DE GRUYTER OPEN

Scientific Annals of Economics and Business
63 (3), 2016, 429-440
DOI: 10.1515/saeb-2016-0132

SOLVENCY AND LIQUIDITY LEVEL TRADE-OFF: DOES IT EXIST IN CROATIAN BANKING SECTOR?

Ana KUNDID NOVOKMET[*], Antonia MARINOVIĆ[**]

Abstract

We focus on 32 Croatian banks in the period 2002-2010 in order to investigate the solvency-liquidity nexus. Dynamic panel data analysis is applied on two basic models in which current liquidity ratio and equity to assets ratio are set as dependent variables, interchangeably, and other explanatory variables employed to capture the effect of bank size, profitability and asset quality as well as macroeconomic environment. We found two-way positive relationship between bank solvency and liquidity. However, bank size plays an important role in the capital and liquidity management, and trade-off between the solvency and liquidity level is found for the larger banks. Therefore, policymakers should take into consideration capital and liquidity interdependence, as well as the bank size effect when designing capital and liquidity requirements in order to downsize the regulatory burden for smaller banks, and increase them for larger banks. Namely, larger banks tend to minimize regulatory costs by avoiding simultaneous increase of liquidity and solvency. Small banks do exactly the opposite and stock both, capital and liquidity, what potentially makes their funds allocation sub-optimal, from their own as well as social point of view. Altogether, the paper contributes to scarce empirical evidence regarding bank solvency and liquidity interdependence, particularly when the post-transitional banking sectors are taken into consideration. It adds to knowledge on bank financial management in praxis, and bank managers and prudential authorities might find it relevant for their policies design and implementation.

Keywords: banks, liquidity, solvency, banking regulation, Croatia

JEL classification: G21, G28

1. INTRODUCTION

During the financial crisis 2007/2008, many banks faced asset quality impairments, liquidity shortages and solvency problems, and consequently bankrupted (Imbierowicz and Rauch, 2014). After numerous bank failures and bailouts, the Basel Committee on Banking Supervision developed the new regulatory framework which aims to improve the banking sector ability to absorb shocks arising from the financial and economic disturbances. However, when creating the new framework based on liquidity and additional capital

[*] Faculty of Economics, University of Split, Croatia; e-mail: *akundid@efst.hr*.
[**] Enel Split Ltd, Croatia; e-mail: *a.marinovic92@gmail.com*.

requirements the Committee did not take into consideration that liquidity and solvency are two interrelated aspects of the business of banking. In this paper we summarize and extend the existing work on the liquidity and solvency concept and their nexus. The aim of this study is to identify the relationship between liquidity and solvency in the Croatian banking sector and to find out the impact of macroeconomic environment (proxy with GDP growth variable), bank asset quality (approximated with the non-performing loans indicator), profitability (measured with the return on assets) and size on bank liquidity and solvency levels in the period from 2002-2010. The most of data were collected and/or calculated from the publications available on the Croatian National Bank's (CNB) website, while some of them were supplemented with the data disclosed in annual reports of sample banks. The rest of the paper is organized as follows. Section 2 reviews the literature regarding liquidity and solvency relationship with the Basel III framework in focus. Section 3 discloses empirical strategy and discusses research findings. In the last section conclusions are drawn.

2. LITERATURE REVIEW

Theoretical background explains liquidity creation as a consequence of certain level of bank capital throughout two opposing views about the relationship sign. Under the first stand, as discussed by e.g. Bhattacharya and Thakor (1993) the higher capital facilitates bank liquidity creation throughout better risk absorption. The other view, as summed up by Berger and Bouwman (2009), agrees that the higher bank capital has negative impact on bank liquidity creation due to: 1) the "financial fragility structure" effect - the higher capital means less monitoring and less attention paid to deponents which leads to less liquidity creation, and 2) the "crowding-out of deposits" effect as capital is less liquid than deposits and without deposits there is no credit supply and no opportunity to make a profit. In reality the bank liquidity and solvency nexus is much more complex than the above described cases from which it is transparent that the role of liquidity in shaping the bank capital is ignored (Distinguin *et al.*, 2013). Namely, empirical researches mainly employ a certain solvency indicator as a determinant of bank liquidity (e.g. Vodová, 2011; Munteanu, 2012). Thus, empirical investigations which analyse the two-way relationship between bank liquidity and solvency are still novelty, although the new regulatory framework i.e. Basel III spurred vivid discussions about this nexus. The following observations additionally underline a relevance of this topic. Pierret (2015) did an empirical research on the sample composed of 49 publicly traded US banks over a 13-year period (2000-2013) and found that insolvency risk increases more during a crisis for banks which hold more short-term debt. Furthermore, the results indicate that a positive impact of bank profitability on its liquidity via short-term liabilities tends to disappear in crisis when bank is expected to suffer the capital financing shortage, so the aforementioned author highlights that well-capitalized banks reduce their individual and thus overall systemic risk. Similarly, Tarullo (2013) pointed out that additional capital requirements, above levels agreed within the Basel III framework, are necessary for banks which hold too much short-term debt. According to Diamond and Rajan (2000) bank runs together with the systemic risk play a major role in bank liquidity and solvency relationship. As a result of the fear of their spreading as well as the risk of repeating a financial crisis, the Basel Committee on Banking Supervision proposed new reforms under the Basel III standard. Although higher capital ratios and new liquidity requirements are goaled to improve the banking sector stability, their high implementation costs might have a negative impact on banks' profitability. According to the summary of the Basel III monitoring report (Basel

Committee on Banking Supervision, 2015), which was carried out in 224 banks, the full implementation of the new regulatory framework will strengthen bank capital and liquidity levels, but the only requirement which is almost completed in 2015 is that for Tier 1 capital. For instance, for the full implementation of other capital standards (Tier 2 capital and Leverage ratio) and liquidity standards (LCR-liquidity coverage ratio and NSFR-net stable funding ratio) there is still more than 950 billion EUR missing. With reference to that, Allen *et al.* (2012) emphasize the existence of trade-off between high costs of adjustments to the new reforms and financial stability. Also, they highlight the negative consequences of the new reform on bank liquidity management and the necessity of changing the regulatory definition of liquid assets. Authors conclude that the implementation of Basel III regulatory framework requires cooperation between macroprudential and monetary policy and bank supervisors. The role of the monetary policy was analysed by Merkl and Stolz (2009). Their empirical research for the German banking sector for the period from 1999-2004 analysed the effects of banks regulatory capital on the transmission of monetary policy and revealed results that banks which are holding less capital and having less interbank liquidity react more restrictively to a monetary tightening than their average peer. Thus, Ercegovac and Kundid (2011) conclude that the new liquidity regulation and capital reform in the banking sector are not sufficient; changes in bank strategy, effectiveness of bank managers, market discipline and the redefinition of the lender of last resort role are necessary. Otherwise the Basel III regulatory framework will not be able to prevent future collapses of banking sectors. The work of several authors that additionally inspired this study hereafter follows.

For instance, Distinguin *et al.* (2013) studied the relationship between bank regulatory capital buffer and liquidity in the US and the European banking sector for the period from 2000-2006. The main result of this empirical testing conducted on the sample composed of 574 US banks and 207 European banks showed that banks decrease their regulatory capital when creating more liquidity. Also, the results showed that small-sized US banks actually strengthen their solvency when they meet higher liquidity needs. On the other hand, large banking institutions underestimate liquidity risk because of their too-big-to-fail position, but also due to managing their liquidity with off-balance sheet instruments. Somewhat earlier Berger and Bouwman (2009) obtained an empirical research also for the US banks for the period from 1993-2003 and found that even when they fulfill the minimum regulatory capital requirements, they strengthen their capital levels if facing higher liquidity creation demand, in order to ensure the higher risk protection. Moreover, predictions about the possible trade-off existence between the benefits for the financial stability and the costs of lower liquidity creation induced by higher capital requirements are made (e.g. by Berger and Bouwman, 2009; Horváth *et al.*, 2012), so the new Basel standard might jeopardize liquidity creation, especially in the small-sized banks for which the negative impact of capital on liquidity creation was shown (e.g. in Berger and Bouwman, 2009). However, the risk of excessive liquidity creation for the banking stability should not be neglected as, for instance, Fungáčová *et al.* (2013) revealed results that the excessive liquidity creation increased the bank failure probability in the Russian banking sector over the period from 2000-2007. On the other hand, Batavia *et al.* (2013) presented results for the study covering liquidity creation within the global banking sector in the 1999-2008 period, and confirmed that banks which were solvent and profitable and had higher performing assets in the pre-bear phase were more able to ensure liquidity creation in the bear phase. A conclusion can be made on the desirability of having prudent liquidity creation i.e. the one which is smoothed during various phases of economic cycle, whereat bank solvency, profitability and asset quality could be considered as

its main drivers. At last, Horváth *et al.* (2012) investigated the relation between bank capital and liquidity creation on the sample which encompassed 31 banks in the Czech Republic for the period from 2000-2010. Their research confirmed the financial fragility hypothesis and warned like Berger and Bouwman (2009) about the threat of contraction in liquidity creation in the financial sector caused by the new capital regulation. But besides that Horváth *et al.* (2012) also noticed an opposite relation – which means authors finding a negative, bi-causal relation between capital and liquidity creation, and concluded about the negative effects of excessive liquidity creation for the bank solvency as well.

To sum up, despite differences, the most of the presented findings justify necessity of implementing the minimum liquidity ratios as supplement to capital ratios, but without providing an answer regarding the optimal level i.e. the one which will ensure the banking sector stability, without causing sizeable loss in the economic output. Some studies highlight the relevance of bank size for the regulatory compliance, and stress out the challenge of imposing regulation on large banks, which often adopt regulatory rules in a different way than smaller ones and in contrast with regulator's intentions. Bank profitability and asset riskiness might also explain liquidity creation, as well as its economic surrounding i.e. the phase of economic cycle in the broadest sense. But regardless of those features, insolvent bank could hardly be liquid and thus the positive capital-liquidity relation is expected, while the impact of bank liquidity on its solvency is somewhat ambiguous. Altogether, a research hypothesis **H1** is set up:

H1: Bank solvency and liquidity are mutually determined whereat the nature of the relationship depends on bank size.

3. EMPIRICAL EVIDENCE

The empirical research of bank solvency and liquidity interdependence is carried out on a data sample of 32 commercial banks in the Republic of Croatia in the period from 2002-2010. No later data have been taken into consideration due to crisis circumstances and regulatory measures adopted in order to prevent further disorder in the banking sector. Furthermore, only banks which had business and thus data continuity during the observed 9-year period were taken into consideration. Calculation of financial indicators is based on the publications available on the Croatian National Bank's (CNB) website as well as annual reports disclosed by sample banks. As the collected data have a spatial component (the data for 32 banks), as well as a time component (the data for the period of up to 9 years), the panel data analysis is considered as more suitable for the simultaneous analysis of both data characteristics, than the time series analysis or multiple regression method. To be more precise, data estimation is performed using the dynamic panel model which contains the lagged values of the dependent variable as due to a process of the first-order autoregression the usage of multiple regression is not recommendable. Namely, financial indicators in one period depend on the same financial indicators in the previous period. Generally, the dynamic relations could be expressed in the following manner:

$$y_{it} = \mu + \gamma \cdot y_{i,t-1} + \beta_1 \cdot x_{it1} + \beta_2 \cdot x_{it2} + \ldots + \beta_K \cdot x_{itK} + \alpha_i + \varepsilon_{it}, \; i = 1,\ldots N, t = 1,\ldots T \tag{1}$$

where i denotes an individual and t denotes time, μ is an intercept, γ is a parameter of the lagged dependent variable, β_1, β_2, ..., β_K are the parameters of the exogenous variables, x_{it} are independent variables, α_i is an individual-specific effect and ε_{it} the error term.

Moreover, for the empirical estimation, the GMM (generalized method of moments) Arellano-Bond two-step estimator is used, as the GMM system (Blundell-Bond estimator) is more appropriate in the case of larger number of groups and high value of autoregressive parameter.

Liquidity and solvency indicators are interchangeably employed both, as dependent and independent variables in developed models. Liquidity (LIQ) is measured with current liquidity ratio i.e. short-term assets over short-term liabilities, while solvency (CAP) is proxy with equity to assets ratio. Surely, those indicators are used as a second-best solution, due to lack of data for LCR (liquidity coverage ratio) and NSFR (net stable funding ratio), as well as capital adequacy ratio and other indicators related to regulatory capital. We consider the following variables as independent ones: non-performing loans over total loans (NPL) in order to control the credit risk/asset quality aspect and return on assets (ROA) as profitability indicator. In addition, GDP growth serves to depict macroeconomic surrounding, while interaction variables are used for identifying the bank size effect. Thus, SIZE_LIQ i.e. bank size dummy*LIQ serves to point out adjustment of bank, according to its size and liquidity level to solvency, which means that this variable is used only when CAP is dependent variable. On the other hand, SIZE_CAP or bank size dummy*CAP is used in order to find out the impact of bank size and solvency on liquidity level, and is employed only when LIQ is dependent variable. According to the CNB's criteria banks whose market share exceeds 5% are considered to be large banks, while those with market share in range from 1-5%, and below 1% are medium-sized and small banks, respectively. We use dummy variable 1 for large and medium-sized banks, and 0 for small banks. Correlation matrix confirms that the there exists no multicollinearity problem (Table no. 1). All calculations were made in STATA 13, while figures were made in EViews 8. Altogether, the following models are developed:

$$LIQ_{it} = \mu + \gamma LIQ_{i,t-1} + \beta_1 NPL_{it} + \beta_2 ROA_{it} + \beta_3 CAP_{it} + \beta_4 GDP_{it} + \beta_5 \text{SIZE\_}CAP_{it} + \\ + \alpha_i + \varepsilon_{it};\ i = 1,\ldots,32,\ t = 1,\ldots,9 \tag{2}$$

$$CAP_{it} = \mu + \gamma CAP_{i,t-1} + \beta_1 NPL_{it} + \beta_2 ROA_{it} + \beta_3 LIQ_{it} + \beta_4 GDP_{it} + \beta_5 \text{SIZE\_}LIQ_{it} + \\ + \alpha_i + \varepsilon_{it};\ i = 1,\ldots,32,\ t = 1,\ldots,9 \tag{3}$$

where i denotes an individual and t denotes time, μ is an intercept, γ is a parameter of the lagged dependent variable, β_1, β_2, …, β_K are the parameters of the exogenous variables, α_i is an individual-specific effect and $\varepsilon_{i,t}$ the error term.

Table no. 1 – Correlation matrix

	CAP	NPL	ROA	LIQ	GDP	SIZE_ LIQ	SIZE_ CAP
CAP	1						
NPL	0.2083	1					
ROA	0.1516	-0.0735	1				
LIQ	0.4853	0.3140	0.1212	1			
GDP	0.0507	-0.1373	0.2635	0.0440	1		
SIZE_LIQ	-0.2637	-0.2178	0.1183	-0.3154	0.0041	1	
SIZE_CAP	-0.1898	-0.1892	0.0766	-0.3978	-0.0949	0.8855	1

Source: authors' calculation

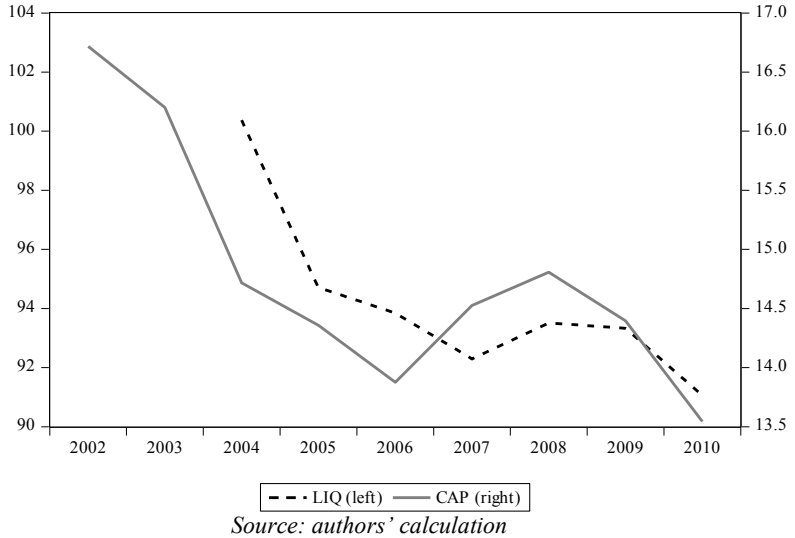
Due to assumed interdependence between liquidity and solvency, when one of these variables is playing independent variable in the model, we treat it as endogenous variable. The descriptive statistics is encompassed with Table no. 2.

Table no. 2 - Descriptive statistics

Variable	Mean	St. deviation	Minimum	Maximum	Number of observations
CAP	14.7933	7.748998	4.545018	48.85991	288
LIQ	94.1557	20.68456	56.93971	186.19	224
ROA	0.984665	1.884622	-15.89966	7.73952	288
NPL	6.759694	6.462263	0.394999	42.23772	288
GDP	2.626636	3.625510	-5.991053	5.371068	288

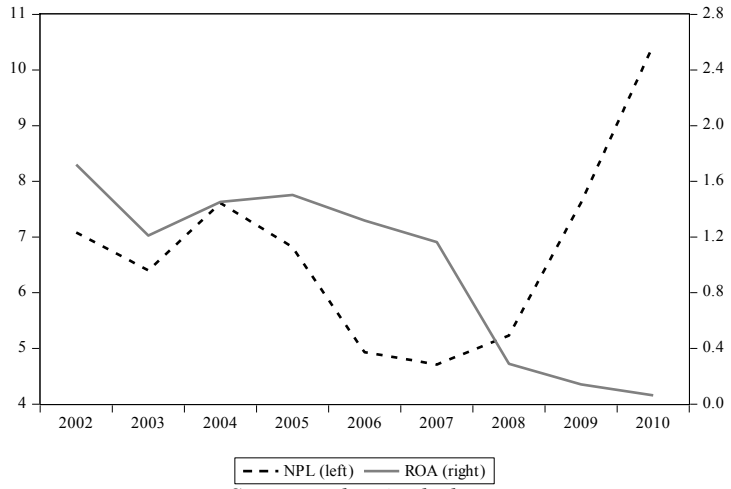
Source: authors' calculation

The mean value of equity to assets ratio is slightly lower than 15%, whilst current liquidity ratio has the mean value of about 94% (Table no. 2). However, Figure no. 1 shows that there is certain dynamics in those variables movements. Thus, the solvency indicator continuously falls down over the period 2002-2006 from the level of 16.5% to the level of about 14%. Since then it rose up to the level of almost 15%, after which is dropped to 13.5%. In the period from 2004-2010, starting with the mean value of 100%, the liquidity indicator was falling the most of time, ending the year 2010 with less than 92% of short-term assets to short-term liabilities.



Source: authors' calculation

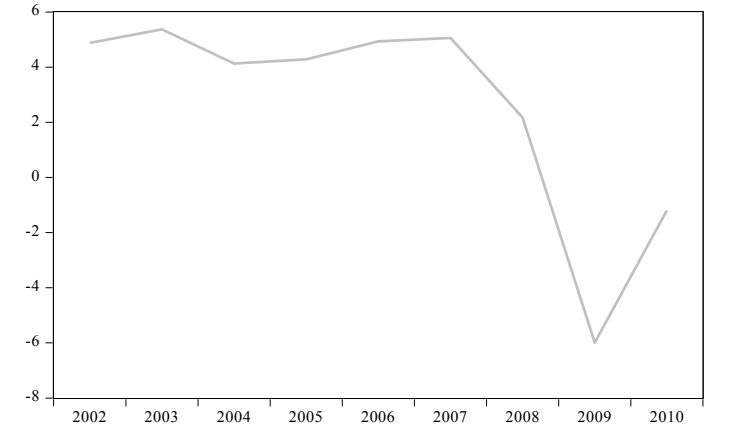
Figure no. 1 – The mean values of liquidity and solvency indicator



Source: authors' calculation

Figure no. 2 – The mean values of credit risk and profitability indicator

Approximately, 6.8% of loans had reduced collectability (Table no. 2). Nevertheless, cyclicality of the NPL variable is transparent from the Figure no. 2 and its average movement is obviously U-shaped. The banking sector's ROA is almost 1% on average, and conclusion on its satisfying profitability can be made. However, attention should be paid to its continuous reduction since 2005. At last, NPLs and ROA are in line with macroeconomic surrounding (Figure no. 3) i.e. GDP growth and banking sector profitability are decreasing simultaneously with the greater credit risk.



Source: authors' calculation

Figure no. 3 – The mean value of GDP growth

Table no. 3 reveals the empirical results of the estimated panel models. Sargan's test as well as autocorrelation test (the second-order i.e. m_2 test) prove reliability and quality of all models as they exceed 0.10. The first-order autocorrelation (i.e. m_1) can be ignored as it is often being expected.

Both lagged dependent variables ($LIQ_{i,t-1}$ and $CAP_{i,t-1}$) have positive signs and are statistically significant. Thus, there is a certain persistency of these variables. However, estimated parameters are higher in case of $CAP_{i,t-1}$ which means that solvency is more defined by the previous year than liquidity ratio. A conclusion can be made that the speed of adjustment of liquidity profile is higher than the speed of adjustment of solvency profile, a phenomenon that has a stronghold both in banking theory and practice. Namely, certain cyclicality in the bank capital accumulation and consumption is already confirmed for the South-Eastern European countries (Kundid Novokmet, 2015, p. 143), what justifies prudential requirements regarding the counter-cyclical capital buffers as banks "are not always in a position to make ad hoc adjustments to the targeted capital levels". Results suggest that an increase in the equity to assets ratio in one period will add to solvency ratio in the following period. In our case, decrease of the $CAP_{i,t-1}$ will cause a reduction in the $CAP_{i,t}$ (Figure no. 1). Altogether, active liquidity management is more available to banks than the active capital management.

Table no. 3 – Panel data estimations using Arellano-Bond estimator

Explanatory variables	**MODEL 1 (LIQ)**	**MODEL 2 (LIQ)**	**MODEL 3 (CAP)**	**MODEL 4 (CAP)**
$LIQ_{i,t-1}$	0.22671*** (0.01858)	0.2462*** (0.01975)	-	-
$CAP_{i,t-1}$	-	-	0.49692*** (0.00735)	0.48654*** (0.0882)
$NPL_{i,t}$	-0.05227* (0.03005)	-0.08412** (0.03669)	0.05333*** (0.00861)	0.06115*** (0.007204)
$ROA_{i,t}$	0.39098*** (0.64832)	0.13335** (0.05492)	0.77084*** (0.00192)	0.76757*** (0.00663)
$CAP_{i,t}$	0.13424*** (0.046395)	0.45893*** (0.5604)	-	-
$LIQ_{i,t}$	-	-	-0.02312*** (0.00271)	0.02303*** (0.00323)
$GDP_{i,t}$	-0.03592 (0.033120)	-0.05369 (0.04092)	-0.03915*** (0.00458)	-0.03865*** (0.00759)
$SIZE\_CAP_{i,t}$	-	-0.28407** (0.12682)	-	-
$SIZE\_LIQ_{i,t}$	-	-	-	-0.084605*** (0.08424)
α	69.4582*** (2.62799)	64.1372*** (2.4253)	7.79978*** (0.30875)	5.36359*** (0.55175)
Number of observations	160	160	192	192
Number of groups	32	32	32	32
Sargan test (p-value)	0.5987	0.6063	0.3546	0.3496
m_1 test (p-value)	0.0534	0.0600	0.0164	0.0088
m_2 test (p-value)	0.9684	0.9468	0.9995	0.5406

*Notes: *** Statistically significant at 1% level, ** statistically significant at 5% level, * statistically significant at 10% level.*

Source: authors' calculation

Credit risk variable (NPL) negatively affects bank liquidity, but positively drives its solvency. This is expected as lower credit collectability means lower liquidity inflows and

higher probability of liquidity crisis occurrence. Contrary, higher credit risk-taking should lead to a consequent capital build up by banks in order to be compliant with capital requirements. However difficult it might be to raise additional capital, adjustment costs of changing the bank risk profile are still more severe (Rime, 2001). On the other hand, more profitable business of banking (ROA) improves both liquidity and solvency. Namely, more profitable banks have easier i.e. more available and affordable access to short-term funding and obviously possess high quality i.e. performing assets. In addition, large banks are usually more profitable (e.g. Căpraru and Ihnatov, 2015) and do not have liquidity-profitability trade-off as they rather adopt borrowed liquidity strategy or balanced liquidity management strategy than the asset conversion strategy (Rose and Hudgins, 2013), what is empirically confirmed for the Croatian banking sector in the pre-crisis period (Kundid Novokmet *et al.*, 2016). But besides availability of the interbank market funds, attention should be payed to affordability of the short-term liabilities as it is confirmed that over the period 2003-2008 Croatian banks profitability was more determined with the interest costs on received loans than the interest costs on received deposits (Kundid, 2014). Thus, sizeable increase of the interest costs on received loans, whether explicit ones what is the first sign of the financial turmoil, or implicit ones i.e. with associated regulatory costs, might justify maintaining higher asset liquidity even for the large banking institutions, which is usually happening simultaneously with the end of credit expansion, but still some presence of the profit persistency. With regards to profitability and solvency the obtained results are even more expected as bank profit is a part of its equity funds. Thus, bank capital can be increased internally, by earnings-retaining policy and vice versa, lower profitability might be a sign of market saturation and linked to equity to assets ratio meltdown due to excessive (risk-weighted) asset growth in the previous period. Figures no. 1 and no. 2 confirm that in Croatia slowdown in the banking sector profitability and equity capital spending happened simultaneously. Moreover, the negative impact of GDP growth on solvency confirms that there is certain cyclicality of CAP variable in case of these 32 banks, as higher the GDP growth, lower is the equity to assets ratio. Namely, after an initial capital build up phase which followed after the problems in many Croatian banks and rehabilitation process, credit growth and capital spending phase took place in a situation of favourable macroeconomic indicators i.e. until the year of 2007. The same conclusion would be valid for the LIQ models if GDP growth was statistically significant.

Finally, the interdependence between liquidity and solvency is confirmed. In model in which liquidity is set out as dependent variable it is found that more capitalized banks maintain higher liquidity. This confirms the view that by proving a certain credit capacity, higher capital enables bank to meet its liquidity needs. Similarly, for the Czech banking sector over the period 2001-2009, Vodová (2011) confirmed the assumption that sufficiently capitalized banks are expected to be liquid too. Further, Munteanu (2012) revealed the same positive effect of solvency (i.e. Tier 1 capital ratio) on bank liquidity (proxy with liquid assets over deposits and short-term funding) for the Romanian banking sector from 2002-2007. Another explanation of our findings arises from the banking praxis in which small-sized banks are usually better capitalized ones (as they are not too-big-to-fail), and at the same time adopt asset conversion liquidity strategy due to unfavorable position on the interbank deposit and loan market. Namely, from the liquidity model with the interaction variable SIZE_CAP it can be concluded that larger banks with the higher capital base, will mostly tend to reduce their liquidity i.e. there is a trade-off between their solvency and liquidity as they want to use their capital for placements and not for liquidity storage. In

addition, due to their credit capacity and too-big-to-fail status they can significantly increase short-term liabilities what reduces the value of selected liquidity indicator. On the other hand, if those banks have poor solvency, their growth limitations are reached as well as their going into debt, and thus they will maintain higher liquidity. In comparison to that, in the models in which solvency is set out as dependent variable mixed results occur, depending on the inclusion or exclusion of interaction variable. Thus, in case when SIZE_LIQ in included in model, LIQ has positive effect on solvency, and in the opposite case it has negative effect on solvency. We assume that the results are not consistent with the previous ones due to smaller number of observations in the first two models for the LIQ variable. However, explanation for the last case follows. Larger banks with higher liquidity ratio tend to decrease their solvency by increasing liabilities if the asset growth is planned or by liquid assets storage (in contraction times when profitability decreases) for which the regulatory capital is not required (or is just modestly required). Vice versa, larger banks with lower liquidity ratio will endeavor to increase their solvency as their short-term funding possibly reached the maximum and in order to avoid fire sales of assets.

At last, a conclusion can be made that in the most cases solvency is in complementary relationship with liquidity, except in the case of larger or too-big-to-fail banks where there is a certain trade-off. However, solvency problems cannot be solved with additional liquidity, while liquidity problems might be partly solved in case of solvent banks, as the lender of last resort should finance only illiquid, but solvent banks. Altogether, research findings demonstrate that separate regulation of liquidity and solvency is not desirable, while isolated management of solvency and liquidity is impossible as they are interrelated.

4. CONCLUSIONS

Recently, supranational prudential authorities prescribed additional capital and new liquidity requirements in order to outsource the lender of last resort function towards banks. However, in design of aforementioned requirements, policymakers neglected the linkage between solvency and liquidity as well as the relevance of bank size, what could be rather important factors for shape of regulatory compliance by banks, and consequently for achievement of regulators' intentions and targeted goals/results they had on mind when those regulatory instruments were enforced. We uphold the view that set up of linear regulatory instruments (i.e. the ones prescribed equally for all banks, regardless of their financial condition or size), rather than discretionary ones (i.e. those which would take into account bank specificities) makes one-size-fits-all problem still actual, and adds to permanent inefficiency of banking regulation. More precisely, with regards to the proposed measures, we assume that too much burden will be put on small banks, in comparison to larger banks, which are too-big-to-fail and thus, in a position to adapt to regulatory requirements in a more cost-efficient way.

Based on a 9-year data range for 32 Croatian banks we confirmed that liquidity and solvency regulation (and planning compliance with it) should be conducted simultaneously and special attention paid to too-big-to-fail banks as they tend to minimize regulatory costs with solvency-liquidity trade-off. Our results lead us towards a proposal of higher capital requirements for the larger and less liquid banks, similarly to policy recommendations disclosed by French *et al.* (2010) via Squam Lake Group report. In addition, disparities in solvency and liquidity ratio were found to be driven with asset quality, profitability and partly with an overall economic growth. At last, we recommend usage of Basel III liquidity

and solvency indicators (e.g. LCR, NSFR, capital adequacy ratio) in future empirical work in order to obtain additional proof for our conclusions.

Acknowledgement

This paper is an outcome of the diploma thesis written by A. Marinović under the supervision of A. Kundid Novokmet at the university graduate degree program in Business Studies, Financial Management course of study, at the Faculty of Economics, University of Split. The diploma thesis oral exam was successfully completed on 10/02/2016. The diploma thesis is available online at: <https://repozitorij.efst.unist.hr/islandora/object/efst%3A50/datastream/PDF/view> [Accessed 15 April 2016]. The paper was presented at the 8th international scientific conference "The Economies of Balkan and Eastern Europe Countries in the Changed World - EBEEC 2016" organized by the TEI EMTH, Accountancy and Finance Department and University of Split, Faculty of Economics, Split, Croatia, May 6-8, 2016.

References

Allen, B., Chan, K. K., Milne, A., and Thomas, S., 2012. Basel III: Is the cure worse than the disease? *International Review of Financial Analysis, 25*, 159-166. doi: http://dx.doi.org/10.1016/j.irfa.2012.08.004

Basel Committee on Banking Supervision, 2015. Basel III monitoring report. March 2015: Bank for International Settlements.

Batavia, B., Parameswar, N., Murthy, S. R., and Wague, C., 2013. Avoiding a liquidity crunch: do pre-bear phase bank ratios matter? Evidence from a world-wide sample. *Journal of Applied Economics and Business Research, 3*(1), 1-13.

Berger, A. N., and Bouwman, C. H. S., 2009. Bank liquidity creation. *Review of Financial Studies, 22*(9), 3779-3837. doi: http://dx.doi.org/10.1093/rfs/hhn104

Bhattacharya, S., and Thakor, A. V., 1993. Contemporary banking theory. *Journal of Financial Intermediation, 3*(1), 2-50. doi: http://dx.doi.org/10.1006/jfin.1993.1001

Căpraru, B., and Ihnatov, I., 2015. Determinants of Bank's Profitability in EU15. *Analele ştiinţifice ale Universităţii "Al.I. Cuza" din Iaşi. Ştiinţe economice / Scientific Annals of the Alexandru Ioan Cuza University of Iasi. Economic Sciences, 62*(1), 93-101. doi: http://dx.doi.org/10.1515/aicue-2015-0007

Diamond, D. W., and Rajan, R. G., 2000. A theory of bank capital. *The Journal of Finance, 55*(6), 2431-2465. doi: http://dx.doi.org/10.1111/0022-1082.00296

Distinguin, I., Roulet, C., and Tarazi, A., 2013. Bank regulatory capital and liquidity: Evidence from US and European publicly traded banks. *Journal of Banking & Finance, 37*(9), 3295-3317. doi: http://dx.doi.org/10.1016/j.jbankfin.2013.04.027

Ercegovac, R., and Kundid, A., 2011. Sadržaj i posljedice novog uređenja kapitala u bankarstvu. *Računovodstvo, revizija i financije, 21*(8), 117-121.

French, K. R., Baily, M. N., Campbell, J. Y., Cochrane, J. H., Diamond, D. W., Duffie, D., . . . Stulz, R. M., 2010. *The Squam Lake report: fixing the financial system*. USA: Princeton University Press.

Fungáčová, Z., Turk Ariss, R., and Weill, L., 2013. Does excessive liquidity creation trigger bank failures? *BOFIT Discussion Papers, 2*, 1-34.

Horváth, R., Siedler, J., and Weill, L., 2012. Bank capital and liquidity creation Granger-causality evidence. *ECB Working paper series, 1497*(nov.), 30.

Imbierowicz, B., and Rauch, C., 2014. The relationship between liquidity risk and credit risk in banks. *Journal of Banking & Finance, 40*, 242-256. doi: http://dx.doi.org/10.1016/j.jbankfin.2013.11.030

Kundid, A., 2014. Heterogeneous funding patterns and income structure of Croatian banks: panel data evidence. *Theoretical and Applied Economics, 21*(9), 23-42.

Kundid Novokmet, A., 2015. Cyclicality of bank capital buffers in South-Eastern Europe: Endogenous and exogenous aspects. *39*(2), 139-169. doi: http://dx.doi.org/10.3326/fintp.39.2.2

Kundid Novokmet, A., Pečarić, M., and Vukadin, M., 2016. Strategije upravljanja likvidnošću banaka u Hrvatskoj: osvrt na pretkrizno razdoblje. In A. Stojanović and H. Šimović (Eds.), *Aktualni problemi i izazovi razvoja financijskog sustava* (pp. 43-62). Zagreb: Ekonomski fakultet.

Merkl, C., and Stolz, S., 2009. Banks' regulatory buffers, liquidity networks and monetary policy transmission. *Applied Economics, 41*(16), 2013-2024. doi: http://dx.doi.org/10.1080/00036840802360245

Munteanu, I., 2012. Bank liquidity and its determinants in Romania. *Procedia Economics and Finance, 3*, 993-998. doi: http://dx.doi.org/10.1016/S2212-5671(12)00263-8

Pierret, D., 2015. Systemic risk and the solvency-liquidity nexus of banks. 54. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2346606 doi:http://dx.doi.org/10.2139/ssrn.2346606

Rime, B., 2001. Capital requirements and bank behaviour: Empirical evidence for Switzerland. *Journal of Banking & Finance, 25*(4), 789-805. doi: http://dx.doi.org/10.1016/S0378-4266(00)00105-9

Rose, P. S., and Hudgins, S. C., 2013. *Bank management & financial services* (9th ed. ed.). USA: McGraw-Hill.

Tarullo, D. K., 2013. Evaluating Progress in Regulatory Reforms to Promote Financial Stability. *Speeches.*Retrieved 20 January 2016, from https://www.federalreserve.gov/newsevents/speech/tarullo20130503a.htm

Vodová, P., 2011. Liquidity of Czech commercial banks and its determinants. *International Journal of Mathematical Models and Methods in Applied Sciences, 5*(6), 1060-1067.