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The Impact of Bank Liquidity on the Lebanese Banks' Risk Taking Behavior

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Abstract

This paper investigates the impact of bank liquidity on the risk-taking behavior using a panel data of audited financial statement of 21 Lebanese commercial banks for the period from 2008 to 2015. Bank risk was measured as risk weighted asset ratio, loan loss provision divided by total assets, and net interest income ratio, while liquidity was measured as liquid asset divided by total assets. To achieve this objective, this study includes control variables and time dummy variables. Three models were tested depending on the definition of risk using the fixed effect model. Our results support the view that bank liquidity increases the bank total risk but decreases the bank lending risk. Furthermore, capital buffers stimulate banks to take more risk and size normally increases bank's risk in response to higher liquidity. This conclusion might suggest that higher capital requirements under Basel III are likely to increase bank risk with the implementation of new liquidity ratio. This study provides an understanding between liquidity and bank risk taking which may help regulators to modify the banking regulation in the future when bank liquidity levels change.

Keywords: Bank; Liquidity; Risk; Lebanon; Fixed effect model; Capital; Size

1. Introduction

The recent financial crisis has demonstrated the importance of liquidity as a safety buffer. According to Haan and Willem (2012), the collapse of the financial system in 2008 could be attributed to a bad bank's liquidity management, which could give rise to market and funding liquidity risk. Furthermore, Hong, Huang and Wu (2014) stated that the liquidity risk is an essential contributor to banks' failures in 2009-2010 as a result of the financial crisis in 2007-2008. Additionally, Ly (2015) attributed the failure of large banks such as Lehman Brothers and Northern Rock to liquidity risk and the dependency on the short range funding.

As a response to the worldwide financial crunch in 2009 and with respect to liquidity management, the Bank for International Settlement (BIS) published a consultative paper in June 2008 entitled 'Sound Liquidity Risk Management and Supervision' (Basel Committee on Banking Supervision, 2008); Financial Services Authority (FSA) introduced a new liquidity regime in October 2009 (FSA, 2009); International Monetary Fund (IMF) reviewed its stress test experience in 2008; US introduced Dodd-Frank Wall Street Reform since July 2010; Bank of England had focused on managing funding liquidity risk since 2008; and the European Central Bank (ECB) provided a new measurement of funding liquidity risk in 2009 (Drehmann & Nikolaou, 2009). Moreover, the Basel Committee on banking supervision had issued a vigorous framework related to the liquidity risk, 'Principles for Sound Liquidity Risk Management and Supervision' (Basel Committee on banking supervision, 2009). It had introduced regulations to control bank's liquidity gap through two financial ratios, mainly the Liquidity Coverage ratio (that captures the capacity of banks to survive a 30-day period after a shortfall in liquidity) and the Net Stable Funding Ratio (that captures the long term stable sources of funding) (Hull, 2012). However, whether increasing bank liquidity will make banks less risky and the financial system more stable is not yet known. Therefore, determining the impact of liquidity on bank risk behavior is an important issue given the regulatory reforms's focus on getting banks to be more liquid.

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Even though banks are generally advised to maintain a liquidity buffer to ensure themselves against shocks, Acharya and Naqvi (2012) suggest that lending process tends to be aggressive when banks have an excess liquidity. Their theoretical predictions suggest that high level of liquidity can increase bank risk, which deserve further attention given the significant impact that risky banks can have on the whole financial system. Khan et al. (2015) have mentioned that a high level of liquidity creates an agency problem that persuades managers to relax the lending standards by setting a discount rate lower than the one that maximizes the bank's profit. Moreover, Altunbas, Carbo, Gardener and Molyneux (2007) affirm that liquid banks tend to take more risk than the illiquid ones. Thus, it is important to study the impact of liquidity on bank risk taking behavior, in order to ensure a stable financial system and then a stable economy.

In the case of Lebanon, given the absence of capital markets, the banking industry dominates the financial system and is the key sector in the economy. In order to ensure the stability in the Lebanese financial market, Lebanese banks should be efficient and safe. Given the vital role played by the Lebanese banks in promoting economic growth, this study aims to study the impact of liquidity on Lebanese banks' risks. In particular, there is a paucity of empirical studies in Lebanon addressing the relationship between liquidity and bank risk. Thus, this paper attempts to address this gap by empirically investigating the impact of liquidity on the financial stability of banks in Lebanon. Moreover, it also examines the influence of bank's capital and size on the liquidity and bank risk relation.

The rest of the paper is organized as follows. Section 2 presents an overview of the Lebanese banking sector, followed by the literature review in Section 3. Section 4 describes the data, defines the variables, and explains the model. Subsequently, Section 5 presents and discusses the finding of the results, while Section 6 displays the conclusions and provides recommendations for future analysis.

2. Overview of the Lebanese Banking Sector

By funding both the public deficit and the private sector, the Lebanese banking sector plays a crucial role in sustaining the country's economy. Despite the volatile political and economic environment that has been present in Lebanon and neighboring countries in recent years, the banking sector assets have witnessed a growth rate of 4.8% in 2015. This progress can be attributed to many factors. First, total assets of the banking sector represent more than 360 percent of size of GDP, being one of the highest in the world. Second, the banking sector growth remains dependent on the core customer deposits, where the latter accounts for 82% of total liabilities, reflecting the stable funding source of Lebanese banks, with low reliance on capital markets. The large deposit base is accredited to Lebanese diaspora that remit their money to the Lebanese Banks. As of 2015, remittances to Lebanon are estimated to reach $7.2 billion, representing 14% of GDP, ranking the second highest among Arab countries. Moreover, deposits to asset ratio was 81.8% in 2015, as compared to an average of 67.8% for MENA, 65.5% for Emerging Markets; and 54.1% worldwide.

Bilanbanques divides the banking sector into four groups based on the size of deposits. Alpha Group are banks with customer deposits above US$ 2billion, then Beta Group are banks with customer deposits between US$ 500 million and US$ 2 billion. Gamma Group are banks with customer deposits between US$ 200 million and US$ 500 million, and finally Delta Group are banks with customer deposits below US$ 200 million.

The strength of the Lebanese banking sector is mainly attributed to its liquidity, capital adequacy and stringent regulatory foundation. Banks in Lebanon remain highly liquid with loans-to-deposits ratio of 39 percent (recorded at year-end 2015), indicating the ample liquidity available within the sector. This ratio is significantly lower (higher liquidity) than the MENA average of 77%, Emerging Markets average of 79.5% and the world average of 87.1%. A closer look shows that liquidity is inversely related to the size of banks, where the most liquid group is the Gamma group. In terms of capitalization, Lebanese banks remained adequately capitalized with a capital adequacy ratio (as per Basel II requirements) of 15.03 percent recorded in 2015, both exceeding the global standard and the minimum requirement set by the Central Bank of Lebanon (BDL). The analysis of capitalization by Lebanese banks' groups in 2015 shows that smaller banks in Lebanon are better capitalized than larger banks. This ratio is 30.73% for Delta Group as compared to only 14.63% for Alpha Group in 2015. Banks in Lebanon conduct their activities within a rigorous regulatory framework and under close supervision, operating under the jurisdiction of BDL and the Banking Control Commission. Through its sound governance and stringent rules and regulations, BDL has shielded

the Lebanese banking sector from major financial crises and set forth a solid foundation for prudential banking activity in the country. Besides, through its large foreign reserves base and gold holdings, BDL has long been able to absorb adverse shocks with the potential to negatively impact the Lebanese economy.

Moving to asset quality, despite reporting a slight improvement in the past year, it is still behind the regional average but in line with emerging market and global benchmark. The ratio of doubtful loans to gross loans had dropped from 6.55% in 2014 to 6.37% in 2015, but still higher than the regional average of 3.6%. The strong regulation of Lebanese banks encouraged them to take all needed measures to maintain adequate coverage. A closer look shows that small sized groups (Delta Group) have the highest ratio of doubtful loans, but also are the best provisioned as the ratio of loan loss reserves on doubtful loans as a percentage of doubtful loans reported a high ratio of 80.77% (Bankdata Financial Services, 2016).

Despite that Lebanese banks have traditionally maintained high liquidity ratios and high capitalization ratio, mostly as a safe practice to sustain the high risks of the country, their profitability and efficiency came short of all benchmarks. The return on average equity in 2015 was 10.8% for Lebanon, below a regional average of 12.1%, an emerging market average of 16.3% and a global average of 14.8%. This ratio registered the highest ratio for the largest banks (Alpha Banks). The cost to income ratio scored 50.8% for Lebanon, versus 40.6% in MENA, 51.6% in emerging markets, and 53.0% at the global level. Similarly, larger banks are found to be more efficient, mainly due to the economy of scale, with a cost to income ratio of 48.86% for Alpha banks and 69.18% for Delta banks (Bankdata Financial Services, 2016)

In summary, the Lebanese banking sector is financially sound and stable given an environment of strict regulation and supervision. It has been characterized by a strong liquidity, adequate capitalization, good asset quality, appropriate provisioning, but lower profitability and efficiency.

3. literature review

Since the recent financial crisis, the concept of liquidity has become the main focus for regulators, financial institutions and academics. Nevertheless, there is no uniform definition of liquidity. As stated by Crockett (2008, p.14) "Liquidity is easier to recognize than to define". Liquidity is defined as the ability of the financial institution to realize cash when needed which can be through cash or marketable securities held by the bank or through reserves kept at the central bank (Elliott, 2014). Liquidity can include market liquidity, funding liquidity, accounting liquidity and central bank liquidity.

Before the financial crisis of 2008, the main focus of the Basel committee was to ensure that banks had sufficient capital to meet up their risks. However, it turned out that liquidity risk was a major driver for the financial crisis and the failure of many large banks such as Lehman Brothers in the United States and Northern Rock in the United Kingdom. In response to this, the Basel Committee updated its requirements for liquidity risk management in 2008 in a paper entitled "Sound Liquidity risk management and supervision" (Basel Committee on Banking Supervision, 2008). This document was made of seventeen principles divided into 5 areas of focus, which are (1) Fundamental principle for the management and supervision of liquidity risk; (2) Governance of liquidity risk management; (3) Measurement and management of liquidity risk; (4) Public disclosure; and (5) The role of supervisors. In 2010, "Basel III: International framework for liquidity risk measurement, standards and monitoring" was published followed by "Basel III: A global regulatory framework for more resident banks and banking systems" in 2011. Since then, many updates were released, such as "Basel III: The liquidity coverage ratio and liquidity risk monitoring tools" in January 2013 and "Basel III: The net stable funding ratio" in October 2014; (Basel Committee on Banking Supervision, 2015, p.4). Thus, Basel III introduced two main ratios that measure the ability of banks to survive liquidity pressures, which are liquidity coverage ratio (LCR) and net stable funding ratio (NSFR). The first objective is to promote the resilience of the liquidity profile of banks over a shorter term horizon by ensuring that banks have sufficient high quality liquidity asset to survive a stress scenario over 30 calendar days and LCR has been developed to achieve this objective (Basel Committee on Banking Supervision, 2013). The second objective is to promote the long term resilience by ensuring that banks have more stable source of funding and NSFR has been developed for this purpose (Basel Committee on Banking Supervision, 2014). While LCR applies to short term liquidity management, NSFR is related to long term structural liquidity management.

LCR is calculated as High Quality Liquid Asset (HQLA) divided by Net Cash Outflows in a 30-day period. This ratio should be greater than 100% in order for the bank to meet its short term obligations. According to Basel Committee on Banking Supervision (2010), the LCR was planned to be implemented completely from 2015.

However, there were some concerns regarding the negative implications of LCR on the lending procedures in part and on the economy as a whole. Therefore, the Basel Committee on Banking Supervision (2013) decided to start at 60% of LCR in 2015, to be raised 10% every year. However, some banks had started the early implementation of LCR (Watt, 2013). The Net Funding Ratio (NSFR) measures the liquidity management of the bank for a one-year period rather than a one-month period, calculated as the amount of stable funding divided by required amount of stable funding. This ratio should be greater than 100%, so the amount of stable funding is higher than the required one.

3.1. Impact of Bank Liquidity on Bank's Risk: Theoretical Framework

The positive relationship between liquidity and bank risk is well supported by existing theories in the literature, mainly the agency theory and the free cash flow hypothesis. Acharya and Naqvi (2012) theoretically explained that when banks have a high level of liquidity, their managers tend to take more risk by fiercely lowering the lending standards for the purpose of increasing the volume of loans. This behavior is due to the fact that managers' compensations are based most of the time on the volume of loans. To increase loan volume, managers are also encouraged to reduce the rate on loan, a rate lower than the one that maximizes shareholders' wealth. Since auditing to investigate managers' lending decisions is only performed in case of liquidity deficit, excess liquidity will make managers overconfident that their lending practices will not be investigated (Agenor & Aynaoui, 2009, and Berger & Bouwman, 2009). Moreover, Cao and Illing (2008) stated that liquidity gives insurance against aggregate risk which will encourage banks to overinvest in risky activities for higher return. Khan et al. (2015) affirmed in their article that agency problem may tempt managers to set loan rates lower than the rate that maximizes shareholders' profit for the purpose of increasing loan volume.

According to the free cash flow hypothesis developed by Jensen (1986), the access of managers to a free cash flow will induce them to waste shareholders' money through organizational inefficiencies, such as a renovation of their offices or through investing at below the cost of capital. Thus, the increase of excess liquidity will drive managers to enlarge the bank riskiness through an aggressive lending which will lead to a decrease in the value of the firm. In another vein, Wagner (2007) theoretically investigated the relationship between the increase in asset liquidity (measured by the low discount rate on loan sales) and bank stability (measured by the probability of default). In normal times, the increase in asset liquidity does not have any effect on the stability of the bank. However, during financial crisis, a lower discount rate on loan sales reduces bank's stability, thus increasing the probability of default. Thus, he concluded by stating that the impact of asset liquidity on bank risk depends on the economic conditions; bank liquidity will increase bank risk, only during crisis. This result suggests that the recent financial crisis may have aggravated the adverse impact of bank liquidity on bank risk taking.

3.2. Empirical Framework

There is some empirical evidence supporting the positive relationship between the liquidity of bank and bank risk. Altunbas et al. (2007) examine the relationship between capital, liquidity, risk and efficiency of European banks. The sample chosen for this research crossed around 15 European countries (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden and UK) for a period between 1992 and 2000. The results of this research suggest that banks with higher capital, liquidity and better efficiency tend to take on more risk. Fungacova, Ariss and Weill (2013) examine the effect of liquidity creation level on the failure of Russian banks. Based on an unbalanced panel of 33,000 quarter observations for the period crossing between 2000 and 2007, the authors conduct a panel logit model. The result is that the excessive liquidity creation can be counterproductive for the bank. Liquidity creation above a certain threshold increases the probability of bank failure.

Hong et al. (2014) examine the relationship between the new liquidity risk measures (liquidity coverage ratio (LCR) and the net stable funding ratio (NSFR)) and U.S. commercial bank failures. The database is based on quarterly data set that includes 334,365 bank-quarter observations for a period crossing from 2001 to 2011.

The results show that liquidity risk affects the bank system in an idiosyncratic and systemic way. The probability of failure of the U.S commercial banks is negatively related with the NSFR (a measure of funding stability) but positively related with the LCR (a measure of asset liquidity). Therefore, high funding stability lessens the bank probability of failure, nonetheless, high liquidity increases the probability of bank failure. Khan et al. (2015) examine the impact of bank liquidity on U.S. bank risk-taking behavior. The sample used in this research analysis is based on a quarterly data consisting of 166,567 bank-quarters for unique 4,749 U.S. bank Holding Companies for the period crossing from 1986 Q4 to 2014 Q4. The empirical evidence shows that more liquid banks tend to take on more risk. The results show that an increase in bank deposits reduces net interest income (increases banks risk). Similarly, an increase in deposits increases the loan loss provision and risk-weighted assets, indicating that a high level of liquidity triggers banks risk. Moreover, an increase in bank deposits reduces the z-score and capital buffers, which means that a higher level of liquidity makes banks riskier.

4. Data and Variables

4.1. Sample and Data

The sample consists only of commercial Lebanese banks (excluding investment and Islamic banking) over the period 1995-2008. Bank specific data are collected from BANKSCOPE complemented with the annual reports of the banks. Although there exists roughly 50 commercial banks operating in Lebanon (according to the Association of Banks in Lebanon), commercial banks without at least five consecutive financial reports or without unconsolidated reports will be excluded , resulting in a sample of 21 banks for a period of 7 years: Bank Audi; Bank Blom; Fransabank; Byblos Bank; SGBL; Bank of Beirut; Bankmed; Banque Libano-Francaise; Credit Libanais; BLC Bank; IBL Bank; Credit Bank; Bank Bemo; Lebanon & Gulf Bank; MEAB; Emirates Lebanon Bank; HSBC Bank Middle East; Federal Bank of Lebanon; Bank de L'industrie et du Travail; Ahli International Bank, and CSC Bank. To address the outlier problems, all variables have been winsorized at the 5th and 95th percentile.

4.2. Variables and Hypotheses Development

The dependent variable, which is the bank's risk, is measured in two ways: Bank Lending risk (credit risk) and Bank total risk. Two ratios will be used to measure bank lending risk, while only one ratio will be used to measure the total risk.

1. **Bank lending risk**: First, and following Acharya and Naqvi (2012), bank lending risk is measured as net interest income divided by total loans, whereby a low rate indicates an aggressive lending, translated into higher risk. Net interest income is defined as interest income minus interest expenses. Second, loan loss provisions can be also considered as a measure of lending risk (Lee and Hsieh, 2013), where a bank keeping more loan loss provisions indicates higher risk. Loan Loss provisions can also reflect the aggressiveness of banks' lending decisions (Shrieves and Dahl, 1992).

2. **Overall Bank Risk**: Similar to previous studies (Delis, Hasan, and Tsionas, 2014, Rime, 2001; Hussain & Hassan, 2004), we employ the ratio of risk weighted assets to total assets as a measure of bank overall risk. The allocation of bank assets across different categories of risk is the major determinant of bank risk. Since lower net interest income implies higher risk, while higher loan loss provision ratio and higher risk weighted assets ratio signal higher risk, and to facilitate a more consistent interpretation, the values for net interest income will be multiplied by -1 so that a higher value for all bank risk measures indicates higher risk.

The main test variable is the **Bank Liquidity** (LIQ) (+). The higher the liquidity, the higher the bank's ability to absorb losses. However, banks with high liquidity are not profitable since liquid assets provide lower income, therefore, banks might undertake riskier activities to generate higher income (Handorf, 2014). In this way, liquidity regulation, by adversely affecting bank profitability, might increase bank risk. Thus, liquidity is expected to have a positive impact on risk. Furthermore, a lagged relation between liquidity and bank risk is assumed, which means that liquidity increases the risk in the next period. Given that there is no consensus on how liquidity is measured, this paper will adopt Altunbas et al. (2007) and Ly (2015) way of measuring liquidity, whereby liquidity is measured as the ratio of liquid assets to total assets.

H1: Banks with higher liquidity take more risks.

The control variables include only the bank characteristics for bank i in period t, which are commonly adopted in the literature as potential determinants of bank risk, limited by data availability. These variables are bank capital, bank size, profitability, loans ratio, efficiency and diversification deposits ratio (Shrieves & Dahl, 1992; Rime, 2001; Lee & Hsieh, 2013).

1. **Bank Capital (CAP)** (+): The impact of capital adequacy on risk is debatable, especially in emerging countries. On one side, banks with a high level of capital are able to take on more risk without falling below the required regulatory capital. They are also induced to take more risks since higher capital requirements reduce bank's profits (Gonzalez, 2005). Koehn and Santomero (1980), Kim and Santomero (1988) and Gonzalez (2005) state that the implementation of the new capital requirement restricts the risk-return edge of banks through forcing banks to reduce their leverage. This might encourage banks to reconsider their portfolio risk assets by increasing their risk taking behavior for the purpose of increasing their return. Furthermore, banks will tend to take on more profitable high risk loans in order to increase the value of equity (Blum, 1999). Therefore, the increase in capital requirements might have a negative effect on the risk taking behavior of the bank. On the other side, capital regulation encourages banks to reduce banks' risk in order to meet capital requirement or in order to avoid falling below minimum capital requirements (Furlong & Keeley, 1989; Repullo, 2005; Konishi & Yasuda, 2004). In order to meet higher capital ratios, banks try to reduce high risk assets (Hyun & Rhee, 2011). Other researchers found a U-shape relationship between capital and bank risk, where undercapitalized banks reduce their risk as capital increases, while well-capitalized banks increase their risk as capital increases (Calem & Rob, 1996). This relationship implies that overcapitalized and undercapitalized banks are riskier than banks with intermediate levels of capital. Overcapitalized banks tend to increase their risk-taking behavior with an increase in the capital requirements. Undercapitalized banks are willing to take on higher level of risk because they can easily transfer the costs in case of default (Calem and Rob, 1996). Overall, the literature indicates that banks with larger capital buffers are more willing to take risks than those which are less capitalized. The relation between bank regulatory capital and bank liquidity has been examined by Distinguin et al. (2013). Banks facing lower liquidity strengthen their solvency standards. They actually lessen their Tier 1 and Tier 2 capital when they face higher liquidity. Thus, bank riskiness should be dependent on both capital and liquidity levels. According to Diamond and Raja (2001), the relationship between bank capital and bank liquidity is explained through the crowding-out effect. Banks consider deposits as more effective hedge for agents than the bank equity investments. Actually, deposits are more insured and withdrawable at par value, while bank capital has a stochastic value that depends on the state of the banks' fundamentals and the liquidity of the stock exchange. Therefore, under-capitalized banks face larger challenges to provide funds, which push them to hold more liquid assets. Thus, according to the fragility-crowding out hypothesis, capital and liquidity are negatively related. In contrast, Berger and Bouwman (2009) expand the risk absorption hypothesis, which states that higher capital enhances the ability of the bank to create liquidity. Liquidity creation increases the bank's exposure due to the fact that banks with higher liquidity creation tend to lose more when they are forced to sell illiquid assets in order to satisfy the liquidity needs of customers. Capital is measured by the capital adequacy ratio, calculated as the summation of Tier 1 and Tier 2 capital over the risk weighted assets (Fatima, 2014), with the expectation that banks with higher capital and liquidity levels are willing to take on more risks.

H2: Banks with higher capital take more risk, especially in response to higher bank liquidity.

2. **Bank Size (SIZE)** (-): The impact of size on bank risk is ambiguous. On one side, large banks are less risky since they have more opportunity to diversify their loan portfolios risk more efficiently due to greater economies of scale and scope (Demsetz et al., 1997). An inverse relationship between size and earning volatility has been supported by De Haan and Poghosyan (2012) especially during the financial crisis and by Boyd and Runkle (1993). For instance, large banks tend to be more diversified than smaller banks, resulting in lower firm-specific risk. On the other side, large banks tend to take on more risk due to the moral hazard problem and 'too big to fail' theory. According to Panzera and Rossi (2011), large institutions are more attracted to increase their risk taking behavior, as they exploit the implicit guarantee offered by the government in case of failure. Berger and Bouwman (2009) found that the relation between capital and liquidity depends on bank size. While bank capital increases liquidity for large banks, it reduces the liquidity for smaller banks, concluding that larger banks are less prone to risk in response to higher liquidity.

3. The financial fragility crowding out and risk absorption hypotheses can explain the importance of the size in determining the relationship between capital and liquidity. First, the risk absorption hypothesis states that a positive relationship between capital (lower risk) and liquidity is more applicable for large banks. This hypothesis conceives that liquidity creation enriches the likelihood of losses for the bank, hence, the bank capital becomes more likely to absorb losses. Larger banks are more related to this hypothesis due to the fact that they are more exposed to regulators' examinations and market discipline. Second, the financial crowding out hypothesis states that a negative relationship between capital and liquidity is more applicable for smaller banks due to the fact that smaller banks tend to raise more local funds than large banks (Fungacova, Weill & Zhou, 2010).

A financial crowding hypothesis asserts that higher capital ratio crowds out deposits, thus reducing liquidity creation. Hence, a lower liquidity creation minimizes the bank's exposure to risk for smaller banks (Diamond & Rajan, 2001). However, irrespective of their capital structure, we expect that larger banks are less likely to take on risk in response to higher liquidity levels. Bank size is measured as the natural logarithm of total assets following many studies (Vodova, 2011).

H3: Larger banks take less risk, especially in response to higher bank liquidity.

4. **Profitability (PROF)** (-): There is a widespread agreement about the negative relationship between bank profitability and risk. Poor profitable banks tend to invest more in riskier activities in order to increase their return (Jensen and Meckling, 1976). There is an empirical evidence that performance may serve as a leading indicator of future problem loans, since worse performance may be a proxy for lower skills with respect to lending resulting in a higher credit risk (Louzis, Vouldis, and Metaxas, 2012). In contrast, according to Martynova, Ratnovski and Vlahu (2015), a high level of profitability allows banks to borrow and invest in riskier investments on a larger scale. Profitability is measured by Return on Equity (ROE), defined as net income divided by total equity with an expected negative effect on bank risk.

5. **Loan ratio (LOAN)** (+): The share of loans in total banking asset is considered an important driver of credit liquidity risk for the bank (Saunders & Cornett, 2016). Many studies have found a positive relationship between loan ratio and banking problems, where a higher ratio increases NPL and insolvency (Blasko & Sinkey, 2006). This variable is defined as net loans divided by total assets; the higher the ratio, the higher the risk.

6. **Efficiency Ratio (EFF)** (-): Many studies found that inefficiency is a source of bank risk. Recent studies have used the cost to income ratio as a proxy for efficiency, where a high ratio indicates a lower efficiency (Ghosh, Narian & Sahoo, 2003; Louzis, Vouldis, and Metaxas, 2012). A high cost to income ratio indicates low cost efficiency, which is positively associated with an increase in NPL, bad management, poor skills in credit scoring and monitoring, thus leading to a higher risk (Berger & DeYoung, 1997). Following Tripe (1998), cost to income ratio is defined as the operating expenses (non-interest costs which are administrative and fixed costs) divided by the operating income (net interest income and non-interest income). The ratio does not include bad and doubtful debt expenses due to the fact that those expenses reflect the quality of previous decisions and not the current performance of the bank.

7. **Revenue Diversification (DIV)** (+/-): Revenue diversification is one of the banks' characteristics that might have an effect on the bank risk behavior. There are various activities that provide non-interest income such as fees, commissions, and trading. The greater the proportion of these activities in a bank's portfolio, the greater is the diversification, and the greater is the risk reduction (Diamond, 1984). However, De Jonghe (2010) found that traditional banking activities are less risky, so diversified banks will tend to exhibit higher risk. This positive relationship between revenue diversification and risk was supported by many studies (Demirguc-Kunt & Huizinga, 2010; Stiroh, 2004). In this study, Herfindahl Hirschmann Index will be used to calculate revenue diversification, which is defined as follows (Odesanmi & Wolfe, 2007):

RVD=(〖(NON/NETOP)〗^2+〖(NET/NETOP)〗^2

Where: NON represents the non-interest income, which is the sum of net commission fees, net trading loss or profit and other non-interest income. NET represents the net-interest income, or interest income minus interest expenses. NETOP represents the net operating revenue = (NON+NET)

The maximum of HHI being 1 represents the lowest level of income diversification. Thus, the higher the HHI is, the lower the diversification is.

The ambiguity of the empirical evidence suggests the possibility of having either a positive or a negative relationship between revenue diversification of a bank and its risk.

8. **Crisis Dummy (CRISIS):** The financial crisis of 2008 is captured by creating a dummy variable, which is equal to one for the years greater than 2009 and zero otherwise. The positive relationship between the financial crisis and the bank risk is expected.

Table 1 shows the list of variables used in the regression analysis.

Table 1
DEFINITION OF VARIABLES

Explanatory Variables	Notation	Definition and Source	Expected signs
Dependent variables			
Risk Weighted Assets Ratio	(RWA)	Risk Weighted Assets/Total Assets	NA
Loan Loss Provision Ratio	(LLP)	Loan Loss Provision/ Total Assets	NA
Net interest Income Ratio	(NNI)	Interest income minus interest expenses / Total Loans	
Bank-specific variables			
Liquidity	LIQ	Liquid Assets/ Total Assets	Positive
Capital Ratio	(CAP)	Tier I and Tier II/Risk Weighted Assets (BANKSCOPE)	Positive
Size	(SIZE)	Ln of Total Assets (BANKSCOPE)	Negative
Profitability	(PROF)	Net Income/ Total Equity (BANKSCOPE)	Negative
Loan Ratio	(LOAN)	Loans/ Total Assets	Positive
Efficiency	(EFF)	Operating Expenses/ Interest and Non-Interest Income	Negative
Revenue Diversification	(DIV)	HHI Index	Positive/Negative
Dummy variables			
Crisis	(CRISIS)	1 during the crisis (2008-2010), 0 otherwise	Positive

4.3. Model

The panel data, also known as longitudinal or cross-sectional time-series data, takes the general form denoted as follows:

$$Y = \propto + \beta X_{i,t} + e_{i,t}$$

Where Y represents the dependent variable, which is the bank risk or bank lending risk for bank i in period t; and Xi,t is a vector of explanatory variables for bank i in time t; e represents the disturbance term; $\propto$ is a constant term; and β represents the regression coefficient of the explanatory variables. i and t represents the cross-sectional and time-series dimensions respectively

Henceforth, based on the explanatory variables chosen, the specific form of this model is:

$$Risk_{i,t} = \propto + \beta_1 LIQ_{i,t-1} + \beta_2 CV_{i,t} + TD_{i,t} + e_{i,t}$$

Where Risk = Bank total risk or Bank lending risk
LIQ = Liquidity ratio
CV = Control variables
TD = Time dummies

The dependent variable, Bank Lending Risk, is measured as loan loss provision over total loans and net interest income over total loans. The bank total risk is measured by the risk weighted asset ratio. The independent test variable, LIQ, is the liquidity measure for bank i, in year t-1. A lagged relationship between liquidity and bank risk is assumed since liquidity increases the risk in the next period. The independent control variables are bank characteristics for bank i, in year t. These variables are the capital adequacy ratio (CAP), the natural logarithm of total assets (SIZE), return on equity (PROF), total loans to total assets (LOAN), cost to income ratio (EFF), and HHI index (DIV).

Moreover, a dummy variable related to the crisis (CRISIS) is included in order to capture the effect of the financial crisis of 2008. Time specific effects are captured by introducing time dummies (TD). The latter is important to control macroeconomic effects over time. Thus, the final model is as follows:

$$Risk_{i,t} = \alpha + \beta_1 LIQ_{i,t-1} + \beta_2 CAP_{i,t} + \beta_3 SIZE_{i,t} + \beta_4 PROF_{i,t} + \beta_5 LOAN_{i,t} + \beta_6 EFF_{i,t} + \beta_7 DIV_{i,t} + \beta_8 CRISIS_{i,t} + TD_{i,t} + e_{i,t}$$

Furthermore, we extend the model in order to test the relationship between liquidity and risk for banks with high capital buffers and with large banks by generating test dummies to be interacted with Liquidity.

HIGH is a dummy variable equals to one for well- capitalized banks and zero otherwise, while BIG is a dummy variable equals to one for large banks, and zero otherwise. HIGH capitalized banks are the ones having a capital adequacy ratio in the top 25 percentile, and BIG banks are the ones that their size is in the top 25 percentile. Thus, the model will be extended as follows:

$$Risk_{i,t} = \propto + \beta_1 LIQ_{i,t-1} + \beta_2 Testdummy_{i,t} + \beta_3 LIQ_{i,t-1} \times Testdummy + \beta_3 CV_{i,t} + TD_{i,t} + e_{i,t}$$

Since we are dealing with a panel data, some tests using STATA software will be performed in order to choose the suitable model for our data.

5. Empirical evidence

5.1. Descriptive Statistics

Descriptive statistics for the winsorized variables, including the mean, the standard deviation, the minimum, and the maximum, are reported in Table 2. The number of observations for each variable is equal to 168 observations. The RWAD reports the highest standard deviation as compared to other variables, revealing more significant variance than other variables. The average natural logarithm of the total assets which was used as a proxy for the bank size is 14.855. On average, liquid assets, loan, and the risk weighted assets constitute 25.17%, 30.55%, and 59.31% of total assets respectively. For the average bank in the sample, the loan loss provision and the net interest income constitute 0.64% and 7.49% of total loans, respectively, which shows that the Lebanese banks are not aggressive in their lending. The average capital adequacy ratio is 13.42% which is higher than the minimum capital adequacy ratio of 8% supporting the strict regulation imposed by the central bank of Lebanon. The average profitability reports a value of 11.58%, with a standard deviation of 10.13%. The average cost to income ratio, which was used as a proxy for efficiency, is 56.87%, showing that the Lebanese banks are not that efficient. Finally, the revenue diversification reports an average value of 59.06%, showing a certain degree of diversification among Lebanese banks.

Table 2 DESCRIPTIVE STATISTICS

Variables	Obs	Mean	SD	Min	Max
RWAD	168	0.5931	0.2621	0.1845	1.4411
LLP	168	0.0064	0.0131	0.0001	0.0975
NII	168	0.0749	0.0782	0.0176	0.5628
LIQ_{t-1}	168	0.2517	0.1383	0.0872	0.7326
CAP	168	0.1342	0.0498	0.0813	0.3291
SIZE	168	14.855	1.5598	12.02	17.55
PROF	168	0.1158	0.1013	0.0013	0.7573
LOAN	168	0.3055	0.1217	0.0605	0.6069
EFF	168	0.5687	0.1698	0.3503	1.1489
DIV	168	0.5906	0.1059	0.3954	0.8777

5.2. Unit Root Test

An important assumption for a panel data technique is that the data must be stationary. According to Brooks (2008), a no stationary data could lead to spurious regression. The stationarity of the data is tested using the Fisher test as suggested by Maddala and Wu (1999). Under the Dickey-Fuller test, the null hypothesis is that all panels contain unit roots. Results in Table 3 indicate that all variables are stationary since their P-values are below 0.05; thus rejecting the null hypothesis.

Table 3 Fisher-type unit-root test based on Dickey-Fuller test			
Ho: All panels contain unit roots **H1: At least one panel is**			
Variables	**Lags**	**Chi-squared**	**P-value**
RWAD	0	313.4599	0.0000
LLP	0	100.3232	0.0000
NII	0	198.2258	0.0000
LIQ_{t-1}	0	324.2280	0.0000
CAP	0	361.5602	0.0000
SIZE	0	259.9398	0.0000
PROF	0	155.8902	0.0000
LOAN	0	180.0937	0.0000
EFF	0	127.4088	0.0000
DIV	0	138.0313	0.0000

5.3. Serial Correlation Test

Since it is a panel data rather than a time series data, the Wooldridge test is used to test autocorrelation for three different regressions, depending on the definition of the dependent variable.

Table 4 Wooldridge test for autocorrelation in panel data					
H0: no first order autocorrelation					
RWAD		**LLP/TL**		**NII/TL**	
F(1, 20)	10.296	F(1, 20)	6.667	F(1, 20)	8.588
Prob > F	0.0044	Prob > F	0.0178	Prob > F	0.0083

(Source: STATA)

Given the null of no serial correlation, the null hypothesis was rejected in the three regressions as shown in Table 4, since the p-value is lower than the significance level of 0.05. Hence, serial correlation exists in the three regressions. However, according to Torres-Reyna (2007), serial correlation is considered to be a problem for macro panels with a T greater than 20-30 years. Since we are dealing with a micro panel data for which the time dimension T (8 years) is largely less important than the individual dimension N (20 banks), serial correlation should not be considered a problem.

5.4. Homoscedasticity Test

The Breusch Pagan and white tests are used to test for the existence of heteroscedasticity for the three different dependent variables. Results in Table 5 indicate that the null hypothesis is rejected for the three regressions, since the p-values are lower than 0.05, suggesting the presence of heteroscedasticity. Therefore, in order to solve heteroscedasticity issue, the regression analysis will be adjusted using the robust standard errors known as Huber/White estimators (Zumbach, 2011).

Table 5 Breusch Pagan ad White Tests			
For Bank Risk (RWAD)			
Breusch-Pagan Test		White's test	
Ho: Constant variance		Ho: homoskedasticity Ha: unrestricted heteroskedasticity	
chi2	8.99	chi2	128.52
P-value	0.0027	P-value	0.000
For Bank Lending risk (LLP/TL)			
Breusch-Pagan Test		White's test	
chi2	294.32	chi2	110.51
P-value	0.000	P-value	0.000
Bank Lending risk (NII/TL)			
Breusch-Pagan Test		White's test	
chi2	192.61	chi2	139.77
P-value	0.000	P-value	0.000

(Source: STATA)

5.5. Multicollinearity Test

The existence of multicollinearity between the independent variables is tested using Pearson correlation (Wooldridge, 2002).

Multicollinearity is considered a serious problem if the correlation coefficients are more than 0.8 (Cooper and Schindler, 2012). Results in Table 6 suggest that muticollienarity is not a serious problem given that all coefficients are less than the cut-off point set by Cooper and Schindler.

Table 6
Pearson Correlation Test of explanatory variables

	RWAD	LLP	NII	LIQ_{t-1}	CAP	SIZE	PROF	LOAN	EFF	DIV
RWAD	1.000									
LLP	0.020	1.000								
NII	0.472	0.397	1.000							
LIQ_{t-1}	0.314	0.064	0.409	1.000						
CAP	0.091	-0.08	0.480	0.179	1.000					
SIZE	-0.005	-0.12	-0.24	0.028	-0.062	1.000				
PROF	0.068	0.022	0.277	0.136	-0.061	0.109	1.000			
LOAN	0.103	-0.08	-0.45	-0.14	-0.216	0.174	0.007	1.000		
EFF	0.146	0.007	0.014	0.055	0.157	-0.37	-0.287	0.306	1.000	
DIV	0.163	0.148	0.270	0.066	0.299	-0.12	0.049	0.004	0.477	1.000

(Source STATA)

5.6. Choice of Regression

There are mainly two types of panel estimator namely, the fixed effect models (FEM) and the random effects models (REM). To choose between the FEM and REM, a test of over identification restrictions between fixed and random effects (Xtoverid) was used and the results for the three regressions are reported in Table 7. Rejecting the null hypothesis suggests that REM is inconsistent and FEM model is better. Results in Table 7 show that the null hypothesis is rejected regardless of the dependent variable (Prob>Chi2 is less than 0.05), concluding that the fixed effect is more efficient than the random effect in all regressions.

Table 7 Xtoverid Test		
For Bank Risk (RWAD)	**For Bank Lending Risk (LLP/TL)**	**For Bank Lending Risk (NII/TL)**
• Prob>chi2 = 0.000	• Prob>chi2 = 0.000	• Prob>chi2 = 0.000

(Source: STATA)

5.7. Presentation of findings

Since the results provided evidence in favor of the fixed effect model, the fixed effect model with robust standard errors (to control for heteroscedasticity) is estimated for three dependent variables; namely risk weighted assets ratio (Case I), the net interest income ratio (Case II) and the loan loss provision ratio (Case III). By comparing the results for the three cases (Table 8), the findings revealed that Case I was the most efficient in estimating the regression results, with the highest regression fit of 50.51 percent. However, Case II has a lower regression fit than Case I (adjusted R-square = 44.38 percent), but a larger number of significant explanatory variables than Case I, and the highest F value of 123.10. As for Case III, it has the lowest regression fit of 36.75 percent but the same number of significant explanatory variables as in Case I.

It is important to mention that a reduction in the net interest income ratio (Case II) implies higher bank lending risk, while an increase in the risk weighted assets density (Case I) and in loan loss provision (Case III) implies higher bank total risk. To facilitate comparison, we have multiplied the value of net interest income ratio by -1, so that a higher value of all dependent variables indicates a higher risk.

5.7.1. Overall Risk of Banks

Table 8, Case I shows that liquidity increases overall bank risk as shown by the significant and positive coefficient at 5% level of significance, consistent with Acharya and Naqvi's (2012) theoretical argument. Therefore, high liquidity is positively related to bank's total risk, clearly accepting the first hypothesis H1.

As for control variables, efficiency ratio was found to be an important determinant of bank overall risk. The sign of the coefficient is consistent with Ghosh et al. (2003)'s hypothesis that a low cost to income ratio indicates higher efficiency, which is positively related to better skills and credit scoring, thus leading to a lower risk. Thus, there is a positive relationship between bank inefficiency and bank total risk.

Table 8
Regression analysis results

	Bank Total Risk (RWAD)		Bank Lending Risk (NII/TL)		Bank Lending Risk (LLP/TL)	
	Case I		**Case II**		**Case III**	
Risk	**Coef.**	**P>|t|**	**Coef.**	**P>|t|**	**Coef.**	**P>|t|**
LIQ_{t-1}	0.6285	0.050*	-0.9492	0.040*	-0.0295	0.001**
CAP	-1.4045	0.023*	-0.3460	0.000**	0.0106	0.621
SIZE	0.4392	0.434	0.0056	0.546	0.0038	0.021*
PROF	0.7652	0.094	-0.1568	0.199	-0.0678	0.023*
LOAN	0.9590	0.578	0.1105	0.029*	-0.0165	0.378
EFF	0.4740	0.014*	-0.0628	0.324	-0.0092	0.417
DIV	0.5151	0.123	-0.1830	0.032*	0.04576	0.130
Crisis	0.0177	0.757	0.0207	0.253	0.01074	0.045*
Regression	• Number of obs = 168 • F (13,20) = 23.54 • Prob > F = 0.0000 • Adj R^2 = 0.5051		• Number of obs = 168 • F (12,20) = 123.01 • Prob > F = 0.0000 • Adj R^2 = 0.4438		• Number of obs = 168 • F (13,20) = 17.10 • Prob > F = 0.0000 • Adj R^2 = 0.3675	

*, ** indicates significance at 5% and 1% respectively
(Source STATA)

5.7.2. Lending Risk of Banks

Cases II and III in Table 8 examine the effect of bank liquidity on the lending risk of bank as measured by net interest income divided by total loans, and by loan loss provision divided by total loans. Results suggest a negative relationship between liquidity and bank lending risk as measured by NII/TL and LLP/TL, significant at 5% and 1% respectively. The sign of the coefficient is inconsistent with Acharya and Naqvi (2012)'s hypothesis that banks tend to reduce their lending rate in response to a higher liquidity level. The results suggest that high liquidity, although it leads to higher total risk, has the potential to reduce bank lending risk.

As for control variables, capital ratio was found to be a significant determinant of bank risk taking behavior in II, with a negative sign, suggesting that banks having higher equity are less risky. According to Furlong and Keeley (1989), shareholders are seen as holders of a call option on the bank with unlimited profits but limited losses. Thus, shareholders tend to increase the value of their option in the absence of the regulations through lessening the level of capital and increasing the level of risk. Therefore, the presence of regulations could minimize this moral hazard problem through ensuring that shareholders are able to absorb part of the losses. Thus, banks with low level of capital tend to increase their risk in order to increase their profitability, and consequently their capital level. The results that banks having higher equity are less risky supporting Repullo's (2005) finding that bank risk taking is negatively related to capital requirements, and Konishi and Yasuda (2004) who found that the implementation of capital adequacy requirements had reduced risk taking by commercial banks.

The bank size was found to be statistically significant only in Case III. The positive relationship between bank size and bank lending risk is consistent with the 'too big to fail' theory. Thus, the 'too-big-to-fail' status will give large banks incentives to take on additional risk. Profitability was found to be statistically significant at 5% only in Case III. The sign of the coefficient is consistent with Jensen and Meckling (1976)'s hypothesis that more profitable banks tend to have lower risk-taking incentives than less profitable banks. Loan ratio was found to be positively related to risk, significant only in Case II at 5%. The sign of the coefficient is consistent with Blasko and Sinkey (2006)'s hypothesis that high level of loan ratio increases NPL and insolvency. Revenue diversification was found to be statistically significant determinant of bank risk taking behavior in Case II. The sign of the coefficient is consistent with Diamond (1984)'s hypothesis that revenue diversification reduces all types of risks.

As long as the revenue streams from different activities are less than perfectly correlated, revenue diversification should offer banks' opportunities to reduce their risks by lowering the volatility of their revenues and profits. This negative relationship is consistent with Berger, Demsetz, and Strahan (1999), Barth, Caprio, and Levine (2004), Stiroh and Rumble (2006) who found that diversification of income through non-traditional activities is positively associated with bank stability.

Finally, Crisis was found to be significant only in Case III. The sign of the coefficient is consistent with Altunbas et al. (2011)'s hypothesis that financial crises contributes to the build-up of risk by many institutions. There is a positive relationship between a financial crisis and loan loss provisions ratio.

5.7.3. Banks with High Capital Buffer

Table 9 reports the effect of bank capital on the relation between liquidity and risk taking behavior. A dummy variable HIGH is created, which takes the value of 1 for high capitalized banks, 0 otherwise. High capitalized banks are banks in the top 25th percentile, and the interaction variable (Highliq) refers to the interaction between the dummy variable (High) and the liquidity variable. The interactive variable between high capital buffer and liquidity is positive and significant at 1% only in case I. Banks with higher capital buffer engage in a higher risk taking behavior as measured by risk weighted assets than banks with lower capital buffer when they are flushed with liquidity. Therefore, the results are consistent with Gonzalez (2005)'s hypothesis argument that higher capital requirement induce banks to take on more risk in response to higher bank liquidity. The result suggests that highly capitalized banks tend to take less risk in the absence of liquidity and more risk when they are liquid. However, the liquidity interacted with the capitalization is insignificant in Case II and in Case III, indicating that liquidity does not affect the relationship between capital and bank lending risk.

Table 9 . Liquidity and Bank Risk in Banks with High Capital Buffers

	Bank Total Risk (RWAD)		**Bank Lending Risk (NII/TL)**		**Bank Lending Risk (LLP/TL)**	
	Case I		**Case II**		**Case III**	
Risk	**Coef.**	**P>|t|**	**Coef.**	**P>|t|**	**Coef.**	**P>|t|**
LIQ_{t-1}	0.0972	0.585	-0.020	0.655	-0.0235	0.070
High	-0.300	0.000**	0.0288	0.288	0.0042	0.151
Highliq	0.780	0.006**	-0.1979	0.101	-0.010	0.449
SZ	0.0839	0.063	0.0031	0.705	0.0035	0.044*
PROF	0.6816	0.094	-0.1736	0.190	-0.0676	0.019*
LR	-0.0849	0.626	0.1306	0.041*	-0.0146	0.444
EFF	0.5416	0.002**	-0.0859	0.196	-0.1065	0.350
RED	0.397	0.273	-0.2058	0.017*	0.0465	0.109
Crisis	0.0623	0.253	-0.0187	0.311	0.0105	0.057*
Regression	• Number of obs = 168 • F (14,20) = 46.24 • Prob > F = 0.0000 • Adj R^2 = 0.5190		• Number of obs = 168 • F (14,20) = 14.13 • Prob > F = 0.0000 • Adj R^2 = 0.4322		• Number of obs = 168 • F (14,20) = 22.36 • Prob > F = 0.0000 • Adj R^2 = 0.3715	

*, ** indicates significance at 5% and 1% respectively

5.7.4. Big Banks

Table 10 reports the impact of size on the relationship between liquidity and bank risk taking behavior. A dummy variable, Big, is introduced, which takes the value of 1 for large banks (large banks are the ones in the top 25th percentile) and zero otherwise. As for Bigliq, it is the interactive term resulting from multiplying the dummy variable with the liquidity variable. The interactive variable between big banks and liquidity is positive and significant at 5% only in Case III, indicating that that large and liquid banks benefit from being 'too big to fail' by enlarging their risk taking behavior in order to increase their return (Wilmarth, 2010).

Table 10. Liquidity and Bank Risk in Large banks						
	Bank Total Risk (RWAD)		**Bank Lending Risk (NII/TL)**		**Bank Lending Risk (LLP/TL)**	
	Case I		**Case II**		**Case III**	
Risk	**Coef.**	**P>|t|**	**Coef.**	**P>|t|**	**Coef.**	**P>|t|**
LIQ_{t-1}	0.6754	0.017*	-0.087	0.027*	-0.029	0.005**
Big	-0.0138	0.889	-0.0140	0.481	-0.005	0.310
Bigliq	0.0850	0.828	0.0501	0.507	0.0394	0.049*
CAP	-1.4558	0.022*	-0.356	0.000	0.0103	0.585
PROF	0.8037	0.080	-0.154	0.188	-0.066	0.028*
LR	0.2567	0.253	0.139	0.088	0.0007	0.964
EFF	0.4511	0.035*	-0.068	0.311	-0.007	0.506
RED	0.5866	0.037*	-0.173	0.023*	0.05	0.076
Crisis	0.0060	0.920	-0.0220	0.257	0.010	0.056*
Regression	• Number of obs = 168 • F (14,20) = 1136 • Prob > F = 0.0000 • Adj R-squared = 0.4945		• Number of obs = 168 • F (14,20) = 157.63 • Prob > F = 0.0000 • Adj R-squared = 0.4424		• Number of obs = 168 • F (14,20) = 25.10 • Prob > F = 0.0000 • Adj R-squared = 0.3726	

*, ** indicates significance at 5% and 1% respectively

6. Conclusion

In order to investigate the impact of bank liquidity on bank risk, a fixed effect model regression was conducted on a sample consisting of twenty-one Lebanese banks over a period of eight years from 2008 to 2015. The dependent variable is defined in three ways, the risk weighted assets ratio as a measure of total risk; the loan loss provision ratio and net interest income ratio as a measure of lending risk. The bank specific factors included in this study are the bank liquidity, size, capital, profitability, loan ratio, efficiency, and revenue diversification. Crisis and time dummies are also included. The results obtained depend on how risk is measured. There is a positive relationship between bank liquidity and bank total risk, which is consistent with Acharya and Naqvi (2012)'s theoretical argument that a high level of liquidity boosts banks to increase their risk taking behavior. The main empirical implication of this model is that a high level of liquidity tends to increase the bank total risk but decrease the bank lending risk. Thus, the access of managers to free cash flow motivates them to enlarge the bank total riskiness. However, there is a negative relationship between bank liquidity and bank risk taking behavior from the lending perspective. Moreover, while testing the impact of other factors on bank risk behavior, we concluded that some variables are significant with bank total risk while others are significant with bank lending behavior.

In addition, extensions to the models were made in order to test the effect of bank capital and size on the relationship between liquidity and bank risk taking behavior. The results also indicate that well-capitalized banks are riskier than lower capitalized banks only when they are liquid. The size of the bank is positively related to the bank risk taking behavior, supporting the too big to fail theory. Furthermore, larger banks take more risk as compared to smaller banks when they are flushed with liquidity, which is consistent with the too big to fail hypothesis.

Overall, our results support the view that bank liquidity increases bank total risk. Furthermore, capital buffers stimulate banks to take more risk and size normally increases bank's risk in response to higher liquidity. This conclusion might suggest that higher capital requirements under Basel III are likely to increase bank risk with the implementation of new liquidity ratio. This study provides an understanding between liquidity and bank risk taking which may help regulators to modify the banking regulation in the future when bank liquidity levels change. The analysis suffers from some limitations. Firstly, the small sample size (limited to 21 banks) may affect the qualities of the results. Secondly, due to the presence of outliers in the sample chosen, the top and bottom 5% of all observations for all variables have been winsorized. Thirdly, only six bank control variables were included in the research. It is possible that other factors might have a greater impact on the relationship between bank liquidity and its risk-taking behavior than the ones included in the research. For example, economic variables were not included in the model regression.

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