

ADEKVATNOST KAPITALA I LIKVIDNOST BANAKA PREMA BAZELU III: STUDIJA PANEL PODATAKA ZA 13 KOTIRANIH BANAKA (2014–2021)

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Rezime: Ova studija istražuje uticaj Bazel III propisa o adekvatnosti kapitala na pozicije likvidnosti komercijalnih banaka u trinaest zemalja članica Bazelskog komiteta između 2014. i 2021. godine. Koristeći analizu panel podataka, model fiksni efekata (FEM) se pokazao kao najprikladnija tehnika procene, nadmašujući i model slučajnih efekata i model najmanjih kvadrata u smislu objašnjavajuće moći (prilagođeni $R^2 = 0,83$) i statističke robusnosti (Hausmanov test $p = 0,003$). Empirijski rezultati potvrđuju značajnu inverznu korelaciju između pokazatelja adekvatnosti osnovnog kapitala banke i likvidnosti banaka, potvrđujući teorijski kompromis koji je postavio okvir Bazel III. Pored toga, utvrđeno je da kreditni rizik, rizikom ponderisana aktiva i profitabilnost imaju merljiv uticaj na ponašanje likvidnosti. Studija preporučuje višeslojni pristup adekvatnosti kapitala koji uračunava i rizike, kao i razvoj integriranih sistema ranog upozoravanja i kompozitnih indeksa likvidnosti. Ovi nalazi nude vredne uvide u politiku za prilagođavanje prudencijalnih propisa koji uravnotežuju solventnost i likvidnost u heterogenim bankarskim institucijama.

Ključne reči: Bazel III, adekvatnost kapitala, likvidnost banaka, analiza panel podataka, kreditni rizik, rizikom ponderisana aktiva.

JEL klasifikacija: G21, G28, C23, G32

Uvod

Međunarodni bankarski sistem otkrio je tokom globalne finansijske krize 2007-2008. godine neke od najozbiljnijih strukturnih slabosti, posebno neadekvatne kapitalne bafere i slabe profile likvidnosti koji ozbiljno štete finansijskoj stabilnosti. Shodno tome, Bazelski komitet za bankarski nadzor (BCBS) uspostavio je Bazel III, regulatorni okvir koji je osmišljen da redefiniše globalne prudencijalne standarde kroz jačanje zahteva za adekvatnost kapitala i uvođenje propisa o likvidnosti. Centralna karakteristika ovog okvira je naglašavanje pokazatelja adekvatnosti osnovnog kapitala, koji bi trebalo da deluje kao primarna zaštita od sistemskih šokova. Međutim, ova reforma stvara kritičnu dilemu u pogledu politika, jer iako povećanje kapitalnih bafera može poboljšati solventnost, time bi se takođe mogao ograničiti kapacitet banaka da generišu likvidnost za privredu, što bi uticalo na posredničku funkciju bankarskog sektora.

Ova studija ispituje ovaj regulatorni kompromis, koristeći empirijski pristup za analizu odnosa između adekvatnosti kapitala i likvidnosti banaka prema propisima Bazela III. Koristeći uravnotežen panel od trinaest sistemski važnih javno kotiranih banaka iz zemalja članica Bazelskog komiteta, uključujući Al Radži banku (Al Rajhi Bank), Sitibanku (Citibank) i Dojče banku (Deutsche Bank), studija obuhvata period od 2014. do 2021. godine nakon implementacije. Smeštanjem analize u ovaj vremenski okvir, studija beleži kako su banke implementirale obaveze Bazela III i koje su strateške kompromise napravile kako bi se pridržavale poboljšanih standarda kapitala, uz održavanje obezbeđivanja likvidnosti.

Primarni cilj ove studije je da se ispita kako zahtevi za adekvatnost kapitala Bazela III (posebno pokazatelj adekvatnosti osnovnog kapitala) utiču na pozicije likvidnosti banaka, operacionalizovane kroz odnos kredita i imovine. Ovi istraživački ciljevi pokrili su i empirijski odnos i praktične implikacije regulatornih reformi na prakse upravljanja likvidnošću u međunarodno aktivnim finansijskim institucijama.

Da bi se podržala ovakva analiza, ovo istraživanje takođe uključuje i nekoliko sekundarnih ciljeva. Prvo, nastoji da uporedi i proceni performanse tri istaknute metodologije panel podataka: model najmanjih kvadrata (PRM), model fiksnih efekata (FEM) i model slučajnih efekata (REM), u proceni odnosa kapitala i likvidnosti. Sprovođenjem provera robusnosti u ovim modelima, studija identifikuje statistički najpouzdaniji i najreplikabilniji okvir za analizu regulatornih uticaja u bankarskim skupovima podataka širom zemlje.

Zatim, ovaj rad istražuje posredničku ulogu osnovnih finansijskih varijabli, uključujući koeficijente nenaplativih kredita (NPL), nivoe rizikom ponderisane aktive (RWA), povraćaj na kapital (ROE) i efikasnost upravljanja imovinom (AM). Ovi indikatori treba da budu uključeni u model kao moderatorski faktori koji bi potencijalno mogli uticati i na smer i na intenzitet odnosa između kapitalnih bafera i ishoda likvidnosti. Ovaj deo istraživanja produbljuje objašnjenje tako što navodi institucionalne karakteristike koje uslovljavaju regulatornu efikasnost.

Krajnji cilj rada je da pruži bolje preporuke na nivou politika o tome kako poboljšati prudencijalnu regulativu. Konkretnije, preporučuje harmonizaciju zahteva za adekvatnošću kapitala sa ciljevima likvidnosti, uz istovremeno promovisanje heterogenosti institucija u domenu kapaciteta, izloženosti riziku i strateškog fokusa. Stoga, ovo istraživanje doprinosi tekućim diskusijama o stvaranju otpornih, ali funkcionalno prilagodljivih regulatornih arhitektura u postkriznoj eri.

Predstavljajući empirijsku analizu uz čvrsto metodološko potkrepljenje i uvid u politike, ovo istraživanje pruža upotpunjen argument o tome kako pravila kapitala Bazela III utiču na ponašanje likvidnosti

među bankama. Rezultati studije su prilično aktuelni jer se odvijaju u vreme kada svetske finansijske vlasti preispituju neke od svojih standarda u vezi sa regulacijom zbog promena u sistemu kroz koji se kreću tržišta i izazova sistemskog rizika koji se javljaju.

Da bi se postigli ovi ciljevi, ostatak rada je organizovan na sledeći način: prvo je dat pregled relevantne literature o Bazelu III, adekvatnosti kapitala i likvidnosti banaka, zatim je dato objašnjenje metodologija istraživanja sa detaljima o uzorku, varijablama i ekonometrijskom pristupu. Nakon toga sledi empirijska analiza i procena modela, nakon čega se iznose rezultati i diskusija o istim. Rad se završava glavnim zaključcima i preporukama za politike.

Pregled literature

Finansijski ekosistem u postkriznoj eri je dao podsticaj akademikima da traže regulatorni okvir koji se može povezati sa Bazelom III, posebno u smislu isticanja adekvatnosti kapitala u odnosu na zahteve za likvidnost. Naučnici su izneli teorijske modele, empirijske studije i studije slučaja o institucionalnim razlikama u rešavanju pitanja adekvatnosti kapitala i likvidnosti.

Rani doprinos u istraživanju Eichberg & Summer (2005) modelirao je sistemske implikacije adekvatnosti kapitala u međubankarskim odnosima, upozoravajući da regulatorna ograničenja kapitala mogu pojačati širenje rizika. Slično tome, Dermine (2015) uvodi argument o koeficijentu leveridža kao ograničenju u masovnim podizanjima depozita kod ročne transformacije, čime se ponovo ističe pomenu ta zabrinutost. U radu iz 2019. godine, (Bui, 2019) dodato je da programi likvidnosti i kapitalni baferi daju pomešane rezultate: oni služe za povećanje otpornosti, ali mogu i povećati sistemsku sličnost među bankama. Tokom kriza, Ačarja i Meruš (Acharya & Merrouche, 2013) posmatrali su slučajeve gomilanja likvidnosti među bankama, čime su započeli novi istraživački tok u vezi sa kompromisom između kapitala i likvidnosti. Berger i Bouman (Berger & Bouwman, 2018) i Mehran i Takor (Mehran & Thakor, 2011) dali su teorijska objašnjenja kapitala, poboljšavajući stvaranje likvidnosti, iako kasnije studije (npr. Casu, Di Pietro, & Trujillo-Ponce, 2019) sugerišu dvostruko uzročni, obrnuti odnos gde veći kapital može smanjiti stvaranje likvidnosti i obrnuto. Polazeći od ovako definisane odrednice, Fajfer i dr. (Pfeifer et al., 2017) su dalje primetili da veza između kapitala i likvidnosti zavisi od strukture imovine i kanala profitabilnosti, posebno u pogledu bankarskih sistema u nastajanju, kao što je slučaj sa Češkom.

Empirijska istraživanja na nacionalnom nivou dodatno potvrđuju ovaj složeni odnos. Konovalova (2016) analizirala je adekvatnost kapitala i likvidnost u Letoniji, sugerišući mogući prigušujući efekat Bazela III na bankarsku aktivnost. Na isti način, Pislari (2024) procenjuje dostignuća i ograničenja zahteva Bazela III za likvidnost među moldavskim bankama, uz zaključak da, iako usklađenost sa sobom donosi izazove, poboljšanje institucionalne otpornosti jeste siguran rezultat. Prema nalazima koje su dali drugi autori (Jasrotia, Mishra, and Sharma 2020), implementacija Bazela III u Indiji postigla je rezultat gde usklađenost sa koeficijentom adekvatnosti kapitala povećava poverenje investitora; međutim, ciljevi profitabilnosti su pomešani.

Druge studije se dalje bave efektima adekvatnosti kapitala na kreiranje kredita i preuzimanje rizika. Neuspeh okvira Bazela II da obezbedi adekvatne zaštitne bafere pre krize i time nametne ozbiljne državne intervencije dokumentovan je u istraživanjima (Hebbink, Kruidhof, & Slingenberg, 2014). U skladu sa tim, definisana je razlika između nivoa kvaliteta kapitala (Anginer & Demirgüç-Kunt, 2014), zaključujući da visokokvalitetni kapital smanjuje sistemski rizik, dok hibridni ili slab kapital može po-

goršati nestabilnost. Baltali i Tanega (2011) potvrdili su taj zaključak kritikujući hibridizaciju kapitala u okviru Bazela II i ističući pomak Bazela III ka jačim standardima akcijskog kapitala.

Pored sistemskog rizika, naučnici su se fokusirali na efekat Bazela III na bankarsko kreditiranje i poslovne rezultate. Jedni istraživači su pronašli pomešane dokaze u azijskim bankama (Lee & Hsieh 2013), dok su drugi (Fiordelisi, Marques-Ibanez, & Molyneux, 2011) (Pasiouras & Kosmidou, 2007) istakli posredničku ulogu operativne efikasnosti i korporativnog upravljanja u Evropi. Istraživanje je, zatim, izvršeno i na indonežanskim bankama (Margono, Wardani, & Safitri, 2020), gde su i adekvatnost kapitala i likvidnost pozitivno uticali na učinak, posredovani rizikom kamatne stope.

Literatura se takođe bavi praktičnim izazovima implementacije modela rizikom ponderisane imovine (RWA). Repulo i Suarez (Repullo & Suarez, 2013) su dali teorijsku kritiku manipulacije RWA, dok su Fahlenbrah, Prilmajer i Štulc (Fahlenbrach, Prilmeyer, & Stulz, 2018) dokumentovali kako se banke strateški prilagođavaju pragovima RWA. Ova zapažanja podržava Bazelski komitet (2017, 2022), koji se osvrću na nenamernu regulatornu arbitražu i evoluirajuće standarde.

Regulacija likvidnosti, posebno koeficijent pokriva likvidnosti (LCR) i koeficijent neto stabilnih izvora finansiranja (NSFR), predstavlja još jednu stalnu brigu. Usledio je predlog kritičke analize sposobnosti LCR-a da se nosi sa sistemskim nedostacima likvidnosti (Hartlage, 2012a, 2012b), dok su drugi autori (Hlebik, 2017) istraživali uticaj NSFR-a na stabilnost evropskih banaka. Dalja istraživanja potvrdila su da kombinovanje pravila o kapitalu i likvidnosti značajno smanjuje verovatnoću kriza nakon recesije (Chiba, 2021). Druga studija (Resti, 2011) slično zaključuje da bi Bazel III zahtevao od banaka da revidiraju operativne modele, strategije cena i metrike profitabilnosti.

Na preseku regulacije kapitala i ponašanja depozita, Arping (2017) predlaže nemonoton odnos gde umereno povećanje kapitalnih zahteva može istisnuti depozite, ali značajno povećanje može poboljšati bezbednost i priliv depozita. Ova tenzija se odražava i kod drugih istraživanja (Syron & Randall, 1991), koji su izdali rana upozorenja o procikličnoj prirodi kapitalnih zahteva, posebno u skladu sa Zakonom o unapređenju Federalne korporacije za osiguranje depozita SAD.

Što se tiče kreditnog rizika i upravljanja problematičnim kreditima, istraživanja su potvrdila da makro i institucionalni faktori oblikuju dinamiku kapitala problematičnih kredita (Messai & Jouini, 2013) (Ghosh, 2015), pri čemu regulacija igra promenljivu ulogu u zavisnosti od konteksta. Houston i dr. (Houston et al. 2020) dodatno su zakomplikovali sliku pokazujući kako globalne banke koriste mehanizme strateškog izbegavanja kako bi zaobišle regulatorna ograničenja.

Poboljšana robusnost ekonometrijske analize koju su usvojile studije uglavnom je posledica novih dostignuća u ekonometriji. Gudžarati i Porter (Gujarati & Porter, 2009) su pružili dijagnostičke testove za multikolinearnost i autokorelaciju, dok Baltagi (2021) uvodi savremene metode panel podataka kako bi se poboljšao kvalitet zaključivanja. Alati su rešili neslaganje u rezultatima koje su predstavili Li i Šei (Lee & Hsieh, 2013) u odnosu na rezultate drugih autora (Demirgüç-Kunt, Pedraza, & Ruiz-Ortega, 2020).

Moderna literatura se fokusira na održivost i transparentnost u proceni regulative. Vodok i Grejvs (Waddock & Graves, 2020) proučavali su odnos metrika održivosti i učinka banaka, dok su Penman i Jehuda (Penman & Yehuda, 2019) procenjivali implikacije za vrednovanje praksi u finansijskom obećavanju. Ovo odražava ono što se naziva širom agendom da se prudencijalna regulacija poveže sa ekonomskim ciklusima (Brei, Borio, & Gambacorta, 2020) i dugoročnim ciljevima politika (Demirgüç-Kunt & Huizinga, 2010).

Okvir Bazela III je stoga podstakao višestruku istraživačku agendu koja se bavi dinamikom kreditiranja kapitala, sistemskim rizikom, upravljanjem likvidnošću, merama učinka i drugim aspektima institucionalnog upravljanja. Literatura na ovu temu ostaje aktivna i razvija se u skladu sa regulatornom praksom tako da empirijski rezultati istraživanja pružaju savete o politikama za supervizore i doprinose opštoj stabilnosti finansijskih tržišta.

Metodologija istraživanja

Ovaj empirijski poduhvat koristi kvantitativni istraživački dizajn, zasnovan na panel podacima, ispitujući dinamički odnos između adekvatnosti kapitala i likvidnosti banaka u okviru Bazela III. Studija razmatra period 2014-2021, što je ključno jer obuhvata post-implementacione efekte Bazela III na različite bankarske sisteme. Studija pruža robusne i generalizujuće uvide, pružajući međunacionalnu analizu trinaest sistemski važnih komercijalnih banaka iz zemalja članica Bazelskog komiteta o tome kako regulacija kapitala interaguje sa obezbeđivanjem likvidnosti na globalnom nivou u bankarskim praksama.

Izbor uzorka zasniva se na svrsishodnom uzorkovanju, ciljajući banke koje su u potpunosti u skladu sa Bazelom III i reprezentativne su za različita regulatorna i makroekonomska okruženja. Konačni uzorak obuhvata sledeće banke: Al Rajhi Bank (Kraljevina Saudijska Arabija), First Abu Dhabi Bank (Ujedinjeni Arapski Emirati), Citibank (Sjedinjene Američke Države), Lloyds Banking Group (Ujedinjeno Kraljevstvo), China Construction Bank (Kina), Mizuho Financial Group (Japan), Deutsche Bank AG (Nemačka), Société Générale SA (Francuska), Bank of Nova Scotia (Kanada), HDFC Bank Ltd (Indija), Oversea-Chinese Banking Corporation (Singapur), Standard Bank Group (Južnoafrička Republika) i Türkiye Cumhuriyeti Ziraat Bankası (Turska). Ove banke su odabrane na osnovu njihovog međunarodnog prisustva, regulatorne relevantnosti, dostupnosti podataka i strateškog značaja za njihove nacionalne bankarske sisteme. Raznolikost uzorka poboljšava eksternu validnost nalaza i podržava međujurisdikcionu procenu uticaja Bazela III. Sledeća tabela predstavlja odabrane banke.

Tabela 1 – Banke izabrane za istraživanje

Banka	Zemlja	Opravdanje za odabir
Al Rajhi Bank	Saudijska Arabija	U skladu sa Bazelom III, međunarodni značaj
First Abu Dhabi Bank	UAE	Regionalni predstavnik, dostupnost podataka
Citibank	SAD	Sistemska značaj, globalno poslovanje
Lloyds Banking Group	UK	Usvajanje Bazela III, strateški značaj
China Construction Bank	Kina	Jedna od najvećih svetskih banaka
Mizuho Financial Group	Japan	Usklađenost sa Bazelom III, makroekonomski značaj
Deutsche Bank AG	Nemačka	Globalno sistemski značajna institucija
Société Générale SA	Francuska	Evropski predstavnik, dostupnost podataka
Bank of Nova Scotia	Kanada	Usvajanje Bazela III, zastupljenost u Severnoj Americi
HDFC Bank Ltd	Indija	Perspektiva tržišta u razvoju

Oversea-Chinese Banking Corporation (OCBC)	Singapur	Predstavnik azijskog finansijskog centra
Standard Bank Group	Južnoafrička Republika	Jedini afrički predstavnik, usvajanje Bazela III
Ziraat Bankası	Turska	Perspektiva tržišta u razvoju, regulatorni značaj

Izvor: Sastavili autori na osnovu javno dostupnih podataka iz godišnjih izveštaja odabranih banaka (2014–2021) i publikacija Bazelskog komiteta za bankarski nadzor (BCBS)

Hipoteze testirane u ovoj studiji formulisane su na sledeći način:

- Hipoteza 1 (H1): Adekvatnost kapitala ima statistički značajan uticaj na likvidnost banaka za banke koje posluju u jurisdikcijama članica Bazela III. Navedena hipoteza 1 je glavna hipoteza rada. U prilog ovoj centralnoj tvrdnji, studija takođe testira sledeće pomoćne hipoteze:
- Hipoteza 2 (H2): Kreditni rizik, meren odnosom problematičnih kredita i ukupnih kredita, značajno utiče na likvidnost banaka.
- Hipoteza 3 (H3): Profitabilnost, merena kroz prinos na kapital (ROE), ima značajan uticaj na rezultate likvidnosti.
- Hipoteza 4 (H4): Efikasnost upravljanja imovinom, izražena odnosom operativnog prihoda i ukupne imovine, značajno utiče na likvidnost banaka.

Zajedno, ove hipoteze ispituju i direktan efekat adekvatnosti kapitala i indirektan uticaj varijabli specifičnih za banku na likvidnost prema Bazel III propisima.

Empirijski model koristi strukturirani skup finansijskih varijabli zasnovanih na bankarskoj teoriji i potkrepljenih prethodnim istraživanjima. Zavisna varijabla je likvidnost banke, operacionalizovana kao odnos kredita i ukupne aktive. Ova mera, široko usvojena u bankarskoj literaturi, odražava udeo ne-likvidne imovine koju banka drži, pri čemu veće vrednosti ukazuju na povećanu izloženost riziku likvidnosti. Fokusna nezavisna varijabla je adekvatnost kapitala, definisana korišćenjem pokazatelja adekvatnosti osnovnog kapitala banke u skladu sa Bazel III standardima. Ovaj koeficijent meri osnovni kapital banke u odnosu na njenu rizikom ponderisanu aktivu i čini osnovu propisa o solventnosti prema Bazel III.

Četiri druge objašnjavajuće varijable su uključene u model kako bi se obratila pažnja na institucionalnu heterogenost i kontrolu za druge zbunjujuće faktore. Kreditni rizik je indikovao odnosom nenaplativih kredita i ukupnih kredita, što pokazuje kvalitet imovine i kreditne inherentne izloženosti banke. Odnos rizikom ponderisane aktive i ukupne imovine ukazuje na opterećenje regulatornog kapitala prema nivou osetljivosti na rizik. Profitabilnost se definiše odnosom prinosa na kapital, što ukazuje na neto prihod u odnosu na ukupni kapital i sposobnost banke da ostvari prinose za akcionare. Na kraju, efikasnost upravljanja imovinom predstavljena je odnosom operativnog prihoda i ukupne imovine, što pokazuje koliko efikasno banka koristi svoje resurse da bi ostvarila operativne prinose.

Ove varijable su odabrane na osnovu osnovnih empirijskih studija, uključujući: Berger & Bouwman (2018) u vezi sa likvidnošću banaka; Demirgüç-Kunt et al. (2020) u vezi sa adekvatnošću kapitala; Houston et al. (2020) u vezi sa kreditnim rizikom; Fahlenbrach et al. (2018) u vezi sa aktivom ponderisanim rizikom; Penman & Yehuda (2019) u vezi sa prinosom na kapital; i Waddock & Graves (2020) o

efikasnosti upravljanja imovinom. Uvođenje ovih varijabli omogućava studiji ne samo da utvrdi direktne posledice adekvatnosti kapitala, već i da testira kako interne karakteristike banaka posreduju u ishodima likvidnosti u datom regulatornom okruženju.

Odabrana struktura panela omogućava praćenje vremenskih trendova, kao i poprečni presek varijanse među uzorkovanim bankama. Stoga, studija može da se bavi neprimećenom heterogenošću i mogućom endogenošću na rigorozan i transparentan način. U brojnim ekonometrijskim procenama, analiza će popraviti slučajne i objedinjene regresije, u cilju da značajno doprinese pouzdanim dokazima o vezi između kapitala i likvidnosti u teoriji i politikama.

Empirijska analiza i procena modela

Ova studija predstavlja empirijski okvir i ekonometrijsku analizu koji su korišćeni za analizu odnosa između adekvatnosti kapitala i likvidnosti banaka u regulatornom okruženju Bazela III. Korišćen je pristup panel podataka za obuhvatanje, kako intertemporalnih, tako i poprečnih preseka aspekata među trinaest odabranih komercijalnih banaka iz zemalja članica Bazelskog komiteta za period od 2014. do 2021. godine. Analiza se sprovodi u pet faza: (1) specifikacija modela, (2) deskriptivna statistička analiza glavnih varijabli, (3) analiza strukture korelacije, (4) procena i poređenje regresionih panela i (5) interpretacija rezultata i testiranje istraživačkih hipoteza. Ovaj opsežni analitički niz na taj način osigurava da su empirijski rezultati statistički robusni, teoretski ubedljivi i relevantni za politike.

Model istraživanja

Model regresije panel podataka (korišćen u modovima panela) korišćen je za ispitivanje odnosa između adekvatnosti kapitala i likvidnosti unutar banaka. Ova studija bi primenila taj model jer uzima u obzir vremenske promene i individualne karakteristike koje poseduje svaka banka. Model je izražen na sledeći način:

$$BAL = \beta_0 + \beta_1 CAP + \beta_2 NPL + \beta_3 RWA + \beta_4 ROE + \beta_5 AM + \varepsilon_{it}$$

Gde su:

BAL: Zavisna promenljiva (likvidnost banke).

CAP: Glavna nezavisna promenljiva (adekvatnost kapitala).

NPL, RWA, ROE, AM: Kontrolne objašnjavajuće promenljive.

β_0 : Konstanta.

β_0 - β_5 : Koeficijenti regresije.

ε_{it} : Greška.

Deskriptivna analiza studijskih varijabli

Sledeća tabela prikazuje deskriptivnu statistiku studijskih varijabli, izračunatu na osnovu godišnjih izveštaja objavljenih na veb-sajtovima banaka uzorkovanih za period 2014–2021:

Tabela 2 - Deskriptivna statistika studijskih varijabli

Varijabla	2014	2015	2016	2017	2018	2019	2020	2021
Prosek BAL	0,6450	0,6428	0,6428	0,7113	0,6531	0,6262	0,6299	0,6194
Prosek CAP	0,1799	0,1833	0,1791	0,1729	0,1649	0,1715	0,1678	0,1736
Prosek NPL	0,0188	0,0167	0,0134	0,0117	0,0105	0,0105	0,0129	0,0197
Prosek RWA	0,8437	0,8639	0,8824	0,8876	0,9017	0,8611	0,8691	0,8571
Prosek ROE	0,1009	0,1343	0,1182	0,1147	0,1341	0,1335	0,1335	0,1374
Prosek AM	0,0387	0,0390	0,0381	0,0365	0,0371	0,0355	0,0366	0,0375

Izvor: Sastavljeno iz finansijskih izveštaja komercijalnih banaka uključenih u uzorak studije

Adekvatnost kapitala (CAP) banaka Bazelskog komiteta kretala se između 16,5% i 18,3% tokom perioda 2014–2021, dostigavši vrhunac 2015. godine zbog pooštavanja Bazela III, a opadajući u periodu 2016–2017. godine zbog kreditne ekspanzije (odnos kredita i aktive porastao je na 71,1%). Odnos se poboljšao nakon 2018. godine sa smanjenim kreditnim rizikom (nenaplativi krediti na 1,05%) i povećanom profitabilnošću (ROE na 13,4%). Varijacije među bankama odražavaju različite poslovne modele, ali su sve ostale iznad minimuma od 10,5%, što pokazuje otpornost bankarskog sektora u skladu sa Bazelom III.

Analiza korelacione matrice

Tabela 3 - Rezultati korelacione matrice

Varijabla	BAL	CAP	NPL	RWA	ROE	AM
BAL	1,000					
CAP	-0,452	1,000				
NPL	0,324	-0,302	1,000			
RWA	0,683	-0,823	0,402	1,000		
ROE	-0,124	0,652	-0,251	-0,304	1,000	
AM	0,253	0,184	-0,104	0,052	0,351	1,000

Izvor: Sastavili autori koristeći Stata softver (verzija 17)

Analiza korelacione matrice otkriva složenu dinamiku u odnosima između bankarskih varijabli, sa korelacionim obrascima koji se mogu analizirati na sledeći način:

Koeficijent korelacije (-0,452) ukazuje na umereno inverznu vezu između likvidnosti (BAL) i adekvatnosti kapitala (CAP), što odražava fenomen „bega ka kvalitetu“ (Acharya & Merrouche, 2013) gde banke sa većim rezervama kapitala povećavaju svoja ulaganja u visokokvalitetnu likvidnu imovinu, a ne u kredite.

Što se tiče interakcije nenaplativih kredita (NPL) sa drugim varijablama, pozitivna korelacija (0,324) sa likvidnošću (BAL) može ukazivati na „paradoks likvidnosti“ gde se nenaplativi krediti akumuliraju u

bankama sa većom likvidnošću zbog fleksibilnijih politika kreditiranja (Bonner et al., 2015). Negativna korelacija (-0,302) sa adekvatnošću kapitala odražava mehanizam „apsorpcije kapitala“ gde nenaplativi krediti iscrpljuju kapitalne resurse banaka.

Što se tiče dinamike rizikom ponderisane aktive (RWA), jaka negativna korelacija (-0,823) sa adekvatnošću kapitala pokazuje intenzivnu konkurenciju za resurse između zahteva za solventnost i upravljanja rizicima, što je u skladu sa okvirom istraživanja (Repullo and Suarez, 2013) u vezi sa uticajem Bazela III. Jaka pozitivna korelacija (0,683) sa likvidnošću (BAL) otkriva strategiju „preuzimanja rizika likvidnosti“ gde banke povećavaju svoja ulaganja u visokorizičnu imovinu kako bi kompenzovale niske prinose.

Što se tiče ose profitabilnosti (ROE), pozitivna korelacija (0,652) sa adekvatnošću kapitala (CAP) podržava „hipotezu o podsticaju kapitala“ (Mehran i Thakor, 2011) gde banke sa jačim propisima o kapitalu postižu veće prinose. Negativna korelacija (-0,304) sa rizikom ponderisanom aktivom (RWA) odražava kompromis između profitabilnosti i upravljanja rizikom, što je u skladu sa modelom u istraživanjima (Brei et al., 2020).

Za efikasnost upravljanja imovinom (AM), umerena korelacija (0,351) sa ROE ukazuje na prisustvo „efekta operativne efikasnosti“ na profitabilnost (Demirgüç-Kunt & Huizinga, 2010). Slabe korelacije sa drugim varijablama mogu odražavati relativnu nezavisnost faktora operativne efikasnosti.

Vredi napomenuti da visoke vrednosti korelacije između RWA-CAP (-0,823) i BAL-RWA (0,683) ukazuju na potencijalne probleme multikolinearnosti. Međutim, analiza faktora inflacije varijanse (VIF) nije zabeležila vrednosti veće od 3,2, što isključuje ozbiljne probleme multikolinearnosti (Gujarati & Porter, 2009). Ipak, umerena korelacija (-0,304) između rizično ponderisane aktive i prinosa na kapital zaslužuje pažnju, jer odražava strukturnu tenziju između zahteva za prinosom i ograničenja u upravljanju rizicima, kao što je detaljno razmotreno od strane Bazelskog komiteta (2017) u okviru Bazela III.

Procena i izbor panel modela

Procenjena su tri panel modela: model najmanjih kvadrata (PRM), model fiksnih efekata (FEM) i model slučajnih efekata (REM). FEM je nadmašio druge sa prilagođenim R^2 od 0,83 (u odnosu na 0,57 za PRM) i značajnim Hausmanovim testom ($\chi^2 = 22,46$, $p = 0,003$), što potvrđuje njegovu pogodnost.

Tabela 4 - Procena statističkog modela

Varijabla	FEM	REM	PRM
Konstanta	-	0,682*** (0,105)	0,725*** (0,118)
CAP	-0,394*** (0,112)	-0,305*** (0,092)	-0,211** (0,101)
NPL	0,083 (0,179)	0,095 (0,184)	0,138 (0,207)
RWA	0,316** (0,145)	0,298** (0,136)	0,281** (0,129)
ROE	0,187* (0,107)	0,176* (0,103)	0,168* (0,098)
AM	-0,043 (0,065)	-0,037 (0,066)	-0,029 (0,061)

Izvor: Sastavili autori koristeći Stata softver (verzija 17)

Tabela 5 - Poređenje modela

Kriterijum	FEM	REM	PRM
Prilagođeni R²	0,83	0,74	0,57
F-test (p<0.001)	25,83***	-	-
LM-test (p<0.001)	-	30,15***	-
Hausman (p=0.003)	22,46***	-	-
Pogodnost za studiju	Odlična	Umerena	Slaba

Izvor: Sastavili autori koristeći Stata softver (verzija 17)

Tumačenje rezultata

Rezultati procene tri modela otkrivaju jasnu evoluciju u snazi i preciznosti parametara pri prelasku sa modela najmanjih kvadrata (PRM) na model slučajnih efekata (REM), a zatim na model fiksnih efekata (FEM). Dok je PRM pokazao ograničen efekat (-0,211) adekvatnosti kapitala (CAP) na likvidnost banaka (BAL), ovaj efekat se produbio (-0,305) u REM-u i dostigao svoj vrhunac (-0,394) u FEM-u, potvrđujući snažnu inverznu vezu između zahteva za adekvatnošću kapitala i likvidnosti banaka. Postepeno poboljšanje je takođe primećeno u statističkom značaju koeficijenata, posebno za promenljivu rizikom ponderisane aktive (RWA), čiji se koeficijent povećao sa 0,281 u PRM-u na 0,316 u FEM-u.

Rezultati statističkih testova su takođe pokazali jasnu superiornost FEM-a. LM test (30,15) je potvrdio superiornost REM-a u odnosu na PRM, dok su F-test (25,83) i Hausmanov test (22,46) pokazali superiornost FEM-a u odnosu na oba modela. Značajno povećanje prilagođenog koeficijenta determinacije (R²) sa 0,57 u PRM-u na 0,83 u FEM-u odražava sposobnost drugog modela da objasni najveći deo varijanse u podacima, što ga čini najpogodnijim za svrhe ove studije.

Empirijski nalazi dosledno pokazuju superiornost modela fiksnih efekata (FEM) za ispitivanje dinamike adekvatnosti kapitala i likvidnosti u bankama regulisanim Bazelom III. Ovaj pristup modeliranju je posebno povoljan jer efikasno uzima u obzir heterogenost specifičnu za banku, generiše preciznije i pouzdanije procene koeficijenata, obuhvata veće varijacije u skupu podataka i ostaje teoretski u skladu sa regulatornim principima Bazela III.

Empirijski nalazi ističu ključnu ulogu karakteristika specifičnih za instituciju u dizajnu regulatorne politike, posebno u upravljanju osetljivom ravnotežom između kapitalnih bafera i odredbi likvidnosti. Naša analiza modela fiksnih efekata otkriva snažnu negativnu povezanost ($\beta = -0,394$, $p < 0,01$) između koeficijenata adekvatnosti kapitala i nivoa likvidnosti među bankama koje su u skladu sa Bazelom III, što je potkrepljeno jakom statistikom modela (prilagođeni R²=0,83) i testovima specifikacije (Hausman $\chi^2=22,46$). Ovi rezultati potkrepljuju teorijski kompromis koji su postavili okviri Bazela III, a istovremeno potvrđuju prethodne dokaze (Bouheni & Rachdi, 2015) koji pokazuju smanjenje likvidnosti od 0,35% po povećanju kapitala od 1%. Snaga ove veze izgleda da je ublažena organizacionim upravljanjem i operativnim okvirima (Lee & Hsieh, 2013).

Ispitivanje hipoteze o kreditnom riziku dalo je statistički beznačajne rezultate ($\beta = 0,083$, $p > 0,1$), što ukazuje na minimalan uticaj problematičnih kredita na pozicije likvidnosti među bankama u Bazelu III. Ovaj nalaz je u suprotnosti sa početnim očekivanjima i odražava različitu efikasnost nadzora u različitim jurisdikcijama, kao što su pokazala istraživanja (Messai & Jouini 2013). Goš (Gosh, 2015) dalje

razjašnjava ovu vezu, pokazujući da robusni sistemi rezervisanja za gubitke po kreditima mogu ublažiti uticaj kreditnog rizika na likvidnost.

Analiza hipoteze o profitabilnosti otkrila je marginalno značajnu pozitivnu korelaciju ($\beta=0,187$, $p<0,1$) između povrata na kapital i nivoa likvidnosti, pružajući kvalifikovanu podršku za predloženu korelaciju. Ovi nalazi potkrepljuju postojeća istraživanja koja demonstriraju složene, nelinearne interakcije između profitabilnosti banaka i upravljanja likvidnošću (Goddard et al., 2013), a posebno tendenciju institucija sa boljim učinkom da održavaju veće rezerve likvidne imovine (Pasiouras & Kosmidou, 2007).

Hipoteza o upravljanju imovinom nije postigla statističku značajnost ($\beta=-0,043$, $p>0,1$), što sugerise da ne postoji značajna veza između efikasnosti upravljanja imovinom i nivoa likvidnosti. Ovaj ishod verovatno odražava moderatorski uticaj karakteristika vlasništva (Altunbas et al., 2011), zajedno sa potrebom za detaljnijom klasifikacijom imovine u takvim analizama (Fiordelisi et al., 2011).

Zaključak

Ova studija istražuje uticaj propisa o adekvatnosti kapitala Bazela III na likvidnost banaka u međunarodnom panelu od trinaest komercijalnih banaka koje posluju u zemljama članicama Bazelskog komiteta tokom perioda 2014–2021. Koristeći ekonometrijsku analizu panel podataka, istraživanje je identifikovalo model fiksnih efekata (FEM) kao statistički najprikladniju metodu, nadmašujući i REM i PRM u pogledu objašnjavajuće moći, konzistentnosti parametara i kontrole nad neprimećenom heterogenošću. Takav metodološki izbor zahteva preciznu analizu dinamike na nivou banke i divergencija specifičnih za instituciju u regulatornom odgovoru.

Rezultati podržavaju postojanje strukturnog kompromisa između adekvatnosti kapitala i likvidnosti. U ovom kontekstu, rezultati pokazuju da je povećanje pokazatelja adekvatnosti osnovnog kapitala banke u velikoj meri povezano sa smanjenjem likvidnosti, pretežno ilustrovano odnosom kredita i imovine, što ukazuje na to da su banke sa jačim kapitalnim baferima manje sklone da drže veći udeo nelikvidne imovine. Štaviše, jasna prednost preferiranog modela fiksnih efekata (sa prilagođenim R^2 od 0,83) naglašava važnost kontrole vremenski nepromenljivih karakteristika specifičnih za banke koje utiču na strategije upravljanja likvidnošću. Studija je pokazala da kreditni rizik (NPL), profitabilnost (ROE) i rizikom ponderisana aktiva (RWA) utiču na likvidnost u različitom stepenu, iako se njihov uticaj može razlikovati po snazi i značaju u različitim specifikacijama alternativnog modela.

Implikacije ovih rezultata su ključne za regulatornu praksu i razvoj politika. Autori preporučuju implementaciju višeslojnog okvira adekvatnosti kapitala usklađenog sa institucionalnom heterogenošću među bankama. Takav okvir bi obezbedio kompozitni indeks regulatornih metrika koje obuhvataju izloženost RWA, sistemski značaj i sektorsku osetljivost na rizik kako bi se na dinamičniji način kapitalizovali kapitalni zahtevi. Ovaj pristup bi pomogao da se izbegne prekomerno ograničavanje banaka konzervativnim pragovima kapitala koji nenamerno suzbijaju stvaranje likvidnosti, posebno za banke sa jakim operativnim fundamentima.

Pored toga, istraživanje ističe potrebu za integrisanim mehanizmima za praćenje kreditne likvidnosti. Regulatorna tela se podstiču da razviju sisteme ranog upozoravanja (EWS) koji kombinuju indikatore kreditnog rizika, kao što je verovatnoća neizvršenja obaveza (PD), sa metrikama likvidnosti u realnom vremenu. Model ranog informisanja zasnovan na logističkoj regresiji mogao bi da posluži kao alat za nadzor usmeren ka budućnosti, povezujući limite koncentracije kredita sa pragovima operativne likvidnosti, čime bi se omogućile proaktivnije regulatorne intervencije.

Studija dalje predlaže pravljenje i usvajanje kompozitnog indeksa likvidnosti koji kombinuje koeficijent pokrića likvidnosti (LCR) i koeficijent neto stabilnih izvora finansiranja (NSFR) Bazel III sporazuma sa indikatorima likvidnosti zasnovanim na tržištu. Ovaj indeks bi odražavao i regulatornu usklađenost i uslove na tržištu likvidnosti, nudeći opsežniju perspektivu i za interno upravljanje likvidnošću i za eksternu nadzornu procenu. Implementacija takvog alata zahteva razvoj modernog modela određivanja cena likvidnosti koji uzima u obzir oportunitetne troškove kapitalnih rezervi i uključuje premije rizika likvidnosti.

U budućnosti, istraživanja trebalo bi da se detaljnije bave efektima interakcije između adekvatnosti kapitala, likvidnosti i makroekonomske volatilnosti u uslovima stres testiranja. Proširenje skupa podataka kako bi se uključile godine oporavka nakon pandemije COVID-19 takođe bi moglo dati vredne uvide u otpornost mehanizama Bazela III u periodima sistemskih šokova. Štaviše, integrisanje tehnika mašinskog učenja u modele predviđanja rizika i regulatorno prognoziranje može dodatno poboljšati preciznost procena kompromisa između kapitala i likvidnosti u modernom bankarstvu.

Za kraj, ovo istraživanje doprinosi rastućoj empirijskoj literaturi o regulaciji bankarstva nakon krize, pružajući snažne dokaze o nijansiranom odnosu između kapitala i likvidnosti u okviru Bazela III. Nalazi istraživanja naglašavaju važnost prilagođavanja regulatornih intervencija institucionalnim realnostima i podstiču razvoj fleksibilnijih nadzornih okvira zasnovanih na podacima, koji usklađuju finansijsku stabilnost sa funkcionalnošću bankarskog sistema.

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CAPITAL ADEQUACY AND BANK LIQUIDITY UNDER BASEL III: A PANEL DATA STUDY OF 13 LISTED BANKS (2014–2021)

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Abstract: *This study investigates the impact of Basel III capital adequacy regulations on the liquidity positions of commercial banks across thirteen Basel Committee member countries between 2014 and 2021. Using panel data analysis, the Fixed Effects Model (FEM) emerged as the most suitable estimation technique, outperforming both the Random Effects and Pooled Regression models in terms of explanatory power (Adjusted $R^2 = 0.83$) and statistical robustness (Hausman test $p = 0.003$). Empirical results confirm a significant inverse relationship between Tier 1 capital ratios and bank liquidity, validating the theoretical trade-off posited by the Basel III framework. Additionally, credit risk, risk-weighted assets, and profitability were found to exert measurable influences on liquidity behavior. The study recommends a tiered, risk-sensitive capital adequacy approach and the development of integrated early warning systems and composite liquidity indices. These findings offer valuable policy insights for tailoring prudential regulations that balance solvency and liquidity across heterogeneous banking institutions.*

Keywords: Basel III, Capital Adequacy, Bank Liquidity, Panel Data Analysis, Credit Risk, Risk-Weighted Assets.

JEL: G21, G28, C23, G32

Introduction

The international banking system was to reveal some of the most serious structural weaknesses, especially inadequate capital buffers and fragile liquidity profiles that severely damage financial stability, during the global financial crisis of 2007-2008. Accordingly, the Basel Committee on Banking Supervision (BCBS) established Basel III, a regulatory framework that was designed to redefine global prudential standards through strengthening the capital adequacy requirements and the introduction of liquidity regulations. A central feature of this framework is emphasis on the Tier 1 capital, which should act as the primary safeguard against systemic shocks. This reform, however, generates a critical policy dilemma, for while an increase in capital buffers might improve solvency, it might also restrict the capacity of banks to generate liquidity for the economy, thus affecting the intermediation function of the banking sector.

This study examines this regulatory trade-off and, in doing so, takes an empirical approach to analyze the relationship between capital adequacy and bank liquidity under Basel III regulation. Using a balanced panel of thirteen systemically important publicly listed banks across member countries of the Basel Committee, including Al Rajhi Bank, Citibank, and Deutsche Bank, the study covers the period from 2014 to 2021 after the implementation. By situating the analysis within this timeframe, the study captures how banks have operationalized Basel III mandates and the strategic trade-offs they have made to comply with enhanced capital standards while sustaining liquidity provision.

The primary objective of this study is to examine how Basel III's capital adequacy requirements (specifically Tier 1 capital ratios) influence banks' liquidity positions, operationalized via the loans-to-assets ratio. These objectives addressed both the empirical relationship and the practical implications of regulatory reforms on liquidity management practices in internationally active financial institutions.

To support this inquiry, the research also pursues several secondary objectives. First, it seeks to compare and evaluate the performance of three prominent panel data methodologies, Pooled Regression Model (PRM), Fixed Effects Model (FEM), and Random Effects Model (REM), in estimating the capital-liquidity relationship. By conducting robustness checks across these models, the study identifies the most statistically reliable and replicable framework for analyzing regulatory impacts in cross-country banking datasets.

Second, the analysis explores the mediating role of core financial variables, including non-performing loan (NPL) ratios, risk-weighted asset (RWA) levels, return on equity (ROE), and asset management (AM) efficiency. These indicators are to be incorporated within the model as moderating factors which could potentially affect both the direction and the intensity of the relationship between capital buffers and liquidity outcomes. This part of the research gives more depth to the explanation by spelling out the institutional characteristics which condition regulatory effectiveness.

The ultimate objective of the study is to provide better policy-related recommendations on how to improve prudential regulation. More specifically, it recommends harmonization of capital-adequacy requirements with liquidity objectives while promoting heterogeneity of institutions in capacity, exposure to risk, and strategic focus. Therefore, the research adds to ongoing debates around the creation of resilient yet functionally adaptable regulatory architectures in the post-crisis era.

By presenting empirical analysis along with methodological rigor and policy insight, the study provides a rounded argument on how Basel III capital rules create liquidity behavior among banks. The study findings are quite timely as they unfold in a time when the world financial authorities are in the midst of re-evaluating some of their standards regarding regulation due to changes in the system through which markets move and systemic risk challenges that arise.

To achieve these objectives, the remainder of the paper is organized as follows: it first reviews the relevant literature on Basel III, capital adequacy, and bank liquidity, then explains the research methodology with details on the sample, variables, and econometric approach. This is followed by the empirical analysis and model estimation, after which the results are reported and discussed. The paper closes with the main conclusions and policy recommendations.

Literature Review

The post-crisis era's financial landscape provided fertile ground for academics to look for Basel III relatable framework, specifically in terms of their emphasis on capital adequacy versus liquidity requirements. Scholars have floated theoretical models, empirical studies, and case studies in institutional differences in addressing the issues of capital adequacy and liquidity.

The early contribution from Eichberger and Summer (2005) modeled the systemic implications of capital adequacy in interbank relations, warning that regulatory capital constraints may amplify risk contagion. Likewise, Dermine (2015) introduced an argument around the leverage ratio as a restriction on runs in maturity transformation institutions, echoing this concern. In 2019, Bui added that liquidity programs and capital buffers produce mixed results: they serve to enhance resilience but may also increase systemic similarity among banks. During crises, Acharya and Merrouche (2013) observed liquidity hoarding behaviors among banks, therefore starting a new research stream into the capital-liquidity trade-off.

Berger and Bouwman (2018) and Mehran and Thakor (2011) provided theoretical explanations of capital, enhancing liquidity creation, even though afterwards studies (e.g., Casu, Di Pietro, & Trujillo-Ponce, 2019) suggest a bi-causal reverse relationship whereby higher capital may reduce liquidity creation and vice versa. Within the view starting from this enhanced speculation, Pfeifer et al. (2017) further noted that capital-liquidity nexus depends on asset structure and profitability channels, especially in regard to emerging banking systems such as the case with the Czech Republic.

Country-specific empirical inquiries further confirm this complex relationship. Konovalova (2016) analyzed capital adequacy and liquidity in Latvia while suggesting a possible damping effect of Basel III on bank activity. In the same fashion, Pislari (2024) evaluated Basel III liquidity requirements' achievements and restrictions among Moldovan banks and concluded that, although complying does bring challenges, improving institutional resilience is the result for sure. According to the findings given by Jasrotia, Mishra, and Sharma (2020), the implementation of Basel III in India achieved the result whereby CAR compliance raises investor confidence; however, the profitability objectives are mixed.

Other studies further delve into the effects of capital adequacy on credit creation and risk taking. The failure of the Basel II framework to provide adequate buffers prior to the crisis and thus impose severe state interventions is documented by Hebbink, Kruidhof, and Slingenberg (2014). In line with this, Anginer and Demirgüç-Kunt (2014) differentiated between capital quality levels, finding that high-quality capital reduces systemic risk, while hybrid or weak capital may exacerbate instability. Baltali and Tanega (2011) reinforced this point by critiquing the hybridization of capital under Basel II and highlighting Basel III's shift toward stronger equity capital standards.

Beyond systemic risk, scholars have focused on the effect of Basel III on bank lending and performance. Lee and Hsieh (2013) found mixed evidence across Asian banks, while Fiordelisi, Marques-Ibanez, and Molyneux (2011) and Pasiouras and Kosmidou (2007) highlighted the mediating role of operational efficiency and corporate governance in Europe. Margono, Wardani, and Safitri (2020) extended this to Indo-

nesian banks, where both capital adequacy and liquidity positively influenced performance, mediated by interest rate risk.

The literature also addresses the practical implementation challenges of risk-weighted asset (RWA) models. Repullo and Suarez (2013) provided a theoretical critique of RWA manipulation, while Fahlenbrach, Prilmeier, and Stulz (2018) documented how banks strategically adjust to RWA thresholds. These observations are supported by the Basel Committee (2017, 2022), which reflect on unintended regulatory arbitrage and evolving standards.

Liquidity regulation, particularly the Liquidity Coverage Ratio (LCR) and Net Stable Funding Ratio (NSFR), is another recurring concern. Hartlage (2012a, 2012b) offered a critical analysis of LCR's ability to address systemic liquidity shortages, while Hlebig (2017) investigated the impact of NSFR on European banking stability. Chiba (2021) confirmed that combining capital and liquidity rules significantly reduces the likelihood of post-recession crises. Resti (2011) similarly noted that Basel III would require banks to overhaul operational models, pricing strategies, and profitability metrics.

At the intersection of capital regulation and deposit behavior, Arping (2017) proposed a non-monotonic relationship where moderate increases in capital requirements may crowd out deposits, but substantial increases can improve safety and deposit uptake. This tension is echoed in Syron and Randall (1991), who issued early warnings about the procyclical nature of capital requirements, particularly under the FDIC Improvement Act.

Regarding credit risk and NPL management, Messai and Jouini (2013) and Ghosh (2015) confirmed that macro and institutional factors shape NPL capital dynamics, with regulation playing a variable role depending on context. Houston et al. (2020) further complicated the picture by showing how global banks employ strategic avoidance mechanisms to sidestep regulatory constraints.

The enhanced robustness of econometric analysis adopted by the studies has been mainly due to new advances in econometrics. Gujarati and Porter (2009) provided diagnostic tests for multicollinearity and autocorrelation, while Baltagi (2021) introduced the contemporary panel data methods to improve inferential quality. The tools have resolved the disagreeing outcomes represented by Lee and Hsieh (2013) against those of Demirgüç-Kunt, Pedraza, and Ruiz-Ortega (2020).

Modern literature, finally, focuses on sustainability and transparency in evaluating regulation. Waddock and Graves (2020) studied the relationship of sustainability metrics to bank performance, while Penman and Yehuda (2019) evaluated implications for valuation of practices in financial disclosure. This mirrors what is called the larger agenda to put prudential regulation with economic cycles (Brei, Borio, & Gambacorta, 2020) and long-term policy goals (Demirgüç-Kunt & Huizinga, 2010).

The Basel III framework has thus stimulated a multifaceted research agenda addressing capital-lending dynamics, systemic risk, liquidity management, performance measures, and other aspects of institutional governance. Literature remains vibrant and evolves in tandem with regulatory practice such that empirical research outcomes provide policy advice to supervisors and contribute to the more general stability of financial markets.

Study Methodology

This empirical effort utilizes quantitative research design-based panel data econometrics to investigate dynamic relationship between capital adequacy and bank liquidity under the framework of Basel III. The study considers

the period 2014–2021, which is instrumental since it captures the post-implementation effects of Basel III on various banking systems. The study provides insights that are robust and generalizable by analyzing cross-nationally the thirteen systematic important commercial banks from Basel Committee member countries on how capital regulation interacts with liquidity provisioning on the global scale in banking practices.

The sample selection is grounded in purposive sampling, targeting banks that are fully Basel III-compliant and representative of distinct regulatory and macroeconomic environments. The final sample includes Al Rajhi Bank (Kingdom of Saudi Arabia), First Abu Dhabi Bank (United Arab Emirates), Citibank (United States), Lloyds Banking Group (United Kingdom), China Construction Bank (China), Mizuho Financial Group (Japan), Deutsche Bank AG (Germany), Société Générale SA (France), Bank of Nova Scotia (Canada), HDFC Bank Ltd (India), Oversea-Chinese Banking Corporation (Singapore), Standard Bank Group (South Africa), and Türkiye Cumhuriyeti Ziraat Bankası (Turkey). These banks are selected based on their international presence, regulatory relevance, data availability, and strategic importance to their respective national banking systems. The diversity of the sample enhances the external validity of the findings and supports a cross-jurisdictional assessment of Basel III's impact. The following table represents the selected banks.

Table 1 - Banks Selected for the Study

Bank	Country	Justification for Selection
Al Rajhi Bank	Saudi Arabia	Basel III compliant, international relevance
First Abu Dhabi Bank	UAE	Regional representative, data availability
Citibank	USA	Systemically important, global operations
Lloyds Banking Group	UK	Basel III adoption, strategic importance
China Construction Bank	China	One of the largest global banks
Mizuho Financial Group	Japan	Basel III compliant, macroeconomic significance
Deutsche Bank AG	Germany	Global systemically important institution
Société Générale SA	France	European representative, data availability
Bank of Nova Scotia	Canada	Basel III adoption, North America representation
HDFC Bank Ltd	India	Emerging market perspective
Oversea-Chinese Banking Corporation (OCBC)	Singapore	Asian financial hub representative
Standard Bank Group	South Africa	Only African representative, Basel III adoption
Ziraat Bankası	Turkey	Emerging market perspective, regulatory relevance

Source: Compiled by the authors based on publicly available data from annual reports of the selected banks (2014–2021) and Basel Committee on Banking Supervision (BCBS) publications.

The hypotheses tested in this study are formulated as follows:

- Hypothesis 1 (H1): Capital adequacy has a statistically significant impact on bank liquidity for banks operating in Basel III member jurisdictions. The stated Hypothesis 1 is the main hypothesis of the work. In support of this central proposition, the study also tests the following auxiliary hypotheses:
- Hypothesis 2 (H2): Credit risk, measured by the ratio of non-performing loans to total loans, significantly influences bank liquidity.

- Hypothesis 3 (H3): Profitability, measured through return on equity (ROE), has a significant impact on liquidity outcomes.
- Hypothesis 4 (H4): Asset management efficiency, proxied by the ratio of operating income to total assets, significantly affects bank liquidity.

Collectively, these hypotheses examine both the direct effect of capital adequacy and the indirect influence of bank-specific performance variables on liquidity under Basel III regulation.

The empirical model employs a structured set of financial variables grounded in banking theory and supported by prior research. The dependent variable is bank liquidity, operationalized as the ratio of loans to total assets. This measure, widely adopted in the banking literature, reflects the proportion of illiquid assets held by a bank, with higher values indicating increased exposure to liquidity risk. The focal independent variable is capital adequacy, defined using the Tier 1 capital ratio in conformity with Basel III standards. This ratio measures a bank's core capital to its risk-weighted assets and forms the bedrock of solvency regulation under Basel III.

Four other explanatory variables have been incorporated into the model to address the institutional heterogeneity and control for other confounding effects. Credit risk is indicated by the ratio of non-performing loans to total loans, which serves to show the asset quality and credits inherent exposures of the domain bank. The ratio of risk-weighted assets to total assets indicates the regulatory capital burden by level of risk sensitivity. Profitability is defined by the ratio of return on equity, indicating net income against total equity to indicate the capacity of the bank to produce returns for shareholders. Lastly, asset management efficiency is presented by the ratio of operating income to total assets, which indicates how efficiently the bank utilizes its resources to earn operating returns.

These variables were selected based on the underpinning empirical studies, including Berger and Bowman (2018) regarding bank liquidity; Demirgüç-Kunt et al. (2020) regarding capital adequacy; Houston et al. (2020) regarding credit risk; Fahlenbrach et al. (2018) regarding risk-weighted assets; Penman and Yehuda (2019) regarding return on equity; and Waddock and Graves (2020) on asset management efficiency. The introduction of these variables allows the study not only to establish the direct consequence of capital adequacy but also to test how internal characteristics of banks mediate the liquidity outcomes within a given regulatory environment.

The selected panel structure enables tracing temporal trends as well as the cross-sectional variance among the sampled banks. Thus, these allow the study to address unobserved heterogeneity and possible endogeneity in a rigorous and transparent manner. In numerous econometric estimations, the analysis will fix random and pool regressions, hoping to add substantially to reliable evidence on the capital-liquidity nexus in theory and policy.

Empirical Analysis and Model Estimation

The study presents the empirical framework and econometric analysis that were used to analyze the relationship between capital adequacy and bank liquidity under the Basel III regulatory environment. A panel data approach was used to capture both inter-temporal and cross-sectional aspects among thirteen selected commercial banks from Basel Committee member countries for the period 2014 to 2021. The analysis is done in five stages: (1) model specification, (2) descriptive statistical analysis of principal variables, (3) analysis of correlation structure, (4) estimation and comparison of regression panels, and (5) interpretation of results and testing of research hypotheses. This extensive analytical

sequence thus ensures that the empirical results are statistically robust, theoretically cogent, and policy-relevant.

Study Model

A panel data regression model (used in going through Panel Modes) was employed to explore the relationship between capital adequacy and liquidity within banks. This study would apply the model since it takes into consideration temporal changes and individual characteristics possessed by each bank. The model is expressed as follows:

Where: $BAL = \beta_0 + \beta_1 CAP + \beta_2 NPL + \beta_3 RWA + \beta_4 ROE + \beta_5 AM + \varepsilon_{it}$

BAL: Dependent variable (bank liquidity).

CAP: Main independent variable (capital adequacy).

NPL, RWA, ROE, AM: Control explanatory variables.

β_0 : Constant term.

β_0 - β_5 : Regression coefficients.

ε_{it} : Error term.

Descriptive Analysis of Study Variables

The following table presents the descriptive statistics of the study variables, calculated from the annual reports published on the websites of the sample banks for the period 2014–2021:

Table 2 - Descriptive Statistics of Study Variables

Variable	2014	2015	2016	2017	2018	2019	2020	2021
Average BAL	0.6450	0.6428	0.6428	0.7113	0.6531	0.6262	0.6299	0.6194
Average CAP	0.1799	0.1833	0.1791	0.1729	0.1649	0.1715	0.1678	0.1736
Average NPL	0.0188	0.0167	0.0134	0.0117	0.0105	0.0105	0.0129	0.0197
Average RWA	0.8437	0.8639	0.8824	0.8876	0.9017	0.8611	0.8691	0.8571
Average ROE	0.1009	0.1343	0.1182	0.1147	0.1341	0.1335	0.1335	0.1374
Average AM	0.0387	0.0390	0.0381	0.0365	0.0371	0.0355	0.0366	0.0375

Source: Compiled from the financial statements of the commercial banks included in the study sample.

The capital adequacy (CAP) of Basel Committee banks fluctuated between 16.5% and 18.3% during 2014–2021, peaking in 2015 due to Basel III tightening and declining in 2016–2017 due to credit expansion (loans-to-assets ratio rising to 71.1%). The ratio improved after 2018 with reduced credit risk (NPL to 1.05%) and increased profitability (ROE to 13.4%). Variations across banks reflect differing business models, but all remained above the 10.5% minimum, demonstrating the banking sector's resilience under Basel III.

Correlation Matrix Analysis

Table 3 - Correlation Matrix Results

Variable	BAL	CAP	NPL	RWA	ROE	AM
BAL	1.000					
CAP	-0.452	1.000				
NPL	0.324	-0.302	1.000			
RWA	0.683	-0.823	0.402	1.000		
ROE	-0.124	0.652	-0.251	-0.304	1.000	
AM	0.253	0.184	-0.104	0.052	0.351	1.000

Source: Compiled by the authors using Stata software (version 17).

The correlation matrix analysis reveals complex dynamics in the relationships between banking variables, with correlational patterns that can be analyzed as follows:

The correlation coefficient (-0.452) indicates a moderate inverse relationship between liquidity (BAL) and capital adequacy (CAP), which reflects the “Flight to Quality” phenomenon (Acharya and Merrouche, 2013) where banks with higher capital reserves increase their investments in high-quality liquid assets rather than loans.

Regarding the interaction of non-performing loans (NPL) with other variables, the positive correlation (0.324) with liquidity (BAL) may indicate a “liquidity paradox” where non-performing loans accumulate in banks with higher liquidity due to more flexible lending policies (Bonner et al., 2015). The negative correlation (-0.302) with capital adequacy reflects the “capital absorption” mechanism where non-performing loans deplete banks’ capital resources.

As for the dynamics of risk-weighted assets (RWA), the strong negative correlation (-0.823) with capital adequacy shows intense competition for resources between solvency requirements and risk management, consistent with the framework of (Repullo and Suarez, 2013) regarding Basel III’s impact. The strong positive correlation (0.683) with liquidity (BAL) reveals a “liquidity risk-taking” strategy where banks increase their investments in high-risk assets to compensate for low returns.

Concerning the profitability axis (ROE), the positive correlation (0.652) with capital adequacy (CAP) supports the “Capital Incentive Hypothesis” (Mehran and Thakor, 2011) where banks with stronger capital regulations achieve higher returns. The negative correlation (-0.304) with risk-weighted assets (RWA) reflects a trade-off between profitability and risk management, consistent with the model of (Brei et al., 2020).

For asset management efficiency (AM), the moderate correlation (0.351) with ROE indicates the presence of an “operational efficiency effect” on profitability (Demirgüç-Kunt and Huizinga, 2010). The weak correlations with other variables may reflect the relative independence of operational efficiency factors.

It is worth noting that the high correlation values between RWA-CAP (-0.823) and BAL-RWA (0.683) suggest potential multicollinearity problems. However, variance inflation factor (VIF) analysis did not

record any values exceeding 3.2, ruling out serious multicollinearity issues (Gujarati and Porter, 2009). Nevertheless, the moderate correlation (-0.304) between risk-weighted assets and return on equity warrants attention, as it reflects the structural tension between return requirements and risk management constraints, as discussed in detail by (Basel Committee, 2017) within the Basel III framework.

Panel Model Estimation and Selection

Three panel models were estimated: Pooled Regression Model (PRM), Fixed Effects Model (FEM), and Random Effects Model (REM). The FEM outperformed others with an adjusted R^2 of 0.83 (vs. 0.57 for PRM) and significant Hausman test ($\chi^2=22.46$, $p=0.003$), confirming its suitability.

Table 4 - Statistical Model Estimation

Variable	FEM	REM	PRM
Constant	-	0.682*** (0.105)	0.725*** (0.118)
CAP	-0.394*** (0.112)	-0.305*** (0.092)	-0.211** (0.101)
NPL	0.083 (0.179)	0.095 (0.184)	0.138 (0.207)
RWA	0.316** (0.145)	0.298** (0.136)	0.281** (0.129)
ROE	0.187* (0.107)	0.176* (0.103)	0.168* (0.098)
AM	-0.043 (0.065)	-0.037 (0.066)	-0.029 (0.061)

Source: Compiled by the authors using Stata software (version 17).

Table 5 - Model Comparison

Criterion	FEM	REM	PRM
Adjusted R^2	0.83	0.74	0.57
F-test ($p<0.001$)	25.83***	-	-
LM-test ($p<0.001$)	-	30.15***	-
Hausman ($p=0.003$)	22.46***	-	-
Fit for Study	Excellent	Moderate	Weak

Source: Compiled by the authors using Stata software (version 17).

Interpretation of Results

The results of estimating the three models reveal a clear evolution in the strength and precision of the parameters when transitioning from the pooled regression model (PRM) to the random effects model (REM) and then to the fixed effects model (FEM). While the PRM showed a limited effect (-0.211) of capital adequacy (CAP) on bank liquidity (BAL), this effect deepened (-0.305) in the REM and reached its peak (-0.394) in the FEM, confirming a strong inverse relationship between capital adequacy requirements and bank liquidity. A gradual improvement was also observed in the statistical significance of the coefficients, particularly for the risk-weighted assets (RWA) variable, whose coefficient increased from 0.281 in the PRM to 0.316 in the FEM.

The results of the statistical tests also demonstrated clear superiority of the FEM. The LM test (30.15) confirmed the REM's superiority over the PRM, while the F-test (25.83) and Hausman test (22.46) showed the FEM's superiority over both models. The notable increase in the adjusted coefficient of determination (R^2) from 0.57 in the PRM to 0.83 in the FEM reflects the latter model's ability to explain the largest portion of the variance in the data, making it the most suitable for the study's purposes.

The empirical findings consistently demonstrate the superiority of the fixed effects model (FEM) for examining capital adequacy-liquidity dynamics in Basel III-regulated banks. This modeling approach is particularly advantageous as it effectively accounts for bank-specific heterogeneity, generates more precise and reliable coefficient estimates, captures greater variation in the dataset, and remains theoretically congruent with Basel III regulatory principles.

The empirical findings underscore the critical role of institution-specific characteristics in regulatory policy design, particularly in managing the delicate equilibrium between capital buffers and liquidity provisions. Our fixed effects model analysis reveals a robust negative association ($\beta = -0.394$, $p < 0.01$) between capital adequacy ratios and liquidity levels among Basel III-compliant banks, supported by strong model fit statistics (adjusted $R^2 = 0.83$) and specification tests (Hausman $\chi^2 = 22.46$). These results substantiate the theoretical trade-off posited by Basel III frameworks while corroborating prior evidence (Bouheni & Rachdi, 2015) showing a 0.35% liquidity reduction per 1% capital increase. The strength of this relationship appears moderated by organizational governance and operational frameworks (Lee & Hsieh, 2013).

Examination of the credit risk hypothesis yielded statistically insignificant results ($\beta = 0.083$, $p > 0.1$), suggesting minimal influence of non-performing loans on liquidity positions among Basel III banks. This finding contrasts with initial expectations and reflects varying supervisory effectiveness across jurisdictions, as demonstrated by Messai and Jouini (2013). Ghosh (2015) further clarifies this relationship, showing that robust loan loss provisioning systems can mitigate credit risk's liquidity impact.

Analysis of the profitability hypothesis revealed a marginally significant positive association ($\beta = 0.187$, $p < 0.1$) between return on equity and liquidity levels, offering qualified support for the proposed relationship. These findings corroborate existing research demonstrating complex, non-linear interactions between bank profitability and liquidity management (Goddard et al., 2013), particularly the tendency of higher-performing institutions to maintain more substantial liquid asset buffers (Pasiouras & Kosmidou, 2007).

The asset management hypothesis failed to achieve statistical significance ($\beta = -0.043$, $p > 0.1$), suggesting no substantial relationship between AM efficiency and liquidity levels. This outcome likely reflects the moderating influence of ownership characteristics (Altunbas et al., 2011), coupled with the need for more granular asset classification in such analyses (Fiordelisi et al., 2011).

Conclusion

This study investigates the impact of Basel III capital adequacy regulations on bank liquidity across a cross-national panel of thirteen commercial banks operating in Basel Committee member countries during the 2014–2021 period. Employing panel data econometrics, the research identified the Fixed Effects Model (FEM) as the most statistically appropriate method, outperforming both the Random Effects Model (REM) and the Pooled Regression Model (PRM) in terms of explanatory power, parameter consistency, and control over unobserved heterogeneity. Such a methodological choice warrants an

accurate analysis of bank-level dynamics and institution-specific divergences in regulatory response.

The results support the existence of a structural trade-off between capital adequacy and liquidity. In this context, the results show that the increase in Tier 1 capital ratio is greatly associated with a decrease in liquidity, predominantly proxied by the loans-to-assets ratio, which indicates that banks with stronger capital buffers are less inclined to hold a higher proportion of illiquid assets. Furthermore, the clear advantage of the preferred fixed effects model (with an adjusted R^2 of 0.83) emphasizes the importance of controlling for time-invariant bank-specific characteristics that affect liquidity management strategies. The study finds that credit risk (NPL), profitability (ROE), and risk-weighted assets (RWA) affect liquidity to varying degrees, although their influence may differ in strength and significance across the alternative model specifications.

The implications of these results are central to regulatory practice and policy development. The authors recommend implementing a tiered capital adequacy framework aligned with institutional heterogeneity among banks. Such a framework would provide a composite index of regulatory metrics comprising RWA exposure, systemic importance, and sectoral risk sensitivity to capitalize capital requirements in a more dynamic way. This approach would help avoid over-constraining banks with conservative capital thresholds that inadvertently suppress liquidity creation, especially for banks with strong operational fundamentals.

In addition, the research highlights the need for integrated credit-liquidity monitoring mechanisms. Regulatory authorities are encouraged to develop Early Warning Systems (EWS) that combine credit risk indicators, such as probability of default (PD), with real-time liquidity metrics. A logistic regression-based EWS model could serve as a forward-looking supervisory tool, linking credit concentration limits with operational liquidity thresholds, thereby enabling more proactive regulatory interventions.

The study further proposes the design and adoption of a composite liquidity index that combines Basel III's Liquidity Coverage Ratio (LCR) and Net Stable Funding Ratio (NSFR) with market-based liquidity indicators. This index would reflect both regulatory compliance and liquidity market conditions, offering a more nuanced perspective for both internal liquidity management and external supervisory assessment. Implementing such a tool requires the development of a modern liquidity pricing model that accounts for the opportunity cost of capital reserves and incorporates liquidity risk premiums.

Looking ahead, future research should explore the interaction effects between capital adequacy, liquidity, and macroeconomic volatility under stress-testing conditions. Expanding the dataset to include post-COVID-19 recovery years could also yield valuable insights into the resilience of Basel III mechanisms in periods of systemic shocks. Moreover, integrating machine learning techniques in risk prediction models and regulatory forecasting may further enhance the precision of capital-liquidity trade-off assessments in modern banking.

In conclusion, this research contributes to the growing empirical literature on post-crisis banking regulation by providing robust evidence of the nuanced relationship between capital and liquidity under Basel III. Its findings underscore the importance of tailoring regulatory interventions to institutional realities and encourage the development of more flexible, data-driven supervisory frameworks that align financial stability with banking system functionality.

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