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PREDVIĐANJE LCR-A S BDP-OM, NPL-OVIMA I ROE – SLUČAJ HRVATSKE[1]

PREDICTING LCR WITH GDP, NPLS AND ROE – THE CASE OF CROATIA[1]

SAŽETAK: Cilj ovog rada je ispitati pokretače koeficijenta likvidnosne pokrivenosti (LCR) u Hrvatskoj. Svrha studije je ispitati i analizirati učinak povrata na kapital (ROE), nenaplativih kredita (NPL) i bruto domaćeg proizvoda (BDP) na koeficijent likvidnosne pokrivenosti (LCR) u hrvatskom bankarskom sektoru. Populacija ove studije je hrvatski bankarski sektor od trećeg kvartala 2016. do trećeg kvartala 2021. godine. Empirijski rezultati ukazuju na realne stope rasta BDP-a i razine NPL-a kao pokretača LCR-a u Hrvatskoj, dok učinci povrata na kapital nisu empirijski podržani. Rezultati ovog ispitivanja ukazuju da NPL-i i BDP istodobno utječu na LCR. Slijedom toga, ova studija ima utjecaj na banke u Hrvatskoj.

KLJUČNE RIJEČI: koeficijent likvidnosne pokrivenosti (LCR), bruto domaći proizvod (BDP), loši krediti (NPL), povrat na kapital (ROE)

ABSTRACT: This paper aims to examine drivers of Liquidity coverage ratio (LCR) in Croatia. The intention of this study is to examine and analyse the effect of Return on Equity (ROE), Non-performing Loans (NPL), and Gross domestic product (GDP) on Liquidity Coverage Ratio (LCR) in the Croatian banking sector. The population of this study is Croatian banking sector from q3 2016 to q3 2021. Empirical results suggested real GDP growth rates and NPL levels as LCR drivers in Croatia while effects from ROE were not empirically supported. The results of this study indicate NPLs and GDP simultaneously affect LCR. Consequently, the study has implications for banks in Croatia.

KEY WORDS: Liquidity coverage ratio (LCR), Gross domestic product (GDP), Non-performing loans (NPL), Return on Equity (ROE)

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UVOD

Likvidnost banaka uvijek je vrlo važno pitanje u upravljanju bankama u cijelom svijetu, a isto je i u Hrvatskoj. Jedna od najkorištenijih mjera je koeficijent likvidnosne pokrivenosti (LCR) koji se fokusira na kratkoročnu likvidnost i izračunava se kao koeficijent pokrivenosti neto odljeva i rezervi likvidnosti.

Pitanje koje ovaj članak postavlja je: može li se LCR hrvatskih banaka predvidjeti poznavanjem nekih drugih makroekonomskih inputa (BDP, NPL omjer i ROE). Pri tome su autori razvili tri glavne hipoteze:

- Hipoteza 1: Veća profitabilnost dolazi s manjom likvidnošću,
- Hipoteza 2: Veći omjeri loših kredita (NPL) završavaju s nižom likvidnošću,
- Hipoteza 3: Veći bruto domaći proizvod (BDP) povećao bi likvidnost banaka.

Struktura rada je sljedeća: nakon uvoda objašnjavaju se rizik likvidnosti i osnove LCR-a. Sljedeće poglavlje opisuje pregled literature. U završnom poglavlju analizira se veza između razina LCRL-a i glavnih makroekonomskih pokazatelja (BDP-a, omjera NPL-a i ROE).

INTRODUCTION

The liquidity of banks was always very important issue in bank management as over the world – and the same is in Croatia. One of the most used measure is liquidity coverage ratio (LCR) ratio which focuses on short-term liquidity and is calculated as the ratio of net outflow coverage to liquidity reserve.

The question in this paper is whether LCR of Croatian banks can be predicted by knowing some of the other macro economical inputs (GDP, NPL ratio, and ROE). In doing that authors have developed three main hypothesis:

- Hypothesis 1: Higher profitability comes with lower liquidity,
- Hypothesis 2: Higher non-performing loans (NPL) ratios end up with lower liquidity,
- Hypothesis 3: Higher gross domestic product (GDP) would increase the banks liquidity.

The structure of the paper is as follows: after introduction, the liquidity risk and LCR basics are explained. The next chapter describes major literature review. Final chapter analyses the link between LCRL levels and major macroeconomic indicators (GDP, NPL ratio, and ROE).

RIZIK LIKVIDNOSTI I OSNOVE LCR-A

Likvidnosni rizik definira se kao rizik da financijska institucija, odnosno u ovom slučaju banka, neće moći slobodno konvertirati svoju imovinu planiranom i potrebnom dinamikom. Osim toga, Peterlin (2004) definira rizik likvidnosti kao rizik neusklađenosti imovine i obveza prema izvorima sredstava u gospodarskom subjektu, što može rezultirati poteškoćama u likvidnosti (nedostatkom sredstava za podmirenje dospjelih obveza) ili čak bankrotom gospodarskog subjekta. Nadalje, Prohaska (1996) definira rizik likvidnosti za banku kao rizik nemogućnosti naplate potraživanja (glavnica, kamata, naknada) na dan dospijeća, ali

LIQUIDITY RISK AND LCR BASICS

Liquidity risk is defined as the risk that the financial institution, ie in this case the bank, will not be able to freely convert its assets to the planned and necessary dynamics. Besides, Peterlin (2004) defines liquidity risk as the risk of mismatch of assets and liabilities according to the sources of funds in the economic entity, which may result in liquidity difficulties (lack of funds to settle due liabilities) or even bankruptcy of the economic entity. Moreover, Prohaska (1996) defines liquidity risk for the bank as a risk of inability to collect receivables (principal, interest, fees) on the due date, but also the inability of the bank to fulfil the obligation for the loan.

i nemogućnost banke da ispuni kreditnu obvezu. Konačno, Leko (1993) razlikuje šire i uže pokriće rizika likvidnosti. U užem smislu, rizik likvidnosti upozorava na opasnost da se vrijednosni papiri neće moći prenijeti u gotovini u željeno vrijeme i po željenoj cijeni. U širem smislu, rizik likvidnosti znači opasnost da se nemonetarni oblik imovine neće moći pretvoriti u gotovinu bez gubitaka.

Govoreći o regulatornim mjerama, treba spomenuti da, osim propisivanja minimalnih kapitalnih zahtjeva, regulatori određuju i minimalne rezerve likvidnosti u bankarskom sustavu. Osnovni instrumenti koji se upotrebljavaju za utvrđivanje rezervi likvidnosti su zahtjevi za rezerve i različiti omjeri likvidnosti.

Stoga je glavna promjena regulatornog bankarskog standarda Basel III nastala u području upravljanja rizikom likvidnosti, prvenstveno uvođenjem koeficijenata LCR i NSFR (*Net Stable Funding Ratio*) u svakodnevno poslovanje banaka:

- LCR ili koeficijent likvidne pokrivenosti određuje ograničenja likvidnosti ovisno o očekivanim kratkoročnim odljevima, i
- NSFR ili neto stabilan koeficijent financiranja orijentiran je na dugoročni, strukturni likvidnosni položaj u banci.

Kao što je gore navedeno, koeficijent likvidnosne pokrivenosti (LCR) pokazatelj je koji se pojavio kao dio reforme baselskih propisa nakon velike krize 2008. godine. Usredotočen je na kratkoročnu likvidnost i izračunava se kao koeficijent pokrivenosti neto odljeva i rezerve likvidnosti. Odnosi se na udio likvidne imovine koju drže banke ili druge financijske institucije. Taj je omjer u biti generički test otpornosti čiji je cilj predvidjeti šokove na cijelom tržištu i osigurati da banke imaju dovoljno kapitala za sve kratkoročne poremećaje likvidnosti koji se mogu dogoditi na tržištima.

LCR je doista mjera financiranja likvidnosnog rizika koju su banke osmislile nakon Lehmanove krize 2008. 2014. je donošenje te mjere postalo obvezno za europske banke (u Ujedinjenom

Finally, Leko (1993) distinguishes between broader and narrower coverage of liquidity risk. In a narrower sense, liquidity risk warns of the danger that securities will not be able to be transferred in cash at the desired time and at the desired price. In a broader sense, liquidity risk means the danger that a non-monetary form of property will not be able to convert in cash without losses.

Speaking about regulatory measures, it should be mentioned that in addition to prescribing minimum capital positions, regulators also determine minimum liquidity reserves in the banking system. The basic instruments used to set liquidity reserves are required reserve requirements and various liquidity ratios.

Thus, the main change in the Basel III regulatory banking standard arose in the area of liquidity risk management, primarily by introducing LCR and NSFR (Net Stable Funding Ratio) ratios in the day-to-day operations of banks:

- LCR or liquidity coverage ratio sets liquidity limits depending on expected outflows in the short term, and
- NSFR or net stable funding ratio is oriented towards a longer-term, structural liquidity position in the bank.

As stated above, the liquidity coverage ratio (LCR) is an indicator that emerged as part of the reform of the Basel regulations after the great crisis of 2008. It focuses on short-term liquidity and is calculated as the ratio of net outflow coverage to liquidity reserve. In details, it refers to the proportion of the liquid assets held by banks or other financial institutions. This ratio is essentially a generic stress test that aims to anticipate market-wide shocks and make sure that banks have enough capital preservation for any short-term liquidity disruptions that may happen on markets.

The LCR is indeed a funding liquidity risk measure conceived and designed for banks after the Lehman crisis of 2008. The adoption of that measure has become mandatory for European

Kraljevstvu od 1. listopada 2015.), a sve banke moraju imati najmanje jednu takvu mjeru u sustavu, počevši od 2018.

PREGLED LITERATURE

Početni plan međunarodne normizacije bio je prilagoditi likvidnost i regulaciju kapitala. Međutim, tijekom proteklih desetljeća likvidnost se smatrala presloženom te su stoga opće smjernice smatrane boljim pristupom u prepuštanju pitanja likvidnosti nacionalnim tijelima. Bonner & Hilbers (2015) u svom članku naglašavaju da je zaključak radnih skupina Bazelskog odbora iz 1980-ih bio da će adekvatnost kapitala, koja je definirana prvim Baselskim sporazumom, također potaknuti banke na poboljšanje standarda likvidnosti. Uloga kapitala je prigušiti gubitke, a likvidna imovina može se nositi s rizikom bankarskih transakcija. Kapital i likvidnost banaka često se promatraju odvojeno, međutim, oni su međusobno povezani na više načina ili, kako je Goodhart (2009) istaknuo, kapital i likvidnost banaka su međusobno povezani kao nelikvidna banka koja trenutačno može postati insolventna, a nesolventna banka nelikvidna.

Gore opisano stajalište prema riziku likvidnosti bilo je slično sve do Velike recesije. Okvir za upravljanje rizikom likvidnosti stvoren je početkom prošlog desetljeća, uz veliku promjenu u uvođenju koeficijenta pokrivenosti likvidnosti (LCR) i neto stabilnog omjera financiranja (NSFR).

Stajalište Admatija & Hellwiga (2013) je da bi središnja banka mogla osigurati likvidnost solventnim institucijama kako bi pomogla bankama u rješavanju problema likvidnosti te stoga regulacija likvidnosti nije uvijek potrebna. De Haan i Van den End (2013) u svom radu prezentiraju međusobni utjecaj kapitalnih i likvidnosnih tampon zona, posebno u razdoblju procvata gospodarskog ciklusa. Zaključak njihovog istraživanja je da manje kapitalizirane banke drže više likvidne imovine u odnosu na svoje likvidne obveze. Distinguin et al. (2013.) navode da je implementiranje koeficijenta

banks from 2014 (in the UK from 1st October 2015) and which starting from 2018, it will have to be not less than one for all banks in the system.

LITERATURE REVIEW

The initial plan of international standardisation was to adjust liquidity and capital regulation. However, during past decades liquidity was considered too complex and therefore general guidelines were considered as better approach leaving liquidity issues to national authorities. Bonner & Hilbers (2015) in their paper emphasize that the conclusion of working groups of the Basel Committee in 1980s was that capital adequacy which was defined in original Basel I would also encourage banks to enhance liquidity standards. The role of the capital is to absorb losses whereas liquid assets could deal with the risk of bank runs. Bank capital and liquidity are often observed separately, however, they interrelate in a number of ways or as Goodhart (2009) pointed out that bank capital and liquidity interrelate as an illiquid bank can instantaneously become insolvent, and an insolvent bank illiquid.

The above mentioned point of view towards liquidity risk was similar up to the Great Recession. The framework for liquidity risk management was created at the beginning of the last decade, with major change in introduction of the Liquidity Coverage Ratio (LCR) and the Net Stable Funding Ratio (NSFR).

The view of Admati & Hellwig (2013) that solvent institutions could be provided liquidity by the central bank in order to help the bank with the liquidity problems and therefore the regulation of liquidity is not always necessary. De Haan & Van den End (2013) present in their work the interplay of capital and liquidity buffers, especially in booming time of economic cycle. The conclusion of their research is that less capitalized banks hold more liquid assets against their liquid liabilities. Distinguin et al. (2013) present that

likvidnosti u regulaciju važnije za velike banke nego za male, jer velike banke podcjenjuju rizik likvidnosti zbog svoje pozicije da su prevelike da bi se dopustilo njihovo propadanje (TBTF) ili zbog korištenja izvanbilančnih instrumenata u upravljanju likvidnošću. Adrian i Boyarchenko (2018) pretpostavljaju da bi zahtjevi za likvidnošću mogli biti korisniji od kapitalnih zahtjeva. Zaključak je da rast potrošnje neće biti umanjen, jer pooštravanje zahtjeva za likvidnošću smanjuje vjerojatnost sistemskih poteškoća i povezanosti s potrošnjom.

Premija LCR-a mogla bi za svaku vrstu kredita povećati njihovu vrijednost u smislu usklađenosti s uredbom. Posljedica je da regulacija likvidnosti generira određene premije na međubankovnom tržištu koje se ogledaju u povišenim kamatnim stopama. Bech i Keister (2017) u svojim istraživanjima LCR-a utvrđuju da je količina visokokvalitetne likvidne imovine ključna odrednica troškova financiranja banaka, dok rezerve središnje banke nisu od te važnosti. Zaključuju i da bi povećanje udjela likvidnosti moglo imati kontrakcijski učinak u monetarnoj politici. Greenwood et al. (2016) ističu da bi snažan utjecaj LCR-a na monetarnu politiku mogao potaknuti monetarna tijela da prikažu jaku bilancu kako bi se osigurala likvidnost banaka.

Carlson et al. (2015) tvrde da je jedan od razloga uvođenja LCR-a bio suzbijanje uloge središnjih banaka kao pružatelja likvidnosti. Do istog zaključka došli su Greenwood et al. (2016) te Bech i Keister (2017), iako se njihovi modeli odigravaju drukčijim kanalima.

Coeuré (2016) i Quarles (2018) ističu da su dužnosnici Europske središnje banke (ESB) i Sustava federalnih rezervi (Fed) identificirali ograničenost monetarne politike koja se odnosi na koeficijente likvidnosti kao ključni rizik. Prema njihovim riječima, odgovor politike trebao bi uključivati jaku bilancu središnje banke ili povećanje likvidnosti.

Kritičari LCR-a raspravljaju o negativnom materijalnom učinku na gospodarski rast i

putting liquidity ratios into regulation is of more relevance for large banks than for small banks as large banks underestimate liquidity risk, due to their too-big-to-fail (TBTF) position or by usage of off-balance sheet instruments in managing liquidity. Adrian & Boyarchenko (2018) assume that liquidity requirements could be more useful than capital requirements. The reasoning is that consumption growth will not be impaired as tightening liquidity requirements lowers the likelihood of systemic distress and relation to consumption.

An LCR premium could increase for each type of loan their value in terms of complying with the regulation. The consequence is that liquidity regulation generates certain premia in interbank market reflected in elevated interest rates. Bech & Keister (2017) find in their research of LCR that quantity of high-quality liquid assets is crucial determinant of banks' funding cost whereas central bank reserves are not of that importance. They also conclude that rise in liquidity ratios could have contractionary effect in monetary policy. Greenwood et al. (2016) point that the strong influence of LCR on monetary policy could push monetary authorities to preserve large balance sheet in order to provide banks' liquidity.

Carlson et al. (2015) argue that one of the reasons of the introduction of LCR was to curb the central banks' role as liquidity providers. The same conclusion was reached in papers of Greenwood et al. (2016) and Bech & Keister (2017) although their models play out through different channels.

Coeuré (2016) and Quarles (2018) point out that European Central Bank (ECB) and Federal Reserve (Fed) officials has identified restrictiveness of monetary policy related to the liquidity ratios as a crucial risk. According to them the policy response should involve large central bank's balance sheet or to enlarge liquidity.

Critics of the LCR argue about negative material effect on economic growth and lending to the real economy, particularly to SMEs. According

kreditiranje realnog gospodarstva, posebno malih i srednjih poduzeća. Prema izvješću EBA-e (2013), makroekonomski troškovi LCR-a minimalni su i rezultiraju povećanjem raspona kredita, što je makroekonomski pokazatelj od -5 i -3 baznih bodova tijekom prijelaznog razdoblja, odnosno dugoročno.

Nema mnogo radova kojima je cilj utvrditi odnose između LCR-a i makroekonomskih *inputa*. Jedan od rijetkih *inputa* dolazi od Cucinellija (2013). Autor je analizu napravio na temelju uzorka od 1080 banaka iz eurozone, i uvrštenih i neuvrštenih na burzu. Rezultati su pokazali da su veće banke iz uzorka imale veću izloženost riziku likvidnosti, dok banke s većom kapitalizacijom predstavljaju bolju likvidnost u dugoročnoj perspektivi. Štoviše, rezultati su pokazali da kvaliteta imovine utječe samo na rizik likvidnosti u kratkoročnom vremenskom razdoblju. Nadalje, govoreći o specijalizaciji – banke specijaliziranije za kreditnu djelatnost pokazuju ranjiviju strukturu financiranja. Konačno, tijekom krize upravljanje rizikom likvidnosti mijenja se samo u kratkoročnom razdoblju.

Isti autor – Cucinelli (2013) – napravio je analizu odnosa između koeficijenta likvidnosti i vjerojatnosti neispunjenja obveza (ili kreditnog rizika). Rezultati te studije pokazuju postojanje odnosa samo za LCR i kreditni rejting. S druge strane, ovom studijom nije utvrđena povezanost između dugoročne likvidnosti i kreditnog rizika. U odnosu na krizu, rezultati ukazuju na različito upravljanje likvidnošću banaka samo u kratkom vremenskom razdoblju.

Štoviše, treba napomenuti vrlo zanimljivo istraživanje iz Mashambe (2018). Autor je napravio analizu na temelju uzorka od 40 banaka koje posluju na 11 tržišta u nastajanju, za razdoblje od 2011. do 2016. godine, koje je korišteno u studiji. Iznenađujuće, ovo je istraživanje pokazalo da je regulatorni pritisak koji proizlazi iz zahtjeva za LCR povećao profitabilnost banaka na tržištima u nastajanju. Logično objašnjenje navedeno u ovoj studiji bilo je da su banke na tržištima u nastajanju upravljale svojom likvidnošću na način koji je u skladu s pravilom LCR-a,

to EBA report (2013) macro-economic costs of the LCR are minimal and result in an increase in loan spreads that translates into a macro-economic impact of -5 and -3 basis points during the phase-in period and in the long run, respectively.

There are not many papers aiming to find relationships between LCR and macro economical inputs. One of the rare inputs come from Cucinelli (2013). The author has made the analysis based on the sample of 1080 listed and non-listed Eurozone banks. The results highlighted those bigger banks from the sample had a higher liquidity risk exposure, while banks with higher capitalization present a better liquidity on long horizon. Moreover, the results showed that the assets quality have impact only on liquidity risk in short-term time horizon. Furthermore, speaking about the specialization – banks more specialized on the lending activity show a more vulnerable funding structure. Finally, during the crisis, the liquidity risk management changes only on the shorter-term horizon.

The same author – Cucinelli (2013) – has made the analysis of relationship between liquidity ratios and probability of default (or credit risk). The results of that study show the existence of the relationship only for the LCR and credit rating. On the other hand side, this study did not find relationship between the long-term liquidity and credit risk. In relation to the crisis, the results highlight divergent bank liquidity management only in the short time horizon.

Moreover, one should note one very interesting research from Mashamba (2018). The author has made an analysis based on the sample of 40 banks operating in 11 emerging markets over the period 2011 to 2016 which was used in the study. Surprisingly, this study demonstrated that regulatory pressure stemming from LCR requirement increased the profitability of banks in emerging markets. The logical explanation given for by this study was that banks in emerging markets managed their liquidity in a manner that

stoga uredba nije imala štetne učinke na banke u gospodarstvima u nastajanju.

Naposlijetku, postoji jedno slično istraživanje s jednim od autora, ali napravljeno na uzorku indijske banke – Sitepu (2019). Cilj ove studije bio je analizirati učinak povrata imovine (ROA), koeficijenta adekvatnosti kapitala (CAR), operativnih troškova na operativni prihod (OCOI), loših kredita (NPL), fondova trećih strana (TPF) i utjecaj veličine banke na LCR u bankarskom sektoru. Rezultati ovog ispitivanja pokazali su da ROA, CAR, OCOI, NPL, TPF i veličina banke istovremeno utječu na LCR. S druge strane, NPL-ovi imaju negativan i relativno visok učinak na LCR, ROA, OCOI, TPF, a varijable veličine banke imaju pozitivan, ali ne i značajan učinak na LCR. CAR ima negativan, ali ne i značajan učinak na LCR.

ISTRAŽIVAČKI PODACI I METODOLOGIJA

Uzorak istraživanja u ovom radu uključuje koeficijent likvidnosne pokrivenosti (LCR), nenaplative kredite (NPL), povrat kapitala (ROE) i realne stope rasta bruto domaćeg proizvoda (BDP) za razdoblje 2016q3 – 2021q3 (3. kvartal 2016. do 3. kvartala 2021.).

Podaci dobiveni uzorkovanjem za LCR, NPL i ROE preuzeti su iz Hrvatske narodne banke, dok su realne stope rasta BDP-a i bruto domaćeg proizvoda preuzete iz Državnog zavoda za statistiku. Opisna statistika iz uzorka istraživanja navedena je u Tablici 2 u prilogu.

Kao metodološki pristup u ovom radu autori su odabrali kvantilnu regresiju (Koenker & Bassett, 1978) zbog njenih poželjnih svojstava u slučaju kršenja pretpostavki potrebnih za standardni pristup na temelju procjene najmanjih kvadrata. Stoga procjenjujemo vezu između LCR-a i njegovih pretpostavljenih pokretača za prvi kvartilni medijan i treći kvartil ili kako je formulirano u jednadžbi:

$$LCR_t = C + \beta_1 \cdot GDP_t + \beta_2 \cdot NPL_t + \beta_3 \cdot ROE_{t-1} + \varepsilon$$

is consistent with LCR rule hence the regulation had no detrimental effects on banks in emerging economies.

Finally, there is one similar research with the authors` one but made with Indians` bank sample – Sitepu (2019). This study aimed to analyse the effect of Return On Assets (ROA), Capital Adequacy Ratio (CAR), Operational Costs to Operating Income (OCOI), Non-performing Loans (NPL), Third Party Funds (TPF) and bank size on LCR in the banking sector. The results of this study indicated ROA, CAR, OCOI, NPL, TPF and bank size simultaneously affect LCR. On the other hand side, NPLs have a negative and relatively high effect on LCR. ROA, OCOI, TPF and bank size variables have positive but not significant effect on LCR. CAR has a negative but not significant effect on LCR.

RESEARCH DATA AND METHODOLOGY

Research sample in this paper includes Liquidity coverage ratio (LCR), Non-performing loans (NPL), return on equity (ROE) and real gross domestic product growth rates (GDP) for period 2016q3 – 2021q3.

Sample data for LCR, NPL and ROE were retrieved from Croatian National Bank while real GDP gross domestic product growth rates were retrieved from Croatian Statistical Office. Descriptive statistics from the research sample was provided in Table 2 in the appendix.

As a methodological approach in this paper authors have selected quantile regression (Koenker & Bassett, 1978) due to its desirable properties in case of violation of assumptions required for standard approach based on estimates from ordinary least squares. Hence, we estimate link between LCR and its assumed drivers for first quartile median and third quartile or as formulated in equation:

$$LCR_t = C + \beta_1 \cdot GDP_t + \beta_2 \cdot NPL_t + \beta_3 \cdot ROE_{t-1} + \varepsilon$$

Kada se uzmu u obzir pokretači LCR-a u jednadžbi, BDP i NPL su egzogena varijabla, jer LCR teško može utjecati na BDP ili NPL. Međutim, priroda odnosa između LCR-a i ROE nije tako jasna. Viši LCR znači da bi likvidnija imovina s manjom zaradom i potencijalnim učinkom mogla biti niži ROE. Istodobno, razina LCR-a može biti posljedica ROE. U ovom slučaju očito je prisutna problematika endogenosti. Kako bi se prevladala potencijalna pogrešna specifikacija i pitanje endogenosti, ROE je uzet iz prethodnog tromjesečja, a učinci ROE uzeti su u obzir uz *lag* jedan, budući da LCR u tekućem tromjesečju ne može utjecati na razinu ROE u prethodnom tromjesečju.

Nedavna primjena kvantilnog regresijskog pristupa može se naći u Bošnjak et al. (2020) ili Bošnjak et al. (2021). Općenito, jednadžba je procijenjena primjenom kvantilnog regresijskog pristupa – kako bi se ilustrirali učinci kvantile zavisne varijable.

Za izgradnju modela autori su koristili R softver s nekoliko knjižnica, ugrađenih i spremnih za korištenje.

Slijedom metodološkog postupka pod nazivom Istraživački podaci i metodologija, dobivene su procjene i sažete su u Tablici 1.

Slijedom procjena u Tablici 1, statistički značajna povezanost između LCR-a i njegovih pretpostavljenih pokretača utvrđena je samo u prvom kvartilu LCR-a. Stoga se najniže razine LCR-a koje znače manje ili jednako 5.064 mogu objasniti BDP-om, NPL-om. Međutim, nema empirijskih dokaza koji podupiru učinke ROE na LCR. Empirijski rezultati upućivali su na pozitivnu povezanost između realnih stopa rasta BDP-a i LCR-a. Stoga više stope rasta realnog BDP-a podrazumijevaju veću likvidnost, dok NPL narušava LCR na najnižoj razini te bi se NPL mogao smatrati ozbiljnom prijetnjom održavanju likvidnosti. Zaključno, empirijski rezultati teoretski su sastavni dijelovi i ukazuju na postojanje odnosa između LCR-a i njegovih pretpostavljenih pokretača na najnižoj razini LCR-a, s iznimkom ROE-a.

When considering LCR drivers in equation GDP and NPL are exogenous variable since LCR can hardly affect GDP or NPL. However, nature of the relationship is not so clear between LCR and ROE. Higher LCR means more liquid asset with lower earnings and potential effect might be a lower ROE. At the same time, level of LCR might be a consequence of ROE. In this case, issue of endogeneity is present evidently. To overcome potential misspecification and issue of endogeneity ROE was taken from previous quarter and effects from ROE were considered with lag one, since LCR in current quarter cannot affect level of ROE in a previous quarter.

Recent application of quantile regression approach can be found in Bošnjak et al. (2020) or Bošnjak et al. (2021) among others. In general, equation was estimated by using quantile regression approach – to illustrate effects across quantile of dependent variable.

For building the model authors have used R software with several built-in and ready to used libraries.

Following methodological procedure entitled research data and methodology estimates were obtained and summarized in Table 1.

Following estimates in Table 1 statistically significant linkage between LCR and its assumed drivers were found only in first quartile of LCR. Therefore, the lowest levels of LCR meaning less or equal to 5.064 can be explained with GDP, NPL. However, there is no empirical evidence that supported effects from ROE on LCR. Empirical findings suggested positive linkage between real GDP growth rates and LCR. Hence higher real GDP growth rates implies more liquidity while NPL undermines LCR at its lowest level and NPL might be considered as a serious threat to liquidity maintenance. Conclusively, empirical finding are theoretically constituents and point out existence of the relationship between LCR and its assumed drivers at the lowest level of LCR with exception of ROE.

TABLICA 1. PROCJENE POKRETAČA KOEFICIJENTA LIKVIDNOSNE POKRIVENOSTI
TABLE 1. ESTIMATES OF LIQUIDITY COVERAGE RATIO DRIVERS

τ	VARIJABLA VARIABLE	PROCJENE (STANDARDNA POGREŠKA) ESTIMATES (STD. ERROR)	t-VRIJEDNOST t-VALUE	p-VRIJEDNOST p-VALUE
0,25	C	5.41835 (0.05987)	90.49449	0,00000
	BDP	0,11133 (0,05122)	2.17545	0,04493
	NPL	-0,02907 (0,00923)	-3.14900	0,00621
	ROE	-0,00854 (0,00506)	-1,68927	0.11056
0,50	C	5.23499 (0.06963)	75.18633	0,00000
	BDP	0,16614 (0,11092)	1.49779	0,15253
	NPL	-0,00178 (0.01013)	-0.17547	0,86278
	ROE	-0,00233 (0.00703)	-0.33212	0.74386
0,75	C	5.19093 (0,07255)	71.54938	-0.25767
	BDP	0,07422 (0.16776)	0.44242	0.66376
	NPL	0,00865 (0.00665)	1.29909	0.21126
	ROE	-0,00217 (0.00842)	-0.25767	0.79976

Izvor: izračun autora / Source: Authors' calculation

ZAKLJUČAK

Ciljevi rada bili su analizirati i razumjeti odnose između LCR-a i BDP-a, NPL-a i ROE u hrvatskom bankarskom sektoru. Populacija ove studije je hrvatski bankarski sektor od trećeg kvartala 2016. do trećeg kvartala 2021. godine.

Kao što je gore navedeno, BDP i NPL mogu objasniti samo najnižu likvidnost (25% najniže

CONCLUSION

The goals of the paper were to analyse and to understand the relationships between LCR and GDP, NPL, and ROE in the Croatian banking sector. The population of this study is Croatian banking sector from q3 2016 to q3 2021.

As discussed above, only the lowest liquidity (25% of the lowest liquidity in the observation period)

likvidnosti u promatranom razdoblju). U ovom slučaju odnos između LCR-a i stope rasta BDP-a je pozitivan (BDP raste i LCR raste, tj. BDP pada i LCR pada), a odnos između LCR-a i NPL-a je sljedeći – viši NPL, niži LCR. Svi spomenuti odnosi su logični jer:

- u okruženju višeg BDP-a očekuje se bolja likvidnost banaka, a samim time i viši LCR;
- u slučaju pogoršanja kreditnog rizika logično je da banke imaju niže novčane priljeve, a samim time i niže LCR-ove.

Svi navedeni rezultati su logični i u skladu s hipotezom istraživanja (potvrda hipoteze #2 i #3). Međutim, važno je naglasiti da je to istina samo u slučaju nižih LCR-ova – što je također logično, jer je u vrijeme niskih LCR-ova važno razumjeti što najviše utječe na njegove razine.

Međutim, dokazi o povezanosti LCR-a i ROE nisu empirijski potkrijepljeni te stoga hipoteza #1 nije dokazana. Ovdje bi u budućnosti trebalo provesti više istraživanja na širem uzorku.

Ukupno, rezultati ove studije pokazuju da NPL i BDP istodobno utječu na LCR samo u području najniže likvidnosti. NPL ima negativan učinak na LCR, dok BDP ima pozitivan učinak na LCR.

BILJEŠKA

[1] Stavovi izneseni u ovom članku su stavovi autora i ne odražavaju nužno stajalište Hrvatske narodne banke.

can be explained by GDP and NPL. In this case, the relationship between LCR and GDP growth rate is positive (GDP grows and LCR grows, i.e. GDP falls and LCR falls), the relationship between LCR and NPL – higher NPL lower LCR. All the mentioned relationships are logical since:

- in higher GDP environment it is expected that liquidity of banks is better and therefore LCR higher;
- in the case of worsening of credit risk, it is logical that banks would have lower cash-inflows and therefore lower LCRs.

All of the above findings are logical and in line with research hypothesis (confirming Hypothesis #2 and #3). However, it is imporatnt to stress out that this is true only in the case of lower LCRs – which is also logical since in the times of low LCRs it is important to understand what influences its levels the most.

However, the evidence of relationship between LCR and ROE was not empirically supported, and therefore Hypothesis #1 was not proved. Here more research should be done in future aiming to have broader sample.

Altogether, the results of this study indicate NPL and GDP simultaneously affect LCR only in the field of the lowest liquidity. NPL has a negative effect on LCR while GDP has positive effect on LCR.

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[1] The views expressed in this article are those of the authors and do not necessarily reflect the position of the Croatian National Bank.

DODATAK / APPENDIX

TABLICA 2. OPISNA STATISTIKA / TABLE 2. DESCRIPTIVE STATISTICS

	LCR	NPL	ROE	BDP
Min. / Min.	5.064	4.68	3.080	-0.12086
1. kvart. / 1st Qu.	5.157	5,45	5.610	-0,07522
Medijan / Median	5.205	7,33	8. 300	-0.02255
Srednja vrijednost / Mean	5.197	7.82	7.703	0,0139
3. kvart. / 3rd Qu.	5,233	8,81	9.820	0.10983
Maks. / Max.	5.332	12,78	11.200	0,15287

Izvor: izračun autora / Source: Authors' calculation

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