LIQUIDITY IN LEBANESE COMMERCIAL BANKS AND ITS DETERMINANTS

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ABSTRACT

The last global financial crisis reemphasized the importance of liquidity for the well-functioning of the banking sector and the financial markets. Given the importance of banks in the Lebanese financial markets, this paper aims to identify the determinants of liquidity of Lebanese commercial banks for the period from 2005 to 2013.

Results show that bank liquidity is positively related to bank size and interbank rate, and negatively related to loan growth rate, inflation and the financial crisis. The impact of capital, economic growth, unemployment, short term interest rate, and lending interest rate on liquidity is not conclusive. No difference was found between listed and unlisted banks.

INTRODUCTION

Banks, due to their role as financial intermediaries, are exposed to many types of risks such as credit risk, liquidity risk, capital risk, and interest rate risk. Liquidity risk is defined as banks' ability to fund their assets and meet their obligations, without incurring unacceptable level of losses (BCBS, 2008). By transforming short term deposits into medium to long term loans, banks are exposed to liquidity risk. Therefore, banks must be ready to meet the retirements of deposits by holding some liquid assets. Although liquid assets reduce liquidity risk, they have an opportunity costs since they generate low or no return.

Before the crisis, banks did not consider liquidity risk a priority as compared to other types of risks such as default, capital, and interest rate risk. However, the financial crisis had changed the whole picture by highlighting the importance of liquidity management, with the failure, resolution, or forced merger of some banks (Teply, 2011). In response to the crisis, the Basel committee on Banking Supervision (BCBS) - whose aim is to enhance the financial stability and to improve the quality of banking supervision methods- issued, in December 2010, new guidelines for managing liquidity risk and Basel III introduced new requirements which force banks to hold higher level of capital and liquid assets.

In Lebanon, given the absence of a secondary market, banks dominate the financial sector. Thus, the aim of this paper is to identify the determinants of liquidity of Lebanese commercial banks, which is important to the well-being of banks' operations, the economy, and the country as a whole. This topic has returned to be a hot topic since the financial crisis.

The outline of this paper is as follows: Section 2 provides a literature review, while section 3 presents the data, defines the variables, and specifies the econometrical model. Empirical determinants of bank's liquidity are presented and discussed in Section 4. Finally, section 5 concludes.

LITERATURE REVIEW

Overview of Banking Sector in Lebanon

Regulated by Banque du Liban (BDL), the banking sector continues to be the backbone of the Lebanese economy, being ranked 12th worldwide in 2011 (World Economic Forum, 2011-2012) and 29th in 2013 (World Economic Forum, 2013-2014) in terms of soundness. Total assets of this sector grew by 8.5% in 2013 to represent 379% of the size of GDP at the end of the year, while deposits increased by 9% to represent 312.2% of GDP. These two ratios are among the highest in the world, highlighting the growth and the importance of this sector. Furthermore, this sector is the major provider of capital to business, where loans accounted for 109% of GDP in 2013 (IDAL, 2014). It is also the supporter of the government's debt through the purchase of government Treasury bills. As of 2013, the total number of commercial banks operating in Lebanon reached 56 (Financial Access Survey [FAS], 2014).

The Lebanese banks were able to remain shielded from the global financial crisis of 2008. One of the factors that enabled them to remain resilient and to operate normally is the liquidity. Subject to the high reserve requirements set by BDL, the Lebanese banking sector was able to enjoy high liquidity by all standards, well above regional and international benchmark. Measured by net primary liquidity divided by total deposits, this ratio reported a high level of 30.9% in 2010, slightly decreasing to 29.1% in 2011, before reaching 31.6% and 30.7% in 2012 and 2013 respectively. This high liquidity ratio is mainly due to higher liquidity in foreign currency as compared to domestic currency. For example, in 2013, this ratio reached 20% in domestic currency versus 35.3% in foreign currency.

Liquidity can be also measured by a mirror image, which is loan to deposit ratio, whereby a high ratio suggests low liquidity. This ratio reached 37.7% in 2013, lower than the regional average of 70.2%, the emerging market average of 77.1%, and the global average of 83.1% (Bank Audi, 2014). All these ratios are highlighting the strong liquidity position that the Lebanese banking sector is enjoying.

Theories of Bank Liquidity

Liquidity is defined as the ability of the bank to meet its obligations and to finance any increase in assets, without incurring unacceptable losses (BCBS, 2008). Banks' primary function is to collect deposits and lend them. Therefore, banks are transforming short term deposits into long term and illiquid assets, exposing themselves to liquidity risk. If a large part of depositors demanded their money, the bank might be forced to liquidate its illiquid assets at unfavorable price or borrow at unfavorable costs. The result of a liquidity shortage is a loss of value, which might lead to a solvency crisis (Aspachs, Nier, & Tiesset, 2005) or even to default (Ozdincer & Ozyildirim, 2008). In fact, the absence of liquidity might lead to a liquidity risk. Liquidity risk can be of two types: funding liquidity risk and market liquidity risk. First, funding liquidity risk is defined as the bank's risk of not being able to meet its future cash flows without affecting its operations. Second, market liquidity risk is defined as the risk of not being able to offset or eliminate a position because the market is not deep or disrupted. These two types of risks are interacted in the crisis period (Drehman & Nikolaou, 2013); for example, the exposure to funding liquidity risk might lead to asset sales or a decrease in the price of assets, leading to market liquidity risk. Similarly, the exposure to market liquidity risk might lead to higher margin, leading to funding liquidity risk. Thus, these two risks work together.

To avoid liquidity risk, Aspachs et al. (2005) suggested three mechanisms that banks can use. First, banks can hold a high amount of liquid assets, such as cash, balances with central banks, short term securities, and reverse repo. Liquid assets serve as a buffer against liquidity risk by reducing the probability that a deposit withdrawal will threaten the viability of the bank. Second, banks can use their liability side of the balance sheet by borrowing from other banks in case of liquidity demand, thus relying on the interbank market. Third, banks can use again their liability side of the balance sheet by relying on the central bank as a lender of last resort.

Vento and La Ganga (2009) emphasized that liquidity risk is not an isolated risk. It is the result and the cause of other risks within the banking sector. For example, credit risk might lead to liquidity risk and liquidity risk might lead to legal risk.

Empirical Overview of Determinants of bank Liquidity

Although liquidity was an old topic, this theme regains its importance following the financial crisis of 2007. Many researchers and international organizations tested the determinants of liquidity which are listed in chronological order starting from 2005.

Aspachs et al. (2005) investigated the determinants of liquidity of 57 UK-resident banks, using quarterly data from 1985 to 2003. They found that interest margin and loan growth rate negatively affect bank liquidity, while profitability and bank size do not have a significant impact. They also found that liquidity is negatively related to real GDP growth and the policy rate.

Fielding and Shortland (2005) examined the determinants of excess liquidity in the Egyptian banking sector. They found that the level of economic output, discount rate, and the violent political incidence have a positive effect on liquidity, and cash to deposit ratio and economic reform have a negative effect.

Valla, Saes-Escorbiac, and Tiesset (2006) investigated the determinants of liquidity of English banks using both bank specific and macroeconomic variables. Concerning the bank specific variables, they found that liquidity is negatively related to the probability of obtaining support from the central bank, the interest rate margin measuring the opportunity costs of holding liquid assets, loan growth, and bank profitability. No clear relationship was found between bank size and liquidity. Concerning the macroeconomic variables, they found that liquidity is negatively related to the business cycle measured by GDP and the monetary policy effect measured by short term interest rate.

Lucchetta (2007) investigated the importance of interest rate on bank's risk taking and the decision to hold liquid assets in European countries and found a positive relationship between interbank rate and liquidity and a negative relationship between monetary interest rate and liquidity. Furthermore, he found a negative impact of loans divided by total assets, and loan loss provision divided by net interest revenue, and a positive impact of bank size.

Bunda and Desquilbet (2008) analyzed the liquidity of 1107 commercial banks in 36 emerging countries between 1995 and 2000, using bank specific variables, market and macroeconomic variables, and exchange regimes. They found that liquidity is negatively related to (i) bank size as measured by total assets, (ii) lending interest rate, (iii) and the presence of financial crisis. On the other side, liquidity is positively related to (i) capital adequacy ratio as measured by equity divided by total assets, (ii) presence of regulation obliging banks to be liquid, (iii) public expenditures divided by GDP, (iv) inflation rate, and (v) Exchange rate regime. Banks in extreme regimes (floating or hard pegs) are more liquid than countries in intermediate regimes.

Rauch, Steffen, Hackethal, and Tyrrel (2010) investigated the determinants of liquidity of German's 457 state owned saving banks over 1997 to 2006 and found that liquidity is negatively related to monetary policy interest rate, level of unemployment, bank size measured by number of customers, and bank profitability. At the same time, saving quotas and liquidity in the previous period positively affect liquidity.

In the same year, Moore (2010) analyzed the liquidity of commercial banks in Latin America and Caribbean countries, and found that liquidity positively depends on current macroeconomic situation, and negatively depends on cash to deposit ratio and money market interest rate.

Vodova (2011) investigated the factors affecting the liquidity of 22 banks operating in Czech Republic using a panel data from 2001 to 2009. By considering four firm specific variables and eight macroeconomic variables, he found that capital adequacy, lending interest rate, interbank interest rate, and non-performing loans positively affect bank liquidity, while inflation rate, GDP growth, and financial crisis negatively affect bank liquidity. However, bank size has an ambiguous impact, and unemployment, interest margin, bank profitability, and repo rate have no significant impact on banks' liquidity.

The positive impact of capital adequacy on liquidity has been confirmed by Bonfim and Kim (2012). They used a regression analysis on a panel data covering European and North American banks in 2002-2009 and found that the impact of bank specific variables such as size, performance, and loan deposit ratio depends on the type of liquidity measure used. However, they found that the bank size has a positive impact on liquidity.

In the same year, Fadare (2011) aimed to identify the determinants of liquidity in Nigerian banks from 1980 to 2009 by using a linear least square method. They found that monetary policy rate and lagged loan to deposit rate significantly predict banking liquidity.

All these empirical evidences suggest that commercial bank liquidity is determined by bank specific factors (capital adequacy ratio, profitability, size, etc…), macroeconomic factors (interest rates, economic cycle, etc…) and other factors such as regulations, financial crisis, and political accidents.

DATA

This study is based on the annual observations of 23 commercial banks covering a 9 year period between 2005 and 2013. Bank specific data were obtained from BANKSCOPE, which includes the financial statistics of all banks; the data was complemented with the annual reports of Lebanese banks. As for macroeconomic data, they were obtained from many sources such as International Financial Statistics of International Monetary Fund (IMF) and Banque du Liban website (central bank of Lebanon). Although there exists 56 commercial banks in Lebanon in the year 2013 (FAS, 2014), the banks included in this study are only those having observations for at least 6 years on BANKSCOPE. Due to some missing information, the obtained data is unbalanced panel data.

VARIABLES

Dependent Variable

Liquidity can be achieved by (1) holding a portfolio of assets that can be easily converted into cash without a significant loss of value (cash, reserves, or government securities), (2)

holding significant volume of stable core deposits (nonvolatile deposits), and (3) maintaining credit line with financial institutions implying the ability to borrow anytime needed.

Because there is no consensus on the best way to measure liquidity, this study will use four different liquidity ratios as the dependent variable, similar to many studies (Moore, 2010; Vodova, 2011).

1. Liquid assets/Total assets (L1): where liquid assets include cash, deposits with central banks and other banks, short term government securities and reverse repos. The higher the ratio, the higher the liquidity, and the higher the capacity of banks to absorb liquidity shocks. However, a higher ratio can be interpreted as a measure of inefficiency, since liquid assets have lower yield. Therefore, it is important to have a good balance between liquidity and profitability.
2. Liquid assets/ customer deposits (L2): this ratio captures the bank's ability to meet its obligations in terms of funding and bank's sensitivity to deposit withdrawals. The denominator here is replaced by only deposits ignoring the fact that banks can borrow from other banks in case of liquidity needed. Although some studies used in the denominator deposits of households, deposits of banks and other financial institutions, and short term debt securities, this ratio will not be used in this study due to many missing information from Bankscope. Similar to L1, a higher ratio signals a better capacity to absorb liquidity risk, and a lower sensitivity to deposits withdrawals.
3. Loans/ Assets (L3): This ratio measures the percentage of banks' assets tied up in illiquid loans. Contrary to the above two measures, a higher ratio suggests a lower bank's liquidity.
4. Loans/ deposits and short term financing (L4): This ratio relates illiquid assets with liquid liability with similar interpretation as L3, where a higher ratio suggests lower liquidity.

Although these ratios are not able to always capture all liquidity, they are widely used because they are easy to calculate and interpret.

Independent Variables

The selection of variables was based on the cited empirical studies, limited by data availability. The independent variables will be divided into two broad categories: (1) bank specific determinants and (2) macroeconomic determinants. The bank specific factors include capital adequacy ratio (+), bank size (?), loan growth (-), and nonperforming loans (-). The macroeconomic factors include growth of real gross domestic product (-), inflation rate (+), liquidity premium (-), short term interest rate (+), interbank rate (+), real interest rate on lending (-), and unemployment (+). In addition, two dummy variables will be included, to represent the financial crisis period and to differentiate between listed and unlisted banks. Other variables such as political events, exchange rate regime and economic reform are excluded since these variables made no sense in Lebanese conditions.

This study considers four bank specific factors as follows:

1. Capital Adequacy Ratio (CAP) (+): The impact of capital adequacy on liquidity and liquidity creation is debatable, especially in emerging countries. Liquidity creation is defined as transforming less liquid assets into more liquid liabilities. The more liquidity is created, the greater is the possibility and magnitude of losses associated with meeting the liquidity demands of customers by disposing illiquid assets. On one side, and under the hypothesis of 'risk absorption', higher capital ratio will improve banks' ability to absorb risks associated with liquidity creation, thus increasing the bank's ability to create more liquidity (Repullo, 2004). On the other side, under the 'financial fragility-crowding out' hypotheses, higher bank capital may hinder creation because it makes the bank's capital structure less fragile or because it crowds out deposits. Capital adequacy ratio is measured as Equity Capital/ Total Assets (Bonfim & Kim, 2012) with a positive effect on liquidity ratios, since solvent banks are found to be more liquid.

2. Bank size (SIZE) (+/-): The impact of size on bank liquidity is not clear. On one side, according to the 'too big to fail' hypothesis, large banks tend to be less liquid. If large banks see themselves as too big to fail, they will be less motivated to hold liquid assets. By benefiting from an implicit guarantee (assistance of Lender of less resort), large banks tend to invest more in riskier assets and hold less liquid assets (Lucchetta, 2007). On the other side, small banks are more likely to be involved in traditional intermediation activities and hold small liquid assets (Rauch et al. 2010; Bunda & Desquilbet, 2008). Bank size is measured as the natural logarithm of total assets following many studies (Bonfim & Kim, 2012; Vodova, 2011; Horvath, Seidler, and Weill, 2014).
3. Loan growth (GROWTH) (-): Loans are considered as the principal activity of most commercial banks as they generate the most important source of revenue. However, they are illiquid. Therefore, an increase in the demand for loans will lead to less liquid assets, resulting in a negative relationship between loan growth and banks' liquidity (Pilbeam, 2005). Loan Growth is measured as the annual growth rate of gross loans. Banks which specialize in lending activity tend to have higher exposure to liquidity risk, thus a lower liquidity ratio (Bonfim & Kim, 2012; Valla et al. 2006).
4. Nonperforming loan Ratio (NPL) (-): Non performing loans are loans that are not up to date in terms of payment of interest and principal. Thus, they measure the quality of bank assets. The presence of large proportion of non-performing loans might lead to liquidity problem since depositors and foreign investors might lose their confidence in the bank (Bloem & Gorter, 2001). Therefore, non-performing loans as a proportion of gross loans have an expected negative impact on bank liquidity.

This study will not include any measure of profitability such as net interest margin, return on equity or return on assets as independent variables since they are considered to be more or less codetermined with asset liquidity. In fact, many studies found that liquidity has an impact on bank profitability.

In addition to the bank specific variables, 7 macroeconomic variables are included in this study.

1. Real GDP growth rate (GROWTH) (-): Economic cycle affects banks' activities; demand for loans is higher during expansion and lower during downturns. Therefore, in expansion, the number of profitable investments is higher, which induces banks to lend more, resulting in less liquid assets (Valla et al. 2006). This variable was used by many studies (Aspachs et al. 2005; Valla et al. 2006; Vodova, 2011). It is measured as the percentage change in Gross Domestic Product (GDP) using constant prices and is taken from the International Monetary Fund, World Economic Outlook Database.
2. Inflation (INF) (+): An increase in inflation will reduce the real rate of return, creating market frictions and credit rationing. The result is fewer loans, reduction in intermediary activity and a higher amount of liquid assets held by banks. Therefore, a positive relationship is expected between inflation rate and liquidity. Furthermore, since loans made by banks are long term loans, their nominal values are sticky and highly affected by inflation. Therefore, a higher inflation will motivate banks to hold liquid asset to reduce their vulnerabilities to inflation. This variable was used by Vodova (2011) and Bunda and Desquilbet (2008). Inflation is defined as the percent change in the index using end of period consumer prices and is taken from the International Monetary Fund, World Economic Outlook Database.
3. Liquidity premium (LP) (-) = Defined as the difference between interest rate on loans and interest rate on deposit, LP is expected to have a negative impact on bank liquidity. Higher interest rate margin will motivate banks to lend more and to hold less liquid assets (Aspach et al. 2005; Valla et al. 2006). This variable is obtained from International Financial Statistics (IFS).
4. Short term interest rate (INT) (+): Short term interest rate is the rate paid on money market securities. A higher short term interest rate will motivate banks to invest more in these short term instruments, which will improve their liquidity positions. Therefore, a positive relationship between short term interest rate and liquidity is expected (Pilbeam, 2005). Given that Treasury bills are considered as the most liquid and safest assets, short term interest rate is measured as the interest rate on 3 month T-bill and is obtained from BDL statistics. This variable is especially important in the case of Lebanon since Lebanese banks are the main supporters of the government's debt through the purchase of government Treasury bills.

5. Interbank Interest rate (IRB) (+): This variable represents the illiquidity cost since banks lacking liquidity can borrow in the interbank market to meet their cash needs. It was used by Lucchetta (2007) who argued that the higher this rate is, the more expensive is the cost of illiquidity and the more liquid the banks are. This variable is obtained from BDL statistics.
6. Real Interest rate on loans (RL) (-): It is calculated as the lending interest rate adjusted for inflation as measured by the GDP deflator and is obtained from World Development Indicators (WDI), which is the primary World Bank database. A negative relationship is expected since the higher the lending interest rate is, the more profitable the loans are, which will push banks to lend more and to maintain less liquid assets. However, with the presence of asymmetric information, Stiglitz and Weiss (1981) found that adverse selection will lead to credit rationing, so that banks' liquidity might increase with the presence of high interest rates.
7. Unemployment rate (+): This variable is obtained from World Development Indicators (WDI) and is included because an increase in unemployment rate will reduce the demand for loans, enabling banks to be more liquid.

Furthermore, a number of other macroeconomic variables were evaluated to be included in the model, such as discount rate, deposit interest rate and lending interest rate. However, due to significant correlation among the variables, they were dropped from the model in order to avoid muticollinearity problem.

Table 1
EXPLANATORY VARIABLES AND EXPECTED SIGNS

EXPLANATORY VARIABLES	NOTATION	DEFINITION AND SOURCE	EXPECTED SIGNS
Dependent variables			
Liquid assets/Total Assets	(L1)	Liquid assets/Total assets (BANKSCOPE)	NA
Liquid assets/ Deposits	(L2)	Liquid assets/ Total Deposits (BANKSCOPE)	NA
Loans/ Assets	(L3)	Net Loans/ Total assets (BANKSCOPE)	NA
Loans/Dep and Short term Funding	(L4)	Net loans/ Deposits and Short term funding (BANKSCOPE)	NA
Bank-specific variables			
Capital Ratio	(CAP)	Equity/Assets (BANKSCOPE)	Positive
Size	(SIZE)	Ln of Total Assets (BANKSCOPE)	Positive/Negative
Loan Growth	(GLOAN)	Change in Gross loans (BANKSCOPE)	Negative
Non-Performing Loans ratio	(PL)	Non-Performing Loans/ Gross Loans (BANKSCOPE)	Negative
Macroeconomic variables			
Economic Growth	(GROWTH)	Real GDP Growth Rate (WEO)	Negative
Inflation	(INF)	Percentage change in inflation using end of period prices (WEO)	Positive
Liquidity Premium	(LP)	Lending Interest Rate – Deposit Interest Rate (IFS)	Negative
Short term Interest Rate	(INT)	Interest rate on 3 month T-bills (BDL)	Positive
Interbank Rate	(IRB)	Interbank (BDL)	Negative
Real Interest on Loans	(RL)	Lending interest – % change in GDP deflator (WDI)	Negative
Unemployment	(UMP)	Unemployment Rate (WDI)	Positive
Dummy variables			
Dummy 1	(D1)	1 during the crisis (2008-2010), 0 otherwise	Negative
Dummy 2	(D2)	1 if listed bank, 0 otherwise	Positive

In addition to the above mentioned variables, two dummy variables are included:

8. Dummy variable 1 (D1): This variable is used to distinguish the period before the financial crisis from the period after. It is equal to 1 during the financial crisis (2008-2012), and 0 otherwise (2005-2007 period and 2013 period). The negative impact of the financial crisis on the liquidity ratio had been highlighted in many studies (Bunda & Desquilbet, 2008; Vodova, 2011).
9. Dummy Variable 2 (D2): This variable is used to distinguish listed banks from unlisted banks. It is equal to 1 if banks are listed, 0 otherwise. Nguyen, Skully, and Perera (2012) found that listed banks usually hold more liquid assets than non-listed banks.

MODEL

In order to identify the determinants of the liquidity of Lebanese commercial banks, a panel data regression analysis is used, which takes the following equation:

$$Y = \alpha + \beta_{it} X_{it} + \varepsilon_{it} \quad (1)$$

Where Y is the dependent variable measuring liquidity for bank i in time t, X_{it} is a vector of explanatory variables for bank i in time t, α is a constant, β is slope of the variable and εi is the error term.

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.

Descriptive Statistics

Table 2 presents the descriptive statistics for the dependent and independent variables involved in the regression, including mean, standard deviation, minimum and maximum. The results show that most variables comprise 170 observations except growth in loans, NPL (due to missing reported figure from Bankscope), and unemployment (due to unavailable data). Variables containing loans such as growth in loans and net loans divided by total assets present larger standard deviation with 22.44112 and 10.19225 respectively as compared with other variables. It revealed that the quantity of loans has more significant variance than other variables.

Table 2
DESCRIPTIVE STATISTICS

VARIABLES	OBS	MEAN	STD DEV	MIN	MAX
L1	170	.2899883	.1285224	.07225	.8395045
L2	170	.3541414	.1631921	.0905254	1.353085
L3	170	28.09981	10.19225	8.622	63.51
L4	170	32.09844	11.56946	11.318	68.69
CAP	170	8.592488	2.962659	3.494	35.773
SIZE	170	8.258256	1.328531	3.818459	10.90703
GLOANS	158	19.29766	22.44112	-49.68	122.05
NPL	149	11.88389	12.16183	.34	74.79
GROWTH	170	5.537059	3.847166	1	10.3
INF	170	5.354876	1.849306	.517	7.212
LP	170	2.00126	.342959	1.476667	2.490833
INT	170	4.67225	.5069485	3.926667	5.22
IRB	170	3.227941	.5532571	2.75	4
RL	170	4.660176	3.462081	-.8462127	11.8559
UMP	155	22.56516	.5413539	21	22.8

Unit Root Test

Before proceeding with the regression, some tests are needed. First, the stationary of the data will be tested using a Fisher test- a unit root test for unbalanced panel data as suggested by Maddala and Wu (1999).

Results reported in Table 3 show that the null hypothesis of non-stationary (or presence of unit root) is rejected for all variables except short term interest rate, interbank rate, and liquidity premium. Since the dependent variable is stationary, we are less likely to get spurious results even if some variables are not stationary.

Table 3
FISHER TEST FOR A PANEL UNIT ROOT TEST USING ADF

VARIABLES	Chi2(46)	P-Value
L1	138.0735	0.0000
L2	151.8448	0.0000
L3	237.2095	0.0000
L4	254.2093	0.0000
CAP	221.8591	0.0000
SIZE	109.1474	0.0000
GLOANS	82.2865	0.0008
NPL	146.7197	0.0000
GROWTH	87.8911	0.0002
INF	256.6205	0.0000
LP	0.6695	1.0000
INT	13.8646	1.0000
IRB	12.0708	1.0000
RL	108.2474	0.0000
UMP	971.2679	0.0000

To confirm this, stationary of errors will be tested using Fisher test. For example, using L1 as the dependent variable, results show a p-value of 0.0003, rejecting the null hypothesis of non-stationary. Thus, we can conclude that there are no unit roots in the panel under the given test conditions (included panel mean and time trend for bank variables and time trend for macroeconomic variables).

Choice of Regression

The estimation used should take into consideration the special features of the panel data. In static relationship, the literature applies pooled OLS, fixed effect, or random effect model. To choose between the fixed effect (FE) and the random effect (RE), Hausman test (1978) for the exogeneity of the unobserved error component is used. Rejecting the null hypothesis suggests that RE is inconsistent and FE model is better. Results in Table 4 show that accepting or rejecting the null hypothesis depends on the dependent variable. Thus, the analysis is divided into 2 parts: L1 and L2 as the dependent variables on one side, and L3 and L4 as the dependent variables on the other side.

First, using L1 and L2 as the dependent variables, the null hypothesis is rejected (Prob>Chi2 is less than 0.05), concluding that the fixed effect is more efficient than random

effects. The results suggest that each bank has its own individual characteristics that may have an influence on the liquidity. Next, to choose between fixed effect and pooled OLS, the Restricted F test reports a p-value of 0.0000, suggesting that fixed effect is better than pooled OLS. Therefore, the choice of FE indicates the importance to control for all time-invariant difference between banks. Given that fixed effect model will be used for L1 and L2, the next step is to use a joint test to see if time fixed effects are needed. The null hypothesis is that all time fixed effects coefficients are equal to zero. The Prob>F reported in Table 4 is lower than 0.05, rejecting the null hypothesis and suggesting the need to include time fixed effect in our model.

Second, using L3 and L4 as the dependent variables, the null hypothesis cannot be rejected (Prob>Chi2 is more than 0.05), indicating that the random effect is more efficient estimator. Then, to choose between random effect and pooled OLS, Breush and Pagan LM test (1980) is used, with a null hypothesis that variance across entities is zero. Prob>Chibar2 reported in the last row in Table 4 is lower than 0.05, concluding that a simple pooled OLS regression cannot be used. Therefore, a random effect model is run when L3 and L4 are used as dependent variables.

Since some studies suggest the presence of a dynamic model, where bank liquidity position might persist over time, a dynamic model will be run by including the lagged dependent variable among the independent variables.

Table 4
HAUSMAN TEST, F-TEST, TESTPARM AND LM TEST

TESTS	L1	L2	L3	L4
Hausman Test: Ho: difference in coefficients not systematic				
Chi2(8)	29.23	29.37	0.54	1.10
Prob	0.0003	0.0003	0.9998	0.9975
F-test that all u_i=0				
F(21,95)	11.01	9.50	27.01	26.83
Prob>F	0.0000	0.0000	0.0000	0.0000
Testparm				
F(3, 95)	8.40	10.59		
Prob>F	0.0004	0.0001		
Breusch and Pagan Lagrangian multiplier test for random effect				
Chibar2(01)			117.96	116.35
Prob>chibar2			0.0000	0.0000

Multi-Collinearity

To detect multicollinearity, a correlation matrix for all independent variables is conducted. Multicollinearity is considered a serious problem if the correlation coefficients are more than 0.8 (Cooper & Schindler, 2010). Results in Table 5 suggest that muticollinearity is not a problem given that all coefficients are less than the cut-off point set by Cooper and Schindler (2010).

Serial Correlation

Serial correlation, or correlations between errors, should be tested since it might cause smaller standard errors and higher R-squared. Since the Durbin Watson test can be used only in time series, Lagram-Multiplier test derived by Wooldridge (2002) is applied to test autocorrelation in panel-data. Given the null of no serial correlation, the results in Table 6 show that the data has no first order autocorrelation when L1 and L2 are used as the dependent variables since the probability is higher than 0.05. However, when L3 and L4 are used as the dependent variables, results indicate the existence of first order autocorrelation (prob<0.05).

Since serial correlation is considered to be a problem in macro panels with long time series, and since our data is made of only few years, we can conclude that autocorrelation is not a problem. However, for more reliable results, regressions run will be adjusted for autocorrelation, especially in the case of L3 and L4.

Table 6
WOOLDRIDGE TEST FOR AUTOCORRELATION IN PABEL DATA

WOOLRIDGE TEST	L1	L2	L3	L4
F(1,21)	4.007	2.313	33.259	38.552
Prob>F	0.0584	0.1432	0.0000	0.0000

Heteroscedasticity

To detect the presence of heteroscedasticity, Wald Test as suggested by Baltagi (2008) is employed. The null hypothesis is homoscedasticity, or constant variance, meaning that the variance of the error is the same for all individuals. Table 7 reports a P-value lower than 0.05, rejecting the null hypothesis and concluding the presence of heteroskedasdicity regardless of the dependent variables. Therefore, the regression coefficients will be adjusted for heteroskedasdicity.

More specifically, when L1 and L2 are used as the dependent variables, the fixed effect regression used will be adjusted for heterosckedasticy by using robust standard errors known as Huber/White estimators and will be also adjusted for autocorrelation by including robust and clustered standard errors (White, 1980; Rogers, 1993). As for L3 and L4, a fixed effect model is not the best estimator. With the presence of heterosckedasticy and autocorrelation, the generalized least square (GLS) can be used since standard errors estimates can be robust to disturbance as heteroscedastic, contemporaneously cross-sectionally correlated, and autocorrelated of type AR(1). However, GLS is feasible only if the number of entities (N) is less than number of periods (T). Given that our data is made of 22 banks and only 9 years, the latter is not appropriate. Furthermore, Beck and Katz (1995) argued that GLS tends to produce unacceptably small standard errors estimates. Instead, they advocate the use of Prais-Wisnten regression, with panel corrected standard errors. Therefore, Prais-Winsten regression will be used, with panel-specific AR (1) to adjust for autocorrelation and heteroskedastic panels corrected standard errors.

Table 7
MODIFIED WALD TEST FOR GROUP-WISE HETEROSCEDASTICITY

TEST	L1	L2	L3	L4
Chi2(7)	926.52	1622.55	11966.64	9563.15
Prob	0.0000	0.0000	0.0000	0.0000

EMPIRICAL FINDINGS

Presentation of Findings

The empirical evidence on the determinants of banks' liquidity is based on unbalanced panel data. Although two models are presented for each dependent variable, the analysis will be based on the best model.

Using L1 and L2 as the dependent variables, the first model reports the fixed effect technique with robust and clustered standard errors to control for heterosckedasticity and autocorrelation respectively and with the inclusion of time dummies (as shown by Testparm test). The second model (Model 2) reports the dynamic model with robust standard errors where the lagged dependent variable will be included within the independent variables to see whether banks' liquidity exhibits certain degree of persistence over time. Table 8 suggests a high coefficient of determination (within R2 of 0.4972 and 0.5376) and the estimated model fits the panel data as shown by the high F test in case of model 1 and the high Wald test in case of model 2.

To test whether residuals are serially correlated at specified range (1-1; 1-2) and at specific lag 2, Table 9 reports Cumby and Huizinga test (1992) where a p-value higher than 0.1 indicates the presence of serial correlation.

Results show that the residuals from Model 1 are not serially correlated when L1 and L2 are used as the dependent variable. Since the residuals of Model 2 appear to be serially correlated, the analysis will be based on Model 1. Some variables were omitted due to collinearity and they are represented by a coefficient of 0.

By comparing the results for L1 and L2, the regression using L2 as the dependent variable has a higher explanatory power. The findings revealed that these two liquidity ratios are affected by similar factors given a very close number and signs of significant variables. Thus, the discussion of results based on L1 and L2 will be combined together.

Determinants of liquidity measured by L3 and L4 are shown in Table 10. These two ratios have reverse interpretations than L1 and L2, since a higher value means lower liquidity. Thus, a positive impact on liquidity is represented by a negative sign of the coefficient. Similarly, two models are run with L3 and L4 as dependent variables. The first model reports the Prais-Winsten regression with AR (1) and heteroskedastic panels corrected standard errors (Model 1) , while the Model 2 reports the dynamic model with robust standard errors.

Comparing the results for L3 and L4 suggests that these two liquidity ratios are affected by similar factors. Therefore, the discussion of results for both L3 and L4 will be combined together. Table 11 reports Cumby and Huizinga test (1992) when L3 and L4 are used as the dependent variables. Although that the regressions were adjusted for autocorrelation, results show that the residuals are serially correlated for all ranges and for all lags. Due to the presence of serial correlation, results obtained using L1 and L2, are considered to be more reliable than those obtained using L3 and L4.

Table 8
DETERMINANTS OF BANK'S LIQUIDITY (L1/L2 AS DEPENDENT VARIABLES)

	L1 as the dependent variable				L2 as the dependent variable			
	Model 1 (Fixed Effect, Robust and Clustered with Time Dummies)		Model 2 (Dynamic Model, Robust with Time Dummies)		Model 1 (Fixed Effect, Robust and clustered with time dummies)		Model 2 (Dynamic Model, Robust with time dummies)	
	Coef.	P>t	Coef.	P>t	Coef.	P>z	Coef.	P>z
CAP	.0133667	0.016**	.004366	0.421	.0161149	0.013**	.0096844	0.194
NPL	-.0012276	0.130	-.0008112	0.244	-.0014834	0.146	-.000691	0.367
SIZE	.1786031	0.060*	.1430619	0.045**	.2602682	0.019**	.2475066	0.018**
GLOANS	-.0008658	0.005***	-.0009595	0.006***	-.0010824	0.004***	-.001306	0.002***
GROWTH	.0062644	0.145	-.0240094	0.000***	.0096887	0.070*	-.0312075	0.000***
INF	-.0237275	0.003***	-.0792122	0.000***	-.030631	0.002***	-.1104813	0.000***
IRB	.1148101	0.002***	.1402029	0.004***	.1606745	0.000***	.2194733	0.003***
INT	0		0		0		0	
LP	0		0		0		0	
RL	.0093243	0.012**	.0234917	0.000***	.012162	0.006***	.0335087	0.000***
UMP	0		0		0		0	
Dummy 1	-.0459299	0.072*	.0462082	0.168	-.0615855	0.046**	.0661668	0.119
Dummy 2	0		0		0		0	
Lagged L			.4117442	0.029**			.3742853	0.067*
Year 1	0		0		0		0	
Year 2	.1145303	0.019**	0		.1633077	0.005***	0	
Year 3	0		0		0		0	
Year 4	0		0		0		0	
Year 5	0		0		0		0	
Year 6	0		0		0		0	
Year 7	-.0301311	0.036**	-.1029898	0.000***	-.0319471	0.102	-.1315789	0.000***
Year 8	0		0		0		0	
Year 9	0		0		0		0	
Cons	-1.584576	0.073*	-.9783167	0.132	-2.358101	0.022**	-1.913112	0.047**
Obs	128		91		128		91	
Within R^2	0.4972				0.5376			
F (12,21)	12.09	0.000***			15.90	0.000***		
Wald Chi			93.82	0.000***			81.90	0.0000

***, **, and * = significant at the 1% level, 5% level, and 10% level respectively
Variables with a coefficient of 0 were dropped because of collinearity.

Table 9
CUMBY-HUIZINGA TEST FOR AUTOCORRLEATION (L1/L2 AS DEPENDENT VARIABLES)

	L1 as the dependent variable				L2 as the dependent variable			
	Model 1 (Fixed Effect, Robust and Clustered with Time Dummies)		Model 2 (Dynamic Model, Robust with Time Dummies)		Model 1 (Fixed Effect, Robust and clustered with time dummies)		Model 2 (Dynamic Model, Robust with time dummies)	
Range Specified	**Chi2**	**P-value**	**Chi2**	**P-value**	**Coef.**	**P-value**	**Coef.**	**P-value**
1-1	1.754	0.1854	16.091	0.0001	0.522	0.4699	16.868	0.0000
1-2	3.195	0.2024	18.097	0.0001	1.640	0.4405	19.117	0.0001
Lag Specified								
2	1.672	0.1959	11.379	0.0007	1.234	0.2667	12.566	0.0004

Table 10
DETERMINANTS OF BANK'S LIQUIDITY (L3/L4 AS DEPENDENT VARIABLES)

	L3 as the dependent variable				L4 as the dependent variable			
	Model (PW with Panel AR1 and heteroskedastic)		Model 2 (Dynamic Model, Robust)		Model 1 (PW with Panel AR1 and heteroskedastic)		Model 2 (Dynamic Model, Robust)	
	Coef.	P>z	Coef.	P>z	Coef.	P>z	Coef.	P>z
CAP	-.2170271	0.456	-.11613	0.714	.0339292	0.917	.170694	0.638
NPL	-.0665023	0.213	-.0064641	0.869	-.0848806	0.196	-.0084807	0.840
SIZE	-2.008349	0.035**	-7.863646	0.039**	-1.452805	0.121	-9.265285	0.028**
GLOANS	.040313	0.008**	.1073009	0.000***	.0397814	0.030**	.1119529	0.000***
GROWTH	-.1462954	0.205	.0268978	0.906	-.0966553	0.460	.0763645	0.756
INF	-.3486168	0.121	1.89368	0.002***	-.4296815	0.085	2.303425	0.001***
IRB	-.6945789	0.511	-3.354049	0.023**	-.192025	0.875	-3.519557	0.038**
INT	3.091329	0.045**	-1.591749	0.259	3.178667	0.071*	-2.336809	0.108
LP	-12.47713	0.000***	0		-14.26727	0.000***	0	
RL	.436649	0.008***	-.5189146	0.035**	.494083	0.008***	-.6344441	0.017**
UMP	2.6735	0.000***	0		2.616408	0.000***	0	
Dummy 1	2.836048	0.007***	-1.379885	0. 338	3.181476	0.008***	-1.757885	0.244
Dummy 2	-2.314856	0.343	0		-.1552198	0.953	0	
Lagged L			.6971631	0.000***			.7154974	0.000***
Cons	0		82.99239	0.033**	0		94.77832	0.028
Obs	128		91		128		91	
R^2	0.8023				0.8585			
Wald Chi	975.70	0.0000	168.01	0.0000	1923.43	0.0000	215.64	0.0000

***, **, and * = significant at the 1% level, 5% level, and 10% level respectively
Variables with a coefficient of 0 were dropped because of collinearity.

Table 11
CUMBY-HUIZINGA TEST FOR AUTOCORRLEATION (L3/L4 AS DEPENDENT VARIABLES)

	L3 as the dependent variable				L4 as the dependent variable			
	Model (PW with Panel AR1 and heteroskedastic)		Model 2 (Dynamic Model, Robust)		Model 1 (PW with Panel AR1 and heteroskedastic)		Model 2 (Dynamic Model, Robust)	
Range Specified	**Chi2**	**P-value**	**Chi2**	**P-value**	**Coef.**	**P-value**	**Coef.**	**P-value**
1-1	14.786	0.0001	15.953	0.0001	12.858	0.0003	16.244	0.0001
1-2	14.820	0.0006	17.083	0.0002	12.863	0.0016	17.293	0.0002
Lag Specified								
2	12.883	0.0003	13.196	0.0001	11.566	0.0007	13.516	0.0002

Determinants of Bank liquidity as measured by L1 and L2

Starting with the bank specific variables, first, capital positively affects bank's liquidity, consistent with the assumption that banks with sufficient capital should be liquid, in line with previous studies (Vodova, 2011). Higher capital ratio might act as a positive signal to the external public, which will attract more deposits, enabling banks to be more liquid. Second, the positive and statistically significant impact of bank size on liquidityis consistent with the

assumption that small banks focus more on traditional activities such as transforming deposits into loans. By focusing on loans, small banks tend to hold little investment securities, leading to low cash and reserves balance, consistent with Bonfim and Kim (2012) and Lucchetta (2007). Although non-performing loan ratio has the expected sign, the coefficient is not significant. As for the last bank specific variable (loan growth), it has a negative and significant impact, in line with our expectation and consistent with Aspachs et al. (2005) and Valla et al. (2006). The higher the amount of loans provided, the more is the amount of illiquid assets, and the lower is the liquidity. This significant impact reveals that the dependency of Lebanese commercial banks on loans.

Moving to the macroeconomic variables, the economic growth is not significant. Second, the negative significant coefficient of inflation rate might suggest that inflation lowers bank liquidity because it deteriorates overall macroeconomic conditions, consistent with Vodova (2011). Third, the interbank interest rate is positive and significant, suggesting that a higher rate encourage banks to maintain their money in the interbank market as part of liquid assets. Furthermore, a higher rate increases the illiquidity costs if banks need to borrow in the interbank market, pushing banks to be more liquid, consistent with Vodova (2011) and Lucchetta (2007). Fourth, although we expect the short term interest rate to have a positive and significant sign given the dominance of Lebanese commercial banks participation in the Treasury bills market (banks are the major financer of Lebanese government), this variable was dropped from the model because of collinearity. Fifth, the positive effect of real interest rate on lending is surprising. While RL is significant, LP's significance could not be tested due to collinearity. Although it is expected that higher rates on lending encourage banks to lend more and to hold less liquid assets, the positive relationship is consistent with Bunda and Desquilbet (2008) and Vodova (2011), which can be explained with the presence of credit crunch and credit rationing.

Moving to the dummy variables, dummy 1 is negative, indicating that the financial crisis had a negative impact on bank liquidity.

More specifically, result shows that liquidity increases in year 2006 and decreases in year 2011. Dummy 2 is insignificant indicating that listed banks do not differ from unlisted banks.

Determinants of Bank liquidity as measured by L3 and L4

Though the residuals are serially correlated, it is still important to analyze the results obtained in Table 10. The model included four bank-specific variables, with only bank size and growth of loans are significant, while capital position and quality of loans are non-significant. Size is significant with a negative impact on L3 and L4, consistent with the previous finding that smaller banks tend to focus more on lending activities, which lead to lower liquidity. On the other hand, larger banks tend to focus more on investment activities, which lead to higher liquidity. The loan growth has a positive and significant sign, coherent with the fact that loans are illiquid and the higher they grow, the less is the bank liquidity.

As for the macroeconomic variables, only four variables are significant. First, the rate on T-bills has a positive and significant impact on bank loans, illustrating the role of T-bill rate as a benchmark rate. A higher rate leads to an increase in cost of borrowings and lending rates which motivates banks to lend more and to reduce the liquid assets.

Liquidity premium has a negative and significant coefficient. Although unexpected, it supports Bunda and Desquilbet (2008) findings that higher spread will not encourage banks to lend more, due to the existence of credit rationing, similar to the findings obtained using L1 and L2 as the dependent variables. Contrary, the real interest rate on lending has a positive and significant sign, supporting the positive impact of T-bill rates. Finally, unemployment has a positive and significant coefficient in Model 2, suggesting that bank liquidity decreases with unemployment.

As for the dummy variables, results in Table 10 are consistent with the results obtained in Table 8. The financial crisis negatively affects the liquidity of banks, regardless of the measure used.

CONCLUSION

In conclusion, the paper aims to identity the determinants of the liquidity of the Lebanese banks between 2004 and 2013, by using a panel data regression, and four different measures of liquidity. Using four bank specific variables, seven macroeconomic variables and two dummy variables, only few variables proved to be significantly important in determining banks' liquidity. First, the results of this paper show that banks' characteristics explain part of their liquidity. Higher liquidity tends to be associated with bank size and lower growth of loan. These variables are significant regardless of the dependent variables. Second, the paper finds that the impact of macroeconomic indicators on bank liquidity depends on the dependent variables used. Bank liquidity decreases with inflation and increases with real interest rate and interbank rate when L1 and L2 are used as dependent variables. Moreover, bank liquidity decreases with short term interest rate, real interest rate, and unemployment, and increases with liquidity premium when L3 and L4 are used as dependent variables. The impact of real interest rate and liquidity premium on liquidity supports the presence of credit rationing in the Lebanese banking sector, while the impact of interbank rate proves the dependency of the Lebanese banks on the interbank market in case of liquidity shortage. The impact of short term interest rate demonstrates the use of T-bill as a benchmark rate.

Third, the paper supports the persistence of liquidity in the banking sector given the significance of the lagged liquidity. Fourth, the paper finds that the financial crisis has a negative impact on bank liquidity as shown by the significance of Dummy 1. Finally, no significant difference exists between listed and unlisted banks as shown by the insignificance of Dummy 2.

These findings are important in many aspects. The study concludes that bank specific fundamentals must be monitored; since more liquid assets are required as the bank size increases. The central bank regulations also greatly affect the liquidity of Lebanese commercial banks (such as the interbank rate). Moreover, monetary policy needs be monitored due to the undesirable effects of inflation on liquidity. Besides, the negative impact of financial crisis on banks liquidity suggests the need for Lebanese banks to carefully forecast the liquidity requirements as anticipation for future events. Lastly, the unstable political environment needs to be solved to improve liquidity. The results suggest that some of the variables affecting Lebanese banks liquidity may be controlled by the government. The paper is a just a stepping stone and future researches are needed to focus on qualitative factors such as political instability, the currency circulation and salary and wages levels as probable determinants.

ENDNOTES

1 The GLS random model with robust and clustered standard errors adjusted for heterskedasticity and autocorrelation was run. The explanatory power was 0.3220 for L3 and 0.3007 for L4 supporting Beck and Katz (1995)'s recommendation to use Prais Winsten regression instead of GLS regression.

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