An Empirical Study on Liquidity risk and its determinants in Bosnia and Herzegovina

Ganić Mehmed [1]

This paper presents the research of liquidity risk and its determinants in banking sector of Bosnia and Herzegovina (B&H). The aim of this paper is to to examine banks' exposure to liquidity risk in the context of 17 out of 28 commercial banks in B&H, by using data in the period 2002-2012. In the empirical part of the research the multiple regression analysis will be applied with the aim to test the statistical significance and explanatory power of selected variables using various data analysis techniques. For the purpose of analysis of the subject matter and the aim of the research, our paper is organized as follows: After background information about trends in liquidity position of banking sector in B&H and its development is provided in Section 1, Section 2 provides a brief overview of the conducted researches in recent years related to the determinants of the commercial banks' liquidity. Section 3 describes models and variables used in the models & hypotheses. Section 4 analyzes and interprets the empirical findings the impact of explanatory variables on banks' exposure to liquidity risk. Finally, the research conducted in this study showed that most of the analyzed variables had a certain influence on determining the level of banks' exposure to liquidity risk Based on this research the commercial banks should further decide which a variable needs to be used in order to achieve desired level of liquidity.

[1]**Ganić Mehmed**, Assist. Prof. Dr., **International University of Sarajevo, e-mail:** mganic@ius.edu.ba

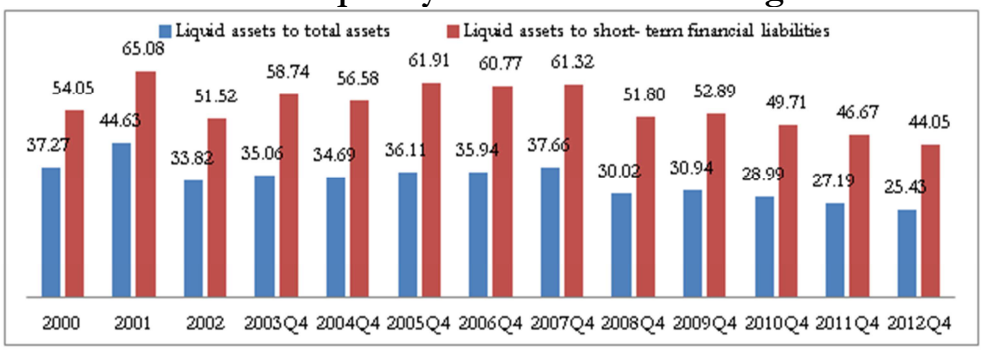
Keywords: liquidity risk, banking sector of B&H, Bank specific determinants, Indicators of liquidity.

JEL Classifications: C33, G21

I. Background Information

During the first decade of transition, in addition to a series of economy policy changes, priority was also given to reform of banking system to accelerate and restore public confidence in the banking system. The changed environment allowed commercial banks to sustain positive long term trends in the form of increased domestic savings. Also, banking sector development in B&H moved forward significantly, either through privatization of stated owned banks or by entry of foreign banks. However, in last few years, the overall financial environment in B&H is particularly affected by the impacts of the sovereign debt crisis in Europe and consequences of the global economic crisis. Fundamentally speaking, many of the activities of commercial banks depend on their ability to provide liquid funds to their clients. Accordingly, commercial banks in B&H are becoming increasingly sensitive to problems related to the maintenance of liquidity. As the transmission of signals from the global crisis to local financial markets first manifested itself through a liquidity crisis, an important impression on the stability of the banking sector and its liquidity position was created. As it is shown in figure 1, over the past twelve years, the share of liquid assets to total assets in B&H decreased from 37.27 percent (in 2000) to 25.43 percent (in 2012), respectively.

Figure 1.
Liquidity indicators of banking sector of B&H



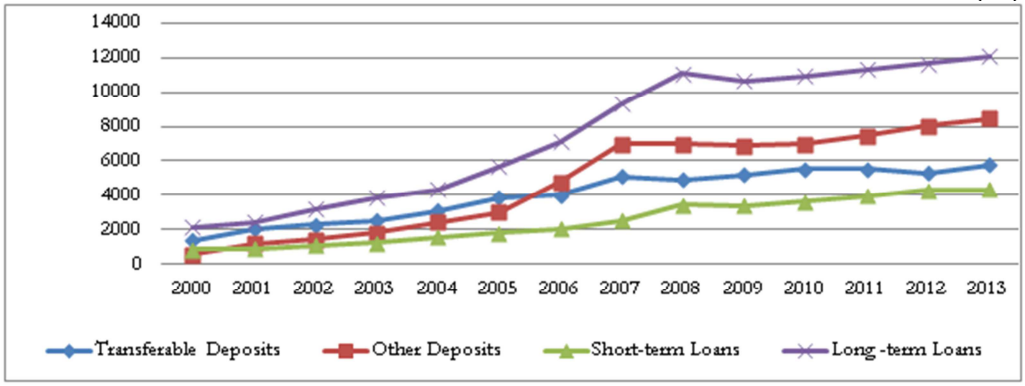
Source: the authors' elaborations on CB of B&H data

At the end of 2007, before the global financial crisis, the ratio of liquid assets to short term financial liabilities (including the interbank obligations) accounted for 61.32 percent of banks' total domestic assets in B&H. As it can be seen from the figure 1, from 2008, changes in the banks' balance-sheet indicators are already apparent in the share and composition of their liquid assets. Clearly, during the period of Q42005-Q42012 the share of liquid assets to short term financial liabilities has substantially dropped from 61.91 to 44.05 percent, primarily as a result of impacts of the sovereign debt crisis in Europe. Most of these commitments can be easily transformed into obligations payable on demand.

Over the period from 2000 to 2012, the share of liquid assets in total assets has decreased steadily since Q42007 and it accounted for 25.43 percent at the end of 2012. Fundamentally speaking, if there is a mismatch between the maturity of banks' deposits and loans, it may jeopardize the solvency of banks. In order to reduce exposure to risk solvency, banks should hold much more liquid assets to provide liquidity. Violation of the liquidity rules can pose a threat to financial stability of B&H, given the absence of lender of last resort mechanism (due to the applied Currency board arrangement). In fact, it is usually

in such circumstances where banks can increase their exposure to systemic risk and weaken confidence in the banking sector. Accordingly, it seems reasonable to consider the maturity structure of loans and deposits of banks in B&H. Overview of the structure is given in figure 2.

Figure 2
The maturity structure of loans and deposits of commercial banks in B&H (%)



Source: the authors' elaborations on CB of B&H data

In 2000 the share of other deposits accounted for only 29.07 percent of total deposits. However, over the last 13 years, unprecedented improvements have been seen in retaining and growing deposits, particularly other deposits (eg. savings and long term deposits). Of course, the question of adequate asset-liability matching is one of the most significant aspects of risk management, (i.e. bank's exposure to liquidity risk). If we take into consideration the composition of deposits it is important to point out that since the end of 2005, transferable deposits recorded a drop in comparison to others deposits. As a result , the share of others deposits in total deposits increased to 59.49 percent in 2013. Equally important is that the share of long-term loans to total loans increased from 64.80 percent as of

the end of 2000 and to 73.57 percent at the end of 2013. Such a structure of loans improved over analyzed time, as it was reflected by improving deposits' composition. Over time, the bank made a significant progress in terms of adjusting the maturity structure of the loans and deposit portfolios, primarily by improving the term structure of savings and new deposits. This is a remarkable achievement given that index coverage of total loans to other deposits almost tripled in terms of commercial banks' balance sheet total from 18.82 percent in 2000 to 51.65 percent in 2013.

II. Literature review

In the banking theory and practice, there are no generally accepted indicators measuring the liquidity of banks. In spite of the fact that there is not enough acceptable indicators for measuring the liquidity, different authors (Sinkey, 2000; Koch et.al., 2000) offered their own approaches for measuring and expressing the liquidity of individual banks and the banking system, as a whole. However, for the purposes of this study it can be recommended to utilize more liquidity indicators, which were aggregated from the data from individual financial reports filed by commercial banks and savings institutions.

The research conducted by Diamond and Dybvig (1983), as well as Diamond and Rajan (1999), found that holding sufficient liquidity is necessary to insure against liquidity risk. The theory of bank run predicts (Diamond and Dybvig, 1983) that the banking assets are mainly long-term and illiquid and that, due to its depreciation and lack of deposit insurance scheme at the national level, the bank may face a surge of creditors, even if it has not declared bankruptcy. According to this theory, the problem occurs on asset side of bank's balance sheet, because the owners of the securities portfolio are exhibiting a decrease in value of their property in case of unexpectedly raised liquidity needs.

This argument is supported by Jacklin and Bhattacharya (1988) suggesting that runs on the banks can also occur if the banks have a low rate of return on assets and equity. Their model is characterized by two –sided asymmetric information problem: the bank might not be able to know the real liquidity needs of depositors, while depositors are asymmetrically informed about bank asset quality. The issue of "liquidity risk and its determinants" has been analyzed by other researchers and different answers have been given ((e.g. asymmetric information - moral hazard (Holmstrom and Tirole, 1998), adverse selection (Kiyotaki and Moore, 2008)). These attitudes can be synthesized down to one ultimate attitude that financially constrained banks would thus tend to hold more liquidity.

In his extensive survey on a sample of ten Central and Eastern European (CEE) countries, over the period from 1994 to 2004, researcher Dinger (2009) empirically examined the effects of foreign banks' penetration on aggregate liquidity and the ability of foreign banks to access liquidity abroad during periods of liquidity distress. He found that liquidity is negatively related to real GDP growth and real per capita GDP. Similar to previous research, Demirgüç-Kunt, A. et al. (2003) used a wide range of sources for their research, using data from over 1,400 banks across 72 countries and concluded that better liquidity equipped banks (cash and government securities) will receive low interest income rather than banks that have less liquid assets.

Aspachs et al. (2005) looked for the nature of relationship between liquidity and set of banking variables, in order to test for the different theoretical relationships among them. This research took place on a quarterly basis in UK resident banks, through the period Q1 1985 to Q4 2003. In their research they came up with the use of two alternative liquidity ratios: Liquidity ratio (1) and Liquidity ratio (2). The findings of their study indicated that liquidity depends on a number of determinants, such as: probability of obtaining the support from lender of last resort, interest margin, loan growth, short term

interest rate, size of bank, GDP as an indicator of business cycle and bank profitability. In their specific work, Arif and Anees (2012) analyzed liquidity risk and used multiple regression model and data from 22 commercial banks in Pakistan in the period 2004-2009 to find out what determined banks' profitability. They found that liquidity risk affects bank's profitability significantly with liquidity gap and non-performing, as well as that liquidity have a negative relationship with profitability.

In another work, Sohaimi (2013) used sample from 56 banks in Malaysia over the period 1997-2012 (i.e. 27 commercial banks, 16 Islamic banks, with the rest of 13 merchant and investment banks), in order to examine the relationship between liquidity risks and financial performance measures by utilizing: deposits, cash, liquidity gap and non-performing loans. Findings of his research showed that liquidity risk affects banks' capital and reserves significantly, with non-performing loans (NPLs), as the important factor in exacerbating the liquidity risk. These elements have a negative relationship with deposits, cash and liquidity gap.

Recent empirical studies by Deléchat, C. et.al. (2012) used a panel of approximatelly 100 commercial banks in countries of Central America in the period 2006-2010. As a result, it was found, that smaller lower-capitalized, less efficient and less profitable banks tend to hold higher liquidity buffers and secondly, that foreign banks, as well as banks with riskier loan portfolios tend to hold less liquidity. Moore (2010) examined the behavior of bank liquidity creation in the financial crisis of 1990s using the sample of countries from Latin America and Caribbean. Examining the position of the banking sector of selected countries in the sample during and after a crisis they found that liquidity tends to fall on average by around 7 percentage points during a crisis. In the 18-month period after the crisis, however, liquidity tends to rise on average by 17 percentage points. The main conclusion of the author based on the results estimated model liquidity is that

liquidity tends to be inversely related to the business cycle, interest rates and the volatility of the cash to deposit ratio. As Berrospide (2013) argues in his research loan loss reserves are another key factor contributing to the increased holdings of liquid assets, especially for small bank.

III. Research Methodology and Data

In the empirical part of the research a Multiple linear regression analysis will be applied in order to test the statistical significance and explanatory power using data analysis techniques, such as: Correlation, R-squared, ANOVA and F-test. The model was tested two times, one with L1 Risk as dependent variable and one with L2 Risk as dependent variables.

Our models can be represented by the following equations:

Yit = f (CAP, NPL, ROE, LLR, TOA, GDP, INF, IRM)

Y1it = β0 + β1 CAP it + β2 NPL it + β3 ROE it + β4LLR it + β5 TOA it + β6 GDP it + β7 RR it + β7LTD it + β8 IRM it + eit

Y2it = β0 + β1 CAP it + β2 NPL it + β3 ROE it + β4LLR it + β5 TOA it + β6 GDP it + β7 RR it + β7LTD it + β8 IRM it + eit

Where are:

Y1it = L1Risk

Y2it = L2 risk

Goal and Hypothesis: The main aim and objective of this paper is to examine banks' exposure to liquidity risk in the context of 17 out of 28 commercial banks in B&H, by using cross-national time series data in the period 2002-2012. Accordingly, our research utilizes the following hypothesis:

Ho: All values of the regression coefficients are equal to zero, (i.e., none of the regression coefficients affects the variation of the dependent variable).

H1: At least one of the significant variables in the regression model explains the variation in the dependent variable (Alternate Hypothesis).

Table 1. Summary of variables used in regression model

Variable	Notation	Measurement	Literature
Capitalization	CAP	the share of own capital on total assets of the bank	Aspachs, O. et.al. (2005) Dinger (2009); Sohaimi (2013)
NPL	NPL	the share of non-performing loans on total volume of loans	Arif and Anees (2012) Sohaimi (2013)
Return on Equity	ROE	the share of net profit on banks´ own capital	Arif and Anees (2012) Aspachs et al. (2005) Deléchat, C. et.al. (2012)
Loan Loss reserves ratio	LLR	Ratio of loan-loss reserves to gross loans	Deléchat, C. et.al. (2012); Aspachs et al. (2005) Berrospide, J. (2013)
Size	TOA	logarithm of total assets of the bank	Deléchat, C. et.al. (2012) Aspachs et al. (2005)
GDP growth (%annual)	GDP	Growth rate of gross domestic product growth	Aspachs et al. (2005) Deléchat, C. et.al. (2012); Dinger (2009);Moore

			(2010) Pana et al. 2009
Reserve ratio	RR	As the ratio of nonearning assets to total deposits for bank i in year t.	Ferreira, C., (2008); De Nicolo et al. (2003)
Loans to deposit ratio	LTD	As the ratio of the loans to deposit ratio for bank i in year t.	Crosse and Hempel (1980) Saunders and Cornet (2007)
Interest Rate Spread	IRM	difference between interest rate on loans and interest rate on deposits	Moore (2010); Demirgüç-Kunt, A. et al. (2003); Aspachs et al. (2005); Dinger (2009);
Liquidity Risk 1	L1Risk	Liquid assets to total assets	Barth et al., 2003; Deléchat, C. et.al. (2012);Vodova, P. (2011)
Liquidity Risk 2	L2 risk	Liquid assets to customer deposits and short-term funding	Chen et al., (2010); Deléchat, C. et.al. (2012) Vodova, P. (2011)

IV. Empirical Results

A preliminary analysis of our models demonstrates that the assumptions underlying the multiple regressions, such as: normality, linearity, multicollinearity, homogeneity of variance and the absence of atypical points are not disturbed. The sample size meets the recommendations given by Stevens (1996) as well as those recommended by other authors (Tabachnick & Fidell, 2007). As you notice from the correlation matrix (table 3) there is not a significant problem of multicolinearity between independent variables. The

correlation coefficients between the independent variables have the value of 0.0046 to - 0.7243, implying low to moderate degree of collinearity between the variables. Correlation matrix between explanatory variables (table 2) reveals that explanatory variables are not highly correlated to each other.

Table 2

Correlation matrix between explanatory variables

	CAP	*NPL*	*ROE*	*LLR*	*TOA*	*RR*	*LTD*	*GDP growth*	*IRsp*
CAP	1.0000								
NPL	0.0401	1.0000							
ROE	-0.0634	-0.3099	1.0000						
LLR	0.0975	0.4546	0.1527	1.0000					
TOA	-0.7243	-0.0915	0.0258	-0.2218	1.0000				
RR	0.6232	-0.0053	0.0397	0.1386	-0.5811	1.0000			
LTD	0.1933	0.0230	0.0046	-0.0025	-0.2088	0.1396	1.0000		
GDP	0.090	-	0.106	0.013	-	0.176	-	1.000	

growth	3	0.2098	8	9	0.2419	8	0.0124	0	
IRsp	0.2164	0.1201	0.0595	0.2221	-0.3999	0.1621	0.0168	0.2704	1.0000

The explanotory variable LTD has a negative correlation coefficient value of -0.0025, -0.2088 and -0.0124 with LLR, TOA and GDP growth respectively. LLR is negatively correlated with TOA, and LTD, but it is positively correlated with all other explanatory variables. Further, the TOA variable also has a negative correlation coefficient with other variables except ROE. However, TOA variable is negatively correlated with other variables, except ROE. Unlike the aforementioned variables, ROE has a positive correlation coefficient with the majority of the variables in the model, except CAP, NPL and IRsp. CAP has a negative correlation coefficient with TOA and ROE, but it is positively correlated with the other explanatory variables.

Additionally, we have also examined the problem of multicollinearity, using the variance inflation factor (VIF). All VIF coefficients are less than 0.005, and tolerance values are over 20%. Breusch-Pagan / Cook-Weisberg test was used to examine the existance of any linear form of heteroscedasticity. The model was tested for Heteroskedasticity using Chi-Square distribution of Breusch-Pagan / Cook-Weisberg test for fixed effect (e.g. M1: Chi2=195.62, Prob > Chi2=0.000 and M2: Chi2= 3635.98, Prob > Chi2=0.000). The null hypothesis for this test indicates the presence of homoskedasticity (i.e. constant error variance.). Since these test results for two regression analysis's p-values are considerably less than 0.05, it reveals that there is evidence for possible presence of heteroskedasticity in our model. The issue was solved by using robust standard errors. Table 3 displays the results of the regression analysis regarding the effect of

explanatory variables on the exposure to liquidity risk of commercial banks in B&H. The corresponding results obtained by analysis of panel data for method of the random effects (RE) and fixed effects (FE) reveal that fixed effect model is preferred. The coefficient of determination in the first model was given by its R-squared of 0.3021, and the second model was given by its R-squared of 0.3705. Adjusted R-squared is used as a better measure of fit and it means that our models can be explained by 26.66% and 33.85% of variability in explanatory variables, respectively. It is obvious,that explanatory power of both models is substantially lower.

Data from multivariate regression analysis shows that both the regression models are statistically significant at 5% each, with the following values of the F statistic: L1 Risk = 7.43 and L2 Risk = 11.58. According to F-test, both models, as a whole are statistically significant and the empirical significance level is less than 1% (Pr > F is <, 0001). Individual t-tests revealed that the following variables: NPL, ROE; LLR, TOA, RR and LTD (Model 1), as well as for CAP, RR and LTD (Model 2) were found to be statistically significant at the empirical significance level of less than 5% (t-test <0.05).

Table 3
Regression results for determinants of liquidity risk measured by L1Risk and L2Risk

Dependent variable	Model 1: L1Risk				Model 2: L2Risk			
Variable	Coefficient	t-statistic	P value	VIF	Coefficient	t-statistic	P value	VIF
C	0.1963748	3.04	0.003	-	-0.9168555	-1.46	0.146	-
CAP	0.0309678	-3.52	0.533	2.531	1.339198	2.36	0.019	2.531
NPL	-0.684159	-2.87	0.001	1.637	-1.515729	-1.08	0.281	1.637
ROE	-0.108434	2.5	0.005	1.282	-0.2909694	-0.84	0.400	1.282
LLR	0.3837576	2.08	0.013	1.549	2.08513	1.63	0.105	1.549
TOA	0.01966	3.7	0.039	2.746	0.1216493	1.5	0.136	2.746
RR	0.0629864	-4.83	0.000	1.783	0.5057001	3.52	0.001	1.783
LTD	-0.05248	-0.79	0.000	1.060	0.2019412	2.49	0.014	1.060

	85							
GDPgrowth	-0.0008751	-1.3	0.433	1.221	0.0052409	0.77	0.440	1.221
IRsp	-0.0032924	3.04	0.196	1.307	0.0349646	1.42	0.157	1.307
R Square	0.3021	DW statistic	1.733	R Square	0.3705	DW statistic	1.545	
Adjusted R Square	0.2666	F statistic	7.43	Adjusted R Square	0.3385	F statistic	11.58	
Std. Error of the Estimate	0.454632	Prob (Fstat)	0.0000	Std. Error of the Estimate	0.3264	Prob (Fstat)	0.000	
Sum of Squares Regression	0.158	Hausman test (p – value)	188.24 (0.0000)	Sum of Squares Regression	11.101	Hausman test (p – value)	131.37 (0.0000)	
Sum of Squares Residual	0.366				Sum of Squares Residual	18.859		

Source: authors' estimation

In Model 1 the paper found that by holding independent variables constant (CAP, NPL, ROE; LLR, TOA, GDP, RR, LTD, IRM), the financial performance will be 0.1963748. The explanatory variables CAP, LLR, TOA and RR have a positive coefficient of 0.0309, 0.3837, 0.1966 and 0.06298, respectively. The following explanatory variables in Model 1: NPL, ROE, LTD, GDP and IR, all have negative coefficients of -0.6841, -0.1084, -0.0524, -0.00087 and -0.00329, respectively. The results of the regression indicate that the NPL have significant negative relation with L1 Risk. In Model 1, the coefficients of NPL, ROE, and LTD show that one unit of increase in NPL, ROE, and LTD decreases L1 Risk by 0.684159, 0.108434, 0.0524885 units, respectively, while one unit increase in LLR, TOA, RR increases L1 Risk by 0.3837576, 0.0001966, 0.0629864 units, respectively. On the other hand, the results from the Model 2, which has L2 Risk as dependent variable, shows that there are three significant variables (i.e. CAP, RR and LTD), which have positive signs and are found to be statistically significant at the empirical significance level of less than 5%. All three explanory variables (i.e. CAP, RR and LTD) have a positive coefficient of 1.339, 0.505 and 0.201, respectively. That implies that one unit of increase in CAP; RR and LTD increases L2 Risk by 1.339198, 0.5057001 and 0.2019412 units, respectively.

V. Conclusion

Analysis of the research results is based on the calculation and analysis of the coefficients of linear and multiple linear correlations. Therefore, this research was undertaken to investigate the influence of selected determinants of bank liquidity risk in the banking sector in B&H. It can be seen from our research that the Model 2 (e.g. L2 Risk as dependent variable) has slightly better Adjusted R Squared (33.85%). The most important determinants of liquidity in the banking sector vary, depending on the variable that is selected as the dependent variable. In the model where the dependent variable L1 Risk, was the

most robust variable to predict banks' exposure to liquidity risk were, as follows: NPL, ROE; LLR, TOA; RR and LTD (Model 1), as well as for CAP, RR and LTD (Model 2). As it is assumed, variable RR is positively related to liquidity risk in both regression models, which were conducted in this paper, while LTD variable has significant negative relation with L1 Risk, as well as significance positive relation with L2 Risk.

The value of the coefficients in Model 1 (e.g. NPL, ROE; LLR, SIZE; RR and LTD) were –(0.684159, -0.108434, 0.38375, 0.01966, 0.0629 and -0.0524), respectively. In other words, it suggests the lower impact of some explanatory variables on L1 Risk, such as: ROE, TOA; RR and LTD. Inverse relation between NPL and L1 Risk is justified by the fact that poor asset quality leads to lower profitability and less liquidity or higher exposure to liquidity risk. This negative relationship between NPL and L1 Risk suggests that increase of NPL has inverse relations on liquidity of commercial banks. ROE also have the negative and significant impact on the liquidity of the bank.. Above results are in the line with the obtained results from previous research [(e.g. Dinger (2009); Aspachs et al. (2005)]. In Model 1, it is determined that ROE has negative and statistically significant impact on liquidity risk measured by L1 Risk, but statistically insignificant impact on banks' liquidity risk measured by L2 Risk. This is consistent with the theoretical approach and expected impact of liquidity on ROE (Arif and Anees, 2012). Moreover, the results of the regression also revealed that only four variables have significant impact on Model 2. Statistically significant bank specific variables in Model 2, as CAP (1.33918), RR (0.5057001) and LTD (0.2019412) have a positive relationship with the L2 Risk. It means that when each of these variables increases it leads to increases in L2 Risk.

The research conducted in this study showed that most of the analyzed variables included in Model 1 had a certain influence on determining the level of banks' exposure to liquidity risk, but generally

speaking, explanatory power of both models was substantially lower. By observing these two parameters for measuring liquidity risk (i.e. L1 Risk and L2 Risk) separately, we showed that Model 2 had a slightly higher explanatory power and that included variables had a greater impact on the dependent variable L2 Risk, in comparison to the case in Model 1.

Table 4
Summary of Hypothesis Testing

	Sign (L1Risk)	Reject H0 (L1Risk)	Sign (L2 Risk)	Reject H0 (L2 Risk)
CAP	+	No	+	Yes
NPL	-	Yes	-	No
ROE	-	Yes	-	No
LLR	+	Yes	+	No
TOA	+	Yes	+	No
GDP	-	No	+	No
RR	+	Yes	+	Yes
LTD	-	Yes	+	Yes
IRsp	-	No	+	No

Reference

Arif, A. and Anees A. N., (2012), "Liquidity risk and performance of banking system", Journal of Financial Regulation and Compliance, Vol. 20 Iss: 2, pp.182 – 195.

Aspachs, O. E. Nier and Tiesset, M. (2005), "Liquidity, Banking Regulation and the Macroeconomics, Evidence on bank liquidity

holdings from a panel of UK-resident banks", BIS, Retrieved from http://http://www.bis.org/bcbs/events/rtf05AspachsNierTiesset.pdf
Banking Agency of Federation of Bosnia and Herzegovina, (2012). Retrieved from http://www.fba.ba
Banking Agency of Republic of Srpska (2012), Retrieved from http://www.abrs.ba/
Barth, J.R, Nolle DE, Phumiwasana T, Yago G. (2003), "A Cross-Country Analysis of the Bank Supervisory Framework and Bank Performance", Financial Markets, Institutions & Instruments, 12: 67-120.
Berrospide, J. (2013), "Bank Liquidity Hoarding and the Financial Crisis: An Empirical Evaluation", Finance and Economics Discussion Series Divisions of Research & Statistics and Monetary Affairs Federal Reserve Board, Washington, D.C.
Central Bank of Bosnia and Herzegovina, (2002-2013). Financial Stability Reports, Annual Reports.
Chen YK, Shen CH, Kao LF. (2010), "Bank Liquidity Risk and Performance". Journal of Financial Regulation, 20(2).
Crosse, H., Hempel, G. (1980), Management Policies for Commercial Banks, 3rd ed., Prentice Hall Inc., Englewood Cliffs, New Jersey.
Deléchat, C., Henao, C. Muthoora, P., Vtyurina, S. (2012), "The Determinants of Banks' Liquidity Buffers in Central America", IMF Working Paper, WP/12/301.
Demirgüç-Kunt, A., Laeven, L., Levine, R. (2003), "The Impact of Bank Regulations, Concentration, and Institutions on Bank Margins," World Bank Policy Research Working Paper NO. 3030.
De Nicolo, G., Geadah, S., Rozhkov, D. (2003), "Bridging the great divide: Poorly developed financial systems in the CIS-7 countries may jeopardize their sustained growth". Finance and Development 40 (4): 42-45.

Diamond, D.W., Dybvig, P.H. (1983), "Bank Runs, Deposit Insurance, and Liquidity." Journal of Political Economy 91 (5): 401–19.

Diamond, D.W., Rajan, R. G. (1999), "Liquidity Risk, Liquidity Creation and Financial Fragility: A theory of Banking," NBER Working Paper 7430 (Cambridge: National Bureau of Economic Research).

Dinger, V. (2009), "Do Foreign-owned Banks Affect Banking System Liquidity Risk? ", Journal of Comparative Economics, Vol. 37, pp. 647–57.

Ferreira, C., (2008); "The banking sector, economic growth and EU integration", Journal of Economic Studies, 35(6): 512-527.

Holmstrom, B., Tirole, J., (1998), "Private and Public Supply of Liquidity," Journal of Political Economy, University of Chicago Press, vol. 106(1), pp. 1-40.

Jacklin C. J., Bhattacharya, B. (1988), "Distinguish panics and information-based bank runs: welfare and policy implications", Journal of Political Economy 96, 568-592.

Kiyotaki, N., Moore, J. H. (2008), "Liquidity, Business Cycles and Monetary Policy, "Princeton University, Edinburgh University and London School of Economics

Koch, T., MacDonald, W., Scott, S. (2000), Bank management, The Dryden Press, Orland

Moore, W. (2010), "How do financial crises affect commercial bank liquidity?: Evidence from Latin America and the Caribbean", MPRA Paper, No. 21473.

Pana, E., Park, J., Query, T. (2009), "The impact of mergers on liquidity creation, " Working Paper.

Sinkey, J. (2000), Commercial Bank Financial Management, Prentice Hall, Englewood Cliffs, New Jersey.

Sohaimi, A.N.A. (2013), "Liquidity Risk and Performance of Banking System in Malaysia", Mara University of Technology Johor, Malaysia.

Stevens, J. (1996), Applied multivariate statistics for the social sciences (3rd edn.). Mahwah, NJ: Lawrence Erlbaum Cooper, D. C., & Schindler, P. S., 2009, „Business Research Methods' 9th edition. Tata McGraw-Hill. New Delhi

Tabachnick, B.G., Fidell, L.S. (2007), Using multivariate statistics (5th edn.). Boston: Pearson Education.

Vodova, P. (2011), "Liquidity of Czech commercial banks and its determinant"s, International Journal of Mathematical Models and Methods in Applied Sciences, 5(6): 1060-1067.

Appendix 1: Test Normality (Model 1)

One-Sample Kolmogorov-Smirnov Test (Model 1)											
	CAP	NPL	ROE	LLR	TOA	RR	LTD	GDP growth	IRsp	L1Risk	
N	187	187	187	187	187	187	187	187	187	187	
Normal Parameters[a,b]	Mean	.143026	.061535	.026949	.053041	5.501715	.624093	.965306	3.272727	5.181818	.253019
Std. Deviation	.090278	.030571	.0984298	.034764	.5504652	.2799672	.3219949	3.1152512	1.530721	.0530850	
Most Extreme Differences	Absolute	.138	.134	.293	.146	.068	.102	.083	.256	.235	.056
Positive	.138	.134	.187	.146	.068	.102	.083	.131	.235	.056	
Negative	-.112	-.099	-.293	-.125	-.056	-.085	-.060	-.256	-.155	-.050	
Kolmogorov-Smirnov Z	1.889	1.826	4.010	1.996	.925	1.389	1.132	3.498	3.207	.771	
Asymp.	.002	.003	.000	.001	.359	.042	.154	.000	.000	.592	

Sig. (2-tailed)										
a. Test distribution is Normal.										
b. Calculated from data.										

Appendix 2: Test Normality (Model 2)

One-Sample Kolmogorov-Smirnov Test (Model 2)											
	CAP	NPL	ROE	LLR	TOA	RR	LTD	GDP growth	IRsp	L2Risk	
N	187	187	187	187	187	187	187	187	187	187	
Normal Parametersa,b	Mean	.143026	.061535	.026949	.053041	5.501715	.624093	.965306	3.272727	5.181818	.661811
Std. Deviation	.090278	.0305713	.098429	.0347641	.5504652	.2799672	.3219949	3.1152512	1.530721	.4013531	
Most Extreme Differences	Absolute	.138	.134	.293	.146	.068	.102	.083	.256	.235	.198
Positive	.138	.134	.187	.146	.068	.102	.083	.131	.235	.198	
Negative	-.112	-.099	-.293	-.125	-.056	-.085	-.060	-.256	-.155	-.118	
Kolmogorov-Smirnov Z	1.889	1.826	4.010	1.996	.925	1.389	1.132	3.498	3.207	2.710	

Asymp. Sig. (2-tailed)	.002	.003	.000	.001	.359	.042	.154	.000	.000	.000
a. Test distribution is Normal.										
b. Calculated from data.										

Appendix 3. Hausman fixed random (Model 1)

```
. hausman fixed random

                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |     fixed        random       Difference          S.E.
-------------+----------------------------------------------------------------
         cap |  -.0336949     .0049424       -.0386373         .034513
         npl |  -.3927677    -.8351799        .2424122        .0613383
         roa |   .0362371     .0467552        .0094819         .005829
         lir |   .2821139     .3843043       -.1023884        .0680343
        size |  -.055613      .0120847       -.0676997        .0238741
          rr |   .0634148     .0643853       -.0009705         .00659
         itd |  -.0387198    -.0517383        .0130367        .0062377
   gdpgrowth |   -.002047    -.0009497       -.0010973         .000348
        irap |  -.0124036    -.0037934       -.0086101         .005319
-------------+----------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(9) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =     188.24
                Prob>chi2 =     0.0000
                (V_b-V_B is not positive definite)
```

Appendix 4. Hausman fixed random (Model 2)

```
. hausman fixed random

                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |     fixed        random       Difference          S.E.
-------------+----------------------------------------------------------------
         cap |   1.272054     1.337678      -.0656236        .268751
         npl |  -.5706045    -1.654048       1.083443       .4884244
         roe |  -.0919796     -.225535       .1335555       .0506957
         llr |   2.191675     2.578759      -.3870845       .5321964
        size |  -.3715652     .1098411      -.4814063       .1855515
          rr |   .4399735     .5003133      -.0603397       .0520433
         ltd |   .0398099     .1819567      -.1421468       .0488468
   gdpgrowth |  -.0039071     .0052177      -.0091248       .0038257
        irsp |  -.0310211     .0348065      -.0658276       .0252631
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(9) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =      131.37
                Prob>chi2 =      0.0000
                (V_b-V_B is not positive definite)
```