-Mazur & Szajt, 2015). Accordingly, the individual characteristics are the bank-specific factors of the bank, which affect its performance. These factors are influenced by internal decisions adopted by the banks' senior management. Consequently, controlling these factors is within the remit of the management board and differs from bank to bank according to their strategies, policies and procedures. These factors include the level of capitalization, credit and deposit portfolios' composition, size, interest rates, management quality, bank size, profitability, concentration, disclosure and others. Empirical literature shows various approaches for approximating bank performance through using financial ratios for profitability or more complex measures such as composite indices to measure the effects of these factors on liquidity risk (Dang, 2011). The following sub-sections will discuss the main internal factors that are affected by liquidity risk, namely: profitability, credit risk, bank size, capital, and other factors such as quality of management.

Profitability

Empirical evidence shows that liquidity risk has a mixed influence on bank profitability depending on the type of financial model the banks operate. These findings may be attributable to the banks' capital structure as greater bank capital reduces liquidity creation (Diamond & Rajan, 2000). For example, Molyneux and Thornton (1992) studied the main determinants of bank performances across 18 European countries over 1986 to 1989 and found an inverse significant relationship between profitability and liquidity holdings, measured by cash, deposits and securities as a percentage of total assets as liquidity holdings represent cost to banks. Furthermore, Bourke (1989)

studied individual characteristics and exogenous determinants of profitability in 12 countries in Europe, North America and Australia, and found a significant positive relationship between liquidity and bank profitability. These results are counter-intuitive as profitability would result from a rise in the risk appetite and employing available resources to increase lending, which would result in a decline in the level of liquidity holdings at banks. Therefore, it could be explained that higher profitability tends to attract more depositors due to the bank's strong financial position, which increases the amount of available resources, hence liquidity holdings. Kosmidou (2008) studied the determinants of banks' profitability in Greece during the period 1990-2002, and found that the liquidity ratio is negatively related to return on average assets (ROAA). In addition, Demirgüç-Kunt and Huizinga (2010) studied various banks (1,334 banks) from 101 countries over the period 1995-2007 and concluded that banks' income and funding strategies could be determined simultaneously. Their results indicated that a higher non-interest income or non-deposit funding share evokes materially higher bank risk, but it is difficult to establish the impact of either variable on the ROA due to endogeneity concerns.

Overall, the results in the empirical literature were mixed depending on the sample, time period, and banking sector in the countries under investigation. Accordingly, the researcher could expect that profitability ratios, measured by Return On Average Assets (ROAA) and the Return On Average Equity (ROAE), will have a negative impact on liquidity risk as the increase in profitability is a result of greater exposure due to a rise in risk appetite, riskier assets and a decrease in the quality of the overall assets and liquid assets. On the other hand, study could find a positive impact of profitability on liquidity as it increases the confidence of depositors and thereby the liquidity resources available. Furthermore, the researcher expect that the influence of net interest margin (NIM) to be weak due to the effect of regulatory measures set by supervisory authorities depending on the frameworks adopted by commercial banks.

Hypothesis (1): Commercial banks with high profitability ratios face higher liquidity risk.

Credit Risk

Although a large body of literature has investigated the mutual impact between credit and liquidity risks, few studies, to the best of my knowledge, have analysed the interactions between those risks and their effects on commercial bank financial ratios over time. Moreover, there is no theoretical consensus on a certain model that reflects how these risks should interact with each other (Imbierowicz & Rauch, 2014). However, the influence of credit risk is considered the main determinant of bank lending behaviour. Credit risk arises when a bank's customers fail to meet their obligations. Thus, a rise in customer defaults will put pressure on banks' capital and decrease their risk appetite. Therefore, credit risk is associated with negative bank lending growth. Accordingly, banks can lend more credit to risky borrowers if they improve the way of managing their credit risk. Therefore, the advantage of improving banks' risk management abilities is that it may result in greater credit availability instead of reducing overall risk in the banking system.

Furthermore, Roulet (2018) concluded that liquidity, measured by the ratio of the non-required amount of stable funding to total assets, has a positive impact on European banks' lending activity growth. However, it has a negative impact on retail extended credit. Moreover, European banks could decrease their exposure to credit retail lending when they are under pressure through having sufficient buffers. This result is consistent with a low interest rate environment, which is similar to the period after the Global Financial Crisis. Diamond and Rajan (2005) showed that the impact of credit risk on liquidity risk is positive. The authors concluded that if banks fund many projects with loans, they (the banks) could not meet depositors' demands, which may trigger them to claim their funds' back if their assets' value have declined significantly. This implies that liquidity risk and credit risk increase simultaneously. Other researchers studied the reciprocal relationship between credit risk and liquidity risk. For example, Acharya and Viswanathan (2011) investigated the relationship between credit risk and liquidity risk for Iranian banks during the period 2005-2012 and concluded that credit risk and liquidity risk have a positive and significant impact on each other. Wójcik-Mazur and Szajt (2015) analysed the determinants of liquidity risk for nineteen advanced economies' commercial banks and concluded the existence of a negative relationship between liquidity measures and credit risk both in the long and short term. This implies the cyclical nature of liquidity risk as the strong increase of lending activity in relation to the volume of acquired deposits is accompanied by the decrease in credit risk. However, others argued that there is little evidence to support any reliable effect of liquidity risk and credit risks in US commercial banks.

Also, Kim and Sohn (2017) used data for commercial banks in the US during the period 1993-2010 to investigate the effects of banks' capital on extending loans that are reliant on liquidity levels. The researchers found that banks with a higher capital structure could affect banks' lending positively, as measured by the growth rate of net loans and unused commitments, and are often related to larger banks with sufficient liquidity, especially during the Global Financial Crisis. Consequently, banks' capital could have a positive impact on banks' credit but only

if the bank has sufficient liquidity buffers. Credit risk, liquidity and capital interrelations have been investigated in the GCC countries. For instance, in a study by Ghosh (2016), a data sample that covers the period of 1996-2012 was used. From the findings, the author concluded that banks with higher liquidity ratios tend to have lower loan growth rates. This effect had increased during the global financial crisis, which implies that credit risk and liquidity risk are positively related. His analysis illustrates that smaller banks tend to hoard more liquidity in response to higher loan portfolio risk. This finding is consistent with Kashyap and Stein (2000) who reported that small banks require higher high-quality liquid asset buffers due to frictions and higher costs of accessing uninsured wholesale funding.

Based on the above, the researcher expect credit risk, measured by non-performing loans (NPL), to have a positive impact on liquidity risk at Jordanian commercial banks as the relationship will be more elaborate due to the high reliance of banks on their regular operations to incur profits. The increase in the level of NPLs reduces banks' asset quality and their ability to allocate their resources to their operations as they have to take more provisions against NPLs.

Hypothesis (2): *Commercial banks with high non-performing loans face higher liquidity risk.*

Bank size

The size of a financial institution has been widely used in empirical literature as a proxy for its importance (Kosmidou, et al., 2017). Some studies have expressed that size is a crude measure for the exposure of the firm to the financial system (Cahan, 1992). Bank size is a control variable that is widely used to control for differences in firm size, and many researchers have included bank size as a variable when studying liquidity determinants explicitly as bank failures could be associated with their size.

Studies that have focused on the determinants of liquidity buffers at commercial banks added another dimension related to the existence of liquidity regulations. For example, Aspachs et al. (2005), Agénor et al. (2004) and Delechat et al. (2012) concluded that there is a negative effect between liquidity buffers and bank size. Larger liquidity buffers should be sought by smaller banks as they have higher funding costs (Kashyap & Stein, 2000); on the other hand, larger banks' overall liquidity needs may be relatively lower as they face lower funding costs, which promotes them as a safe haven to avoid times of high uncertainties and systemic risks (Gatev & Strahan, 2006). Nonetheless, larger banks face liquidity risks that stem from different sources, which are regulated by supervisory authorities (Acharya & Merrouche, 2012). Other studies have concluded that liquidity ratios have a positive relationship with size and capital. For instance, Vodova (2011) studied the causes of liquidity risk using 22 banks during 2006-2009, and found that large banks have lower liquidity targets as they rely on the government and the lender of last resort in the case of shortages. These views support the notion that large banks may induce moral hazard behaviour that causes them to bear excessive risks, with the anticipation that the authorities will bail them out given that the regulators may be reluctant to close them (Farhi & Tirole, 2012). Also, large banks that engage in multiple activities could be translated into higher systemic risks due to the low quality of management and low governance. Thus, systemic risk could be greater with the increase of bank size. Relevantly, Laeven et al. (2016) studied the systemic risk of large banks during the recent financial crisis to identify bank-specific factors that determine risk using a sample of 412 deposit-taking institutions from 56 countries. They found strong evidence that systemic risk increases with bank size. Kim and Sohn (2017) reported that the effects of bank capital on lending differ depending upon the level of bank liquidity across bank sizes; their results showed that liquidity ratios' coefficients are statistically significant and that the size effect is negative, which indicates that small banks focus on traditional lending activities to the non-financial sector, and therefore supply lending relatively more willingly than large banks do. Their results suggest that large and medium banks rely on market funding to finance their lending activities while small banks face some impediments in accessing market funding.

Bonner et al. (2015) found that the relationship between bank liquidity buffers and bank size is substantially weaker in countries with bank liquidity regulations, which implies that liquidity regulations act as a substitute for liquidity management at commercial banks. This result may explain why small banks should hoard more liquidity buffers due to the higher costs of accessing funding (Kashyap & Stein, 2000), whereas large banks may need lower liquidity holdings as they have easier access to funding with lower costs (Gatev & Strahan, 2006). Accordingly, the researcher expect bank size to have positive impact on liquidity as large banks tend to engage in more diverse operations than smaller ones.

Hypothesis (3): Large commercial banks face higher liquidity risks.

Capital

The implementation of the Basel I & II accords increased investigations into the capital rules introduced, the role of capital on banking performance, and lending activities. With the breakout of the Global Financial Crisis in 2008, the Basel committee introduced liquidity assessment measures and tightened capital adequacy rules in order to ensure banks' viability and achieve financial stability (Ben Naceur & Roulet, 2017). Systemic risks were at the heart of the debates after the Global Financial Crisis; capital ratios, bank size and liquidity management are considered the main determinants of risks within the banking sector. Large banks were at the centre of these debates as they tend to have lower capital ratios, less stable funding, and more exposure to potentially risky market-based activities (Laeven, et al., 2014). The Basel III accord address liquidity risk in banks using LCR and NSFR ratios.

Laeven et al. (2016), using a sample of 412 deposit-taking institutions from 56 countries, found evidence that systemic risk is lower in more capitalized banks, with the effects particularly more pronounced for large banks. Also, Banerjee and Mio (2017) used data on UK banks to study the effects of liquidity regulation on banks' balance sheets. They found evidence that well-capitalized banks experience stronger growth in their balance sheets, accumulate less high-quality liquid assets, make efficient use of short-term intra financial loans, and have healthier growth in their non-financial sector lending portfolios. Roulet (2018) used data on commercial banks in Europe to investigate the impact of the new Basel III capital and liquidity regulations on bank lending. The evidence supported that capital ratios have a significant negative impact on large European retail lending growth and other types of lending over the post-2008 financial crisis period. The impact of the new Basel III capital and liquidity regulations has been thoroughly investigated following the 2008 Global Financial Crisis. Ben Naceur and Roulet (2017) used a data sample from 23 countries, mostly developed, over the period of 2008–2015. Their results indicated that capital ratios do not have a significant effect on credit growth at European banks, but capital regulatory measures represented by Tier I and Tier II have a significant negative impact on European banks' credit growth. However, they found that capital ratios have a significant negative impact on credit growth at US banks. Moreover, the study found a positive impact of liquidity ratios, measured by the non-required amount of stable funding to total assets, on credit growth in both European and US banks. Their findings indicate that banks tend to hold liquidity buffers and increase their holdings of liquid assets when they expand their risky activities to avoid liquidity shortages, and improving their ability to absorb risks. Therefore, the effect of capital on banks' liquidity included the effects of banking regulations as Basel II focused on capital ratios to impose restrictions that would ensure banks' viability. The study has used several measures for capital in order to capture the effect of capital on liquidity, and the researcher expect that all of these variables will have a positive effect on liquidity.

Hypothesis (4): *Commercial banks with higher capital face lower liquidity risks.*

Other internal Factors

Other internal factors that affect liquidity management in commercial banks have been thoroughly discussed in the recent literature. For example, Almeida et al. (2004) illustrated that firms with higher financial constraints hoard more liquid assets. Therefore, the inability to access funding for firms may hinder banks through increasing their assets as they will have higher credit constraints. Thus, Delechat et al. (2012) found that financial development and management quality impact liquidity levels positively. Recently, many financial crises were caused by uncertainty over a bank's solvency, which stressed the importance of banks' disclosure requirements to complement regulation (Bonner, et al., 2015).

Ratnovski (2013) focused on the importance of transparency within the banking sector as it allows banks to attract more funds and face some liquidity withdrawals. However, banks should always focus on liquidity requirements and complement them by adopting measures to improve access to market and bank transparency. In addition, he found that the government could choose to drive banks to adopt more transparency measures through decreasing their alternative costs. In addition, he highlighted the need for better corporate governance as a means for improving transparency among banks, which may increase the effectiveness of liquidity requirements. Most of these factors contribute to increasing the efficiency of commercial banks, which measures banks' ability to create income from their assets (ECB, 2010). Their performance is considered to have a crucial impact on stakeholders and investors' decisions (Thoraneenitiyan & Avkiran, 2009). However, banking efficiency could be considered an unobserved variable as it is hard to measure due to the intangibility of banks' products and services. The cost to income ratio illustrates firms' ability to generate profits from their revenue sources (ECB, 2010). Several studies that have focused on European countries have investigated the main factors that impact banks' efficiency, and concluded that the environment and regulations hinder expansion in banks activities. However, these studies found that the regulations improve the cost and profit efficiency of banks (Maudos, et al., 2002; Dietsch & Lozano-Vivas, 2000; Resti, 1997).

Consequently, the researcher expect the quality of management, measured by the cost to income ratio (CTIR), to have a positive impact on liquidity as higher-quality management would reduce governance problems and result in better allocation of bank resources.

Hypothesis (5): *Commercial banks with higher efficiency face lower liquidity risks.*

Methodology

This work follows a quantitative research design, The variables employed in the econometric analysis were acquired from the BankScope database and the central bank of Jordan for thirteen banks depending on data availability for the period 2004-2015. The study started from 2004 as it marks the end of the economic and financial reforms in Jordan that were backed by the IMF (CBJ, 2015). These reforms resulted in the liberalization of the financial sector, the adoption of indirect monetary policy to manage liquidity in the domestic market, and the adoption of a fixed exchange rate regime with the Jordanian dinar in late 1995. The sample population will consist of all operating commercial banks in Jordan. However, due to data limitations, and the existence of Islamic banks, which operate in Jordan, the study will exclude four Islamic banks as their practices, policies, and procedures differ from traditional commercial banks. Thus, the sample will include thirteen commercial banks. The yearly data will cover the period from 2004-2015 for the following commercial banks that operate in Jordan:

Table 1: List of the population in econometric analysis

Bank Name	Date of Establishment
Arab Bank Plc (ARBK)	1930
The Housing Bank for Trade & Finance (THBK)	1974
Jordan Kuwait Bank (JOKB)	1977
Cairo Amman Bank (CABK)	1960
Jordan Ahli Bank Plc (JABK)	1956
Union Bank (UNBK)	1991
Bank of Jordan Plc (BKJO)	1960
Capital Bank of Jordan (CABK)	1996
Arab Jordan Investment Bank (AJIB)	1978
Jordan Commercial Bank (JCBK)	1978
Société Générale de Banque-Jordanie (SGBK)	1993
Arab Banking Corporation (Jordan) (ABCO)	1989
Invest Bank (INBK)	1989

This paper employed a deductive approach to construct and test the research hypotheses. Burrell and Morgan (1979) said that positivism "*seeks to explain and predict what happens in the social world by searching for regularities and causal relationships between its constituent elements*".Accordingly, developing valid and viable hypotheses should take into consideration the impact of these variables on each other (Robson & McCartan, 2016). Consequently, the researcher will test the research hypotheses that were created based on quantitative data and the deductive approach. In this paper, the researcher will use panel data analysis to investigate the impact of internal factors on liquidity risk while controlling for the regulatory and macroeconomic environment. The reason behind that is that analysing liquidity risks on the banking sector through employing time-series analysis would yield results that would be hard to rely on due to the nature of the banking sector. In Jordan, there are two main types of banks – commercial banks and Islamic banks having different policies and operating processes as Islamic banks tend to comply with Sharia law, while commercial banks rely on interest rates as their main source of income. Moreover, the data available for these factors covers a short period, which will make it difficult to use usual time-series analysis as these methods rely on having restrictions on the model with time lags, which raises the collinearity between the variables.

In this paper, a panel estimation technique is used when the data set combines both time series and cross-sections. The flexibility in modelling differences in behaviour across observation units is the main advantage of a panel data set over a cross-section. The framework used will be as follows:

$$yit=\alpha i+\beta' xit+\varepsilon it$$

where αi is an individual effect, which is constant over time (t), and specific to the cross-sectional unit (i). xit represents the regressors and β' represents the correspondent coefficient, and εit is the error term. Next Equation represents the general specification for the random and fixed models. Differences across groups are allowed in

the fixed effect framework to capture the constant term differences through assuming dependency between the explanatory variable and the constant term. On the other hand, the random effects assume that the unobserved effect is uncorrelated with the regressors (Greene, 2012). The difference between the specification for the fixed model and random effects is the random disturbance (μ) characterizing observation (i) and is constant through time. In random effects specification, it is assumed that individual effects are uncorrelated with the other regressors $E(xu)$=0. Thus, the random effects specification could be represented as follows:

$$yit=\alpha i+\beta' xit+\mu i+\varepsilon it$$

Testing whether the random or fixed framework is appropriate, the researcher will use the Hausman test, which focuses on testing whether the unobserved effect is not correlated with the explanatory variables. If the study rejects the null hypothesis, then the researcher should rely on using the fixed effect model as it would be more appropriate. In the case of having a large population, the random effect would be more appropriate to use, whereas the fixed effects framework would be more appropriate is the study focusing on a set of specific units (Baltagi, 1995).

$$LR_{it} = \alpha_{it} + \sum_{k=1}^{5} \gamma_{itk} x_{itk} + \sum_{j=1}^{3} \beta_{itj} y_{itj} + \varepsilon_{it}$$

where (LR) represents the liquidity risk at bank (i) during time (t). In addition ($xitk$) represents the vectors for the banks' characteristics while $yitj$ represents controlling for macroeconomic and regulatory influence. Also, are intercept terms and the regressors' coefficients. The control variables are bank characteristics for bank *i* in period t−1. The list of control variables for bank characteristics and activities used in this study are M2 to GDP, inter-bank interest rates, and the required reserves ratio. The study wanted to control for these dimensions of development as it are focusing on internal factors on liquidity risk. The following section will include a detailed description of the variables used in the analysis.

Liquidity risk stems from various resources that are related to day-to day operations with regards to lending and trading activities (Chorafas, 2007). Thus, the paper used the loan to deposits ratio (LTD) as a proxy for liquidity risk as the ALCO monitors actual cash flows against its projections to determine the effect of transitory or permanent changes in loans and deposits that affect balance sheet positions and take proper actions. In addition, they focus on managing the maturities of the banks' asset with the objective of covering cash flows from matured assets to meet liquidity needs (Koch, et al., 1999; Al Shubiri, 2010; Alzorqan, 2014; Alshatti, 2015).

Liquidity risk: As most bank risks are considered unobserved, researchers have tried to proxy its levels using financial ratios. As banks in Jordan are more conventional in nature, the study has used the **loan to deposits ratio (LTD)** (Bourke, 1989; Molyneux & Thornton, 1992; Barth, et al., 2003; Dezfouli, et al., 2014; Bonner, et al., 2015; Roulet, 2018).

- The **loan to deposits ratio (LTD)**[1] is a widely used measure for liquidity at banks. It is percentage of total loans to total deposits. This ratio expresses the level of long-term liquidity that covers banks' credit. If the ratio is high, it signals that the banks would not have sufficient funds to cover their funding needs. Conversely, if the ratio is too low, the bank may not be earning as much as it could be. The data for these variables was acquired directly from the BankScope database.
- **Profitability:** In the literature, profitability effects on liquidity are mixed. To investigate these effects, this study will use several profitability variables that are used by researchers (Demirgüç-Kunt & Huizinga, 1999; Staikouras & Wood, 2004; Demirgüç-Kunt & Huizinga, 2010; Sufian, 2011; Al-Jafari & Alchami, 2014; Pagratis, et al., 2017).
- **Return on average assets (ROAA):** A widely used indicator for tracking the profitability and scale of the financial performance of banks. ROAA is calculated by taking net income and dividing it by average total assets.
- **Return on average equity (ROAE):** Another measure of profitability that is computed by dividing net income by average shareholders' equity.
- **Net interest margin (NIM):** Another measure of profitability from the banks' core functions. This is calculated by taking the difference between interest income on assets and interest expense on liabilities

[1] BankScope defines the loan to deposit ratio as gross loans to deposits and short-term funding.

to average earning assets. This ratio resembles a bank's ability to make good investment decisions.

- **Capital:** Absorbing more bank risks with higher capital buffers (Berger & Bouwman, 2009), the implementation of the Basel accords I & II increased investigations of introduced capital rules, the role of capital in banking performance, and lending activities. Accordingly, this study will employ several measures for capital in order to capture the effect of capital on liquidity at commercial banks (Vodov, 2013; Bonner, et al., 2015; Roman & Sargu, 2015; Laeven, et al., 2016; Kim & Sohn, 2017).
- **Total capital ratio (TCR):** Refers to bank capital (including tier one and tier two) to risk-weighted assets. It is used to assess a bank's ability to protect depositors and is a measure of a bank capital.
- **Tier 1 regulatory capital (TIER 1):** Refers to a bank's core capital to its risk-weighted assets. This ratio measure a bank's financial strength.
- **Equity to total assets (EQTA):** Represents the amount of assets that shareholders could claim. It is measured by dividing total shareholders' equity to total assets. It is used to assess the financial health of a bank and financial leverage.
- **Bank size:** Banking industry market share is important to consumers and investors alike. It represents the size of a bank's operations and the market structure. In this study, the researcher has calculated market share by taking the natural log of the total assets of each bank (Delechat, et al., 2012; Acharya & Merrouche, 2012; Roman & Sargu, 2015; DeYoung & Jang, 2016).
- **Credit risk:** The effects of credit risk on liquidity risk vary in the literature depending on heterogeneous banks' characteristics and behaviour. Diamond and Rajan (2005) showed that there is a positive relationship between liquidity risk and credit risk. Roman and Sargu, (2015) indicated that impaired loans have a negative impact on liquidity, while Roulet (2018) found that liquidity indicators have positive but perverse effects on bank lending growth.
- **Non-performing loans to total assets (LOLTA)**, which is an indicator that can be calculated by dividing non-performing loan value by total assets using as a measure to proxy credit risk and increases in this ratio illustrate that a bank is more prone to the probability of customers defaulting.
- **Quality of management**: The capability of a bank to create revenues from an asset that it bears, reflecting the management quality of the bank, which is considered an important metric for investors and clients (Thoraneenitiyan & Avkiran, 2009). The study considered using the cost to income ratio (CTIR) (Maudos, et al., 2002; Dietsch & Lozano-Vivas, 2000; Resti, 1997), which is considered as a measure of the management quality of a bank. A lower ratio indicates that a bank is profitable and has high management quality. It is calculated by dividing operating expenses by operating income.

Table 2: List of dependent and independent variables

Dependent variable			
Name	**Symbol**	**Formula / Definition**	**Data Source**
Loan to Deposit	LTD	Loan / deposit	Bankscope
Independent variables			
Bank specific variables			
Name	**Symbol**	**Formula / Definition**	**Data Source**
Profitability Ratio			
Return On Average Assets	ROAA	Net income / average total assets	Bankscope
Return On Average Equity	ROAE	Net income / average total equity	Bankscope
Net Interest Margin	NIM	Interest income - interest paid out	Bankscope
Capital Ratio			
Total Capital Ratio	TCR	Total capital / risk-weighted assets (RWAs)	Bankscope
Tier 1 Regulatory Capital	TEIR1	Equity plus retained earnings to risk-weighted assets	Bankscope
Equity to Total Assets	EQTA	Equity / total assets	Bankscope

Credit risk , bank size and Quality Management ratios			
Cost To Income Ratio	CTIR	Operating expenses/operating income	Bankscope
Market Share, size	MARS	Natural log of total assets	Bankscope
Non-Performing Loans to Total Assets	LOLTA	Total loans where payments have not been made for a period of 90 days / total assets	Bankscope

Control variables			
Regulatory variables			
Required Reserve Ratio	RRR	Portion of depositors' balances that banks must have on hand as cash.	Central bank of Jordan
Inter-bank interest rate	IBR	The rate of interest on short-term loans between banks.	Central bank of Jordan
Macroeconomic variables			
M2 to GDP	MGDP	The ratio of broad money supply to GDP.	Central bank of Jordan

Accordingly, in this study, the researcher will include three control variables:

- The **Required Reserve Ratio (RRR)**, which is a requirement determined by a country's central bank, in order to capture the impact of mandatory liquidity buffers on liquidity. It is the stipulated portion of the customer's deposits that banks must have on hand or in cash.
- Also, the **Inter-Bank Interest Rate (IBR)**, which is the rate of interest charged on short-term loans made between banks, and is included to capture the effects of monetary policy on banks as it is considered the operational target for the central bank.
- For capturing the effects of the macroeconomic environment, the study will use money supply **(M2) to GDP** (financial deepening index), which is a complex concept that expresses long-term economic growth. Many studies were in favour of the relationship between economic growth and money supply (Edward, 1973; Pradhan, 2009; McKinnon, 2010), which is considered a prime requirement for economic growth and a measure of the financial deepening of the economy.

Accordingly, the specification for the empirical models can be illustrated as follows:

$$LTD_{it} = \alpha_{it} + ROAA_{it} + TCR_{it} + MARS_{it} + CTIR_{it} + LOLTA_{it} + \sum_{j=1}^{3} \beta_{itj} y_{itj} + \varepsilon_{it}$$

$$LTD_{it} = \alpha_{it} + NIM_{it} + TCR_{it} + MARS_{it} + CTIR_{it} + LOLTA_{it} + \sum_{j=1}^{3} \beta_{itj} y_{itj} + \varepsilon_{it}$$

$$LTD_{it} = \alpha_{it} + ROAE_{it} + TCR_{it} + MARS_{it} + CTIR_{it} + LOLTA_{it} + \sum_{j=1}^{3} \beta_{itj} y_{itj} + \varepsilon_{it}$$

$$LTD_{it} = \alpha_{it} + ROAA_{it} + TEIR1_{it} + MARS_{it} + CTIR_{it} + LOLTA_{it} + \sum_{j=1}^{3} \beta_{itj} y_{itj} + \varepsilon_{it}$$

$$LTD_{it} = \alpha_{it} + NIM_{it} + TIER1_{it} + MARS_{it} + CTIR_{it} + LOLTA_{it} + \sum_{j=1}^{3} \beta_{itj} y_{itj} + \varepsilon_{it}$$

$$LTD_{it} = \alpha_{it} + ROAE_{it} + TIER1_{it} + MARS_{it} + CTIR_{it} + LOLTA_{it} + \sum_{j=1}^{3} \beta_{itj} y_{itj} + \varepsilon_{it}$$

$$LTD_{it} = \alpha_{it} + ROAA_{it} + EQTA_{it} + MARS_{it} + CTIR_{it} + LOLTA_{it} + \sum_{j=1}^{3} \beta_{itj} y_{itj} + \varepsilon_{it}$$

$$LTD_{it} = \alpha_{it} + NIM_{it} + EQTA_{it} + MARS_{it} + CTIR_{it} + LOLTA_{it} + \sum_{j=1}^{3} \beta_{itj} y_{itj} + \varepsilon_{it}$$

$$LTD_{it} = \alpha_{it} + ROAE_{it} + EQTA_{it} + MARS_{it} + CTIR_{it} + LOLTA_{it} + \sum_{j=1}^{3} \beta_{itj} y_{itj} + \varepsilon_{it}$$

Where LTD is the dependent variables, which represent the loan to deposit ratio and high-quality liquid assets. On the right-hand side, the researcher used three variables to proxy profitability: return on average assets (ROAA), return on average equity (ROAE), and net interest margin (NIM). In addition, the researcher used Tier 1 regulatory capital (TIER1), total capital ratio (TCR), and equity to total assets (EQTA). Moreover, the researcher introduces quality of management proxied using cost to income ratio (CTIR). The size of the bank was estimated using the size of bank assets (MARS). As for credit risk, the researcher will use non-performing loans to total assets (LOLTA). The use of different variables as a proxy for profitability is that the ROAA and ROAE are often used in literature to capture operating efficiency and the ability of commercial banks to generate revenues from various investments, whereas the net interest margins are more related to the core banking duties – namely taking deposits and lending credit. Furthermore, the study has used different variables to estimate the impact of capital on liquidity, as there are regulatory factors that are related to capital that could influence its impact on liquidity.

Results and Discussion

This paper has used quantitative analysis in order to estimate the impact of internal factors on liquidity risk measures for the period 2004-2015 for domestic commercial banks in Jordan. The researcher has used three variables that express profitability (*ROAA, ROAE, NIM*) and the same for capital (*TIER1, TCR, EQTA*). The main reason behind this approach is that profitability measures usually express different meanings depending on the indicator. For example, *ROAA* is often associated with *ROAE*, a widely used indicator that expresses profitability, assessing banks' efficiency managing their revenues and expenses and their ability to generate profits from their financial assets. On the other hand, the *NIM* expresses the net revenues from banks' core functions regardless of fees, which are considered as another element in the bank income statement, as it succinctly summarizes the effectiveness of banks' interest-bearing assets.

Moreover, banks' capital is subject to different regulations set by the supervisory authorities in accordance with Basel regulations to ensure the stability of the banking sector. These regulations may influence the expected impact of capital on liquidity risk, therefore, different sets of variables were used to estimate the impact of capital on liquidity risk. Furthermore, the study had investigated the impact of these variables while controlling for the regulatory and macroeconomic environment through using three econometric techniques and reporting their results in order to investigate whether the unobserved component is equal or varies through cross-section by using random and fixed effects. In addition, the study used OLS regression to test the properties of the data and to authenticate the results that the researcher received from the adopted model based on the Hausman test.

The following section will present the empirical results of the estimated models for the two dependent variables used to proxy liquidity risk (*LTD*). The researcher has estimated the impact of internal variables on liquidity risk while controlling for regulatory and macroeconomic variables. The estimation for several models was employed to resolve the high correlation between variables that are used to proxy profitability and capital and to consolidate the results on the impact of these variables on liquidity risk. The main advantage of a panel data set over a cross-section is that it permits greater flexibility in modelling differences in behaviour across observation units. Differences across groups are allowed in the fixed effect framework to capture the constant term differences through assuming dependency between the explanatory variable and the constant term. On the other hand, the random effects assume that the unobserved effect is uncorrelated with the regressors (Greene, 2012). Testing whether the random or fixed framework is appropriate, the study will use the Hausman test, which focuses on testing whether the unobserved effect is not correlated with the explanatory variables. If the study rejects the null hypothesis, then the researcher should rely on using the fixed effect model as it would be more appropriate. Accordingly, the study has bank-level data to investigate the effects of internal factors over the period 2004 to 2015 while controlling for regulatory and macroeconomic effects.

Before running the analysis, the researcher must take a quick glance at the study main statistical data properties. The study final dataset consists of 2,184 bank-year observations and the descriptive statistics results show the original data, the Winsorized data at the 1st and 99th percentiles, 5th and 95th percentiles, and 10th and 90th percentiles, respectively. The following section will contain the descriptive statistics and data screening results. The descriptive statistics for bank performance indicators illustrated in Table 3 show divergent trends in their profitability, size, capital, and quality of management.

Table 3: Descriptive statistics

Variable	Mean	SD	Min	Max	Skew.	Kurt.
Liquidity Risk						
LTD	4.09	0.21	3.48	4.65	0.1	3.1
Profitability Ratio						
NIM	3.78	0.87	1.44	5.43	-1.1	4.4
ROAA	0.32	0.58	-2.22	1.75	-1.8	9.6
ROAE	2.31	0.61	-0.45	3.93	-1.9	10.6
Capital Ratio						
TIER1	1.04	0.09	0.84	1.27	0.5	2.9
TCR	2.89	0.25	2.36	3.61	0.6	3.0
EQTA	14.17	2.93	6.48	21.96	-0.4	3.0
Credit risk & Quality Management Ratios						
MARS	7.66	1.09	5.41	10.51	1.1	4.4
CTIR	45.93	11.82	13.34	105.31	-0.9	6.4
LOLTA	0.82	0.57	-0.77	3.19	0.1	4.7
Control Variables						
RRR	1.59	0.14	1.36	1.96	1.2	5.1
M2GDP	11.75	4.39	3.76	20.08	-0.8	3.6
IBR	1.25	0.35	0.67	1.87	0.0	1.9

This table reports the summary statistics of the annual data for the commercial banks sample in Jordan during the period 2004-2015. The results are shown for the mean and standard deviation, skewness, and kurtosis for the data before Winsorization.

The results are reported after taking the natural log for data transformation, except for bank size (MARS), which is proxied through taking the natural log of each bank's total assets, to smooth the variability of data while capturing its behaviour. The raw data shows that most of the variables do not follow a normal distribution due to the existence of outliers, which could be explained by taking a look at Jordanian banking sector structure as there is high concentration of assets and liabilities amongst certain banks compared to the rest of the sample, which could explain the existence of outliers in the sample as well as the heterogeneity among cross-sections. Therefore, to deal with the problem of outliers and make the data more reliable, Winsorization is used. The results, presented in Table 4, indicate that most of the outliers in the data were in the 90th percentile as observable changes in the mean of the data set and the standard deviation can be shown in the winsorized data at the 90th percentile. Some of the variable means increased after Winsorization while others decreased, showing that outliers were at both ends of the distributions. Removing those outliers deduced the standard deviation of the variables.

Table 4: Descriptive statistics after Winzorization

Variable	Mean	Median	Max	Min	Std. Dev.	Skew.	Kurt.	J-B	Prob.
Liquidity Risk									
LTD_C	4.1	4.1	4.5	3.7	0.2	0.1	2.5	1.8	0.40
Profitability Ratio									
ROAA_C	0.4	0.4	1.5	-1.8	0.4	-1.4	9.4	319.3	0.00
ROAE_C	2.3	2.4	3.5	0.3	0.4	-1.0	7.2	142.4	0.00
NIM_C	3.8	3.8	5.4	1.7	0.8	-0.3	2.6	4.1	0.13
Capital Ratio									
TIER1_C	1.0	1.0	1.2	0.9	0.1	0.3	2.5	4.5	0.11
TCR_C	2.9	2.8	3.4	2.5	0.2	0.5	2.6	6.2	0.05
EQTA_C	14.1	14.2	19.3	8.3	2.6	0.0	2.1	5.3	0.07
Credit risk & Quality Management ratios									
MARS_C	7.6	7.6	9.3	5.7	0.8	0.3	2.6	3.3	0.19
CTIR_C	45.7	45.1	67.0	19.4	10.0	-0.2	2.6	2.6	0.27
LOLTA_C	0.8	0.8	2.2	-0.4	0.5	0.0	3.5	1.4	0.50
Control variables									
IBR_C	1.2	1.2	1.9	0.7	0.4	0.0	1.9	7.5	0.02
RRR_C	1.6	1.6	2.0	1.4	0.1	1.1	4.9	56.5	0.00
M2GDP_C	11.8	11.2	20.1	3.8	4.4	0.2	2.4	3.0	0.22

The table reports the summary statistics of the annual data for the commercial banks sample in Jordan during the period 2004-2015. The results are shown for the mean and standard deviation, skewness, kurtosis, and J-B normality test for the Winsorized data at the 90th percentile.

After removing the outliers, the data for the 90th percentile (Winsorized) indicated that some of the variables were still not following normal distribution, indicating a high heterogeneity between cross-section groups. However, the dependent (LTD) variables were normal as the J-B test results indicated that the study accept the null hypothesis. As for the explanatory variables, the J-B test indicated that they (ROAA, ROAE, IBR, RRR) do not follow a normal distribution as the study has rejected the null hypothesis that the data follows a normal distribution. In addition, the rest of the variables were normally distributed at the 90th percentile (Winsorized). Therefore, the assumption of normality for some variables in the dataset is not met. However, while meeting the condition is desirable for reasons of estimator performance, it is not essential for either the random or fixed effects approaches for panel data (Clarke, et al., 2010).

Table 5: Normality test

Variable	Adj. Chi ^{2}			
	Original data	**99th%ile**	**95th%ile**	**90th%ile**
		Liquidity Risk		
LTD	0.32	0.32	0.32	2.34
		Profitability Ratio		
NIM	4.37	4.37	4.37	4.40
ROAA	58.54***	58.54***	58.54***	47.5***
ROAE	61.51***	61.51***	61.51***	32.73***
		Capital Ratio		
TIER1	4.15	4.15	4.15	5.43*
TCR	8.15**	8.15**	8.15**	5.91*
EQTA	2.14	2.14	2.14	13.55***
		Credit risk & Quality Management ratios		
MARS	15.06***	15.06***	15.06***	3.49
CTIR	18.87***	18.87***	18.87***	2.97
LOLTA	9.06**	9.06**	9.06**	1.72
		Control variables		
IBR	27.03***	27.03***	27.03***	27.03***
RRR	27.11***	27.11***	27.11***	27.11***
M2GDP	4.21	4.21	4.21	4.21

This table reports the results of the normality tests for the variables in the study. The results are shown for the data before Winsorization – Winsorized data at the 1st and 99th percentiles, 5th and 95th percentiles and 10th and 90th percentiles, respectively. The asterisk signs refer to the significance of the variables: * Significant at 10% ** Significant at 5% *** Significant at 1%, respectively.

The test uses a standardized T-bar statistic, which is built on the Augmented Dicky Fuller statistics averaged across the groups. This statistical method (under general settings) converges in probability to a standard normal variate sequentially with (T, N) tend to infinity. In this study, the researcher will focus on Levin, Lin and Chu test (2002) as it is more appropriate for panel data with finite and small (N, T) dimensions. The results are illustrated for the Winsorized data at the 90th percentile in Table 5.

Table 6: Unit Root Test Results

Variable	Level			1st Difference			Result
	None	**Intercept**	**Intercept & Trend**	**None**	**Intercept**	**Intercept & Trend**	
			Levin, Lin & Chu Unit root test (Common unit root process)				
LTD	0.565	-3.175***	-4.877***	-9.331***	-6.742***	-7.100***	I(0)
ROAA	-5.630***	-7.516***	-3.979***	-9.477***	-0.005	1.565	I(0)
ROAE	-4.233***	-9.659***	-2.949***	-8.678***	-1.911**	-0.980	I(0)
NIM	0.168	-1.767**	-1.487*	-8.606***	-2.125**	-0.816	I(0)
TCR	-0.573	-1.626**	-28.326***	-11.972***	-30.643***	-24.967***	I(0)
TEIR1	-0.143	-3.094***	-31.821***	12.950***	-25.728***	-21.319***	I(0)
EQTA	0.436	-1.033	-16.363***	-11.774***	-19.530***	-15.425***	I(0)
CTIR	1.339	-0.153	-1.532*	-10.901***	-1.165***	-3.167***	I(1)
MARS	5.034	-2.823***	-4.227***	-5.660***	-3.821***	-2.211**	I(0)
LOLTA	-4.493***	-2.545***	-1.348*	-6.358***	-1.999**	-1.638*	I(0)
RRR	0.721	-1.361*	-0.769	-7.931***	-3.255***	-1.756**	I(1)
IBR	-5.127***	-1.835**	-7.240***	-10.297***	-4.259***	-1.794**	I(0)
M2GDP	-6.346***	-3.427***	-0.668	-13.151***	10.878***	14.096***	I(0)

Im, Pesaran, Shin Unit root test (Individual unit root process)							
LTD	-----	-1.51*	-1.858**	-----	-4.259***	-1.034	I(0)
ROAA	-----	-4.393***	-1.351*	-----	-3.681***	-1.159	I(0)
ROAE	-----	-4.905***	-0.334	-----	-2.939***	-1.136	I(0)
NIM	-----	-0.161	0.522	-----	-2.744***	-0.343	I(1)
TCR	-----	-0.308	-6.209***	-----	-8.701***	-4.004***	I(0)
TEIR1	-----	-0.969	-7.149***	-----	-7.953***	-3.919***	I(0)
EQTA	-----	-0.777	-4.711***	-----	-6.865***	-3.091***	I(0)
CTIR	-----	-1.571*	-1.491*	-----	-4.138***	-1.469***	I(1)
MARS	-----	-1.206	-0.370	-----	-2.051**	-0.325	I(1)
LOLTA	-----	-0.549	0.229	-----	-1.055	0.785	I(2)
RRR	-----	-1.736**	0.116	-----	-1.035	1.095	I(0)
IBR	-----	-2.997***	-4.701***	-----	-3.368***	-0.344	I(0)
M2GDP	-----	0.579	0.344	-----	-8.088***	-4.511***	I(1)

This table reports the results of the unit root test for the LLC and IPS test for the winsorized data at the 90th percentile. The asterisk signs refer to the significance of the variables: * Significant at 10% ** Significant at 5% *** Significant at 1%, respectively.

The above table shows that the researcher used the panel unit root tests from Levin, Lin and Chu (2002) (LLC) and Im, Pesaran and Shin (2003) (IPS) to test whether the data are non-stationary in a panel context. The Levin, Lin and Chu (2002) test assumes a common root process whereas the Im, Pesaran and Shin (2003) test assumes an individual unit root process. Common unit root can be defined as an AR structure for the series under consideration. In contrast, the individual root allows for having a different AR structure in the same series (Barbieri, 2009).

The reported results in the following table indicate that the dependent variable (LTD) is stationary at the level in both tests .The results were compatible with the assumptions of the IPS test that allows for differences across groups and different AR structures converge to an equilibrium point with the same speed making this test less restrictive when compared to LLC test (Barbieri, 2009). Most of the variables were stationary except for RRR and CTIR whereas NIM, MARS and M2GDP were stationary at I(I) and LOLTA was stationary at I(2).

In this study, employing the second method if the BP confirmed the existence of heteroskedasticity in the OLS regression models where liquidity risk, represented by LTD, is the dependent variable. The test was used to determine whether the variance in the residuals was constant; the null hypothesis is that residuals are homoscedastic. The researcher will use Robust Standard Errors to resolve the heteroskedasticity issue and increase the efficiency of the estimation.

Loan to Deposit ratio (LTD) analysis

The following table illustrates the results from the models where *LTD* is the dependent variable. Taking a quick glance at the results, they indicate that whether the unobserved component is fixed amongst cross-sections or varies is inconclusive. The results may be in part due to employing the capital variables, which are influenced by the regulatory measures to which banks are subjected to ensuring their stability. As for the analysis of the results for the explanatory variables, the researcher has grouped some of these variables based on their definitions. In the empirical estimation, the study has used OLS, random, and fixed-effects models to estimate the impact of various internal factors on liquidity risk. This analysis will compare the results of different models, though most of the results have the same sign in the three methods.

Table 7: Empirical results about the impact of internal variables on liquidity risk /LTD

Dependent Variable (LTD)	Model 1 RE	Model 2 FE	Model 3 RE	Model 4 FE	Model 5 FE	Model 6 RE	Model 7 FE	Model 8 FE	Model 9 RE
Profitability Ratio									
ROAA	0.109*** (0.031)	0.117*** (0.031)	0.058* (0.031)	-----	-----	-----	-----	-----	-----
ROAE	-----	-----	-----	0.033 (0.025)	0.039 (0.024)	0.055** (0.026)	-----	-----	-----
NIM	-----	-----	-----	-----	-----	-----	0.169*** (0.014)	0.168*** (0.015)	0.139*** (0.013)
Capital Ratio									
TCR	-0.033 (0.079)	-----	-----	0.042 (0.039)	-----	-----	-0.028 (0.047)	-----	-----
TIER1	-----	0.174 (0.170)	-----	-----	0.268** (0.135)	-----	-----	0.038 (0.127)	-----
EQTA	-----	-----	0.026*** (0.005)	-----	-----	0.030*** (0.006)	-----	-----	0.017*** (0.005)
Credit risk & Quality Management Ratios									
CTIR	0.004** (0.001)	0.003** (0.005)	0.004*** (0.001)	0.001 (0.001)	0.001 (0.000)	0.004*** (0.001)	0.086** (0.001)	0.003*** (0.000)	0.003** (0.001)
MARS	-0.098*** (0.036)	-0.024 (0.047)	-0.067** (0.034)	-0.037 (0.031)	-0.034 (0.032)	-0.068*** (0.019)	0.005 (0.035)	-0.079** (-0.079)	-0.088*** (0.028)
LOLTA	0.030 (0.029)	-0.011 (0.024)	0.038 (0.027)	0.004 (0.023)	0.007 (0.023)	0.039 (0.029)	0.099** (0.015)	0.008 (0.016)	0.021 (0.018)
Control Variables									
RRR	0.393*** (0.056)	0.295*** (0.070)	0.222** (0.087)	0.293*** (0.038)	0.285*** (0.034)	0.225*** (0.059)	0.113*** (0.038)	0.095*** (0.037)	0.079* (0.044)
IBR	0.082** (0.034)	0.071*** (0.025)	0.059* (0.032)	0.092*** (0.027)	0.086*** (0.026)	0.062*** (0.019)	-0.002 (0.018)	0.111*** (0.017)	0.086*** (0.021)
M2GDP	-0.004 (0.003)	-0.004 (0.002)	-0.000 (0.003)	-0.003 (0.001)	-0.003* (0.001)	-0.001 (0.002)	0.039** (0.001)	-0.002 (0.001)	-0.001 (0.002)
DARS	0.082** (0.035)	-0.085** (0.031)	0.048 (0.033)	0.090** (0.027)	0.091*** (0.026)	0.050** (0.023)	0.003*** (0.015)	0.039** (0.016)	0.015 (0.019)
Constant	3.966*** (0.407)	3.342*** (0.411)	3.528*** (0.278)	3.522*** (0.291)	3.331*** (0.337)	3.363*** (0.172)	3.733*** (0.392)	3.566*** (0.390)	3.611*** (0.204)
R2	0.234	0.703	0.349	0.674	0.671	0.347	0.818	0.818	0.529
F-statistic	4.955***	15.142***	8.717***	13.194***	13.071***	8.641***	28.668***	28.709***	18.266***
No. Obs.	156	156	156	156	156	156	156	156	156

This table presents the results of the analysis of the econometric models that were mentioned in the methodology section. The analysis is done for the period 2004 to 2015. The dependent variable in these models was the loan to deposits ratio (LTD) whereas the internal factors include ratios for profitability, capital, size, non-performing loans and cost to income ratio. The selection of the models between random and fixed effects was based on the results of the Hausman test. Standard errors in the parentheses are the white robust standard errors. The asterisk signs refer to the significance of the variables: * Significant at 10% ** Significant at 5% *** Significant at 1%.

Post Estimation Test Results

The researcher has employed several tests to check for the robustness of the models used in the analysis. The following table shows the results of the adopted models in the analysis (fixed and random effects models). The F-statistics test is used to test the overall significance of the regression model. Specifically, it tests the null hypothesis that all of the regression coefficients are equal to zero. This tests the full model against a model with no variables and with the estimate of the dependent variable being the mean of the values of the dependent variable. This shows that all of the models of LTD A were significant at the 1% confidence level. The R-squared results were relatively high, indicating that the variables in the models explain most of the variations in the independent variables. Moreover, the J-B test shows that the residuals of the regressions were normally distributed. The VIF for the

models shows that multicollinearity does not exist in the models as all of the results were below the 10 threshold. The redundant fixed effects tests show that the effects were significant in all of the fixed effects models that were selected based on the Hausman test results.

Table 8: Robustness tests for the LTD models

Test	*Model 1 RE*	*Model 2 FE*	*Model 3 RE*	*Model 4 FE*	*Model 5 FE*	*Model 6 RE*	*Model 7 FE*	*Model 8 FE*	*Model 9 RE*
F-statistic	*4.955***	*15.142***	*8.717***	*13.194***	*13.071***	*8.641***	*28.668***	*28.709***	*18.266***
R^2	*0.234*	*0.703*	*0.349*	*0.674*	*0.671*	*0.347*	*0.818*	*0.818*	*0.529*
JB-Test	*0.820*	*2.246*	*1.776*	*1.669*	*1.711*	*2.193*	*1.439*	*1.463*	*2.348*
Heteroscedasticity test	*4.040***	*1.723*	*3.892***	*2.33**	*2.326**	*3.898***	*1.534*	*1.441*	*1.173*
VIF	*1.305*	*3.367*	*1.536*	*3.067*	*3.039*	*1.531*	*5.495*	*5.495*	*2.398*
Redundant fixed effects	-----	*15.342***	-----	*12.961***	*12.748***	-----	*23.567***	*24.220***	-----
Hausman test	*13.63*	-----	*3.87*	-----	-----	*12.97*	-----	-----	*9.05*
Wooldridge serial corr.	*13.619****	*0.974*	*15.231****	*4.393*	*0.459*	*17.393****	*1.942*	*1.273*	*34.865****

*This table presents the robustness test results for the LTD models. The tests include the F-statistic test to see the significance of the overall models; R^2, which is a statistical measure of how close the data are to the fitted regression line; the Jarque-Bera test to gauge the normality of the residuals; the White heteroscedasticity test to see whether the data suffers from unequal variability across the range; VIF results, which quantify the extent of correlation between one predictor and the other predictors in a model; the redundant fixed effects to test the significance of the effects; the Hausman test to choose whether the fixed or the random effects are more appropriate; and the serial correlations test. The asterisk signs refer to the significance of the variables: * Significant at 10%, ** Significant at 5%, *** Significant at 1%.*

However, some of the models suffered from heteroscedasticity and serial correlation in the LTD models, namely models 1, 3, 4 and 6 for heteroscedasticity and 1, 3, 6 and 9 for serial correlation. The reason behind the problem is that the structure of the banking system in Jordan is concentrated with two banks having a market share of more than 50%, which is the reason why the data had to be Winsorized before estimating the models.

The analysis in this chapter covered 13 domestic commercial banks in Jordan during the period 2004 to 2015 to estimate the impact of banks' internal factors – namely, profitability, capital, credit risk, size and quality of management – while controlling for the regulatory and macroeconomic environment. The researcher has used the loan-to-deposit ratio and liquid assets to total assets ratio as proxies for liquidity risk limited by the available data from banks' financial statements. The used data had outliers due to the structure of the banking sector in Jordan where two banks share, in terms of assets, more than 50% of the market. Therefore, the data was Winsorized at the level of the 90th percentile to remove outliers.

The research has faced several limitations while conducting this research. The first was the limited data available as only 13 of the 21 banks had data available. Therefore, the analysis covered 13 domestic commercial banks. Data could not be obtained for the others through the BankScope database or manual data entry as these banks are considered as branches of foreign banks that reside in Jordan and their balance sheets are often consolidated into their foreign counterparts and not published separately. Moreover, the limited availability of long time-series data for each bank constrained the researcher to investigate the research problem in a time span that is in parallel with the development of the banking system in Jordan. In addition, very few studies have investigated the impact of internal factors such as profitability, capital, credit, size and quality of management on liquidity risk within Jordanian commercial banks, whether domestic or foreign branches, and most relevant studies in the literature have focused on the impact of these factors on profitability.

The econometric techniques used in this chapter were OLS, fixed and random effects, which were mainly used in order to observe the behaviour of the unobserved component between cross-sections in the estimated models. The results showed that profitability has a positive impact on liquidity risk. The influence of profitability comes from the limited liquidity resources that banks have in Jordan. An increase in banks' risk appetite would result in an increase in their credit exposures and affect the structure of their balance sheets through decreasing the level of liquid assets held by commercial banks at the expense of liquid assets. Striving to maximise profits through reducing the amount of liquid assets available would impact bank operating exposure, which would result in high risk exposure through increased credit lending.

The analysis shows asset quality deteriorated due to a rise in non-performing loans, and the impact of capital on liquidity risk is influenced by regulatory measures set by the supervisory authorities in addition to internal measures that banks take in order to ensure their viability, such as limiting certain exposures and the existence of liquidity buffers. Therefore, the impact of capital and credit – represented by Tier 1, the total capital ratio and

equity to total assets and non-performing loans – on liquidity risk was found to be ambiguous due to the interactions between different factors.

The impact of bank size, measured by the percentage of bank assets to total banking assets, was different between the main variables (LTD) as larger banks tend to have more operations than just their core banking business, and have more efficient management of liquidity, therefore requiring lower liquidity target levels. Larger banks will also attract more clients and increase their liquid assets through their market power. Moreover, banks with a larger share of operations may have higher exposure to market conditions and the cyclicality of the economy. This can increase their revenues at peak episodes while decreasing their profits and assets quality, resulting in an increase in the need for liquidity to cover their risks, though they are considered more efficient in terms of managing their liquidity.

The impact of the quality of management on bank costs, which usually decline when management can allocate resources more efficiently, minimizes banks costs and increases revenues. This is related to cost management, which emphasizes maximising revenue per unit of cost. Quality of management is an unobserved variable that is hard to estimate due to the intangibility of banks' products and services. The core functions of Jordanian banks are mainly linked to extending credit to various institutions. Therefore, the researcher could view this ratio in Jordan as the average revenue per unit cost for credit facilities because the majority of revenues for domestic commercial banks come from interest payments, which indicate that more efficient management of resources would result in an increase in revenue per unit cost. This results in a decline in the liquidity risks faced by banks.

The control variables for the regulatory environment had a positive impact on liquidity risk with regards to the required reserve ratio where an increase in the percentages required by the authorities results in a decline in the amount of liquid assets available. Moreover, the impact of interbank interest rates was found to be positive as higher interest rates could increase banks' exposures to liquidity risk as it increases the costs borne by banks to secure available funding from the market. The macroeconomic environment control variable was statistically insignificant in most of the reported models, indicating that the regulatory measures set by the central bank plays a crucial role in insulating Jordan's commercial banks from the impacts of macroeconomic cycles. Nevertheless, the dummy variable which represents the impact of the Arab Spring that started in 2010 had a positive impact on liquidity risk. This indicated that Jordanian banks have been negatively impacted by their macroeconomic environment as it decreased their ability to collect funding through deposits as well as extend credit to customers.

The article finds and indicate that internal factors have a major impact on the liquidity risk faced by commercial banks in Jordan. These influences are intertwined with the regulatory measures imposed by the regulatory authorities, which signals that most banks depend on regulatory frameworks to manage their risks. Moreover, the results points to the importance of the risk appetite of commercial banks and their impact on liquidity exposures, which will be influenced in the near future by the adoption of Basel III. The issue of size plays an important role in terms of banks' exposure to liquidity risk, signalling the importance of having more supervision for larger banks in order to reduce their systemic risks and ensure their viability. Finally, the existence of efficient management team who can allocate resources more efficiently can limit the liquidity risks facing banks.

The implication of the results discussed above and the study analysis is that when trying to understand the internal factors that impact liquidity risk within Jordan's commercial banks, it is necessary to include all of the abovementioned factors and not only consider direct contributors to liquidity risk. Therefore, banks in Jordan should take into account the impact of credit, capital, size, profitability, management quality and regulatory and macroeconomic factors when setting liquidity risk exposures. These factors should be analysed and reported on a regular basis to the ALCO committee, which is responsible for determining the bank's asset-liability management framework.

internal factors have a big impact on bank liquidity. The empirical models showed that a rise in profitability would negatively impact banks in Jordan as they rely heavily on traditional banking as a main source of revenue, and maximizing their profit would result in higher exposure to liquidity risk. There is therefore a positive relationship between liquidity risk and interest rate margin ratio, which is attributed to the impact of the lending activities of commercial banks on their margins (Wójcik-Mazur & Szajt, 2015). In addition, capital showed a positive impact on liquidity risk. These results show the influence of regulatory frameworks that are set be supervisory authorities in accordance with Basel requirements (around 8% of risk-weighted assets). In addition, banks are required to have liquidity buffers in order to cover their operational risks that result from a bank's day to day operations. Capitalized banks also have stronger growth in their balance sheets; accumulate less high quality liquid assets tend to finance their risky activities through short-term debt are vulnerable to liquidity shocks and shortages (Banerjee & Mio, 2017).

Moreover, bank size had a negative impact on liquidity risk, as large banks tend to have different operations beyond their core banking business. Moreover, large banks are more attractive to high-liquidity clients and companies and retailers as safe-guard of their money that minimizes liquidity risks by enhancing liquidity positions. In addition, large banks' branch networks also enrich their liquidity position. The findings of the models indicate that the negative impact between quality of management and liquidity risk. An increase in the level of cost to income could be attributed to management having lower efficiency regarding managing risks. This would

result in banks facing higher liquidity risk, and could be explained by the impact of the quality of management on banks' costs. CTIR illustrates firms' ability to generate profits from their revenue sources (ECB, 2010), which ordinarily decline when management are more efficient at allocating resources. As for credit risk, which is proxied by non-performing loans, the models indicate that there is no significant relationship with liquidity.

Regulatory control variables had a significant and positive impact on liquidity risk. These results could be clarified through the impact of higher required reserves from the central bank, which decreases the amount of liquidity available. Macroeconomic variables showed an insignificant impact on liquidity, indicating that the regulatory measures set by the central bank also play a crucial role in insulating the impact of macroeconomic cycles on the commercial banks in Jordan. Nevertheless, the dummy variable – which represents the impact of the Arab Spring that started in 2010 – had a positive impact on liquidity risk, indicating that Jordanian banks have been impacted negatively by the macroeconomic environment as it has decreased their ability to collect funding through deposits as well as expand their credit exposure in the market due to the difficult external conditions.

This article assess the impact of various variables related to banking operations and the regulatory framework in Jordan, including the impact of macroeconomic conditions on Jordanian commercial banks' liquidity. The finding of this research clearly indicate that internal factors have a major impact on liquidity risk as the strategic plan of commercial banks impact the structure of banks' balance sheet and their operations, and thereby their liquidity positions and risk exposures. Therefore, having a consistent strategic plan that is aligned with the bank goals regarding maximizing profits and risk appetite, while mitigating against risk exposures, is imperative to control changes in these factors.

For example, the results indicated that profitability had a positive impact on liquidity risk, which in the case of Jordanian banks should be warranted by the limited resources that banks have, their limited access to wholesale funding, and their reliance on conventional banking as their primary means of generating revenues. On the other hand, the quality of management had a negative impact on liquidity risk, implying the importance of having an efficient management who are able to set strategic plans and limits on risk exposures and risk appetite taking the regulatory and macroeconomic circumstances in Jordan into consideration.

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