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SADRŽAJ

6. *Uvodnik*
Dr Sladjana Andrian Sredojević
Poverenje i ljudi kao konstanta u vremenu promena

10. *Bojana Ostojić i Prof. Ana Gavrilović*
Timska efikasnost, psihološka sigurnost i performanse: perspektiva zaposlenih u bankarskom sektoru Srbije

54. *Prof. Almir Alihodžić*
Determinante kretanja S&P Green Bond Index-a: empirijska analiza uticaja S&P Municipal Bond Index-a i prinosa na američke državne obveznice

98. *Božidar Čakajac*
Analiza međunarodne investicione pozicije Republike Srbije u kontekstu eksterne održivosti

134. *Snežana Colić*
Dinamika sistemskog značaja banaka na tržištu Republike Srbije: Analiza klasterske migracije i strukturnog prilagođavanja

166. *Marica Pejić*
Program usklađenosti poslovanja banaka sa propisima o zaštiti konkurencije: novi trend jačanja konkurencije u Srbiji ili regulatorni trošak?

190. *Vladimir Vasić i Milica Bugarčić*
Definisanje protokola veštačke inteligencije u rešavanju nedostajućih podataka u oblasti bankarstva

TABLE OF CONTENTS

6. *Editorial*
Slađana Andrian Sredojević, PhD
Trust and People as a Constant in Times of Change

32. *Bojana Ostojić and Prof. Ana Gavrilović*
Team Effectiveness, Psychological Safety and Performance: Employees' Perspective in the Banking Sector of Serbia

76. *Prof. Almir Alihodžić*
Determinants of the S&P Green Bond Index: An Empirical Analysis of the Impact of the S&P Municipal Bond Index and the U.S. 10 –Year Treasury Yield

116. *Božidar Čakajac*
Analysis of the International Investment Position of the Republic of Serbia in the Context of External Sustainability

150. *Snežana Colić*
Dynamics of the Systemic Importance of Banks in the Market of the Republic of Serbia: Analysis of Cluster Migration and Structural Adjustment

178. *Marica Pejić*
Competition Compliance Programmes in the Banking Sector: a New Trend in Strengthening Competition in Serbia or a Regulatory Cost?

204. *Vladimir Vasić and Milica Bugarčić*
Defining the Protocol of Artificial Intelligence in Solving Missing Data in the Field of Banking



POVERENJE I LJUDI KAO KONSTANTA U VREMENU PROMENA

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Bankarski sektor danas prolazi kroz jednu od najintenzivnijih transformacija u svojoj istoriji. Veštačka inteligencija, digitalizacija, novi poslovni modeli, promenjena očekivanja klijenata i sve složenije geopolitičko okruženje menjaju način na koji finansijske institucije posluju i stvaraju vrednost. Ipak, centralna poruka 25. Svetske konferencije instituta za bankarstvo (World Conference of Banking Institutes), održane u junu 2026. godine na Univerzitetu Sent Endruz u Škotskoj, bila je iznenađujuće jednostavna: tehnologija menja način rada bankarstva, ali ne i njegove temeljne vrednosti. Ovaj važan međunarodni događaj je okupio predstavnike bankarskih instituta, regulatora, akademske zajednice i finansijskog sektora iz više od dvadeset zemalja sveta, među kojima je bila i Srbija – u njegovom radu, panelima i diskusijama učestvovala je i potpisnica ovih redova kao predstavnica Udruženja banaka Srbije, i Evropske bankarske trening mreže čije je Udruženje član.

Gotovo svi paneli, od diskusija o veštačkoj inteligenciji i budućnosti rada do tema profesionalnih standarda, regulatornih izazova i razvoja ljudskih potencijala, vraćali su se istom pitanju: kako očuvati poverenje u svetu ubrzanih promena. Zaključak je bio jasan: uspeh neće pripasti institucijama koje najbrže uvode nove tehnologije, već onima koje ih primenjuju odgovorno, uz jasnu odgovornost, visoke etičke standarde i profesionalno rasuđivanje.

Posebna pažnja posvećena je ulozi bankarskih profesionalaca u eri veštačke inteligencije. Iako AI postaje sastavni deo poslovnih procesa, učesnici konferencije naglasili su da ljudsko prosuđivanje, kritičko mišljenje, integritet i odgovornost ostaju nezamenljivi. Budućnost pripada modelu u kojem tehnologija osnažuje ljude, a ne zamenjuje ih.

Konferencija je takođe potvrdila da profesionalizam više nije ograničen na tehničko znanje. Savremeni bankarski stručnjak mora da povezuje digitalne kompetencije sa etikom, sposobnošću donošenja odluka u neizvesnim okolnostima i razumevanjem potreba različitih generacija klijenata. Kontinuirano učenje, razvoj novih veština i međunarodna razmena znanja postaju ključni preduslovi održivog razvoja bankarske profesije.

Možda je najznačajnija poruka ovogodišnjeg skupa sadržana u ideji „doslednosti bez uniformnosti". Globalni profesionalni standardi, etički principi i odgovornost mogu predstavljati zajednički imenitelj bankarske profesije širom sveta, uz istovremeno uvažavanje nacionalnih specifičnosti, regulatornih okvira i lokalnih potreba. Upravo u toj ravnoteži između globalnog i lokalnog leži jedan od najvećih izazova budućeg razvoja sektora.

U vremenu kada se tehnološke promene odvijaju brže nego ikada, bankarska industrija dobija jasnu poruku: inovacije jesu neophodne, ali poverenje ostaje njena najvažnija valuta. Zato će ulaganje u stručnost, profesionalne standarde, etičko poslovanje i razvoj ljudi ostati ključ za očuvanje stabilnosti i relevantnosti bankarstva u decenijama koje dolaze.

Za bankarsku zajednicu Srbije, aktivno učešće predstavnika Udruženja banaka Srbije u radu međunarodnih skupova ovakvog formata predstavlja važan doprinos međunarodnoj vidljivosti domaće struke i potvrdu opredeljenosti za kontinuirani razvoj znanja, profesionalizma i inovacija. U vremenu ubrzanih promena, upravo ulaganje u ljude, stručnost i poverenje ostaje najvažniji kapital bankarske profesije.

GLAVNA I ODGOVORNA UREDNICA
Dr Slađana Andrian Sredojević



TRUST AND PEOPLE AS A CONSTANT IN TIMES OF CHANGE

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The banking sector is currently undergoing one of the most intense transformations in its history. Artificial intelligence, digitalisation, new business models, shifting client expectations, and an increasingly complex geopolitical environment are altering the way financial institutions operate and create value. Yet, the central message of the 25th World Conference of Banking Institutes, held in June 2026 at the University of St Andrews in Scotland, was surprisingly simple: technology is changing the way banking operates, but not its fundamental values. This noteworthy international event brought together representatives from banking institutes, regulatory bodies, academia, and the financial sector from over twenty countries, including Serbia; the author of this article participated in the proceedings, panels, and discussions as a representative of the Association of Serbian Banks and the European Banking & Financial Services Training Association, of which the Association is a member.

Almost all panels, ranging from discussions on artificial intelligence and the future of work to topics such as professional standards, regulatory challenges, and human capital development, kept returning to the same question: how to maintain trust in a world of rapid change. The conclusion was clear: success will not lend itself to institutions that adopt new technologies the fastest, but rather to those that implement them responsibly, with clear accountability, high ethical standards, and professional judgment.

Special attention was paid to the role of banking professionals in the era of artificial intelligence. Although AI is becoming an integral part of business processes, conference participants emphasised that human judgment, critical thinking, integrity, and accountability remain irreplaceable. The future belongs to a model in which technology empowers people rather than replacing them.

The conference also confirmed that professionalism is no longer limited to technical knowledge. A modern banking expert must combine digital competencies with ethics, the ability to make decisions under uncertainty, and an understanding of the needs of clients across different generations. Continuous learning, the development of new skills, and the international exchange of knowledge are becoming key prerequisites for the sustainable development of the banking profession.

Perhaps the most significant message of this year's gathering is encapsulated in the concept of "consistency without uniformity". Global professional standards, ethical principles, and accountability can serve as a common denominator for the banking profession worldwide, while simultaneously respecting national specificities, regulatory frameworks, and local needs. It is precisely in this balance between the global and the local that one of the greatest challenges for the sector's future development lies.

In an era where technological changes are unfolding faster than ever, the banking industry is receiving a clear message: innovation is essential, yet trust remains its most vital currency. Therefore, investing in expertise, professional standards, ethical business practices, and human capital development will remain key to preserving the stability and relevance of banking in the decades to come.
For the Serbian banking community, the active participation of the Association of Serbian Banks' representatives in international gatherings of this calibre is a significant contribution to the international visibility of the domestic profession and it reaffirms a commitment to the continuous development of knowledge, professionalism, and innovation. In times of rapid change, investing in people, expertise, and trust remains the banking profession's most valuable asset.

EDITOR-IN-CHIEF
Slađana Andrian Sredojević, PhD

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TIMSKA EFIKASNOST, PSIHOLOŠKA SIGURNOST I PERFORMANSE: PERSPEKTIVA ZAPOSLENIH U BANKARSKOM SEKTORU SRBIJE

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Rezime: *Cilj ovog rada bio je da se ispita funkcionisanje timova u bankarskom sektoru kroz dimenzije jasno definisanih ciljeva, efikasnosti, psihološke sigurnosti i timskih performansi. Istraživanje je sprovedeno tokom maja i juna 2026. godine, a u njemu je učestvovalo 225 zaposlenih u bankama u Srbiji, koji su članovi različitih timova. Rezultati pokazuju da jasni ciljevi značajno doprinose timskoj efikasnosti, dok psihološka sigurnost ima značajan uticaj na performanse. Pored toga, efikasnost i performanse su međusobno značajno povezane, što ukazuje da racionalno korišćenje resursa vodi ka višem kvalitetu timskog rada. Deskriptivna statistika potvrđuje da ispitanici u velikoj meri pozitivno ocenjuju sve analizirane aspekte timskog funkcionisanja. Rezultati pokazuju da uspešno funkcionisanje timova u bankama zavisi od kombinacije jasne strukture, sigurnog i podsticajnog okruženja, kao i sposobnosti da se ciljevi ostvaruju efikasno i kvalitetno. Time se naglašava značaj timske dinamike za postizanje organizacionih ciljeva.*

Ključne reči: banke, bankarsko poslovanje, timovi, timski rad, efikasnost, performanse.

JEL klasifikacija: D23, M54, G21

Uvod

Savremeno okruženje obeleženo je dinamičnim promenama i neizvesnim uslovima poslovanja. Globalizacija tržišta, ubrzani tehnološki razvoj, ekonomske krize, recesija, pad privrednog rasta, pandemije i drugi izazovi nametnuli su organizacijama potrebu za stalnim prilagođavanjem (Hart i sar., 1993; Wang, 2008). Kao odgovor na takve izazove, počeo je da se primenjuje timski rad, kao poseban model organizovanja koji odbacuje rigidnu, vertikalnu hijerarhiju i teži horizontalnim, agilnim i fleksibilnim formama, sposobnim da brzo reaguju na promene (Berber i sar., 2020; Lazarević i Lukić Nikolić, 2024; West, 2012). Tim predstavlja manju grupu ljudi sa različitim, ali međusobno dopunjujućim veštinama, koja se okuplja oko zajedničke svrhe i ciljeva, uz deljenje odgovornosti za postignute rezultate (Katzenbach i Smith, 1993). To je skup od dve ili više osoba koje međusobno komuniciraju, utiču jedni na druge i zajedno snose odgovornost za ostvarenje ciljeva (Cohen i Bailey, 1997).

Afirmacija timova i timskog rada danas je u punom zamahu ne samo u teoriji menadžmenta, već i u praksi. Ipak, formiranje i vođenje timova zahteva specifična znanja, veštine i iskustva, kao i značajna ulaganja vremena i energije, budući da se ponašanje pojedinaca u timu bitno razlikuje od ponašanja pojedinca koji radi samostalno mimo tima (George i Jones, 2012). Potrebno je učiniti veliki napor prilikom procesa izgradnje tima i konstantno pratiti način na koji tim funkcioniše. Takođe, neophodno je stalno otkrivati nove prakse upravljanja timom, imajući u vidu da se timovi razlikuju po svrsi postojanja, zadacima koje obavljaju i okruženju u kojem funkcionišu. Posebnu pažnju treba usmeriti na obuku i razvoj članova tima (Ehigie i sar., 2023).

Danas timovi funkcionišu kao samostalne organizacione jedinice koje upravljaju procesima i zadacima, obučavaju zaposlene, sprovode samokontrolu i snažno se usmeravaju ka ostvarivanju ciljeva (West, 2012). U ekonomiji znanja timovi nisu opcija, već imperativ jer formalna nadogradnja osnovne organizacione strukture timovima donosi brojne prednosti (Senge, 2003). Te prednosti se direktno odražavaju na strateški razvoj, operativnu efikasnost i inovativni kapacitet organizacije (West, 2012). Pre svega, oni doprinose realizaciji organizacione strategije i njenom usklađivanju sa zahtevima okruženja. U organizacijama koje se oslanjaju na timski rad eliminiše se hijerarhija koja usporava donošenje odluka, pa timovi mogu brzo i efikasno da reaguju na promene i događaje iz spoljnog okruženja. Pored strateške usklađenosti, timovi omogućavaju brzu proizvodnju i isporuku proizvoda i usluga uz smanjene troškove. Njihova kolektivna dinamika doprinosi većoj efikasnosti u poređenju sa radom pojedinaca, jer se zadaci obavljaju koordinisano i sinhronizovano (Kozlowski i Ilgen, 2006).

Istovremeno, timovi podstiču organizaciono učenje. Znanje se ne gubi odlaskom pojedinca, već se prenosi među članovima kroz kontinuiranu razmenu iskustava i veština. Kombinacija različitih perspektiva i pristupa rešavanju problema dovodi do unapređenja kvaliteta proizvoda i usluga (Argyris i Schon, 1978). U timovima se nalaze stručnjaci različitih profila, znanja, veština i stavova. Upravo ta raznolikost omogućava brzu razmenu informacija, efikasno učenje i neposrednu komunikaciju. Na taj način, timovi postaju nosioci produktivnosti, efektivnosti i konkurentnosti na globalnom tržištu (Serinkan i Kiziloglu, 2015). Članovi timova zajednički dolaze do rešenja koja su inovativna i prilagođena potrebama tržišta. Različiti načini razmišljanja omogućavaju pokretanje radikalnih promena u organizaciji, jer timovi preispituju osnovne pretpostavke i uvode značajne inovacije u procese, proizvode i usluge (Edmondson i sar., 2001).

Timovi visokih performansi takođe predstavljaju ključni izvor inovacija. Zahvaljujući različitim znanjima, veštinama i sposobnostima članova, oni generišu nove ideje i pronalaze efikasnije načine obavljanja zadataka (Lazarević i Lukić, 2018). Pored toga, timska struktura olakšava koordinaciju i integraciju, jer je osnovna jedinica organizacije tim, a ne pojedinac. Na taj način postavljanje ciljeva i njihovo usklađivanje sa organizacionim prioritetima postaje jednostavnije i efikasnije. Sve navedene prednosti ukazuju na to da timovi visokih performansi nisu samo operativni instrument, već strateški resurs organizacije. Oni omogućavaju brže donošenje odluka, efikasniju proizvodnju, kvalitetniju isporuku, kontinuirano učenje, inovacije i lakšu koordinaciju, čime se obezbeđuje dugoročna konkurentska prednost i održivost poslovanja (Lukić i sar., 2020).

Zbog svih navedenih karakteristika i prednosti, banke su se takođe okrenule timovima i timskom radu u nastojanju da ostvare što bolje rezultate rada (Khan i Mashikhi, 2017; Soomro i sar., 2024; Uzor i Onyemere, 2024). Cilj ovog rada je da se ispita povezanost između jasnoće timskih ciljeva, psihološke sigurnosti i timske efikasnosti, kao i njihov uticaj na performanse timova u savremenom poslovnom okruženju. Poseban akcenat stavljen je na bankarski sektor, gde timski rad postaje od presudne važnosti za unapređenje produktivnosti, inovativnosti i zadovoljstva zaposlenih. Bankarski sektor karakterišu visoki zahtevi u pogledu kvaliteta usluga, brzine donošenja odluka i efikasnog upravljanja ljudskim resursima. Iako brojna istraživanja ukazuju na značaj timskog rada za organizacione rezultate, relativno je mali broj radova koji istovremeno analiziraju povezanost jasnoće timskih ciljeva, psihološke sigurnosti, timske efikasnosti i performansi u kontekstu banaka u Srbiji. Svrha ovog rada je da doprinese boljem razumevanju mehanizama koji određuju uspešnost timova i da pruži empirijske dokaze koji mogu poslužiti menadžerima i donosiocima odluka u kreiranju organizacionog okruženja koje podstiče saradnju, produktivnost i dugoročne poslovne rezultate.

Pregled literature

Proučavanje timova, kao i procesa njihovog formiranja i razvoja, omogućava da se identifikuju ključne karakteristike koje predstavljaju faktore uspešnosti tima. Efikasni timovi se prepoznaju kroz sposobnost ostvarivanja zajedničkih ciljeva i postizanja rezultata. Prema Harvard Business Press (2006), osnovne karakteristike produktivnih timova mogu se sistematizovati na sledeći način:

- **Jasni i nedvosmisleni ciljevi** – Tim mora imati jasno definisane, realne i motivišuće ciljeve, uz punu posvećenost članova njihovoj realizaciji. Poželjno je da članovi učestvuju u procesu definisanja ciljeva, čime se povećava njihova relevantnost i prihvaćenost.
- **Definisane uloge i odgovornost** – Uloge članova i stepen odgovornosti moraju biti precizno utvrđeni, kako bi se obezbedila transparentnost i efikasnost u radu.
- **Kompetentnost članova** – Članovi tima treba da doprinose u skladu sa svojim znanjem, veštinama, iskustvom i kreativnošću. Pretpostavka uspešnog rada jeste da tim okuplja kompetentne pojedince sa relevantnim stručnim sposobnostima.
- **Tolerantnost na greške** – Efikasne timove karakteriše visok nivo tolerancije na sopstvene i tuđe greške, što podstiče učenje i razvoj.
- **Otvorenost za različite ideje** – Neophodna je spremnost na prihvatanje novih stavova, različitih perspektiva i mišljenja.
- **Motivisanost i spremnost na rizik** – Članovi tima treba da budu motivisani i spremni da preuzmu rizik u kreiranju budućih rešenja.

• **Objektivno donošenje odluka** – Odluke se donose na osnovu suštine problema, a ne na osnovu statusa ili uticaja pojedinaca.
• **Poverenje i lojalnost** – Poverenje među članovima, verovanje u njihove sposobnosti, odanost i posvećenost, kao i razvijena empatija, predstavljaju temelj opstanka i uspeha timskog rada.

Brojna istraživanja timova i timskog rada u bankama, potvrdila su da prisustvo navedenih faktora u velikoj meri utiče na timske performanse (Nwatu i Arinze, 2025). Isto tako, istraživanja su potvrdila da zaposleni imaju ključnu ulogu u postizanju uspeha organizacije jer njihovo zadovoljstvo direktno utiče na nivo performansi (Mishra i sar., 2025). Samim tim, jako je važno voditi računa o iscrpljenosti zaposlenih, jer su istraživanja pokazala da je emocionalna iscrpljenost u velikoj meri prisutna u bankarskom sektoru, posebno kod zaposlenih koji rade duže od 10 godina i imaju direktan kontakt sa klijentima (Lukić Nikolić i Mirković, 2024).

U savremenim organizacijama primena timskog rada donosi brojne prednosti. Prema Harvard Business Press (2006), Parker (2008) i Tannenbaum i sar. (2012), ključne prednosti timskog rada mogu se sistematizovati na sledeći način:

• **Bolje organizacione performanse** – Timovi doprinose smanjenju troškova rada, ubrzanom učenju i proširivanju baze znanja, veština i iskustva, što vodi ka unapređenju performansi i jačanju konkurentske prednosti.
• **Veće zadovoljstvo kupaca** – Kroz angažovanje timova na specifičnim zadacima, organizacije obezbeđuju viši kvalitet proizvoda i usluga, kontinuirano prate lojalnost kupaca i identifikuju mogućnosti za unapređenje.
• **Organizaciona fleksibilnost** – Timovi, kao adaptivne jedinice, omogućavaju brže učenje i prilagođavanje promenama iz okruženja, čime se povećava responzivnost i proaktivnost organizacije.
• **Efikasna raspodela zadataka** – Ciljevi i poslovi se mogu raščlaniti na manje segmente i dodeliti timovima, čime se postiže veća efikasnost u realizaciji organizacionih zadataka.
• **Zajednička odgovornost** – Članovi timova kolektivno preuzimaju odgovornost za ostvarene rezultate, uz visok stepen posvećenosti zajedničkim ciljevima.
• **Kreativnost i inovativnost** – Timovi podstiču generisanje novih ideja i pronalaženje praktičnih rešenja, čime se povećava inovativni kapacitet organizacije.
• **Motivisanost i zadovoljstvo poslom** – Rad u timu doprinosi većoj motivaciji i zadovoljstvu zaposlenih, jer omogućava primenu i razvoj novih veština, razmenu informacija i zajedničko donošenje odluka.
• **Brza razmena znanja** – Timovi olakšavaju protok informacija i spremnost članova da reaguju na promene i izazove, što povećava agilnost i otpornost organizacije.

Svaki tim, da bi mogao da funkcioniše na održiv i produktivan način, mora da poseduje određeni stepen kohezije. U timovima sa visokim nivoom kohezivnosti članovi pokazuju snažnu motivaciju da ostanu deo grupe, razvijaju privrženost zajedničkim ciljevima i usmeravaju svoje aktivnosti ka postizanju efikasnosti i produktivnosti (Lazarević i Lukić Nikolić, 2024). Takvi timovi se odlikuju kvalitetnijim međuljudskim odnosima, intenzivnijim interakcijama i spremnošću da provode više vremena zajedno (Al-Rawi, 2008). Članovi nesebično razmenjuju informacije i znanja, pokazuju osetljivost na potrebe drugih, pružaju podršku i razumevanje, čime se smanjuje verovatnoća nastanka konflikata (Ejaz i sar., 2024). Visoko kohezivne grupe karakteriše timski duh, prijateljstvo, za-

jedništvo, saradnja, razumevanje, lojalnost, sigurnost i međusobno poštovanje (Lee i sar., 2025). Kohezija je naročito izražena kada tim ima manji broj članova, kada su članovi relativno homogeni u pogledu potreba, obrazovanja, ponašanja, starosti i porekla, kada su zajednički fokusirani na ciljeve i zadatke, i kada dosledno poštuju uspostavljene norme. Prema Northouse (2012), pozitivni ishodi visoke kohezije ogledaju se u povećanom učešću članova u timskim aktivnostima, boljoj interakciji i komunikaciji, kao i u snažnijem međusobnom uticaju. Članovi razmenjuju pozitivne emocije, razvijaju konzistentnost i lojalnost, prihvataju timske norme i konformiraju se prema njima. Oni rado učestvuju na sastancima, pokazuju viši nivo zadovoljstva i motivisanosti, a njihovo ponašanje postaje jasno usmereno ka ciljevima. Kao rezultat, timovi sa visokim stepenom kohezije postižu veću produktivnost i dugoročno doprinose organizacionom uspehu (Lazarević i Lukić Nikolić, 2024).

Psihološka sigurnost se može definisati kao uverenje da u timu postoji klima koju odlikuju međusobno poverenje i poštovanje članova, kao i osećaj slobode da se ponašaju autentično i otvoreno (Edmondson, 1999). Psihološka sigurnost se posebno ogleda u spremnosti članova da preuzmu lični rizik - da traže povratne informacije, priznaju greške ili zatraže pomoć. U takvom okruženju prisutne su pozitivne namere, međusobna podrška, poštovanje kompetencija i otvoreno priznavanje grešaka, što stvara osećaj poverenja da slabosti neće biti zloupotrebljene niti kažnjene (Newman i sar., 2017). Nasuprot tome, u timovima gde vlada nesigurnost i nedostatak poštovanja, članovi izbegavaju da pokažu ranjivost jer to doživljavaju kao pretnju sopstvenom ugledu i kompetentnosti (Edmondson, 1999; Edmondson i Lei, 2014).

Tokom poslednjih nekoliko decenija brojni autori su nastojali da identifikuju faktore koji doprinose efikasnom i efektivnom funkcionisanju timova. Jedan od pionira u ovom polju, McGregor (1960), u svojoj knjizi The Human Side of Enterprise istakao je niz principa koji se mogu smatrati osnovom za izgradnju uspešnih timova i danas. Prema njegovom pristupu, članovi tima moraju jasno da razumeju dodeljene zadatke i ciljeve, kao i da odgovorno preuzmu svoje uloge i obaveze. Kompatibilnost različitih veština i znanja među članovima predstavlja ključnu pretpostavku za sinergiju, dok neformalna i prijatna atmosfera podstiče otvorenu komunikaciju i aktivno učešće u diskusijama. Odluke se najčešće donose konsenzusom, čime se podstiče sistemsko i kritičko razmišljanje, dok se pojedinci ohrabruju da slobodno iznose svoja mišljenja i ideje. Pored ovih pravila, neophodno je da budu ispunjeni i osnovni uslovi za postojanje tima visokih performansi. To podrazumeva adekvatnu veličinu tima, kao i postojanje zadataka čije obavljanje zahteva timski rad. Tek kombinacijom ovih principa i uslova može da se stvori okruženje u kojem timovi postižu visoke performanse, doprinoseći dugoročnoj održivosti i konkurentnosti organizacije. Na osnovu ovih teorijskih utemeljenja, u radu su postavljene tri hipoteze koje će biti predmet empirijske provere:

Hipoteza 1: Postoji pozitivna povezanost između jasnoće timskih ciljeva i timske efikasnosti. Timovi koji imaju jasno definisane ciljeve pokazuju viši nivo efikasnosti u realizaciji zadataka.
Hipoteza 2: Viši nivo psihološke sigurnosti u timu povezan je sa boljim timskim performansama. Članovi timova koji se osećaju bezbedno da izraze mišljenje, postavljaju pitanja i preuzimaju rizik ostvaruju bolje rezultate i viši nivo produktivnosti.
Hipoteza 3: Postoji značajna povezanost između timske efikasnosti i timskih performansi. Timovi koji efikasno koriste resurse i vreme ostvaruju bolje performanse.

Metodologija istraživanja

U radu je sprovedeno empirijsko istraživanje primenom posebno dizajniranog upitnika, strukturiranog u dva osnovna dela. Prvi deo obuhvata demografske podatke ispitanika (pol, starost, obrazovanje), kao i karakteristike zaposlenja i timova u kojima ispitanici rade. Ovaj deo obuhvata podatke o dužini radnog iskustva u bankarskom sektoru, poziciji u organizacionoj hijerarhiji, načinu rada (iz kancelarije, na daljinu ili hibridno), veličini tima i dužini članstva u trenutnom timu.

Drugi deo upitnika čine merne skale usmerene na četiri ključne dimenzije timskog funkcionisanja: timske ciljeve, timsku efikasnost, psihološku sigurnost i timske performanse. Merne skale su zasnovane na radu Amy Edmondson iz 1999. godine (Edmondson, 1999). Svaka skala sadrži od tri do sedam tvrdnji koje su ocenjene na Likertovoj skali od 1 do 5, čime se omogućava kvantitativna analiza stavova ispitanika i precizno merenje njihovih percepcija. Pouzdanost skala potvrđena je na pilot uzorku od 30 ispitanika primenom Kronbah alfa koeficijenta.

Istraživanje je sprovedeno u onlajn formatu, korišćenjem elektronskog upitnika. Link ka upitniku distribuiran je zaposlenima u bankarskom sektoru u Srbiji, koji su ujedno članovi nekog tima. Distribucija je realizovana putem direktnog slanja upitnika zaposlenima u bankama, uz molbu da upitnik proslede kolegama i drugim članovima timova. Na taj način primenjen je metod lančane distribucije (tzv. „snowball sampling"), koji omogućava širenje uzorka kroz mrežu profesionalnih kontakata. Tokom maja i juna 2026. godine prikupljeno je ukupno 225 odgovora.

Za obradu prikupljenih podataka korišćen je Microsoft® Excel® 2019 i IBM SPSS Statistics, verzija 26. Statistička obrada podataka zasnovana je na primeni korelacione i regresione analize radi utvrđivanja povezanosti između mernih skala. Tabela 1 prikazuje rezultate Kronbahovog koeficijenta alfa za sve skale korišćene u istraživanju. Sve vrednosti prelaze preporučeni prag od 0,7, što ukazuje da skale poseduju visoku internu pouzdanost.

Tabela 1 - Vrednosti Kronbahovog koeficijenta alfa za merne skale

Br.	Skale	N	Kronbah Alfa
1.	Jasnoća timskih ciljeva	3	0,946
2	Timska efikasnost	3	0,931
3	Psihološka sigurnost u timu	7	0,965
4	Timske performanse	4	0,946

Izvor: Autori

Rezultati istraživanja i diskusija

Tabela 2 prikazuje demografske karakteristike ispitanika. U uzorku je nešto veći udeo muškaraca (53,33%) u odnosu na udeo žena (46,67%). Kada je reč o starosnoj strukturi, najveći udeo ispitanika pripada starijim kategorijama: 24,44% je starije od 54 godine, dok je 22,67% ispitanika starosti od 45 do 54 godine, što znači da skoro polovinu uzorka čine ispitanici stariji od 45 godina. U pogledu obrazovanja, najviše ispitanika ima završen fakultet (36,89%), dok značajan procenat poseduje višu ili visoku školu (31,56%).

Tabela 2 - Demografske karakteristike ispitanika

		N	%
Pol			
Muški		120	53,33
Ženski		105	46,67
Starost			
Od 18 do 24		30	13,33
Od 25 do 34		40	17,78
Od 35 do 44		49	21,78
Od 45 do 54		51	22,67
Preko 54 godine		55	24,44
Obrazovanje			
Srednja škola		49	21,78
Viša/visoka škola		71	31,56
Fakultet (osnovne, master i magistarske studije)		83	36,89
Fakultet (doktorske studije)		22	9,78

Izvor: Autori

Tabela 3 prikazuje karakteristike zaposlenja i timova. Najveći broj ispitanika ima preko 10 godina radnog iskustva u bankama (29,33%), što ukazuje na značajnu zastupljenost iskusnih zaposlenih u uzorku. Kada je reč o poziciji, najviše ispitanika pripada srednjem menadžmentu (36,89%), dok su niži menadžment i zaposleni bez menadžerske pozicije zastupljeni u približno jednakom udelu (po 23%). U pogledu načina rada, većina ispitanika radi iz kancelarije (51,11%), dok trećina radi u hibridnom režimu (33,33%). Veličina timova je najčešće srednja (6–10 članova), sa udelom od 37,78%, dok su mali i veliki timovi zastupljeni oko 30%. Kada se posmatra dužina članstva u sadašnjem timu, najviše ispitanika je u timu od 1 do 3 godine (32,00%), dok je značajan procenat ispitanika član tima između 3 i 5 godina (28,44%).

Tabela 3 - Karakteristike zaposlenja i tima

Dužina radnog iskustva u bankama		
Manje od 1 godine	41	18,22
Od 1 do 3 godine	39	17,33
Od 3 do 5 godina	40	17,78
Od 5 do 10 godina	39	17,33
Preko 10 godina	66	29,33
Pozicija		
Top menadžment	37	16,44
Srednji menadžment	83	36,89
Niži menadžment	53	23,56
Zaposleni bez menadžerske pozicije	52	23,11
Način rada		
Iz kancelarije	115	51,11
Na daljinu	35	15,56
Hibridno	75	33,33
Veličina tima		
Mali tim (do 5 članova)	72	32,00
Srednji tim (6 do 10 članova)	85	37,78
Veliki tim (više od 10 članova)	68	30,22
Koliko dugo ste član sadašnjeg tima?		
Manje od 1 godine	52	23,11
Od 1 do 3 godine	72	32,00
Od 3 do 5 godina	64	28,44
Preko 5 godina	37	16,44

Izvor: Autori

Tabela 4 pokazuje da ispitanici u velikoj meri pozitivno ocenjuju jasnoću timskih ciljeva. Srednje vrednosti svih tvrdnji su visoke (M ≈ 4,4–4,5), uz relativno niske standardne devijacije, što ukazuje na saglasnost među ispitanicima. Najveći procenat odgovora nalazi se na najvišim ocenama (4 i 5), što sugeriše da timovi posvećuju značajnu pažnju definisanju i razjašnjavanju ciljeva, a članovi ih doživljavaju kao jasne i dobro komunicirane. Najviše vrednosti za ocene 4 i 5 zabeležene su kod tvrdnje da je tim uložio dosta vremena kako bi razjasnio svima svoje ciljeve, gde je 34,22% ispitanika dalo ocenu 4, a čak 57,78% ocenu 5. Ovi rezultati potvrđuju da jasnoća ciljeva predstavlja važan element timskog funkcionisanja i da ispitanici percipiraju da se u njihovim timovima ulaže vreme i trud kako bi svi članovi bili upoznati sa zajedničkim ciljevima.

Tabela 4 - Deskriptivna statistika za tvrdnje vezane za timske ciljeve

Br.	Tvrdnje	M	SD	Ocene	N	%
1.	Ciljevi ovog tima su jasni	4,43	0,754	1	1	0,44
				2	5	2,22
				3	15	6,67
				4	79	35,11
				5	125	55,56
2.	Tim je posvetio vreme kako bi se svaki član tima upoznao sa ciljevima	4,49	0,669	1	0	0,00
				2	3	1,33
				3	13	5,78
				4	80	35,56
				5	129	57,33
3.	Tim je uložio dosta vremena kako bi razjasnio svima svoje ciljeve	4,46	0,750	1	1	0,44
				2	6	2,67
				3	11	4,89
				4	77	34,22
				5	130	57,78

Izvor: Autori

Tabela 5 pokazuje da ispitanici visoko ocenjuju timsku efikasnost. Sve tvrdnje imaju prosečne vrednosti iznad 4,3, uz niske standardne devijacije, što ukazuje na saglasnost među učesnicima. Najveći procenat odgovora nalazi se na najvišim ocenama (4 i 5), posebno kod tvrdnje da tim uz rad i trud može da postigne sve što odluči, gde je 39,56% ispitanika dalo ocenu 4, a čak 54,67% ocenu 5. Ovi rezultati sugerišu da ispitanici percipiraju ciljeve kao dostižne, ostvarive bez prekomernog napora i da veruju u sposobnost svog tima da postigne zadate ciljeve.

Tabela 5 - Deskriptivna statistika za tvrdnje vezane za timsku efikasnost

Br.	Tvrdnje	M	SD	Ocene	N	%
1.	Postavljeni ciljevi su dostižni za tim	4,39	0,699	1	1	0,44
				2	1	0,44
				3	19	8,44
				4	92	40,89
				5	112	49,78
2.	Tim može da ostvari svoje ciljeve, bez potrebe da ulaže nerazumno mnogo vremena ili napora	4,37	0,728	1	1	0,44
				2	5	2,22
				3	12	5,33
				4	98	43,56
				5	109	48,44
3.	Uz rad i trud, tim može da postigne sve što odluči	4,49	0,606	1	0	0,00
				2	0	0,00
				3	13	5,78
				4	89	39,56
				5	123	54,67

Izvor: Autori

Tabela 6 pokazuje da ispitanici visoko ocenjuju psihološku sigurnost u timu. Sve tvrdnje imaju prosečne vrednosti iznad 4,4, uz niske standardne devijacije, što ukazuje na saglasnost među učesnicima. Najveći procenat odgovora nalazi se na najvišim ocenama (4 i 5). Najviše vrednosti za ocene 4 i 5 zabeležene su kod tvrdnji da članovi tima ne odbacuju jedni druge zato što su drugačiji (40,44% za ocenu 4 i 54,67% za ocenu 5) i da se tokom rada cene i primenjuju veštine i talenti članova (39,56% za ocenu 4 i 54,67% za ocenu 5). Ovi rezultati sugerišu da timovi funkcionišu u okruženju u kojem vlada poverenje, gde greške nisu predmet osude, gde se različitosti prihvataju, a saradnja i međusobna podrška su u značajnoj meri prisutne.

Tabela 6 - Deskriptivna statistika za tvrdnje vezane za psihološku sigurnost u timu

Br.	Tvrdnje	M	SD	Ocene	N	%
1.	Ako neko napravi grešku tokom rada u timu, niko mu to neće zameriti	4,44	0,686	1	1	0,44
				2	1	0,44
				3	16	7,11
				4	88	39,11
				5	119	52,89
2.	Članovi ovog tima mogu da postave teška pitanja i da pričaju o problemima	4,46	0,597	1	0	0,00
				2	1	0,44
				3	9	4,00
				4	100	44,44
				5	115	51,11
3.	Članovi tima ne odbacuju jedni druge zato što su drugačiji	4,50	0,591	1	0	0,00
				2	0	0,00
				3	11	4,89
				4	91	40,44
				5	123	54,67
4.	U timu se svi članovi osećaju bezbedno da preuzmu rizik	4,46	0,668	1	1	0,44
				2	2	0,89
				3	10	4,44
				4	91	40,44
				5	121	53,78
5.	Nije teško tražiti pomoć od drugih članova ovog tima	4,46	0,654	1	0	0,00
				2	2	0,89
				3	14	6,22
				4	88	39,11
				5	121	53,78

Br.	Tvrdnje	M	SD	Ocene	N	%
6.	Niko u ovom timu ne bi namerno potkopavao napore drugih članova tima	4,43	0,658	1	0	0,00
				2	3	1,33
				3	12	5,33
				4	96	42,67
				5	114	50,67
7.	Tokom rada u ovom timu, moje veštine i talenti se cene i primenjuju	4,48	0,648	1	0	0,00
				2	3	1,33
				3	10	4,44
				4	89	39,56
				5	123	54,67

Izvor: Autori

Tabela 7 pokazuje da ispitanici visoko ocenjuju timske performanse. Sve tvrdnje imaju prosečne vrednosti iznad 4,4, uz niske standardne devijacije, što ukazuje na saglasnost među ispitanicima. Najveći procenat odgovora nalazi se na najvišim ocenama (4 i 5). Najviše vrednosti za ocene 4 i 5 zabeležene su kod tvrdnje da u radu tima nikada ne dolazi do krucijalnih grešaka, gde je 37,33% ispitanika dalo ocenu 4, a čak 55,11% ocenu 5. Ovi rezultati sugerišu da ispitanici percipiraju svoje timove kao pouzdane, kvalitetne i orijentisane na kontinuirano unapređenje, što potvrđuje visok nivo performansi i sposobnost da ispune ili prevaziđu očekivanja klijenata.

Tabela 7 - Deskriptivna statistika za tvrdnje vezane za timske performanse

Br.	Tvrdnje	M	SD	Ocene	N	%
1.	Ovaj tim ispunjava ili prevazilazi očekivanja svojih klijenata	4,42	0,671	1	0	0,00
				2	1	0,44
				3	20	8,89
				4	88	39,11
				5	116	51,56
2.	Ovaj tim kvalitetno radi svoj posao	4,45	0,640	1	0	0,00
				2	2	0,89
				3	12	5,33
				4	93	41,33
				5	118	52,44

Br.	Tvrdnje	M	SD	Ocene	N	%
3.	U radu ovog tima nikada ne dolazi do krucijalnih grešaka	4,47	0,661	1	0	0,00
				2	2	0,89
				3	15	6,67
				4	84	37,33
				5	124	55,11
4.	Ovaj tim postaje sve bolji i bolji	4,44	0,625	1	0	0,00
				2	1	0,44
				3	13	5,78
				4	97	43,11
				5	114	50,67

Izvor: Autori

Na osnovu Tabele 8 može se zaključiti da su prosečne vrednosti kompozitnih varijabli za sve merne skale vrlo visoke (od 4,42 do 4,46 na skali od 1 do 5), uz relativno niske standardne devijacije (od 0,585 do 0,689). Samim tim, prosečne vrednosti kompozitnih varijabli ukazuju na visok nivo saglasnosti ispitanika da tim funkcioniše efikasno, sa jasnim ciljevima, psihološkom sigurnošću i timskim performansama.

Tabela 8 - Prosečne vrednosti i standardne devijacije za kompozitne varijable

Br.	Skala	M	SD
1.	Jasnoća timskih ciljeva	4,46	0,689
2	Timska efikasnost	4,42	0,637
3	Psihološka sigurnost u timu	4,46	0,585
4	Timske performanse	4,44	0,602

Izvor: Autori

Rezultati statističkih testova i diskusija

Tabela 9 pokazuje da su svi konstrukti međusobno snažno i statistički značajno povezani, što ukazuje da jasni ciljevi, timska efikasnost, psihološka sigurnost i timske performanse zajedno doprinose koheziji i uspešnosti timskog rada.

Tabela 9 - Matrica korelacija konstrukata

Konstrukt	1	2	3	4
Jasnoća timskih ciljeva	-	0,684**	0,795**	0,712**
Timska efikasnost		-	0,690**	0,755**
Psihološka sigurnost u timu			-	0,739**
Timske performanse				-

$p < 0,01$ (dvostrani test)
Izvor: Autori

Rezultati u Tabeli 10 pokazuju da postoji značajna pozitivna korelacija između jasnoće timskih ciljeva i timske efikasnosti ($r = 0,684$, $p < 0,01$), što znači da timovi sa jasnije definisanim ciljevima postižu viši nivo efikasnosti. Ova povezanost je statistički značajna i potvrđuje hipotezu o njihovoj međusobnoj vezi. Koeficijent determinacije (R2) iznosi 0,47, što znači jasnoća timskih ciljeva objašnjava oko 47% varijanse timske efikasnosti. Drugim rečima, skoro polovina razlika u percepciji timske efikasnosti može se statistički povezati sa razlikama u jasnoći ciljeva.

Tabela 10 - Rezultati Pirsonovog koeficijenta za Hipotezu 1

Varijabla	Timski ciljevi	Timska efikasnost
Timski ciljevi	1,00	0,684**
Sig. (2-tailed)	-	0,000
N	225	225
Timska efikasnost	0,684**	1,00
Sig. (2-tailed)	0,000	-
N	225	225

**Korelacija je značajna na nivou 0,01
Izvor: Autori

Rezultati u Tabeli 11 pokazuju da postoji značajna pozitivna korelacija između psihološke sigurnosti i timskih performansi ($r = 0,739$, $p < 0,01$), što znači da timovi sa višim nivoom psihološke sigurnosti ostvaruju bolje rezultate i viši nivo produktivnosti. Ova povezanost je statistički značajna i potvrđuje hipotezu o njihovoj međusobnoj vezi. Koeficijent determinacije (R2) iznosi 0,55, što znači da psihološka sigurnost u timu objašnjava oko 55% varijanse timskih performansi. Drugim rečima, više od polovine razlika u percepciji performansi može se statistički povezati sa razlikama u nivou psihološke sigurnosti.

Tabela 11 - Rezultati Pirsonovog koeficijenta za Hipotezu 2

Varijabla	Psihološka sigurnost	Timske performanse
Psihološka sigurnost	1,00	0,739**
Sig. (2-tailed)	-	0,000
N	225	225
Timske performanse	0,739**	1,00
Sig. (2-tailed)	0,000	-
N	225	225

**Korelacija je značajna na nivou 0,01
Izvor: Autori

Rezultati u Tabeli 12 pokazuju da postoji značajna pozitivna korelacija između timske efikasnosti i timskih performansi ($r = 0,755$, $p < 0,01$), što znači da timovi koji efikasno koriste resurse i vreme ostvaruju bolje performanse. Ova povezanost je statistički značajna i potvrđuje hipotezu o njihovoj međusobnoj vezi. Koeficijent determinacije (R2) iznosi 0,57, što znači da timska efikasnost objašnjava oko 57% varijanse timskih performansi. Drugim rečima, više od polovine razlika u percepciji performansi može se statistički povezati sa razlikama u nivou efikasnosti tima.

Tabela 12 - Rezultati Pirsonovog koeficijenta za Hipotezu 3

Varijabla	Psihološka sigurnost	Timske performanse
Timske performanse	1,00	0,755**
Sig. (2-tailed)	-	0,000
N	225	225
Timska efikasnost	0,755**	1,00
Sig. (2-tailed)	0,000	-
N	225	225

**Korelacija je značajna na nivou 0,01
Izvor: Autori

Dobijeni rezultati jasno ukazuju na postojanje statistički značajnih pozitivnih veza između ključnih dimenzija timskog funkcionisanja. Prvo, korelacija između jasnoće timskih ciljeva i timske efikasnosti ($r = 0,684$, $p < 0,01$) pokazuje da timovi sa jasno definisanim ciljevima imaju tendenciju da budu efikasniji u realizaciji zadataka. Zatim, psihološka sigurnost u timu je značajno povezana sa timskim performansama ($r = 0,739$, $p < 0,01$), što znači da članovi timova koji se osećaju slobodno da izraze mišljenje, postavljaju pitanja i preuzimaju rizik ostvaruju bolje rezultate i viši nivo produktivnosti. Na kraju, korelacija između timske efikasnosti i timskih performansi ($r = 0,755$, $p < 0,01$) ukazuje da timovi koji efikasno koriste raspoložive resurse i vreme postižu bolje performanse. Sve tri korelacije su visoke, pozitivne i statistički značajne, što potvrđuje da jasnoća ciljeva, psihološka sigurnost i efikasnost predstavljaju ključne faktore koji doprinose kvalitetu timskog rada. Ovi rezultati zajedno daju empirijsku podršku postavljenim hipotezama i ukazuju da se uspešno funkcionisanje tima zasniva na kombinaciji jasne strukture, sigurnog okruženja i racionalnog korišćenja resursa.

Višestruka regresiona analiza prikazana u Tabeli 13 pokazuje da kombinacija jasnoće ciljeva, timske efikasnosti i psihološke sigurnosti objašnjava 67% varijanse timskih performansi ($R^2 = 0,672$), što ukazuje na snažnu prediktivnu moć konstrukata.

Tabela 12 - Rezultati Pirsonovog koeficijenta za Hipotezu 3

Model	R	R^2	Adjusted R^2	Std. Error of Estimate	R^2 Change	F Change	df1	df2	Sig. F Change
1.	0,820	0,672	0,667	0,348	0,672	150,72	3	221	0,000

Izvor: Autori

ANOVA rezultati prikazani u Tabeli 14 pokazuju da je regresioni model statistički značajan ($F(3, 221) = 150,72$, $p < 0,001$), što znači da kombinacija korišćenih prediktora značajno objašnjava varijansu timskih performansi.

Tabela 14 - Rezultati višestruke regresione analize - ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	54,61	3	18,2	150,72	0
Residual	26,69	221	0,12		
Total	81,31	224			

Izvor: Autori

Rezultati u Tabeli 15 pokazuju da su timska efikasnost (β = 0,419, p < 0,001) i psihološka sigurnost (β = 0,305, p < 0,001) najsnažniji prediktori timskih performansi, ali i da jasnoća ciljeva (β = 0,183, p < 0,01) značajno doprinosi objašnjenju. Svi prediktori su statistički značajni, što potvrđuje da zajedno snažno utiču na percepciju timskih performansi.

Tabela 15 - Rezultati višestruke regresione analize - koeficijenti

Prediktor	B	SE	β	t	Sig.	Tolerance	VIF
(Konstanta)	0,582	0,186	-	3,13	0,002	-	-
Jasnoća timskih ciljeva	0,160	0,058	0,183	2,73	0,007	0,333	3,01
Timska efikasnost	0,397	0,053	0,419	7,49	0	0,474	2,11
Psihološka sigurnost	0,314	0,069	0,305	4,52	0	0,327	3,06

Izvor: Autori

Rezultati kolinearnosti prikazani u Tabeli 16 pokazuju da su vrednosti uslovnog indeksa (Condition Index) ispod kritične granice od 30, što ukazuje da su ispunjeni svi uslovi vezani za multikolinearnost. To znači da jasnoća ciljeva, timska efikasnost i psihološka sigurnost mogu zajedno da se koriste u regresionom modelu bez značajnog rizika od multikolinearnosti.

Tabela 16 - Rezultati višestruke regresione analize - kolinearnost

Varijabla	Eigen value	Condition Index	Varijance Proportions (Konstanta)	Jasnoća ciljeva	Timska efikasnost	Psihološka sigurnost
1	3,976	1	0	0	0	0
2	0,013	17,67	0,87	0,13	0,03	0,01
3	0,007	23,68	0,02	0,24	0,95	0,05
4	0,004	29,13	0,11	0,63	0,02	0,93

Izvor: Autori

Dobijeni rezultati su u skladu sa prethodnim istraživanjima koja su ukazala na značaj jasno definisanih ciljeva, psihološke sigurnosti i timske efikasnosti za uspešno funkcionisanje timova. Locke i Latham (2002) pokazali su da jasni i specifični ciljevi usmeravaju ponašanje članova tima, povećavaju motivaciju i doprinose efikasnijem izvršavanju zadataka. Meta-analiza koju je sproveo Stewart (2006) potvrdila je da koordinacija i strukturne karakteristike tima imaju pozitivan uticaj na timske rezultate. Takođe, Richter, Dawson i West (2011) ustanovili su da timski rad i efektivnost timova pozitivno utiču na celokupne organizacione performanse. Edmondson i Lei (2014) pokazali su da psihološka sigurnost predstavlja važan preduslov za timsko učenje, inovativnost i organizacionu efikasnost. Slično tome, Park, Kim i Gully (2017) utvrdili su postojanje pozitivne veze između timske efikasnosti i performansi timova, dok su Grossman, Nolan, Rosch, Mazer i Salas (2022) istakli da kvalitet timske saradnje značajno doprinosi uspešnosti timova. Najnovija istraživanja dodatno potvrđuju ove rezultate. Fyhn, Egeland i Schei (2025) pokazali su da razvoj i održavanje psihološke sigurnosti predstavljaju ključne procese za postizanje visokih timskih performansi, dok su Sommet, Rudmann, Pillaud i Butera (2026) potvrdili da jasno definisani timski ciljevi imaju značajan pozitivan uticaj na ostvarene rezultate tima. Iz navedenih rezultata je jasno da se uspešno funkcionisanje timova zasniva na kombinaciji jasno definisanih ciljeva, psihološki sigurnog okruženja i efikasnog korišćenja raspoloživih resursa.

Zaključak

Rezultati istraživanja u kojem je učestvovalo 225 ispitanika u Srbiji pokazali su da timovi u bankarskom sektoru funkcionišu u okruženju koje karakterišu jasno definisani ciljevi, visoka efikasnost, psihološka sigurnost i značajne timske performanse. Rezultati statističkih analiza potvrđuju da jasnoća timskih ciljeva značajno doprinosi efikasnosti, dok psihološka sigurnost ima značajan uticaj na timske performanse. Takođe, efikasnost i performanse su međusobno značajno povezane, što ukazuje da racionalno korišćenje resursa vodi ka boljem kvalitetu rada.

Deskriptivna statistika dodatno osnažuje ove nalaze, jer pokazuje da ispitanici u velikoj meri pozitivno ocenjuju sve analizirane dimenzije, uz visoke prosečne vrednosti i niske standardne devijacije, što ukazuje na visok stepen saglasnosti među zaposlenima. Ovi rezultati ne samo da potvrđuju teorijske pretpostavke o važnosti jasnoće ciljeva i psihološke sigurnosti, već pružaju empirijsku osnovu za dalja istraživanja u oblasti timskog menadžmenta.

Dobijeni rezultati imaju značajne implikacije kako za teoriju, tako i za praksu. Sa teorijskog aspekta, rad doprinosi razumevanju odnosa između jasnoće timskih ciljeva, efikasnosti i performansi, kao i značaja psihološke sigurnosti u timskom radu u bankama. Sa praktičnog aspekta, menadžeri banaka imaju jasne smernice da kreiranje timskih ciljeva povećava produktivnost i usklađenost sa strategijom organizacije, dok podsticanje psihološke sigurnosti u timu doprinosi kvalitetnijem radu, većoj motivaciji zaposlenih i dugoročnoj održivosti timova.

Sprovedeno istraživanje ima određene nedostatke. Prvo, izbor uzorka putem snowball metode nosi određena ograničenja. Ova tehnika se oslanja na postojeće profesionalne mreže i lične kontakte, što može dovesti do pristrasnosti u uzorku jer su učesnici verovatno međusobno povezani i dele slične karakteristike, pa uzorak nije u potpunosti reprezentativan za celokupnu populaciju zaposlenih u bankarskom sektoru. Pored toga, ovakav pristup otežava kontrolu nad strukturom uzorka (npr. ravnomerna zastupljenost različitih banaka, timova ili hijerarhijskih nivoa), što može uticati na generalizaciju rezultata. Drugo, uzorak je ograničen na bankarski sektor u Srbiji, pa se dobijeni rezultati ne mogu u

potpunosti generalizovati na druge industrije ili međunarodni kontekst. Treće, u procesu istraživanja je primenjen kvantitativni pristup, bez kvalitativnih metoda (intervjui, fokusne grupe, opservacije) koje bi omogućile dublje razumevanje iskustava članova tima.

Samim tim, preporuka za buduća istraživanja je da se primeni rigorozniji pristup uzorkovanju kako bi se smanjila pristrasnost i povećala reprezentativnost uzorka. Na taj način bi se obezbedila veća pouzdanost i validnost rezultata. Pored toga, u budućim istraživanjima bi trebalo obuhvatiti i druge industrije i zemlje. Takođe, poželjno je da se primene i kvalitativne metode poput intervjua, fokus grupa i opservacija, kako bi se omogućilo dublje razumevanje iskustava članova tima. Korisno bi bilo da buduća istraživanja sagledaju i uticaj veštačke inteligencije i drugih tehnologija za automatizaciju na timove i timski rad, jer prodor ovih tehnologija menja dinamiku timske efikasnosti, psihološke sigurnosti i performansi. Na taj način bi se obezbedila sveobuhvatnija slika faktora koji oblikuju savremeno funkcionisanje timova u bankarskom sektoru.

Ipak, i pored navedenih nedostataka, dobijeni rezultati predstavljaju polaznu osnovu za dalji razvoj teorije timskog menadžmenta i praktične primene u bankarskom sektoru, ali i šire, u organizacijama koje teže visokoj efikasnosti i održivim timskim performansama.

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TEAM EFFECTIVENESS, PSYCHOLOGICAL SAFETY AND PERFORMANCE: EMPLOYEES' PERSPECTIVE IN THE BANKING SECTOR OF SERBIA

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Abstract: *The aim of this paper was to examine team functioning in the banking sector through the dimensions of clearly defined goals, effectiveness, psychological safety, and team performance. The research was conducted in May and June 2026 with a sample of 225 employees from banks in Serbia, all of whom were members of various teams. The findings indicate that goal clarity significantly contributes to team effectiveness, while psychological safety exerts a strong influence on performance. Moreover, effectiveness and performance are closely interrelated, suggesting that rational use of resources leads to higher work quality. Descriptive statistics further confirm that respondents largely evaluated all aspects of team functioning positively. Overall, the results highlight that successful team functioning in banks depends on a combination of clear structure, a safe and supportive environment, and the capacity to achieve goals effectively and with quality, underscoring the importance of team dynamics in achieving organizational objectives.*

Keywords: banks, banking business, teams, teamwork, effectiveness, performance.

JEL classificationa: D23, M54, G21

Introduction

The contemporary environment is characterized by dynamic changes and uncertain business conditions. Globalization of the market, accelerated technological development, economic crises, recession, economic growth decline, pandemics and other challenges imposed on organizations the necessity for continuous adaptation (Hart et al., 1993; Wang, 2008). In response to such challenges, teamwork began to be applied, as a special model of organizing that rejects rigid, vertical hierarchy and strives for horizontal, agile and flexible forms, capable of quickly reacting to changes (Berber et al., 2020; Lazarevic and Lukić Nikolić, 2024; West, 2012). A team represents a small group of people with different but complementary skills, who gather around a common purpose and objectives, while sharing responsibility for the results achieved (Katzenbach and Smith, 1993). It is a group of two or more people who communicate mutually, influence each other and are jointly responsible for the achievement of goals (Cohen and Bailey, 1997).

The affirmation of teams and teamwork has become increasingly prominent, not only within contemporary management theory but also across organizational practice. However, the formation and management of teams require specific knowledge, skills and experiences, as well as significant investments of time and energy, since the behavior of individuals in a team is significantly different from the behavior of an individual working independently outside the team (George and Jones, 2012). It is necessary to put a lot of effort into the team building process and constantly monitor the way the team operates. Also, it is necessary to constantly discover new team management practices, bearing in mind that teams differ in their purpose of existence, the tasks they perform and the environment in which they operate. Special attention should be focused on the training and development of team members (Ehigie et al., 2023).

Nowadays, teams function as independent organizational units that manage processes and tasks, train employees, exercise self-control, and are strongly oriented toward achieving goals (West, 2012). In the knowledge economy, teams are not an option, but an imperative because the formal upgrading of the basic organizational structure brings numerous advantages to teams (Senge, 2003). Those advantages are directly reflected in the strategic development, operational effectiveness and innovative capacity of the organization (West, 2012). First of all, they contribute to the realization of the organizational strategy and its alignment with the requirements of the environment. In organizations that rely on teamwork, the hierarchy that slows down decision-making is eliminated, so teams could quickly and efficiently react to changes and events from the external environment. In addition to strategic alignment, teams enable rapid production and delivery of products and services at reduced costs. Their collective dynamics contribute to greater effectiveness compared to the work of individuals, because tasks are performed in a coordinated and synchronized manner (Kozlowski and Ilgen, 2006).

Simultaneously, teams encourage organizational learning. Knowledge is not lost when an individual leaves, but is transferred among members through the continuous exchange of experiences and skills. The mix of different perspectives and approaches to problem solving leads to the improvement of the quality of products and services (Argyris and Schon, 1978). The teams include experts of different profiles, knowledge, skills and attitudes. It is precisely this diversity that enables rapid exchange of information, effective learning and immediate communication. In this way, teams become carriers

of productivity, effectiveness and competitiveness in the global market (Serinkan and Kiziloglu, 2015). Team members jointly come up with solutions that are innovative and adapted to the needs of the market. It is this diversity that enables the initiation of radical changes in the organization, as teams reexamine basic assumptions and introduce significant innovations in processes, products and services (Edmondson et al., 2001).

High performance teams are also a key source of innovation. Due to the various knowledge, skills and abilities of the members, they generate new ideas and find more efficient ways of performing tasks (Lazarević and Lukić, 2018). Furthermore, the team structure facilitates coordination and integration, because the basic unit of the organization is the team, not the individual. In this manner, setting goals and aligning them with organizational priorities becomes simpler and more efficient. All the mentioned advantages indicate that high-performance teams are not only an operational instrument, but already a strategic resource of the organization. They enable faster decision-making, more efficient production, better delivery, continuous learning, innovation and easier coordination, thus ensuring long-term competitive advantage and business sustainability (Lukić et al., 2020).

Due to the numerous advantages and characteristics associated with teamwork, banks have also increasingly adopted teams and team-based work systems in their efforts to achieve superior performance outcomes (Khan and Mashikhi, 2017; Soomro et al., 2024; Uzor and Onyemere, 2024). The aim of this paper is to examine the relationships among team goal clarity, psychological safety, and team effectiveness, as well as their impact on team performance in the contemporary business environment. Particular emphasis is placed on the banking sector, where teamwork has become essential for enhancing productivity, innovation, and employee satisfaction. The banking sector is characterized by high demands regarding service quality, rapid decision-making, and effective human resource management. Although numerous studies have highlighted the importance of teamwork for organizational outcomes, relatively few have simultaneously investigated the relationships among team goal clarity, psychological safety, team effectiveness, and team performance in the context of banks in Serbia. Therefore, the purpose of this paper is to contribute to a better understanding of the mechanisms underlying team success and to provide empirical evidence that may assist managers and decision-makers in creating organizational environments that foster collaboration, productivity, and long-term business performance.

Literature Review

The study of teams, as well as the process of their formation and development, makes it possible to identify the key characteristics that represent the team's success factors. Effective teams are recognized through the ability to achieve common goals and results. According to Harvard Business Press (2006), the basic characteristics of productive teams can be systematized as follows:

- **Clear and unambiguous goals** – The team must have clearly defined, realistic and motivating goals, with the full commitment of the members to their realization. It is desirable that members participate in the process of defining goals, which increases their relevance and acceptance.
- **Defined roles and responsibilities** – The roles of the members and the degree of responsibility must be precisely determined, in order to ensure transparency and efficiency in the work.
- **Member competence** – Team members should contribute according to their knowledge, skills, experience and creativity. The assumption of successful work is that the team gathers competent individuals with relevant professional skills.

• **Tolerance for errors** – Effective teams are characterized by a high level of tolerance for their own and others' errors, which encourages learning and development.
• **Openness to different ideas** – It is necessary to be ready to accept new attitudes, different perspectives and opinions.
• **Motivation and willingness to take risks** – Team members should be motivated and ready to take risks in creating future solutions.
• **Objective decision-making** – Decisions are made based on the essence of the problem, not on the status or influence of individuals.
• **Trust and loyalty** – Trust among members, belief in their abilities, loyalty and commitment, as well as developed empathy, are the foundation for the survival and success of teamwork.

Numerous studies of teams and teamwork in banks have confirmed that the presence of the aforementioned factors greatly affects team performance (Nwatu and Arinze, 2025). Likewise, research has confirmed that employees play a key role in achieving organizational success because their satisfaction directly affects the level of performance (Mishra et al., 2025). Therefore, it is very important to take care of employee exhaustion, because research has shown that emotional exhaustion is largely present in the banking sector, especially among employees who have been working for more than 10 years and have direct contact with clients (Lukić Nikolić and Mirković, 2024).

In contemporary organizations, the implementation of teamwork brings numerous advantages. According to Harvard Business Press (2006), Parker (2008) and Tannenbaum et al. (2012), the key benefits of teamwork could be systematized as follows:
• **Better organizational performance** – Teams contribute to reducing labor costs, accelerating learning and expanding the base of knowledge, skills and experience, which leads to upgraded performance and strengthened competitive advantage.
• **Greater customer satisfaction** – By engaging teams on specific tasks, organizations ensure higher quality products and services, continuously monitor customer loyalty and identify opportunities for improvement.
• **Organizational flexibility** – Teams, as adaptive units, enable faster learning and adaptation to changes in the environment, thus increasing the responsiveness and proactivity of the organization.
• **Efficient distribution of tasks** – Objectives and tasks can be broken down into smaller segments and assigned to teams, which achieves greater efficiency in the implementation of organizational tasks.
• **Shared responsibility** – Team members collectively take responsibility for the results achieved, with a high degree of commitment to common goals.
• **Creativity and innovation** – Teams encourage the generation of new ideas and finding practical solutions, thus increasing the organization's innovative capacity.
• **Motivation and job satisfaction** – Working in a team contributes to greater motivation and employee satisfaction, as it enables the implementation and development of new skills, information exchange and joint decision-making.
• **Rapid exchange of knowledge** – Teams facilitate the flow of information and the readiness of members to respond to changes and challenges, which increases the agility and resilience of the organization.

Every team, in order to be able to function in a sustainable and productive way, must possess a certain degree of cohesion. In teams with a high level of cohesiveness, members show a strong motivation

to remain part of the group, develop commitment to common goals and direct their activities towards achieving effectiveness and productivity (Lazarević and Lukić Nikolić, 2024). Such teams are characterized by better interpersonal relationships, more intensive interactions and willingness to spend more time together (Al-Rawi, 2008). Members selflessly exchange information and knowledge, show sensitivity to the needs of others, provide support and understanding, which reduces the likelihood of conflicts (Ejaz et al., 2024). Highly cohesive groups are characterized by team spirit, friendship, togetherness, cooperation, understanding, loyalty, security and mutual respect (Lee et al., 2025). Cohesion is particularly pronounced when the team has a smaller number of members, when members are relatively homogeneous in terms of needs, education, behavior, age and background, when they are jointly focused on goals and tasks, and when they consistently respect established norms. According to Northouse (2012), the positive outcomes of high cohesion are reflected in the increased participation of members in team activities, better interaction and communication, as well as in stronger mutual influence. Members exchange positive emotions, develop consistency and loyalty, accept team norms and conform to them. They happily participate in meetings, show higher levels of satisfaction and motivation, and their behavior becomes clearly goal-oriented. As a result, teams with a high degree of cohesion achieve higher productivity and contribute to organizational success in the long term (Lazarević and Lukić Nikolić, 2024).

Psychological safety could be defined as the belief that there is a climate in the team characterized by mutual trust and respect among members, as well as a sense of freedom to behave authentically and openly (Edmondson, 1999). Psychological safety is particularly reflected in the willingness of members to take personal risks - to ask for feedback, admit mistakes or ask for help. In such an environment, there are positive intentions, mutual support, respect for competence and open admission of mistakes, which creates a sense of trust that weaknesses will not be abused or punished (Newman et al., 2017). Conversely, in teams where there are insecurity and a lack of respect, members avoid showing vulnerability because they perceive it as a threat to their own reputation and competence (Edmondson, 1999; Edmondson and Lei, 2014).

During the last few decades, numerous authors have tried to identify the factors that contribute to the efficient and effective functioning of teams. One of the pioneers in this field, McGregor (1960), in his book The Human Side of Enterprise highlighted a number of principles that can be considered the basis for building successful teams even today. According to his approach, team members must clearly understand assigned tasks and goals, as well as responsibly assume their roles and responsibilities. The compatibility of different skills and knowledge among members is a key assumption for synergy, while the informal and pleasant atmosphere encourages open communication and active participation in discussions. Decisions are most often made by consensus, which encourages systemic and critical thinking, while individuals are encouraged to express their opinions and ideas freely. Aside from these rules, it is necessary to meet the basic conditions for the existence of a high-performance team. This implies an adequate size of the team, as well as the existence of tasks, the performance of which requires teamwork. Only by combining these principles and conditions can an environment be created in which teams achieve high performance, contributing to the long-term sustainability and competitiveness of the organization. Based on these theoretical foundations, three hypotheses are set in the paper, which will be subject to empirical verification:
Hypothesis 1: There is a positive relationship between team goal clarity and team effectiveness. Teams that have clearly defined goals show a higher level of efficiency in the realization of tasks.
Hypothesis 2: A higher level of psychological safety in a team is associated with better team

performance. Team members, who feel safe to express opinions, ask questions, take risks, and achieve better results and higher levels of productivity.
Hypothesis 3: There is a significant relationship between team effectiveness and team performance. Teams that use resources and time efficiently achieve better performance.

Research Methodology

Empirical research was conducted in the paper using a specially designed questionnaire, structured in two basic parts. The first part includes the respondents' demographic data (gender, age, education), as well as the characteristics of employment and the teams in which the respondents work. This section includes data on the length of work experience in the banking sector, position in the organizational hierarchy, mode of work (from office, remote or hybrid), team size and length of membership in the current team.

The second part of the questionnaire consists of measuring scales aimed at four key dimensions of team functioning: team goals, team effectiveness, psychological safety and team performance. The scales are based on the work of Amy Edmondson in 1999 (Edmondson, 1999). Each scale contains from three to seven statements that are rated on a Likert scale from 1 to 5, which enables quantitative analysis of respondents' attitudes and precise measurement of their perceptions. The reliability of the scales was verified on a pilot sample of 30 respondents using Cronbach's alpha coefficient.

The research was conducted in an online format, using an electronic questionnaire. The link to the questionnaire was distributed to employees in the banking sector in Serbia, who are also team members. The distribution was carried out by directly sending the questionnaire to bank employees, with the request that they forward the questionnaire to their colleagues and other team members. In this way, the method of chain distribution (so-called "snowball sampling") was applied, which enables the spread of the sample through a network of professional contacts. A total of 225 responses were collected during May and June 2026.

Microsoft® Excel® 2019 and IBM SPSS Statistics, version 26 were used to process the collected data. Statistical analysis was based on the application of correlation and regression analysis to determine the relationship between measurement scales. Table 1 shows the results of Cronbach's alpha coefficient for all scales used in the research. All values exceed the recommended threshold of 0.7, indicating that the scales possess high internal reliability.

Table 1 - Values of Cronbach's Alpha Coefficient for Measurement Scales

Number	Scale	N	Cronbach's alfa
1.	Team clear direction	3	0.946
2	Team effectiveness	3	0.931
3	Team psychological safety	7	0.965
4	Team performance	4	0.946

Source: Authors

Research Results

Table 2 shows the demographic characteristics of the respondents. In the sample, there is a slightly higher proportion of men (53.33%) compared to the proportion of women (46.67%). In terms of the age structure, the largest share of respondents belongs to the older categories: 24.44% are over 54 years old, while 22.67% of respondents are between 45 and 54 years old, which means that almost half of the sample consists of respondents over 45 years old. In terms of education, most respondents have university degrees (undergraduate or master's studies) (36.89%), while a substantial proportion indicated that they had completed college-level education (31.56%).

Table 2 - Demographic Characteristics of Respondents

		N	%
Gender			
Male		120	53.33
Female		105	46.67
Age			
From 18 to 24		30	13.33
From 25 to 34		40	17.78
From 35 to 44		49	21.78
From 45 to 54		51	22.67
Above 54 years		55	24.44
Education			
Secondary school		49	21.78
College		71	31.56
University (undergraduate or master's studies)		83	36.89
University (doctoral studies)		22	9.78

Source: Authors

Table 3 shows employment and team characteristics. The largest proportion of respondents reported having more than 10 years of work experience in banking (29.33%), which indicates a substantial representation of experienced employees within the sample. When it comes to position, most respondents belong to middle management (36.89%), while lower management and employees without a managerial position are represented in an approximately equal share (23% each). Regarding the way of working, the majority of respondents work from the office (51.11%), while a third work in hybrid mode (33.33%). The size of the teams is usually medium (6–10 members), with a share of 37.78%, while small and large teams are represented by around 30%. When looking at the length of membership in the current team, most respondents have been in the team for 1 to 3 years (32.00%), while a significant percentage of respondents have been members of the team for 3 to 5 years (28.44%).

Table 3 - Employment and Team Characteristics

Working experience in banks		
Up to 1 year	41	18.22
From 1 to 3 years	39	17.33
From 3 to 5 years	40	17.78
From 5 to 10 years	39	17.33
More than 10 years	66	29.33
Organizational position		
Top management	37	16,.4
Middle management	83	36.89
First line management	53	23.56
Employee without managerial position	52	23.11
The way of work		
From office	115	51.11
Remote	35	15,.6
Hybrid	75	33.33
The size of the team		
Small team (up to 5 members)	72	32.00
Middle team (6 to 10 members)	85	37.78
Large team (more than 10 members)	68	30.22
Membership in current team		
Up to 1 year	52	23.11
From 1 to 3 years	72	32.00
More than 3 years	64	28.44
More than 5 years	37	16.44

Source: Authors

Table 4 shows that respondents rate the clarity of team goals positively to a large extent. The mean values (M) of all statements are high (M ≈ 4.4–4.5), with relatively low standard deviations (SD), which indicates agreement among respondents. The highest percentage of answers is found in the highest grades (4 and 5), which suggests that teams pay considerable attention to defining and clarifying goals, and members perceive them as clear and well communicated. The highest values for grades 4 and 5 were recorded for the statement that the team invested a lot of time to clarify its goals to everyone, where 34.22% of the respondents gave a grade of 4, and even 57.78% gave a grade of 5. These results confirm that the clarity of goals is an important element of team functioning and that the respondents perceive that time and effort are invested in their teams so that all members are familiar with common goals.

Table 4 - Descriptive Statistics Regarding Team Goals Statements

No.	Statements	M	SD	Marks	N	%
1.	It is clear what this team is supposed to accomplish.	4.43	0.754	1	1	0.44
				2	5	2.22
				3	15	6.67
				4	79	35.11
				5	125	55.56
2.	This team spent time making sure every team member understands the team objectives.	4.49	0.669	1	0	0.00
				2	3	1.33
				3	13	5.78
				4	80	35.56
				5	129	57.33
3.	The team has invested plenty of time in clarifying our goals.	4.46	0.750	1	1	0.44
				2	6	2.67
				3	11	4.89
				4	77	34.22
				5	130	57.78

Source: Authors

Table 5 shows that the respondents rate team effectiveness highly. All statements have mean values above 4.3, with low standard deviations, indicating agreement among participants. The highest percentage of answers is found in the highest grades (4 and 5), especially in the statement that with work and effort, the team can achieve everything it decides, where 39.56% of the respondents gave a grade of 4, and even 54.67% gave a grade of 5. These results suggest that the respondents perceive the goals as attainable, achievable without excessive effort and that they believe in the ability of their team to achieve the set goals.

Table 5 - Descriptive Statistics Regarding Team Effectiveness

No.	Statements	M	SD	Marks	N	%
1.	Achieving this team's goals is well within our reach.	4.39	0.699	1	1	0.44
				2	1	0.44
				3	19	8.44
				4	92	40.89
				5	112	49.78
2.	This team can achieve its task without requiring us to put in unreasonable time or effort.	4.37	0.728	1	1	0.44
				2	5	2.22
				3	12	5.33
				4	98	43.56
				5	109	48.44
3.	With focus and effort, this team can do anything we set out to accomplish.	4.49	0.606	1	0	0.00
				2	0	0.00
				3	13	5.78
				4	89	39.56
				5	123	54.67

Source: Authors

Table 6 shows that respondents rate psychological safety in the team highly. All statements have mean values above 4.4, with low standard deviations, indicating agreement among participants. The highest percentage of answers is found in the highest grades (4 and 5). The highest values for grades 4 and 5 were recorded for the statements that team members do not reject each other because they are different (40.44% for grade 4 and 54.67% for grade 5) and that the skills and talents of members are valued and applied during work (39.56% for grade 4 and 54.67% for grade 5). These results suggest that teams operate within environments characterized by trust, where mistakes are not met with condemnation, differences are constructively embraced, and cooperation and mutual support are strongly present.

Table 6 - Descriptive Statistics Regarding Team Psychological Safety

No.	Statements	M	SD	Marks	N	%
1.	If you make a mistake on this team, it will never be held against you.	4.44	0.686	1	1	0.44
				2	1	0.44
				3	16	7.11
				4	88	39.11
				5	119	52.89
2.	Members of this team are able to bring up problems and tough issues.	4.46	0.597	1	0	0.00
				2	1	0.44
				3	9	4.00
				4	100	44.44
				5	115	51.11
3.	People on this team never reject others for being different.	4.50	0.591	1	0	0.00
				2	0	0.00
				3	11	4.89
				4	91	40.44
				5	123	54.67
4.	It is safe to take a risk on this team.	4.46	0.668	1	1	0.44
				2	2	0.89
				3	10	4.44
				4	91	40.44
				5	121	53.78
5.	It is not difficult to ask other team members for help.	4.46	0.654	1	0	0.00
				2	2	0.89
				3	14	6.22
				4	88	39.11
				5	121	53.78

Br.	Tvrdnje	M	SD	Ocene	N	%
6.	No one on this team would deliberately act in a way that undermines my efforts.	4.43	0.658	1	0	0.00
				2	3	1.33
				3	12	5.33
				4	96	42.67
				5	114	50.67
7.	Working with members of this team, my unique skills and talents are valued and utilized.	4.48	0.648	1	0	0.00
				2	3	1.33
				3	10	4.44
				4	89	39.56
				5	123	54.67

Source: Authors

Table 7 shows that respondents rated team performance highly. All statements have average values above 4.4, with low standard deviations, indicating agreement among respondents. The highest percentage of answers is found in the highest grades (4 and 5). The highest values for grades 4 and 5 were recorded for the statement that crucial errors never occur in the team's work, where 37.33% of respondents gave a grade of 4, and even 55.11% gave a grade of 5. These results suggest that the respondents perceive their teams as reliable, quality and oriented towards continuous improvement, which confirms a high level of performance and the ability to meet or exceed client expectations.

Table 7 - Descriptive Statistics Regarding Team Performance

No.	Statements	M	SD	Marks	N	%
1.	This team meets or exceeds its customers' expectations.	4.42	0.671	1	0	0.00
				2	1	0.44
				3	20	8.89
				4	88	39.11
				5	116	51.56
2.	This team does superb work.	4.45	0.640	1	0	0.00
				2	2	0.89
				3	12	5.33
				4	93	41.33
				5	118	52.44

No	Statements	M	SD	Marks	N	%
3.	Critical quality errors never occur in this team's work.	4.47	0.661	1	0	0.00
				2	2	0.89
				3	15	6.67
				4	84	37.33
				5	124	55.11
4.	This team keeps getting better and better.	4.44	0.625	1	0	0.00
				2	1	0.44
				3	13	5.78
				4	97	43.11
				5	114	50.67

Source: Authors

Based on results presented in Table 8, it can be concluded that the mean values of the composite variables for all measurement scales are very high (ranging from 4.42 to 4.46 on a scale from 1 to 5), with relatively low standard deviations (ranging from 0.585 to 0.689). Accordingly, the mean values of the composite variables indicate a consistently high level of agreement among respondents that the team functions effectively, with clear goals, psychological safety, and strong team performance.

Table 8 - Mean Values and Standard Deviations for Composite Variables

No.	Scale	M	SD
1.	Team clear direction	4.46	0.689
2	Team effectiveness	4.42	0.637
3	Team psychological safety	4.46	0.585
4	Team performance	4.44	0.602

Source: Authors

Results of Statistical Tests and Discussion

Table 9 shows that all constructs are strongly and statistically significantly correlated, indicating that clear goals, team efficiency, psychological safety, and team performance jointly contribute to the cohesion and success of teamwork.

Table 9 - Correlation Matrix of Constructs

Construct	1	2	3	4
Team clear direction	-	0.684**	0.795**	0.712**
Team effectiveness		-	0.690**	0.755**
Team psychological safety			-	0.739**
Team performance				-

$p < 0.01$ (two-tailed)
Source: Authors

The results in Table 10 show that there is a significant positive correlation between the clarity of team goals and team effectiveness ($r = 0.684$, $p < 0.01$), which means that teams with more clearly defined goals achieve a higher level of effectiveness. This association is statistically significant and confirms the hypothesis 1 of their mutual relationship. The coefficient of determination is $R^2=0.47$, indicating that clarity of team goals accounts for 47% of the variance in team effectiveness. This suggests that almost half of the variability in perceived team effectiveness can be statistically explained by differences in team clear direction.

Table 10 - Results of Pearson's Coefficient for Hypothesis 1

Variable	Team clear direction	Team effectiveness
Team goals	1.00	0.684**
Sig. (2-tailed)	-	0.000
N	225	225
Team effectiveness	0.684**	1.00
Sig. (2-tailed)	0.000	-
N	225	225

**Correlation is significant at the 0.01 level
Source: Authors

The results in Table 11 show that there is a significant positive correlation between psychological safety and team performance ($r = 0.739$, $p < 0.01$), which means that teams with a higher level of psychological safety achieve better results and a higher level of productivity. This association is statistically significant and confirms the hypothesis 2 of their mutual relationship. The coefficient of determination is $R^2=0.55$, indicating that psychological safety accounts for 55% of the variance in team performance. This finding suggests that differences in perceived team performance are largely explained by variations in the level of psychological safety.

Table 11 - Results of Pearson's Coefficient for Hypothesis 2

Variable	Psychological safety	Team performance
Psychological safety	1.00	0.739**
Sig. (2-tailed)	-	0.000
N	225	225
Team performance	0.739**	1.00
Sig. (2-tailed)	0.000	-
N	225	225

**Correlation is significant at the 0.01 level
Source: Authors

The results in Table 12 show that there is a significant positive correlation between team effectiveness and team performance ($r = 0.755$, $p < 0.01$), which means that teams that use resources and time efficiently achieve better performance. This association is statistically significant and confirms the hypothesis 3 of their mutual relationship. The coefficient of determination is $R^2=0.57$, indicating that team effectiveness accounts for 57% of the variance in team performance. This suggests that differences in perceived team performance are largely explained by variations in team effectiveness.

Table 12 - Results of Pearson's Coefficient for Hypothesis 3

Variable	Team performance	Team effectiveness
Team performance	1.00	0.755**
Sig. (2-tailed)	-	0.000
N	225	225
Team effectiveness	0.755**	1.00
Sig. (2-tailed)	0.000	-
N	225	225

**Correlation is significant at the 0.01 level
Source: Authors

The results obtained clearly indicate the existence of statistically significant positive relationships between the key dimensions of team functioning. First, the correlation between the clarity of team goals and team effectiveness ($r = 0.684$, $p < 0.01$) shows that teams with clearly defined goals tend to be more effective in accomplishing tasks. Then, psychological safety in the team is significantly related to team performance ($r = 0.739$, $p < 0.01$), which means that team members who feel free to express their opinions, ask questions and take risks achieve better results and a higher level of productivity. Finally, the correlation between team effectiveness and team performance ($r = 0.755$, $p < 0.01$) indicates that teams which efficiently use available resources and time achieve better performance. All three correlations are high, positive and statistically significant, which confirms that clarity of goals, psychological safety and effectiveness are key factors that contribute to the quality of teamwork. Together, these results provide empirical support for the set hypotheses and indicate that successful team functioning is based on a combination of clear structure, safe environment and rational use of resources.

The multiple regression analysis presented in Table 13 shows that the combination of team clear direction, team effectiveness, and psychological safety explains 67% of the variance in team performance (R^2=0.672), indicating a strong predictive power of the constructs.

Table 13 - Results of Multiple Regression Analysis - Model

Model	R	R^2	Adjusted R^2	Std. Error of Estimate	R^2 Change	F Change	df1	df2	Sig. F Change
1.	0.820	0.672	0.667	0.348	0.672	150.72	3	221	0.000

Source: Authors

The ANOVA results presented in Table 14 show that the regression model is statistically significant ($F(3, 221) = 150.72$, $p < 0.001$), meaning that the combination of predictors significantly explains the variance in team performance.

Table 14 - Results of Multiple Regression Analysis - ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	54.61	3	18.2	150.72	0
Residual	26.69	221	0.12		
Total	81.31	224			

Source: Authors

The results in Table 15 show that team effectiveness (β = 0.419, p < 0.001) and psychological safety (β = 0.305, p <0.001) are the strongest predictors of team performance, while team clear direction (β = 0.183, p < 0.01) also makes a significant contribution. All predictors are statistically significant, confirming that together they exert a strong influence on the perception of team performance.

Table 15 - Results of Multiple Regression Analysis - Coefficients

Predictor	B	SE	β	t	Sig.	Tolerance	VIF
(Constant)	0.582	0.186	-	3.13	0.002	-	-
Team clear direction	0.160	0.058	0.183	2.73	0.007	0.333	3.01
Team effectiveness	0.397	0.053	0.419	7.49	0	0.474	2.11
Psychological safety	0.314	0.069	0.305	4.52	0	0.327	3.06

Source: Authors

The collinearity results presented in Table 16 show that the Condition Index values are below the critical threshold of 30, indicating that there are no serious problems with multicollinearity. This means that team clear direction, team effectiveness, and psychological safety can be jointly used in the regression model without a significant risk of multicollinearity.

Table 16 - Results of Multiple Regression Analysis - Collinearity

Variable	Eigen value	Condition Index	Varijance Proportions (Konstanta)	Team clear direction	Team effectiveness	Psychological safety
1	3.976	1	0	0	0	0
2	0.013	17.67	0.87	0.13	0.03	0.01
3	0.007	23.68	0.02	0.24	0.95	0.05
4	0.004	29.13	0.11	0.63	0.02	0.93

Source: Authors

The results obtained align closely with previous research emphasizing the importance of clearly defined goals, psychological safety, and team efficiency for successful team functioning. Locke and Latham (2002) demonstrated that clear and specific goals guide team members' behavior, enhance motivation, and contribute to more efficient task performance. Supporting this, Stewart's meta-analysis (2006) confirmed that team coordination and structural characteristics exert a positive influence on overall team performance. Further evidence comes from Richter, Dawson, and West (2011), who found that teamwork and team effectiveness significantly enhance organizational performance. Similarly, Edmondson and Lei (2014) highlighted psychological safety as a critical prerequisite for team learning, innovation, and organizational effectiveness. In line with this, Park, Kim, and Gully (2017) identified a positive relationship between team effectiveness and team performance, while Grossman, Nolan, Rosch, Mazer, and Salas (2022) emphasized that the quality of team collaboration substantially contributes to team success. Recent studies further reinforce these findings. Fyhn, Egeland, and Schei (2025) demonstrated that the development and maintenance of psychological safety are essential processes for achieving high team performance. Likewise, Sommet, Rudmann, Pillaud, and Butera (2026) confirmed that clearly defined team goals exert a significant positive impact on team results. Taken together, these studies provide strong empirical support for the conclusion that successful team functioning rests on a combination of clearly defined goals, a psychologically safe environment, and efficient use of available resources.

Conclusion

The results of the research in which 225 respondents participated in Serbia showed that teams in the banking sector function in an environment characterized by clearly defined goals, high effectiveness, psychological safety and significant team performance. The results of the statistical analysis confirm that the clarity of team goals significantly contributes to effectiveness, while psychological safety has a significant impact on team performance. Also, effectiveness and performance are significantly related to each other, which indicates that rational use of resources leads to better quality of work.

Descriptive statistics further reinforce these findings, showing that respondents largely evaluated all analyzed dimensions positively, with high mean values and low standard deviations, indicating a strong level of agreement among employees. These results not only confirm theoretical assumptions regarding the importance of goal clarity and psychological safety, but also provide an empirical foundation for future research in the field of team management.

The results obtained have significant implications for both theoretical and practical point of view. From the theoretical aspect, the paper contributes to the understanding of the relationship between the clarity of team goals, effectiveness and performance, as well as the importance of psychological safety in teamwork in banks. From a practical aspect, bank managers receive guidance that creating clear team goals increases productivity and compliance with the organization's strategy, while encouraging psychological safety in the team contributes to better work, greater employee motivation and long-term sustainability of teams.

The conducted research has certain shortcomings. First, the choice of sample through the snowball method carries certain limitations. This technique relies on existing professional networks and personal contacts, which may lead to sampling bias, as participants are likely interconnected and share similar characteristics. Consequently, the sample is not fully representative of the entire population

of employees in the banking sector. In addition, such an approach makes it difficult to control the structure of the sample (e.g., balanced representation of different banks, teams, or hierarchical levels), which may affect the generalizability of the results. Second, the sample is limited to the banking sector in Serbia, so the obtained results could not be fully generalized to other industries or the international context. Third, a quantitative approach was applied in the research process, without qualitative methods (interviews, focus groups, observations) that would allow a deeper understanding of team members' experiences.

Accordingly, the recommendation for future research is to apply a more rigorous sampling approach in order to reduce bias and increase the representativeness of the sample. This would ensure greater reliability and validity of the results. Furthermore, future studies should encompass other industries and countries to allow for broader generalization. It is also advisable to employ qualitative methods such as interviews, focus groups, and observations, which would provide deeper insights into team members' experiences. In addition, future research should examine the impact of artificial intelligence and other automation technologies on teams and teamwork, as the penetration of these technologies is reshaping the dynamics of team effectiveness, psychological safety, and performance. In this way, a more comprehensive understanding of the factors shaping the contemporary functioning of teams in the banking sector would be achieved.

Nevertheless, despite the mentioned limitations, the obtained results are a starting point for the further development of team management theory and its practical application in the banking sector, as well as more broadly, in organizations striving for high efficiency and sustainable team performance.

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DETERMINANTE KRETANJA S&P GREEN BOND INDEX-A: EMPIRIJSKA ANALIZA UTICAJA S&P MUNICIPAL BOND INDEX-A I PRINOSA NA AMERIČKE DRŽAVNE OBVEZNICE

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Rezime: *Zelene obveznice predstavljaju jedan od najznačajnijih instrumenata održivog finansiranja i imaju sve važniju ulogu u mobilizaciji kapitala za ekološke i klimatske projekte. Cilj ovog istraživanja je analizirati uticaj prinosa municipalnih obveznica i prinosa na desetogodišnje američke državne obveznice na prinose zelenih obveznica u SAD-u tokom perioda: 2016 – 2025. godine. U istraživanju su korišćeni podaci o indeksima S&P Green Bond Index, S&P Municipal Bond Index te prinos na desetogodišnje američke državne obveznice (U.S. 10Y Treasury Yield). Metodološki okvir obuhvata deskriptivnu statistiku, korelacionu analizu, regresionu analizu primenom metode najmanjih kvadrata (OLS), Augmented Dickey – Fuller (ADF) test stacioniranosti i Engle – Granger test kointegracije. Rezultati istraživanja ukazuju na statistički značajnu pozitivnu povezanost između S&P Green Bond Index-a i S&P Municipal Bond Index-a, dok prinos na desetogodišnje američke državne obveznice ostvaruje statistički značajan negativan uticaj na prinose zelenih obveznica. Engle-Granger test potvrdio je postojanje dugoročne ravnotežne veze (kointegracije) između analiziranih varijabli. Dobijeni rezultati ukazuju na značaj tradicionalnih tržišta obveznica i kretanja kamatnih stopa u objašnjenju performansi tržišta zelenih obveznica.*

Ključne reči: Zelene obveznice, municipalne obveznice, američke državne obveznice, kointegracija, OLS regresija, održive finansije.

JEL klasifikacija: G12, G15, Q56

Uvodna razmatranja

Zelene obveznice su donedavna inovacija u održivim finansijama. Dakle, zelene obveznice su dužnički instrumenti čiji je prihod namenjen finansiranju projekata sa niskom emisijom ugljenika, prihvatljivih za klimu. Emitenti zelenih obveznica su korporacije, opštine, vladini subjekti, i nadnacionalne institucije. U ovom radu termin „municipalne obveznice" koristi se za obveznice koje izdaju savezne države, lokalne jedinice vlasti i njihove agencije u Sjedinjenim Američkim Državama. Radi terminološke doslednosti, ovaj termin koristi se u celom radu. Takođe, može se reći da zelene municipalne obveznice predstavljaju nov način da se otključaju finansije za ulaganja u održivu i urbanu infrastrukturu u SAD. Emisija zelenih obveznica kasni zbog negativnih percepcija viših troškova, nižih prinosa i većeg rizika (Chiang, 2017). Zelene obveznice su u suštini identične redovnim municipalnim obveznicama kako po strukturi, riziku i prinosu. Snažna investiciona potražnja za zelenim obveznicama može omogućiti emitentima da se finansiraju uz niže troškove kapitala, jer povećana potražnja smanjuje zahtevani prinos investitora (Zerbib, 2019).

Zelene obveznice se u nekim situacijama porede sa klimatskim obveznicama (engl. Climate Bonds). I pored toga da se u pojedinim situacijama ove dve vrste obveznica mogu izjednačiti, ipak zelene obveznice predstavljaju širi pojam. Sredstva prikupljena emisijom klimatskih obveznica usmerena su pre svega na smanjenje emisije ugljen-dioksida, te ublažavanje i otklanjanje negativnih efekata klimatskih promena, dok zelene obveznice mogu biti usmerene na sve projekte sa pozitivnim implikacijama na životnu sredinu. Dakle, zelene obveznice su instrumenti posvećeni održivosti, poništenju negativnih efekata klimatskih promena i ekološki orijentisanim projektima. Kako zajmovi koje daju finansijske institucije predstavljaju u većini zemalja najvažniji izvor finansiranja, s tim u vezi obveznice imaju značajnu ulogu u finansiranju i refinansiranju kreditnih aktivnosti finansijskih institucija. U poslednje vreme izdavanje od strane finansijskih institucija je u stalnom porastu. Veliki porast emisija zelenih obveznica u 2016. godini, proizišao je iz velikog obima emisija banaka u Kini, gde su zelene obveznice banaka činile oko 76% ukupnog iznosa kineskih emisija u datoj godini. Na osnovu procene OECD – a izdavanje zelenih obveznica finansijskog sektora ima potencijal da nastavi značajan rast u vrednosti od preko 1,7 biliona dolara do 2035. godine (Janković, 2024).

Oblasti na koje se usmerava emisija zelenih obveznica su sledeće: uvećanje energetske efikasnosti, smanjenje postojećeg i prevencija budućeg zagađenja, održivo šumarstvo, poljoprivredu i ribarstvo, zaštita ekosistema na kopnu i u vodi, ekološki vid transporta i saobraćaja, prečišćavanje i održivo upravljanje vodama, itd. (Janković, 2024) Slika 1 prikazuje ključne oblasti zelenog investiranja.

Slika 1: Ključne oblasti zelenog investiranja



IZVOR: Janković, I. (2024). Zelene obveznice, Univerzitet u Beogradu – Ekonomski fakultet, Centar za izdavačku delatnost, str. 22.

Privlačnost zelenih obveznica u velikoj meri proizilazi iz njihove jednostavnosti u pogledu strukture, ključnih elemenata i postupaka koji definišu ovu vrstu dužničkih hartija od vrednosti, te stoga bi trebalo da omoguće jasan i transparentan prenos informacija do investitora u vezi sa korišćenjem sredstava prikupljenih njihovom emisijom i njihovim ekološkim karakteristikama. Formalno posmatrano, proces izdavanja zelenih obveznica je vrlo sličan izdavanju klasičnih obveznica, gde zelene obveznice podležu istim propisima i zahtevima koji se tiču pravnog okvira i prateće dokumentacije kao i finansijskog izveštavanja. Ono što čini dodatak je da prilikom izdavanja zelene obveznice od emitenta se očekuje da će uključiti u procedure i prateći Okvir zelenih obveznica koji obezbeđuje dodatne informacije i procedure usmerene na uveravanje investitora o ekološki usmerenoj upotrebi prikupljenih finansijskih sredstava (Janković, 2024).

Iako je u dosadašnjoj literaturi značajna pažnja posvećena karakteristikama i performansama zelenih obveznica, ograničen broj istraživanja analizira međusobni odnos tržišta zelenih i municipalnih obveznica uz istovremeno uključivanje promena kamatnih stopa kao makroekonomskog faktora. Posebno su retka istraživanja koja koriste tržišne indekse kao reprezentativne pokazatelje kretanja ovih segmenata tržišta kapitala. Cilj ovog istraživanja je ispitati odnos između S&P Green Bond Index-a i S&P Municipal Bond Index-a, te analizirati uticaj prinosa na desetogodišnje američke državne obveznice na kretanje vrednosti indeksa zelenih obveznica. U istraživanju se primenjuju deskriptivna statistika, korelaciona analiza, OLS regresija, i Engle-Granger test kointegracije. U skladu sa definisanim ciljem istraživanja, u radu se razmatraju sledeća istraživačka pitanja:

1. Da li S&P Municipal Bond Index značajno utiče na dnevne vrednosti S&P Green Bond Index-a?

2. Da li prinos na desetogodišnje američke državne obveznice značajno utiče na dnevne vrednosti S&P Green Bond Index-a?

3. Da li između analiziranih varijabli postoji dugoročna ravnotežna veza (kointegracija)?

Kako bi se odgovorilo na postavljena istraživačka pitanja, u empirijskom delu rada primenjene su odgovarajuće statističke i ekonometrijske metode, uključujući regresionu analizu, testove stacioniranosti i Engle-Grangerov test kointegracije, s ciljem ispitivanja kratkoročnih i dugoročnih odnosa između analiziranih varijabli.

Rad je struktuiran na sledeći način. Nakon uvodnih razmatranja, u drugom delu dat je pregled relevantne literature iz oblasti zelenih i municipalnih obveznica. Treći deo rada posvećen je analizi globalnih trendova na tržištu zelenih obveznica. U četvrtom delu prikazani su metodologija istraživanja, model i korišćeni podaci. Peti deo sadrži empirijske nalaze dobijene primenom deskriptivne statistike, korelacione i regresione analize, kao i testovi stacioniranosti i kointegracije. Na kraju rada iznešeni su zaključci, ključni nalazi istraživanja i njihove implikacije za investitore i kreatore ekonomskih politika.

Pregled relevantne literature

Početkom poslednje decenije tržište zelenih obveznica beleži snažan rast usled povećane potrebe za finansiranjem projekata održivog razvoja i energetske tranzicije. Poseban značaj imaju municipalne zelene obveznice koje omogućavaju lokalnim zajednicama finansiranje ekoloških infrastrukturnih projekata. Dakle, zelene obveznice su finansijski instrumenti sa fiksnim prihodom koje se izdaju radi prikupljanja sredstava za ekološki prihvatljive projekte. Njihova svrha je internalizacija svih ekoloških eksternalija i podsticanje investicija u zelene projekte radi održivog razvoja (Ehlers i Packer, 2017). Državne zelene obveznice su relativno novi finansijski instrument osmišljen za prikupljanje kapitala za osnovne vladine infrastrukturne projekte koji su u skladu sa održivim programom. Ove obveznice takođe mogu smanjiti troškove kapitala za ekološki prihvatljive projekte. Međutim, izdavanje zelenih obveznica je obično skuplje od konvencionalnih obveznica zbog dodatnih administrativnih, pravnih i marketinških troškova (Doronzo i ostali, 2021). Pored toga, postoje dokazi da zelene obveznice imaju niži prinos od konvencionalnih obveznica prilikom emisije, poznat kao „premijska cena" (engl. greenium) (Liaw, 2020). Istraživanje grinijuma posebno na tržištu suverenih zelenih obveznica je ograničeno, ali su Grzegorczyk i Wolff (2022) ukazali na prisustvo malog i negativnog grinijuma na tržištu suverenih obveznica EU. Negativan grinijum znači da su investitori spremni da prihvate niži prinos na državne zelene obveznice u poređenju sa konvencionalnim obveznicama. Jedan od razloga za to je što zelene obveznice pružaju investitorima priliku da ulažu u zelene i održive projekte.

Larcker i Watts (2020) upoređivali su municipalne zelene obveznice sa ekvivalentnim običnim municipalnim obveznicama i otkrili su veoma mali popust na prinos bez dokaza koji podržavaju negativnu premiju na municipalne zelene obveznice. S tim u vezi, došli su do zaključka da je zelena premija de facto nula.

Istorijski gledano, zelene obveznice su bile kažnjene na tržištu municipalnih promena, trgujući se po nižim cenama i višim prinosima, nego što se očekivalo na osnovu njihovih kreditnih profila. Poslednjih godina, kreditni kvalitet municipalnih zelenih obveznica se povećao, a premija je postala pozitivna. S tim u vezi, zelene obveznice postaju sve atraktivnija investicija u cilju premošćavanja jaza u finansiranju klimatskih promena za ublažavanje i prilagođavanje.

Partridge i Medda (2020) analizirali su tržište zelenih municipalnih obveznica u SAD- u i pronašli preliminarne dokaze o postojanju greenium-a. Njihovi rezultati pokazuju da su investitori bili spremni prihvatiti nešto niže prinose na zelene municipalne obveznice u odnosu na uporedive konvencionalne municipalne obveznice. Autori zaključuju da takvi nalazi odražavaju rastuću potražnju za održivim investicijama te ukazuju na sve veću povezanost između tržišta zelenih i municipalnih obveznica.
Tang i Zhang (2020) analizirali su efekte emisije zelenih obveznica na finansijska tržišta koristeći uzorak kompanija iz 28 zemalja u periodu: 2007. – 2017. Njihovi rezultati su pokazali da tržište pozitivno reaguje na emisiju zelenih obveznica, dok se nakon emisije povećavaju institucionalno vlasništvo i likvidnost akcija, što potvrđuje rastući značaj zelenih finansijskih instrumenata na globalnom tržištu kapitala. Asness (2000) analizirao je odnos prinosa akcija i obveznica te objasnio premiju rizika na tržištu akcija.

Reboredo i Ugolini (2020) su među prvima koji su ispitivali vezu između zelenih obveznica i finansijskih tržišta. Autori su razmatrali model strukturne vektorske autoregresije (SVAR) i otkrili su da je tržište zelenih obveznica značajno povezano sa tržištem trezorskih zapisa i valuta. Takođe, su došli do zaključka da postoji slaba veza između zelenih obveznica i tržišta akcija i energije. Hammoudeh i ostali (2020) su takođe koristili pristup uzročnosti preko vremenske promenljive kako bi ispitali uzročnu vezu između tržišta zelenih obveznica i drugih finansijskih indikatora od 2016 do 2020. godine. Autori su došli do zaključka da su prinosi 10- godišnjih američkih trezorskih obveznica primarni faktor koji određuje prinose zelenih obveznica.

Pham i Nguyen (2021) su takođe istraživali zavisnost repa distribucije između zelenih obveznica i energetskih, akcijskih i tradicionalnih tržišta obveznica koristeći metod unakrsnog kvantilograma od oktobra 2014 do februara 2021. godine. Autori su dobili pomešane dokaze, jer se prelivanje između finansijskog i tržišta zelenih obveznica značajno menjalo u različitim kvantilima.

Flammer (2021) analizira korporativne zelene obveznice i utvrđuje da investitori pozitivno reaguju na njihovu emisiju. Takođe, rezultati istraživanja pokazuju da emitenti nakon emisije ostvaruju bolje ekološke performanse, smanjuje se emisija CO2, te privlače dugoročni investitori, što potvrđuje značaj zelenih obveznica kao instrumenta održivog finansiranja.

Nguyen i Le (2025) analizirali su uticaj emisije zelenih obveznica na tranziciju prema obnovljivim izvorima energije u 192 zemlje tokom perioda: 2007– 2021. Rezultati istraživanja su pokazali da emisija zelenih obveznica značajno doprinosi finansiranju projekata obnovljive energije i ubrzava energetsku tranziciju.

Sojoudi i ostali (2026) utvrdili su postojanje značajnog greenium-a na tržištu američkih municipalnih obveznica, pri čemu su investitori bili spremni prihvatiti niže prinose na zelene obveznice radi podrške ekološki održivih projekata. Autori takođe ističu da se intenzitet greenium-a menja kroz vreme i zavisi od karakteristika samih obveznica.

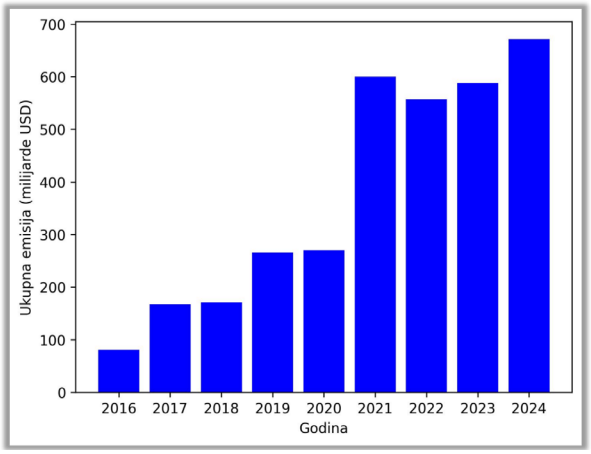
Pored toga novija istraživanja ukazuju na postojanje greenium-a na tržištu zelenih i municipalnih obveznica, što dodatno potvrđuje specifičnost tržišnog vrednovanja zelenih finansijskih instrumenata. Iako su prethodna istraživanja analizirala povezanost zelenih obveznica sa različitim segmentima finansijskog tržišta, rezultati prethodnih istraživanja nisu uvek jednoznačni, a nalazi se razlikuju u zavisnosti od posmatranog tržišta, vremenskog perioda i primenjene metodologije. Pored toga, prethodna istraživanja primenjivala su različite metodološke pristupe, uključujući panel analizu, modele vremenskih serija i druge ekonometrijske modele, dok se u ovom radu primenjuje kombinacija regresione analize, ADF testa stacionarnosti i Engle – Grangerovog testa kointegracije. Takav metodološki pristup omogućava ispitivanje kratkoročnih efekata S&P Municipal Bond Indexa i prinosa na desetogodišnje američke državne obveznice na performanse S&P Green Bond Indexa, kao i utvrđivanje postojanja dugoročne ravnotežne veze između analiziranih varijabli. Na osnovu pregleda relevantne literature, identifikovanog istraživačkog jaza i definisanog cilja istraživanja, formulisane su sledeće istraživačke hipoteze:

H1: Postoji dugoročna ravnotežna veza (kointegracija) između analiziranih varijabli.
H2: Postoji statistički značajna veza između S&P Municipal Bond Index-a i S&P Green Bond Index-a.
H3: Postoji statistički značajan uticaj prinosa na američku 10 – godišnju državnu obveznicu na S&P Green Bond Index.

Globalni trendovi na tržištu zelenih obveznica

Prvu zelenu obveznicu emitovala je Evropska investiciona banka (EIB) 2007. godine, za finansiranje projekata obnovljive energije i energetske efikasnosti. Od tada, zelene obveznice postaju sve popularniji oblik finansiranja. Ilustracije radi, u 2008. godini, ukupna emisija zelenih obveznica bila je manja od milijardu dolara, da bi do kraja 2018. godine, skočila na 143 milijarde dolara. Ovaj trend stručnjaci iz prakse nazivaju bumom zelenih obveznica koji će se verovatno nastaviti u narednim godinama (Morgan Stanley, 2017). Takođe, mnogi komentatori vide zelene obveznice kao alat za rešavanje klimatskih promena. Rast značaja zelenih obveznica na globalnom finansijskom tržištu potvrđuje i kontinuirano povećanje vrednosti njihovih emisija, što prikazuje Slika 2.

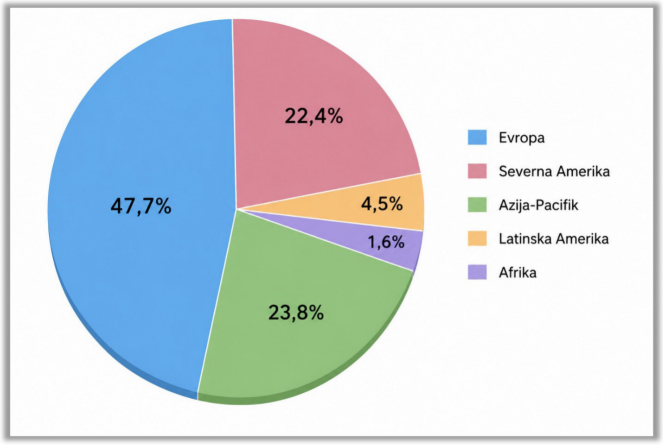
Slika 2: Vrednost emisija zelenih obveznica (u milijardama USD)



IZVOR: Climate Bonds Initiative. (2024). Interactive data platform. https://www.climatebonds.net/market/data/

Ukupna emisija zelenih obveznica u svetu povećana je sa oko 80 milijardi USD u 2016. godini na oko 670 milijardi USD u 2024. godini, što predstavlja povećanje za oko 737%. Značajan rast emisije zelenih obveznica u periodu od 2016. do 2024. godine, može se obrazložiti jačanjem regulatornog okvira u oblasti održivih finansija, rastućom potražnjom investitora za ESG instrumentima, aktivnijim učešćem država kroz izdavanje suverenih zelenih obveznica, povoljnijim uslovima finansiranja u periodu niskih kamatnih stopa pre 2022. godine. Takođe, povećana svest o klimatskim rizicima i potrebi energetske tranzicije usmerila je kapital prema projektima obnovljivih izvora energije, energetske efikasnosti i održive infrastrukture. Isto tako, standardizacija tržišta kroz razvoj međunarodnih principa i taksonomija dodatno je povećala kredibilitet i transparentnost tržišta što je doprinelo ubrzanom rastu ovog segmenta finansijskog tržišta.

Grafikon 1: Emisija zelenih obveznica prema regionu u 2024. godini (u %)



IZVOR: Climate Bonds Initiative (2024). Interactive data platform. https://www.climatebonds.net/market/data/

Regionalno posmatrano, Evropa u 2024. godini učestvuje sa 47,7% u ukupnoj globalnoj emisija zelenih obveznica, dok Azija-Pacifik učestvuje sa 23,8%, Severna Amerika sa 22,4%, Latinska Amerika sa 4,5% i Afrika sa 1,6%. Ovi podaci pokazuju da Evropa, Azija-Pacifik i Severna Amerika zajedno učestvuju sa 93,9% ukupne globalne emisije zelenih obveznica, dok Latinska Amerika i Afrika imaju znatno manje učešće, što ukazuje na potencijal za dalji razvoj tržišta održivog finansiranja u tim regionima. Rast tržišta zelenih obveznica nije ravnomerno raspoređen među zemljama, već je koncentrisan u određenim razvijenim ekonomijama koje imaju značajnu ulogu u finansiranju projekata održivog razvoja. Radi detaljnijeg sagledavanja geografske distribucije tržišta zelenih obveznica, u Tabeli 1 prikazani su podaci o vrednostima emitovanih zelenih obveznica i njihovom procentualnom učešću po odabranim zemljama u prvom polugodištu 2024. godine.

Tabela 1: Emisija zelenih obveznica po zemljama u prvom polugodištu 2024. godine

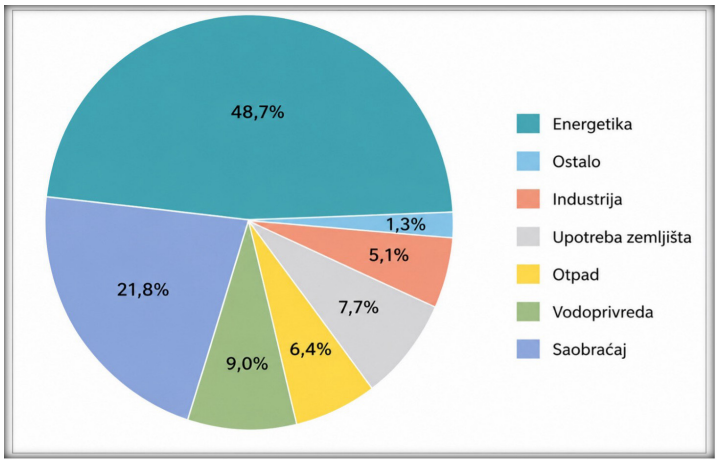
Naziv zemlje	Zelene obveznice (u mlrd USD)	Procentualno učešće
Japan	10,6	11,69%
Italija	12,1	13,35%
Francuska	11,6	12,80%
Australija	4,7	5,18%
Austrija	7,2	7,95%
Nemačka	14,0	15,45%
Kanada	2,9	3,20%
Rumunija	2,2	2,43%
Singapur	1,9	2,09%
Mađarska	1,6	1,77%
Island	0,8	0,88%
Kina	0,8	0,88%
Indija	1,2	1,32%
Velika Britanija	10,1	11,15%
Holandija	2,3	2,54%
Španija	2,1	2,32%
Belgija	1,7	1,87%
Novi Zeland	0,8	0,88%
Danska	0,6	0,66%
Irska	0,6	0,66%
Indonezija	0,5	0,60%
Švajcarska	0,2	0,22%
Peru	0,1	0,11%
Ukupno	90,6	100,00%

IZVOR: Climate Bonds Initiative. (2024). Interactive data platform. https://www.climatebonds.net/market/data/

Podaci prikazani u Tabeli 1 odnose se na odabrane zemlje emitente zelenih obveznica u prvom polugodištu 2024. godine, pri čemu kolona procentualno učešće predstavlja učešće pojedine zemlje u ukupnoj vrednosti emisija prikazanih u tabeli (90,6 mlrd USD). Prikazani podaci u Tabeli 1 ukazuju na značajnu koncentraciju emisija zelenih obveznica u razvijenim ekonomijama tokom prvog polugodišta 2024. godine. Najveći obim emisija zabeležen je u Nemačkoj (14,0 mlrd USD), Italiji (12,1 mlrd USD) i Francuskoj (11,6 mlrd USD) koje zajedno čine deo ukupne emisije zelenih obveznica. S druge strane, najmanje emisije evidentirane su u Peruu, Švajcarskoj i Indoneziji. Ovi podaci potvrđuju da je tržište zelenih obveznica dominantno razvijeno u ekonomski snažnijim zemljama koje aktivno promovišu održivo finansiranje i zelenu tranziciju.

Pored geografske distribucije emisija zelenih obveznica, značajno je analizirati i sektorsku usmerenost prikupljenih sredstava. Struktura emisije zelenih obveznica prema sektorima prikazana je na Grafikonu 2.

Grafikon 2: Sektorska raspodela globalne emisije zelenih obveznica u 2024. godini (u%)



IZVOR: Climate Bonds Initiative. (2024). Interactive data platform. https://www.climatebonds.net/market/data/

Sektorska raspodela emisije zelenih obveznica u 2024. godini, pokazuje dominantno učešće energetskog sektora sa oko 49%, što potvrđuje ključnu ulogu investicija u obnovljive izvore energije i dekarbonizaciju. Takođe, značajan procenat ima i saobraćaj od oko 22%, dok su sektori poput vodoprivrede, upravljanja otpadom i upotreba zemljišta umereno zastupljeni. Ovakva struktura ukazuje da se kapital primarno usmerava ka sektorima sa najvećim potencijalom za smanjenje emisija i ubrzanje klimatske tranzicije.

Metodologija i podaci

Model

Metod običnih najmanjih kvadrata (eng. ordinary least squares - OLS) jedna je od najosnovnijih i najšire korišćenih tehnika procene u statistici i ekonometriji. On pruža relativno jednostavan, ali moćan metod za procenu odnosa među promenljivim, minimiziranjem zbira kvadrata reziduala, tj. razlike

između posmatranih i predviđenih vrednosti zavisne promenljive (Nosheen i ostali, 2025). Klasičan model linearne regresije pod OLS metodom pretpostavlja linearnost parametara, slučajno uzorkovanje, odsustvo savršene multikolinearnosti, egzogenost regresora i homoskedastičnost (Hansen, 2022). U cilju testiranja međusobnih odnosa između tržišta zelenih obveznica, tržišta konvencionalnih municipalnih obveznica i prinosa na desetogodišnje američke državne obveznice, u ovom istraživanju primenjen je model najmanjih kvadrata. Klein i Weill (2018) ukazuju da OLS regresija nije samo korisna metoda za opisivanje podataka, već i pružanje prve pristrasne procene koeficijenata.

U empirijskoj analizi korišćene su dnevne vrednosti S&P Green Bond Indexa i S&P Municipal Bond Indexa za period: 2016 – 2025., dok je prinos na desetogodišnje američke državne obveznice (U.S. 10 – Year Treasury Yield) korišćen kao zasebna objašnjavajuća varijabla. U istraživanju nisu korišćeni dnevni prinosi navedenih indeksa, već njihove dnevne vrednosti, što predstavlja osnovu za procenu modela i interpretaciju dobijenih rezultata. S&P Green Bond Index predstavlja reprezentativan pokazatelj širokog segmenta globalnog tržišta zelenih obveznica i obuhvata državne, supranacionalne, agencijske, korporativne, finansijske i municipalne zelene obveznice. Shodno tome, rezultati ovog istraživanja trebaju se tumačiti u kontekstu tržišta zelenih obveznica obuhvaćenih S&P Green Bond Indexom, te se ne mogu tumačiti isključivo u kontekstu zelenih municipalnih obveznica. Pored regresione analize primenom metode najmanjih kvadrata, u istraživanju su primenjeni Augmented Dickey–Fuller (ADF) test stacioniranosti i Engle – Granger test kointegracije. ADF test korišćen je za ispitivanje stacioniranosti i utvrđivanje reda integracije analiziranih vremenskih serija, dok je Engle-Granger test primenjen radi ispitivanja postojanja dugoročne ravnotežne veze između dnevnih vrednosti S&P Green Bond Index-a, S&P Municipal Bond Index-a i prinosa na desetogodišnje američke državne obveznice. Primena Engle-Granger testa opravdana je u slučaju kada su analizirane varijable integrisane istog reda, odnosno I(1). Svi statistički testovi provedeni su na nivou značajnosti od 5%.

Specifikacija modela definisana je na sledeći način:

$$GB_t = \alpha + \beta_1 MB_t + \beta_2 U.S.10Y_Y_t + \varepsilon_t$$

Gde je:

GB_t – dnevna vrednost S&P Green Bond Indexa;

MB_t – dnevna vrednost S&P Municipal Bond Indexa;

$U.S.10Y_Y_t$ – prinos na američku 10-godišnju državnu obveznicu;

β_1 i β_2 – predstavljaju regresione koeficijente:

ε_t – slučajna greška.

Svi proračuni obično koriste nivo značajnosti od 5%. Stoga je test značajnosti izvršen za sve promenljive korišćenjem t – testa na nivou značajnosti od 95% (Chmelarova, 2007).

Podaci

U ovom istraživanju korišćeni su sekundarni podaci prikupljeni iz relevantnih finansijskih baza podataka. Analiza se zasniva na dnevnim podacima za period od 29. januara 2016. godine do 31. decembra

2025. godine, što obuhvata ukupno 2.481 opservaciju. Kao zavisna varijabla korišćen je S&P Green Bond Index (GB), koji prati performanse globalnog tržišta zelenih obveznica čiji su prihodi namenjeni finansiranju projekata sa pozitivnim ekološkim efektima. Glavna nezavisna varijabla je S&P Municipal Bond Index (MB), koji predstavlja referentni pokazatelj performansi američkog tržišta municipalnih obveznica. Ovaj indeks obuhvata širok spektar obveznica koje emituju savezne države, lokalne zajednice i njihove agencije. Pored toga u model je uključena i druga nezavisna varijabla U.S. 10 - Year Treasury Yield (U.S.10Y), koja predstavlja prinos na desetogodišnje državne obveznice SAD-a i često se koristi kao referentna bezrizična kamatna stopa na finansijskim tržištima. Podaci za S&P Green Bond i S&P Municipal Bond Index preuzeti su iz baze podataka S&P Dow Jones Indices (2025), dok su podaci o prinosu na desetogodišnje američke državne obveznice preuzeti iz Federal Reserve Economic Data (FRED) baze podataka. Nakon usklađivanja datuma trgovanja formiran je jedinstveni skup podataka koji je korišćen za provođenje ekonometrijske analize.

Empirijski nalazi

Deskriptivna statistika

U cilju sagledavanja osnovnih karakteristika analiziranih varijabli, u Tabeli 2 prikazani su rezultati deskriptivne statistike prinosa S&P Green Bond Indexa, S&P Municipal Bond Indexa i prinos na američku desetogodišnju državnu obveznicu.

Tabela 2: Deskriptivna statistika prinosa S&P Green Bond Indexa, S&P Municipal Bond Indexa i prinosa na američku desetogodišnju državnu obveznicu (U.S. 10-Year Treasury Yield) (%) za period: 29.01.2016.-31.12.2025.

Opis	S&P Green Bond index	S&P Municipal Bond Index	U.S.10Y_Y
Srednja vrednost	0,00981	0,00954	0,0738
Medijana	0,01573	0,01688	0,000
Standardna devijacija	0,21507	0,21989	2,9384
Max	1,1112	3,3943	40,740
Min	-1,5517	-2,5897	-27,027
Mera asimetrije	-0,4674	-0,4804	1,4053
Spljoštenost	7,7804	62,068	39,309
Verovatnoća	0,000	0,000	0,000
Broj opservacija	2.481	2.481	2.481

IZVOR: Proračun autora na osnovu podataka preuzetih sa:
https://www.spglobal.com/spdji/en/index-family/fixed-income/us-municipal/#overview

Rezultati prikazani u Tabeli 2 pokazuju da S&P Green Bond Index i S&P Municipal Bond Index imaju vrlo slične prosečne vrednosti prinosa tokom posmatranog perioda. Nasuprot tome, prinos na američku desetogodišnju državnu obveznicu beleži nešto višu prosečnu vrednost i veću volatilnost, što ukazuje na različitu dinamiku kretanja u odnosu na tržište zelenih i municipalnih obveznica. Ovakav rezultat upućuje na postojanje klasičnog odnosa između prinosa i rizika na finansijskim tržištima. Drugim rečima, viši prinos na desetogodišnje američke državne obveznice predstavlja kompenzaciju investitorima za preuzimanje kamatnog i inflacionog rizika, koji su izraženiji kod dugoročnih dužničkih instrumenata. Promene u monetarnoj politici, posebno kretanje referentnih kamatnih stopa i inflaciona očekivanja, značajno utiču na volatilnost prinosa ovih obveznica, što se odražava kroz veću standardnu devijaciju. Ovakav rezultat potvrđuje ulogu prinosa na desetogodišnje američke državne obveznice kao referentne bezrizične kamatne stope na globalnom finansijskom tržištu, čije promene utiču na vrednovanje i atraktivnost različitih segmenata tržišta obveznica.

Posmatrano sa druge strane, niži prinosi i manja kolebljivost zelenih i municipalnih obveznica mogu se objasniti karakteristikama ovih tržišta. Municipalne obveznice uglavnom uživaju poreske olakšice, dok kod zelenih obveznica postoji stabilna i rastuća potražnja investitora motivisanih ESG principima, što doprinosi relativno stabilnijim kretanjima prinosa. Slične prosečne vrednosti prinosa i relativno niska volatilnost ukazuju na mogućnost postojanja dugoročne povezanosti između tržišta zelenih i municipalnih obveznica, što će biti dodatno ispitano primenom Engle-Granger testa kointegracije. Meszaros i ostali (2023) su istražili svojstva volatilnosti zelenih suverenih obveznica evropskih malih otvorenih ekonomija za period između 2016., i 2021. godine, sa akcentom razlika između zelenih suverenih obveznica i konvencionalnih suverenih obveznica tokom posmatranog perioda. Oni su posmatrali tržišta u dve zemlje članice EU tj. Poljsku i Mađarsku te uporedili sa zrelim tržištem Nemačke kao referentnom zelenom tržištu. Rezultati studije su pokazali da zelene suverene obveznice imaju veću volatilnost od tradicionalnih što ukazuje na to da je tržište još uvek sumnjičavo u ovom mladom stanju, te da je ova imovina više reagovala na šokove. Međutim, ove razlike nisu bile toliko velike, što dalje znači da dublje tržište zelenih obveznica može imati slične statističke karakteristike kao tradicionalno tržište.

Tabela 3: Proračun godišnjih prinosa S&P indeksa municipalnih obveznica, S&P indeksa zelenih obveznica i prinosa na desetogodišnje državne američke obveznice za period: 2016.- 2025. godine (u%)

Godina	S&P Municipal Bond Index	S&P U.S. Green Bond Index	U.S.10Y_Y
2016.	0,55%	-0,30%	1,82%
2017.	4,82%	6,56%	2,33%
2018.	1,35%	0,26%	2,91%
2019.	6,89%	8,07%	2,14%
2020.	4,97%	4,77%	0,89%
2021.	1,71%	2,26%	1,45%
2022.	-8,32%	-11,92%	2,95%
2023.	5,64%	6,61%	3,96%
2024.	1,92%	1,41%	4,21%
2025.	4,13%	6,75%	4,29%
Prosek	**2,37%**	**2,45%**	**2,69%**

IZVOR: Proračun autora

Iz prethodne tabele je evidentno da je indeks municipalnih obveznica imao najnižu stopu prinosa u 2022. godini (-8,32%), najvišu stopu prinosa u 2019. godini od oko 6,89% te prosečnu stopu od oko 2,37%. Za razliku od indeksa municipalnih obveznica, berzanski indeks konvencionalnih zelenih obveznica je najnižu vrednost prinosa zabeležio u 2022. godini (-11,92%), najveću vrednost prinosa je ostvario u 2019. godini od oko 8,07%, te prosečnu vrednost od oko 2,45%. Najveća stopa prinosa na desetogodišnje državne američke obveznice je ostvarena u 2025. godini oko 4,29%, najniža vrednost je zabeležena u 2020. godini (0,89%) i prosečna vrednost od oko 2,69%.

Prinos na desetogodišnje državne američke obveznice reflektuje očekivanja investitora u pogledu buduće inflacije i kretanja referentnih kamatnih stopa. U periodima izražene inflacije i restriktivne monetarne politike, kao što je bio slučaj u posmatranom periodu, dolazi do rasta prinosa na državne obveznice, jer investitori zahtevaju višu kompenzaciju za gubitke realne vrednosti novca. I pored toga što su u tabeli 3 prikazane neznatne razlike u prosečnim prinosima između S&P Municipal Bond Index i S&P Green Bond Index, statistički testovi brojnih autora nisu potvrdili postojanje značajnog prinosnog popusta ili premije cena (engl. greenium) za zelene obveznice. Janković i ostali (2022) su otkrili vrlo mali popust na prinos municipalnih zelenih obveznica i zaključili su da je zelena premija faktički jednaka nuli. Kako nema značajnih razlika u prinosima zelenih i konvencionalnih obveznica, investitori mogu odlučiti u koju obveznicu investirati na osnovu drugih faktora kao što su etički ili ekološki faktori, kao i rizik i likvidnost. Navedeni nalazi ukazuju da tržišta zelenih i municipalnih obveznica pokazuju slične karakteristike prinosa, što opravdava dalje ispitivanje njihove međusobne povezanosti primenom korelacione, regresione i kointegracione analize.

Korelaciona analiza

U cilju preliminarnog ispitivanja međusobnih odnosa između S&P Green Bond Index-a, S&P Municipal Bond Index-a i prinosa na desetogodišnje američke državne obveznice, primenjena je Pearsonova korelaciona analiza. Korelaciona analiza omogućava identifikovanje smera i intenziteta linearne povezanosti između posmatranih varijabli. Prema Cohen-u (1988) ukoliko se koeficijent korelacije kreće od 0,10 do 0,29 onda je reč o maloj korelaciji. Takođe, ukoliko se koeficijent korelacije kreće od 0,30 do 0,49 onda je prisutna srednja korelacija. I ukoliko koeficijent korelacije poprima vrednosti od 0,50 do 1,0 onda je evidentno da je korelacija velika.

Tabela 4: Korelaciona analiza (Pearson koeficijent korelacije) između S&P indeksa zelenih obveznica, S&P indeksa municipalnih obveznica i prinosa na desetogodišnje državne američke obveznice za period: 2016.- 2025.

		S&P Green Bond U.S. Dollar Select Index	S&P Municipal Bond Index	U.S.10Y_Y
S&P Green Bond U.S. Dollar Select Index	Pearson Correlation	1,000	0,906	-0,069
	Sig. (2-tailed)	-	0,000	0,001
	N	2,481	2,481	2,481
S&P Municipal Bond Index	Pearson Correlation	0,906	1,000	0,203
	Sig. (2-tailed)	0,000	-	0,000
	N	2,481	2,481	2,481
U.S.10Y_Y	Pearson Correlation	-0,069	0,203	1,000
	Sig. (2-tailed)	0,001	0,000	1,000
	N	2.481	2.481	2.481

IZVOR: Proračun autora

Iz prethodne tabele je evidentno da Pearsonov koeficijent korelacije između S&P Green Bond i S&P Municipal Bond Index-a iznosi 0,906 što ukazuje na veoma jaku pozitivnu povezanost dnevnih promena prinosa između posmatranih indeksa, što sugeriše da se posmatrani indeksi u velikoj meri kreću u istom smeru. Dobijeni rezultat ukazuje da promene prinosa na municipalne obveznice u velikoj meri prate promene prinosa na zelene obveznice, što potvrđuje visok stepen integrisanosti posmatranih tržišta. Dakle, ovi rezultati upućuju na zaključak da investitori koji razmatraju da ulažu u zelene municipalne obveznice mogu očekivati slične trendove kao i kod konvencionalnih municipalnih obveznica. I pored toga što zelene obveznice imaju specifičnu namenu za finansiranje ekoloških projekata, njihovo tržište je u velikoj meri integrisano sa tradicionalnim tržištem obveznica. Dobijeni rezultati su u skladu sa nalazima Gorelicka i ostalih (2024), koji ističu da zelene municipalne obveznice dele brojne karakteristike sa tradicionalnim municipalnim obveznicama, uključujući slične obrasce formiranja prinosa i ponašanja investitora. Mnoge zelene obveznice izdaju iste institucije koje izdaju i klasične obveznice, gde ih investitori posmatraju kao deo šireg tržišta fiksnog prihoda.

[1]*Predstavlja pojam u finansijama koji označava situaciju kada investitori prihvataju niži prinos na zelene obveznice u poređenju sa sličnim konvencionalnim obveznicama istog emitenta, ročnosti i rizika.*

Inverzna veza između kamatnih stopa i cena obveznica potvrđena je u literaturi, gde se ističe da postoji negativan odnos između cene obveznice i kamatne stope (Litvinovs i Raiko, 2017). Dakle, rast kamatnih stopa povezan je sa padom cena obveznica što objašnjava negativnu korelaciju između prinosa na državne obveznice i vrednosti prinosa indeksa zelenih i municipalnih obveznica (-0,069). Iako je negativnog predznaka, intenzitet ove korelacije je nizak, što ukazuje da kretanje prinosa na desetogodišnje američke državne obveznice nije snažno linearno povezano sa promenama prinosa analiziranih indeksa.

Svaka varijabla u modelu koja ima VIF vrednost veću od 3 smatra se multikolinearnom, te je time odbačena iz modela. U slučaju multikolinearnosti, koeficijenti varijabli postali su nestabilni, a standardne greške precenjene. Tabela 5 prikazuje dobijene rezultate multikolinearne analize između posmatranih varijabli u modelu.

Tabela 5: Multikolinearna analiza putem faktora inflacije varijanse (VIF)

Varijable	VIF	1/VIF
S&P Municipal Bond Index	1,04	0,959028
U.S.10Y_Y	1,04	0,959028
Mean VIF	**1,04**	

IZVOR: Proračun autora

Rezultati prikazani u Tabeli 5 pokazuju da su VIF vrednosti za sve nezavisne varijable značajno ispod granične vrednosti od 3. Navedeni rezultati ukazuju na odsustvo problema multikolinearnosti, što potvrđuje pouzdanost procenjenog regresionog modela i omogućava dalju interpretaciju dobijenih koeficijenata.

Test stacioniranosti vremenskih serija (ADF test)

Rezultati Augmented Dickey-Fuller (ADF) testa prikazanog u tabeli 6 pokazuju da niti jedna od analiziranih varijabli nije stacionirana u nivou, budući da su $p > 0,05$.

Tabela 6: Rezultati Augmented Dickey – Fuller (ADF) testa stacioniranosti varijabli

Varijable	ADF statistika	p-vrednost	ADF statistika (prva diferencija)	p-vrednost	Zaključak
S&P Green Bond Index	1,8016	0,983	-41,555	p<0,001	I(1)
S&P Municipal Bond Index	1.4161	0,961	-26,588	p<0,001	I(1)
U.S.10Y_Y	0,4204	0,804	-49,649	0,001	I(1)

IZVOR: Proračun autora

Nakon primene prve diferencije, sve varijable postaju stacionirane, što potvrđuju ADF statistike i p < 0,05. Na osnovu dobijenih rezultata može se zaključiti da su sve analizirane varijable integrisane reda jedan, odnosno I(1). Budući da su sve analizirane varijable integrisane reda jedan, odnosno I(1), ispunjen je osnovni preduslov za primenu Engle-Granger testa kointegracije i ispitivanja postojanja dugoročne ravnoteže između posmatranih varijabli.

Engle-Granger test kointegracije

S obzirom da su sve varijable integrisane istog reda, u narednom koraku izvršen je Engle–Granger test kointegracije kako bi se ispitalo postojanje dugoročne ravnotežne veze između posmatranih varijabli.

Tabela 7: Rezultati Engle–Granger testa kointegracije

Reziduali	ADF statistika	p-vrednost	Zaključak
RESID01	-5,1183	p<0,001	Varijable su kointegrisane

IZVOR: Proračun autora

Rezultati Engle-Granger testa prikazani u Tabeli 7 pokazuju da su reziduali procenjenog regresionog modela stacionirani, što potvrđuje ADF statistika od -5,1183 i p < 0,05. Dobijeni rezultat ukazuje na postojanje dugoročne ravnoteže između analiziranih varijabli. Na osnovu dobijenih rezultata može se zaključiti da između analiziranih varijabli postoji dugoročna ravnotežna veza, odnosno da su S&P Green Bond Index, S&P Municipal Bond Index i U.S. 10Y međusobno kointegrisani. Ovaj nalaz je u skladu sa istraživanjem Rehmana i ostali (2024) koji su primenom Johansenovog testa kointegracije utvrdili postojanje dugoročne povezanosti između tržišta zelenih obveznica i međunarodnih finansijskih tržišta. Njihovi rezultati pokazali su postojanje dve kointegracione veze, što potvrđuje da se tržišta dugoročno kreću zajedno. Sličan zaključak proizilazi i iz rezultata Engle-Granger testa provedenog u ovom istraživanju, čime je potvrđena prva istraživačka hipoteza (H1).

Rezultati regresione analize (OLS)

Nakon provere pretpostavki modela, uključujući odsustvo multikolinearnosti i postojanja kointegracione veze između analiziranih varijabli, u nastavku se prezentuju rezultati regresione analize zasnovane na metodi najmanjih kvadrata. Tabela 8 ilustruje rezultate regresione analize zasnovane na modelu najmanjih kvadrata između nezavisnih varijabli i dnevne vrednosti berzanskog indeksa zelenih obveznica S&P Green Bond U.S. Vrednost F – statistike kod metode najmanjih kvadrata iznosi 9.831,14 kao i p<5% što ukazuje na to da je model statistički visoko značajan (tabela 8).

Tabela 8: Koeficijenti nezavisnih promenljivih pri regresiji najmanjih kvadrata za period: 2016. – 2025.

Regresioni model	Metod najmanjih kvadrata (OLS)		
Zavisna varijabla - S&P Green Bond U.S. Dollar Select Index			
Nezavisne varijable	**Koef.**	**Std. Greška**	**Verovatnoća**
C	5,6097	0,80989	p<0,001
S&P Municipal Bond Index	0,4446	0,00318	p<0,001
U.S.10Y_Y	-1,7534	0,04554	p<0,001
Koeficijent determinacije	0,88807	-	-
Prilagođeni koeficijent determinacije	0,88798	-	-
F-Statistic	9.831,14	-	-
Prob (F-statistic)	p<0,001	-	-

IZVOR: Proračun autora

Primenom jednačine (1) na dobijene podatke po metodi najmanjih kvadrata u tabeli 8 dolazimo do sledećeg prognoziranog modela:

$$GB_t = 5{,}6097 + 0{,}4446 * MB - 1{,}7534 * U.S.10Y_Y$$

Prilagođeni koeficijent determinacije (Adjusted R^2) kod modela najmanjih kvadrata iznosi 0,88798 što ukazuje da je približno 88,8% varijacija dnevne vrednosti S&P Green Bond Index-a objašnjeno promenama dnevnih vrednosti S&P Municipal Bond Index-a i prinosa na američku 10 - godišnju državnu obveznicu (U.S. 10Y_Y). Preostalih 11,2% varijacije može se pripisati drugim faktorima koji nisu uključeni u model. Vrednost F statistike iznosi 9.831,14 uz verovatnoću p<0,001, što potvrđuje da je regresioni model statistički značajan na nivou značajnosti od 5%. Kod metode najmanjih kvadrata vrednost koeficijenata MB i U.S.10Y_Y iznosi 0,4446 i – 1,7534 respektivno. Koeficijent uz varijablu MB je pozitivan, što ukazuje da povećanje prinosa S&P Municipal Bond Index-a za jednu jedinicu povezano je sa povećanjem vrednosti S&P Green Bond Index-a za oko 0,4446 jedinice, uz pretpostavku da ostale varijable ostaju nepromenjene. S druge strane, koeficijent uz varijablu U.S. 10Y_Y je negativan, što ukazuje da povećanje prinosa na američku 10 – godišnju državnu obveznicu za jednu jedinicu povezano je sa smanjenjem vrednosti S&P Green Bond Index-a za oko 1,7534 jedinice, uz nepromenjene ostale uslove. Na osnovu dobijenih rezultata može se zaključiti da postoji statistički značajna pozitivna veza između S&P Municipal Bond Index-a i S&P Green Bond Index-a, čime je potvrđena druga istraživačka hipoteza (H2). Dobijeni nalazi su u skladu sa rezultatima Janković i ostali (2022) koji su takođe utvrdili snažnu povezanost između tržišta zelenih i konvencionalnih municipalnih obveznica. Takođe, Marszalem i Sekula (2024) utvrdili su statistički značajne razlike između prinosa zelenih i konvencionalnih municipalnih obveznica, ali su te razlike uglavnom bile male i promenljive tokom vremena. Njihovi rezultati ukazuju da investitori zelene i konvencionalne obveznice često posmatraju kao slične finansijske instrumente, što potvrđuje visok stepen povezanosti između ova dva segmenta tržišta. Ovakvi nalazi pružaju teorijsku osnovu za očekivanje pozitivne veze između S&P Municipal Bond Index –a i S&P Green Bond Index-a. Dobijeni rezultati dodatno potvrđuju da se tržište zelenih

obveznica ne razvija izolovano, već u značajnoj meri prati dinamiku tradicionalnog tržišta obveznica. Nadalje, rezultati pokazuju da prinos na američke 10 – godišnje državne obveznice (U.S.10Y_Y) ima statistički značajan negativan uticaj na S&P Green Bond Index, čime je potvrđena treća istraživačka hipoteza (H3). Ovaj nalaz je u skladu sa istraživanjem Gozgora i Karakasa (2023), koji su utvrdili negativnu povezanost između prinosa američkih državnih obveznica i prinosa zelenih obveznica.

Slične zaključke iznosi i Tomczak (2024), koja navodi da su prinosi zelenih obveznica značajno određeni kretanjem prinosa na konvencionalne državne obveznice, te opštim nivoom kamatnih stopa. Navedeni rezultati potvrđuju da promene na tržištu državnih obveznica predstavljaju važan faktor koji utiče na performanse tržišta zelenih obveznica. Naime, rast prinosa na američke državne obveznice povećava atraktivnost ulaganja u sigurne državne hartije od vrednosti, zbog čega jedan deo investitora preusmerava sredstva iz zelenih obveznica prema državnim obveznicama. Istovremeno, više kamatne stope povezane su sa višom diskontnom stopom koja se koristi pri vrednovanju obveznica, kao i sa nižom tržišnom vrednošću postojećih zelenih obveznica i njihovih indeksa. Provedena analiza pokazuje da su tržište municipalnih obveznica i kretanje prinosa na američke državne obveznice među ključnim determinantama performansi tržišta zelenih obveznica u posmatranom periodu. Iako analizirani period (2016-2025) obuhvata različite tržišne režime, uključujući pandemiju COVID-19, promene monetarne politike i ciklus rasta kamatnih stopa, cilj ovog istraživanja bio je ispitivanje ukupnih odnosa između analiziranih varijabli tokom celokupnog posmatranog perioda. Buduća istraživanja mogu uključiti analizu podperioda, primenu dummy varijabli za ključne tržišne događaje, kao i testove stabilnosti koeficijenata, čime bi se dodatno proverila robusnost dobijenih rezultata.

Zaključak

Tržište zelenih obveznica poslednjih godina beleži značajan rast, te predstavlja jedan od najvažnijih segmenata održivih finansija. Povećana potreba za finansiranjem projekata iz oblasti zaštite životne sredine, obnovljivih izvora energije i energetske efikasnosti doprinela je većem interesu investitora, finansijskih institucija i kreatora ekonomskih politika za ovaj finansijski instrument. Istovremeno, razvoj tržišta zelenih obveznica sve je više povezan sa kretanjima na tradicionalnim tržištima obveznica i promenama u makroekonomskom okruženju, posebno u pogledu kamatnih stopa. Cilj ovog rada bio je ispitati povezanost između S&P indeksa zelenih obveznica, S&P indeksa municipalnih obveznica i prinosa na desetogodišnje državne obveznice Sjedinjenih Američkih Država u periodu od 2016. do 2025. godine. U svrhu realizacije postavljenog cilja primenjene su metode deskriptivne statistike, korelacione analize, regresione analize primenom metode najmanjih kvadrata (OLS), Augmented Dickey – Fuller (ADF) test stacionarnosti i Engle-Granger test kointegracije.

Rezultati deskriptivne analize ukazuju da su posmatrane varijable pokazivale različitu dinamiku prinosa tokom analiziranog perioda. Najniže stope prinosa i indeks municipalnih i indeks zelenih obveznica ostvarili su tokom 2022. godine, iako su i u pojedinim prethodnim godinama zabeleženi pozitivni prinosi. Istovremeno je tokom 2022. godine evidentiran rast prinosa na američke desetogodišnje državne obveznice. Nakon 2022. godine nisu ostvarene negativne stope prinosa, već je usledio oporavak oba tržišna segmenta, što ukazuje na njihovu međusobnu povezanost i osetljivost na promene kamatnih stopa.

Rezultati korelacione analize pokazali su postojanje veoma snažne pozitivne veze između S&P indeksa zelenih obveznica i S&P indeksa municipalnih obveznica, gde koeficijent korelacije između datih indeksa iznosi 0,906. Dobijeni rezultati regresione analize potvrđuju da indeks municipalnih obveznica ima pozitivan i statistički značajan uticaj na indeks zelenih obveznica, dok prinos na desetogodišnje državne američke obveznice ostvaruje negativan i statistički značajan uticaj. Takođe, visoka vrednost koeficijenta determinacije (R^2=0,888) ukazuje na značajnu objašnjavajuću moć postavljenog modela. Dobijeni empirijski rezultati potvrđuju da tržište municipalnih obveznica predstavlja značajan faktor u objašnjenju kretanja S&P Green Bond Indexa, dok prinos na desetogodišnje američke državne obveznice ima statistički značajan negativan uticaj. Ovi nalazi su u skladu sa postavljenim ciljem istraživanja i potvrđuju postojanje značajne povezanosti između analiziranih tržišnih varijabli.

Rezultati ADF testa pokazali su da su sve analizirane varijable integrisane reda jedan, odnosno I(1). Nakon primene Engle-Granger testa utvrđeno je postojanje dugoročne ravnotežne veze između posmatranih varijabli. Na osnovu navedenog može se zaključiti da su tržište zelenih obveznica, tržište municipalnih obveznica i dugoročne kamatne stope međusobno povezani ne samo kratkoročno već i dugoročno.

Ovo istraživanje ima određena ograničenja koja je potrebno uzeti u obzir prilikom interpretacije rezultata. Prvo, analiza je fokusirana isključivo na američko tržište zelenih i municipalnih obveznica, zbog čega se dobijeni rezultati ne mogu u potpunosti generalizirati na druga finansijska tržišta. Drugo, model uključuje ograničen broj varijabli, odnosno S&P Green Bond Index, S&P Municipal Bond Index i prinos na desetogodišnje državne obveznice SAD-a, dok drugi potencijalno značajni faktori, poput inflacije, referentnih kamatnih stopa, makroekonomskih pokazatelja i ESG faktora, nisu bili obuhvaćeni analizom. Treće istraživanje se zasniva na dnevnim podacima za period 2016.- 2025. godine, što može ograničiti mogućnost sagledavanja dugoročnih strukturnih promena na tržištu obveznica. Četvrto, S&P Green Bond Index predstavlja reprezentativan pokazatelj širokog segmenta globalnog tržišta zelenih obveznica i obuhvata državne, supranacionalne, agencijske, korporativne, finansijske i municipalne zelene obveznice. Zbog toga se rezultati ovog istraživanja odnose na tržište zelenih obveznica obuhvaćenih ovim indeksom, a ne isključivo na segment zelenih municipalnih obveznica. Buduća istraživanja mogu koristiti odgovarajuće indekse ili podatke na nivou pojedinačnih emisija zelenih municipalnih obveznica radi detaljnije analize specifičnosti ovog segmenta tržišta.

Uprkos navedenim ograničenjima, ovo istraživanje pruža vredan doprinos razumevanju odnosa između tržišta zelenih i municipalnih obveznica. Dobijeni rezultati ukazuju na postojanje značajne povezanosti između analiziranih varijabli, pri čemu tržište municipalnih obveznica i kretanje dugoročnih kamatnih stopa imaju važnu ulogu u objašnjavanju kretanja na tržištu zelenih obveznica. Navedeni nalazi mogu biti korisni investitorima, kreatorima ekonomskih politika, i drugim učesnicima na finansijskim tržištima prilikom donošenja investicionih odluka i procene rizika. Imajući u vidu rastući značaj održivih finansija, buduća istraživanja trebala bi biti usmerena na identifikaciju dodatnih faktora koji utiču na razvoj i dugoročnu stabilnost tržišta zelenih obveznica.

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DETERMINANTS OF THE S&P GREEN BOND INDEX: AN EMPIRICAL ANALYSIS OF THE IMPACT OF THE S&P MUNICIPAL BOND INDEX AND THE U.S. 10 – YEAR TREASURY YIELD

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Abstract: *Green bonds represent one of the most important instruments of sustainable finance and play an increasingly significant role in mobilizing capital for environmental and climate-related projects. The aim of this study is to examine the impact of the S&P Municipal Bond Index and the U.S. 10-Year Treasury Yield on the performance of the S&P Green Bond Index over the period 2016–2025. The analysis is based on data for the S&P Green Bond Index, the S&P Municipal Bond Index, and the U.S. 10-Year Treasury Yield. The methodological framework includes descriptive statistics, correlation analysis, ordinary least squares (OLS) regression, the Augmented Dickey–Fuller (ADF) unit root test, and the Engle–Granger cointegration test. The empirical results indicate a statistically significant positive relationship between the S&P Green Bond Index and the S&P Municipal Bond Index, while the U.S. 10-Year Treasury Yield has a statistically significant negative effect on green bond performance. The Engle–Granger test confirms the existence of a long-run equilibrium relationship (cointegration) among the analysed variables. The findings highlight the importance of traditional bond markets and interest rate movements in explaining the performance of the green bond market.*

Keywords: Green bonds, municipal bonds, U.S. Treasury bonds, cointegration, OLS regression, sustainable finance.

JEL classification: G12, G15, Q56.

Introduction

Green bonds are a relatively recent innovation in sustainable finance. They are debt instruments whose proceeds are earmarked for financing low-carbon and climate-friendly projects. Green bonds may be issued by corporations, municipalities, governments, and supranational institutions. Furthermore, municipal green bonds represent a new way of unlocking finance for sustainable and urban infrastructure investments in the United States. In this paper, the term "municipal bonds" refers to bonds issued by U.S. states, local government units, and their agencies. For the sake of terminological consistency, this term is used throughout the paper. The issuance of green bonds initially lagged due to perceptions of higher costs, lower returns, and greater risk (Chiang, 2017). In essence, green bonds are comparable to conventional municipal bonds in terms of their structure, risk, and return. Strong investor demand for green bonds may enable issuers to obtain financing at lower costs of capital, as increased demand reduces investors' required rate of return (Zerbib, 2019).

Green bonds are sometimes compared with climate bonds. Although these two types of bonds may overlap in certain situations, green bonds represent a broader concept. Proceeds raised through the issuance of climate bonds are primarily allocated to reducing carbon dioxide emissions and mitigating the adverse effects of climate change, whereas green bonds may finance a wider range of projects with positive environmental impacts. Therefore, green bonds are financial instruments dedicated to sustainability, climate change mitigation, and environmentally oriented projects. Since loans provided by financial institutions represent the primary source of financing in most countries, bonds play an important role in financing and refinancing the lending activities of financial institutions. In recent years, bond issuance by financial institutions has increased steadily. The significant growth in green bond issuance in 2016 was largely driven by substantial issuances from banks in China, where bank-issued green bonds accounted for approximately 76% of the total value of Chinese green bond issuances in that year. According to OECD estimates, green bond issuance by the financial sector has the potential to continue expanding significantly, exceeding USD 1.7 trillion by 2035 (Janković, 2024).

The main areas targeted by green bond issuance include improving energy efficiency, reducing existing pollution and preventing future pollution, sustainable forestry, agriculture and fisheries, protecting terrestrial and aquatic ecosystems, environmentally friendly transport, wastewater treatment, and sustainable water management, among others (Janković, 2024). Figure 1 illustrates the key areas of green investment.

Figure 1: Key Areas of Green Investment



Source: Janković, I. (2024). Zelene obveznice, Belgrade University – Faculty of Economics, Publishing Centre, p. 22.

The attractiveness of green bonds largely stems from their simplicity in terms of structure, key features, and procedures that define this type of debt security, thereby ensuring a clear and transparent flow of information to investors regarding the use of proceeds and the environmental characteristics of financed projects. From a formal perspective, the issuance process of green bonds is very similar to that of conventional bonds, as green bonds are subject to the same legal and regulatory requirements, documentation standards, and financial reporting obligations. The main additional requirement is that issuers are expected to comply with the Green Bond Framework, which provides additional information and procedures designed to assure investors that the funds raised will be used for environmentally sustainable purposes (Janković, 2024).

Although considerable attention has been devoted in the existing literature to the characteristics and performance of green bonds, only a limited number of studies have examined the relationship between the green bond market and the municipal bond market while simultaneously incorporating interest rate changes as a macroeconomic factor. Studies using market indices as representative indicators of the performance of these capital market segments are particularly scarce. The aim of this study is to examine the relationship between the S&P Green Bond Index and the S&P Municipal Bond Index and to analysed the impact of the U.S. 10-Year Treasury yield on movements in the value of the green bond index. The study employs descriptive statistics, correlation analysis, OLS regression, and the Engle–Granger cointegration test. In line with the stated research objective, the following research questions are addressed:

1. Does the S&P Municipal Bond Index have a statistically significant effect on the daily values of the S&P Green Bond Index?
2. Does the U.S. 10-Year Treasury Yield have a statistically significant effect on the daily values of the S&P Green Bond Index?
3. Is there a long-run equilibrium relationship (cointegration) between the analyzed variables?

To address the stated research questions, the empirical part of the study employs appropriate statistical and econometric methods, including regression analysis, stationarity tests, and the Engle–Granger cointegration test, in order to examine both the short-run and long-run relationships among the analysed variables. The remainder of the paper is organized as follows. Following the introduction, the second section provides a review of the relevant literature on green and municipal bonds. The third section presents an analysis of global trends in the green bond market. The fourth section describes the research methodology, the empirical model, and the data used in the analysis. The fifth section reports the empirical findings obtained through descriptive statistics, correlation analysis, OLS regression, and stationarity and cointegration tests. Finally, the paper concludes by summarizing the main findings and discussing their implications for investors and policymakers.

Review of Relevant Literature

At the beginning of the last decade, the green bond market experienced strong growth driven by the increasing need to finance sustainable development and energy transition. Municipal green bonds are of particular importance, as they enable local communities to finance environmentally sustainable infrastructure projects. Green bonds are fixed-income financial instruments issued to raise capital for environmentally friendly projects. Their primary purpose is to internalize environmental externalities and promote investment in green projects that support sustainable development (Ehlers & Packer, 2017). Sovereign green bonds are a relatively new financial instrument designed to raise capital for government infrastructure projects aligned with sustainable development objectives. These bonds may also reduce the cost of capital for environmentally sustainable projects. However, issuing green bonds is generally more expensive than issuing conventional bonds due to additional administrative, legal, and marketing costs (Doronzo et al., 2021). Furthermore, evidence suggests that green bonds are issued at lower yields than conventional bonds, a phenomenon known as the greenium (Liaw, 2020). Research on the greenium in the sovereign green bond market remains limited; however, Grzegorczyk and Wolff (2022) documented the presence of a small negative greenium in the EU sovereign bond market. A negative greenium indicates that investors are willing to accept lower yields on sovereign green bonds compared with conventional bonds, reflecting their willingness to invest in green and sustainable projects. One of the reasons for this is that green bonds provide investors with the opportunity to invest in green and sustainable projects.

Larcker and Watts (2020) compared municipal green bonds with equivalent conventional municipal bonds and found only a very small yield discount, with no evidence supporting a negative premium on municipal green bonds. Accordingly, they concluded that the green premium was de facto zero. Historically, green bonds were penalized in the municipal bond market, trading at lower prices and higher yields than would be expected based on their credit profiles. In recent years, however, the credit quality of municipal green bonds has improved, and the green premium has turned positive. Consequently, green bonds have become an increasingly attractive investment for bridging the financing gap associated with climate change mitigation and adaptation.

Partridge and Medda (2020) analyzed the U.S. municipal green bond market and found preliminary evidence of the existence of a greenium. Their findings indicate that investors were willing to accept slightly lower yields on green municipal bonds compared with comparable conventional municipal bonds. The authors concluded that these findings reflect the growing demand for sustainable investments and indicate an increasingly strong relationship between the green bond market and the municipal bond market.

Tang and Zhang (2020) examined the effects of green bond issuance on financial markets using a sample of companies from 28 countries over the period 2007–2017. Their results showed that financial markets respond positively to green bond issuance, while institutional ownership and stock liquidity increase following issuance, confirming the growing importance of green financial instruments in global capital markets. In addition, Asness (2000) analysed the relationship between stock and bond returns and explained the equity risk premium.

Reboredo and Ugolini (2020) were among the first researchers to examine the relationship between green bonds and financial markets. Using a Structural Vector Autoregression (SVAR) model, they found that the green bond market is significantly linked to the Treasury bill and foreign exchange markets. They also concluded that the relationship between green bonds and the stock and energy markets is relatively weak. Hammoudeh et al. (2020) likewise employed a time-varying causality approach to investigate the causal relationship between the green bond market and other financial indicators over the period 2016–2020. Their findings indicate that the U.S. 10-Year Treasury Yield is the primary factor determining green bond yields.

Pham and Nguyen (2021) also examined tail dependence between green bonds and the energy, equity, and conventional bond markets using the cross-quantilogram approach over the period from October 2014 to February 2021. The authors reported mixed evidence, as the spillover effects between the financial market and the green bond market varied significantly across different quantiles.

Flammer (2021) analysed corporate green bonds and found that investors respond positively to their issuance. Furthermore, the results indicate that, following bond issuance, issuers achieve better environmental performance, reduce CO2 emissions, and attract long-term investors, confirming the importance of green bonds as an instrument of sustainable finance.

Nguyen and Le (2025) examined the impact of green bond issuance on the transition toward renewable energy sources across 192 countries over the period 2007–2021. Their findings indicate that green bond issuance makes a significant contribution to financing renewable energy projects and accelerating the energy transition.

Sojoudi et al. (2026) found evidence of a significant greenium in the U.S. municipal bond market, with investors willing to accept lower yields on green bonds in support of environmentally sustainable projects. The authors also emphasized that the magnitude of the greenium changes over time and depends on the characteristics of the bonds themselves.

Furthermore, recent studies provide additional evidence of the existence of a greenium in the green and municipal bond markets, further confirming the distinctive market valuation of green financial instruments. Although previous studies have examined the relationship between green bonds and

various segments of the financial market, their findings have not always been consistent and vary depending on the market analysed, the observation period, and the methodology employed. Moreover, earlier research has applied a variety of methodological approaches, including panel data analysis, time-series models, and other econometric techniques, whereas this study employs a combination of OLS regression, the Augmented Dickey–Fuller (ADF) unit root test, and the Engle–Granger cointegration test. This methodological framework enables the examination of the short-run effects of the S&P Municipal Bond Index and the U.S. 10-Year Treasury Yield on the performance of the S&P Green Bond Index, as well as the identification of a long-run equilibrium relationship among the analysed variables. Based on the review of the relevant literature, the identified research gap, and the defined research objective, the following research hypotheses are formulated:

H1: There is a long-run equilibrium relationship (cointegration) among the analysed variables.

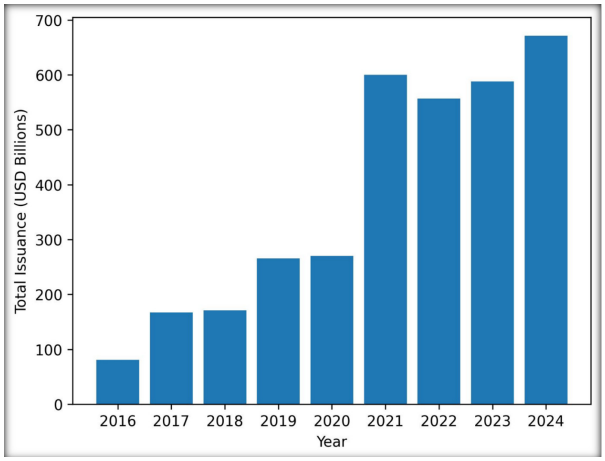
H2: There is a statistically significant relationship between the S&P Municipal Bond Index and the S&P Green Bond Index.

H3: The U.S. 10-Year Treasury Yield has a statistically significant effect on the S&P Green Bond Index.

Global Trends in the Green Bond Market

The first green bond was issued by the European Investment Bank (EIB) in 2007 to finance renewable energy and energy efficiency projects. Since then, green bonds have become an increasingly popular financing instrument. For illustration, in 2008 the total volume of green bond issuance amounted to less than USD 1 billion, but by the end of 2018 it had increased to USD 143 billion. Market practitioners refer to this trend as the green bond boom, which is expected to continue in the coming years (Morgan Stanley, 2017). Furthermore, many commentators regard green bonds as an important instrument for addressing climate change. The growing importance of green bonds in global financial markets is further evidenced by the continuous increase in their issuance volume, as illustrated in Figure 2.

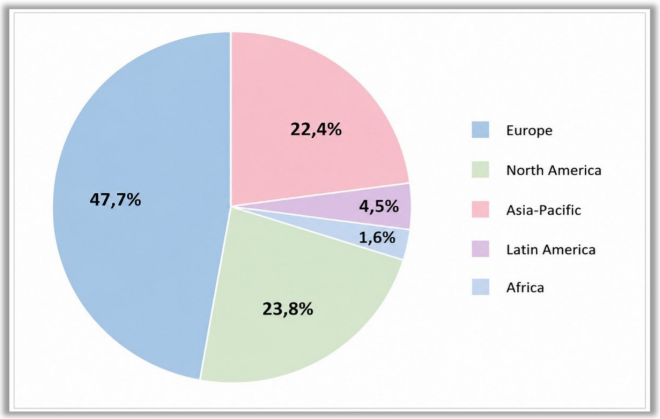
Figure 2: Global Green Bond Issuance Volume (USD billions)



Source: Climate Bonds Initiative. (2024). Interactive data platform. https://www.climatebonds.net/market/data/

Global green bond issuance increased from approximately USD 80 billion in 2016 to around USD 670 billion in 2024, representing an increase of approximately 737%. The substantial growth in green bond issuance over the 2016–2024 period can be attributed to the strengthening of the regulatory framework for sustainable finance, growing investor demand for ESG instruments, increased sovereign participation through the issuance of sovereign green bonds, and more favourable financing conditions during the period of low interest rates prior to 2022. Furthermore, heightened awareness of climate risks and the need for energy transition have directed capital toward renewable energy projects, energy efficiency, and sustainable infrastructure. In addition, the standardization of the market through the development of international principles and taxonomies has further enhanced the credibility and transparency of the market, thereby contributing to the accelerated growth of this segment of the financial market.

Graph 1: Green Bond Issuance by Region in 2024 (in %)



Source: Climate Bonds Initiative (2024). Interactive data platform. https://www.climatebonds.net/market/data/

From a regional perspective, Europe accounts for 47,7% of total global green bond issuance in 2024, followed by the Asia-Pacific region with 23,8%, North America with 22,4%, Latin America with 4,5%, and Africa with 1,6%. These figures indicate that Europe, the Asia-Pacific region, and North America together account for 93,9% of total global green bond issuance, whereas Latin America and Africa have considerably smaller shares, suggesting substantial potential for the further development of sustainable finance markets in these regions. The growth of the green bond market is not evenly distributed across countries but is concentrated in certain developed economies that play a significant role in financing sustainable development projects. To provide a more detailed overview of the geographical distribution of the green bond market, Table 1 presents data on the value of green bond issuance and their percentage shares across selected countries during the first half of 2024.

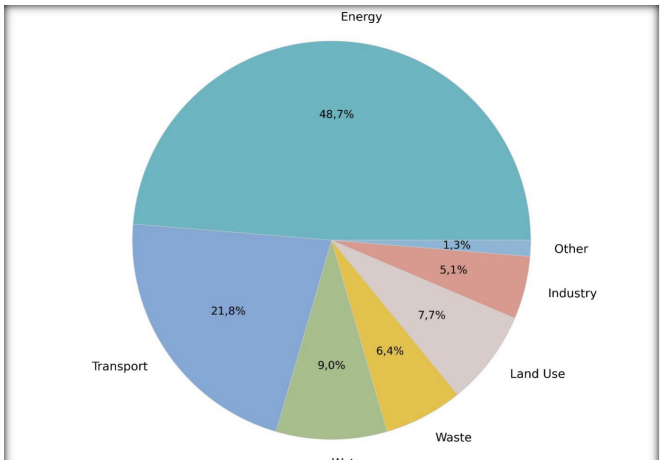
Table 1: Green Bond Issuance by Country in the First Half of 2024

Country	Green Bonds (USD billion)	Percentage Share
Japan	10.6	11.69%
Italia	12.1	13.35%
France	11.6	12.80%
Australia	4.7	5.18%
Austria	7.2	7.95%
Germany	14.0	15.45%
Canada	2.9	3.20%
Romania	2.2	2.43%
Singapore	1.9	2.09%
Hungary	1.6	1.77%
Iceland	0.8	0.88%
China	0.8	0.88%
India	1.2	1.32%
United Kingdom	10.1	11.15%
Netherlands	2.3	2.54%
Spain	2.1	2.32%
Belgium	1.7	1.87%
New Zealand	0.8	0.88%
Denmark	0.6	0.66%
Ireland	0.6	0.66%
Indonesia	0.5	0.60%
Switzerland	0.2	0.22%
Peru	0.1	0.11%
Total	90.6	100.00%

Source: Climate Bonds Initiative. (2024). Interactive data platform. https://www.climatebonds.net/market/data/

The data presented in Table 1 refer to selected countries issuing green bonds during the first half of 2024. The percentage share column indicates each country's contribution to the total value of green bond issuance presented in the table (USD 90.6 billion). The data shown in Table 1 reveal a significant concentration of green bond issuance in developed economies during the first half of 2024. The largest issuance volumes were recorded in Germany (USD 14.0 billion), Italy (USD 12.1 billion), and France (USD 11.6 billion), which together account for a substantial share of total green bond issuance. In contrast, the lowest issuance volumes were recorded in Peru, Switzerland, and Indonesia. These findings confirm that the green bond market is predominantly developed in economically stronger countries that actively promote sustainable finance and the green transition. In addition to the geographical distribution of green bond issuance, it is also important to analyse the sectoral allocation of the funds raised. The sectoral structure of green bond issuance is presented in Graph 2.

Graph 2: Sectoral Distribution of Global Green Bond Issuance in 2024 (in %)



Source: Climate Bonds Initiative. (2024). Interactive data platform. https://www.climatebonds.net/market/data/

The sectoral distribution of green bond issuance in 2024 indicates the dominant share of the energy sector, accounting for approximately 49%, confirming the crucial role of investments in renewable energy sources and decarbonization. In addition, the transport sector represents a significant share of around 22%, while sectors such as water management, waste management, and land use are moderately represented. This structure suggests that capital is primarily directed toward sectors with the greatest potential to reduce emissions and accelerate the climate transition.

Methodology and Data

Model

The ordinary least squares (OLS) method is one of the most fundamental and widely used estimation techniques in statistics and econometrics. It provides a relatively simple yet powerful approach for estimating relationships between variables by minimizing the sum of squared residuals, i.e., the differences between the observed and predicted values of the dependent variable (Nosheen et al., 2025). The classical linear regression model estimated using the OLS method assumes parameter

linearity, random sampling, the absence of perfect multicollinearity, exogeneity of the regressors, and homoscedasticity (Hansen, 2022). To examine the relationships between the green bond market, the conventional municipal bond market, and the yield on the 10-year U.S. Treasury bond, the OLS model was applied in this study. Klein and Weill (2018) point out that OLS regression is not only a useful method for describing data but also for providing the first unbiased estimates of the coefficients. In the empirical analysis, daily values of the S&P Green Bond Index and the S&P Municipal Bond Index for the period 2016–2025 were used, while the yield on the 10-year U.S. Treasury bond (U.S. 10-Year Treasury Yield) was included as a separate explanatory variable. In this study, the daily values of the selected indices, rather than their daily returns, were used, providing the basis for model estimation and the interpretation of the obtained results. The S&P Green Bond Index is a representative indicator of a broad segment of the global green bond market and includes sovereign, supranational, agency, corporate, financial, and municipal green bonds. Accordingly, the findings of this study should be interpreted within the context of the green bond market represented by the S&P Green Bond Index and should not be interpreted exclusively in the context of municipal green bonds. In addition to the ordinary least squares (OLS) regression analysis, the Augmented Dickey–Fuller (ADF) unit root test and the Engle–Granger cointegration test were employed. The ADF test was used to examine stationarity and determine the order of integration of the analyzed time series, whereas the Engle–Granger test was applied to assess the existence of a long-run equilibrium relationship between the S&P Green Bond Index, the S&P Municipal Bond Index, and the yield on the 10-year U.S. Treasury bond. The application of the Engle–Granger test is appropriate when the analyzed variables are integrated of the same order, i.e., I(1). All statistical tests were conducted at the 5% significance level.

The model specification is defined as follows:

$$GB_t = \alpha + \beta_1 MB_t + \beta_2 U.S.10Y_Y_t + \varepsilon_t$$

Where:

GB_t – daily value of the S&P Green Bond Index;

MB_t – daily value of the S&P Municipal Bond Index;

$U.S.10Y_Y_t$ – yield on the 10-year U.S. Treasury bond;

β_1 *i* β_2 – regression coefficients

ε_t – error term.

Statistical analyses are commonly conducted using a 5% significance level. Accordingly, the significance of all variables was assessed using the t-test at the 95% confidence level (Chmelarova, 2007).

Data

This study is based on secondary data collected from relevant financial databases. The analysis relies on daily data covering the period from January 29, 2016, to December 31, 2025, comprising a total of 2.481 observations. The dependent variable is the S&P Green Bond Index (GB), which tracks the performance of the global green bond market, whose proceeds are allocated to financing projects with positive environmental impacts. The main independent variable is the S&P Municipal Bond Index

(MB), which serves as a benchmark indicator of the performance of the U.S. municipal bond market. This index covers a broad range of bonds issued by U.S. states, local governments, and their agencies. In addition, the model includes a second independent variable, the U.S. 10-Year Treasury Yield (U.S.10Y), representing the yield on the 10-year U.S. Treasury bond, which is widely used as a benchmark risk-free interest rate in financial markets. Data for the S&P Green Bond Index and the S&P Municipal Bond Index were obtained from the S&P Dow Jones Indices database (2025), while data on the 10-year U.S. Treasury yield were obtained from the Federal Reserve Economic Data (FRED) database. After aligning the trading dates, a unified dataset was constructed and used for the econometric analysis.

Empirical Findings

Descriptive Statistics

To provide an overview of the main characteristics of the analyzed variables, Table 2 presents the results of the descriptive statistics for the S&P Green Bond Index, the S&P Municipal Bond Index, and the yield on the 10-year U.S. Treasury bond.

Table 2: Descriptive Statistics of the S&P Green Bond Index, S&P Municipal Bond Index, and the U.S. 10-Year Treasury Yield (%) for the period: January 29, 2016 – December 31, 2025

Description	S&P Green Bond index	S&P Municipal Bond Index	U.S.10Y_Y
Mean	0.00981	0.00954	0.0738
Median	0.01573	0.01688	0.000
Standard Deviation	0.21507	0.21989	2.9384
Maximum	1.1112	3.3943	40.740
Minimum	-1.5517	-2.5897	-27.027
Skewness	-0.4674	-0.4804	1.4053
Kurtosis	7.7804	62.068	39.309
Probability	0.000	0.000	0.000
Number of Observations	2,481	2,481	2,481

Source: Calculations by author based on data obtained from:
https://www.spglobal.com/spdji/en/index-family/fixed-income/us-municipal/#overview

The results presented in Table 2 indicate that the S&P Green Bond Index and the S&P Municipal Bond Index recorded very similar average returns over the observed period. In contrast, the yield on the U.S. 10-year Treasury bond exhibited a slightly higher average value and greater volatility, indicating a different pattern of movement compared to the green and municipal bond markets. These findings point to the existence of the classical risk–return relationship in financial markets. In other words, the higher yield on U.S. 10-year Treasury bonds represents compensation to investors for assuming interest rate and inflation risks, which are more pronounced in long-term debt instruments. Changes in monetary policy, particularly movements in benchmark interest rates and inflation expectations, significantly affect the yield volatility of these bonds, as reflected in their higher standard deviation. These findings confirm the role of the yield on U.S. 10-year Treasury bonds as the benchmark risk-free interest rate in global financial markets, whose fluctuations influence the valuation and attractiveness of different segments of the bond market. On the other hand, the lower returns and lower volatility of green and municipal bonds can be explained by the characteristics of these markets. Municipal bonds generally benefit from tax advantages, while green bonds are supported by stable and growing demand from investors motivated by ESG principles, contributing to relatively more stable yield movements. The similar average returns and relatively low volatility also suggest the possibility of a long-term relationship between the green and municipal bond markets, which will be further examined using the Engle–Granger cointegration test. Meszaros et al. (2023) examined the volatility characteristics of sovereign green bonds issued by small open European economies over the period from 2016 to 2021, focusing on the differences between sovereign green bonds and conventional sovereign bonds. They analyzed the markets of two EU member states, Poland and Hungary, and compared them with the mature German green bond market used as a benchmark. The results showed that sovereign green bonds exhibited higher volatility than traditional sovereign bonds, suggesting that this market remains in an early stage of development and that these instruments are more sensitive to shocks. However, these differences were not substantial, indicating that, as the green bond market matures, it may eventually exhibit statistical characteristics similar to those of the conventional bond market.

Table 3: Annual Returns of the S&P Municipal Bond Index, the S&P U.S. Green Bond Index, and the U.S. 10 – Year Treasury Bond Yield for the period: 2016 – 2025 (in%)

Year	S&P Municipal Bond Index	S&P U.S. Green Bond Index	U.S.10Y_Y
2016	0.55%	-0.30%	1.82%
2017	4.82%	6.56%	2.33%
2018	1.35%	0.26%	2.91%
2019	6.89%	8.07%	2.14%
2020	4.97%	4.77%	0.89%
2021	1.71%	2.26%	1.45%
2022	-8.32%	-11.92%	2.95%
2023	5.64%	6.61%	3.96%
2024	1.92%	1.41%	4.21%
2025	4.13%	6.75%	4.29%
Average	**2.37%**	**2.45%**	**2.69%**

Source: Author´s calculations

It is evident from the previous table that the Municipal Bond Index recorded its lowest annual return in 2022 (-8.32%), its highest annual return in 2019 (approximately 6.89%), and an average annual return of approximately 2.37%. In contrast, the S&P U.S. Green Bond Index recorded its lowest annual return in 2022 (-11.92%), its highest annual return in 2019 (approximately 8.07%), and an average annual return of approximately 2.45%. The yield on the U.S. 10-year Treasury bond reached its highest level in 2025 (approximately 4.29%), while the lowest yield was recorded in 2020 (0.89%), with an average value of approximately 2.69%. The yield on the U.S. 10-year Treasury bond reflects investors' expectations regarding future inflation and changes in benchmark interest rates. During periods of elevated inflation and restrictive monetary policy, as was the case over the observed period, Treasury bond yields tend to increase because investors demand higher compensation for the loss of the real value of money. Although Table 3 shows only minor differences in the average returns of the S&P Municipal Bond Index and the S&P U.S. Green Bond Index, empirical evidence reported by numerous authors has not confirmed the existence of a significant yield discount or price premium (known as the greenium) associated with green bonds. Janković et al. (2022) identified only a very small yield discount for municipal green bonds and concluded that the green premium was effectively equal to zero. Since there are no significant differences in the returns of green and conventional bonds, investors may base their investment decisions on other factors, such as ethical and environmental considerations, as well as risk and liquidity. These findings suggest that the green and municipal bond markets exhibit similar return characteristics, thereby justifying further investigation of their interrelationship through correlation, regression, and cointegration analyses.

Correlation Analysis

To preliminarily examine the relationships among the S&P Green Bond Index, the S&P Municipal Bond Index, and the yield on the U.S. 10-year Treasury bond, Pearson correlation analysis was employed. Correlation analysis enables the identification of the direction and strength of the linear relationship between the observed variables. According to Cohen (1988), a correlation coefficient ranging from 0.10 to 0.29 indicates a weak correlation. Similarly, a correlation coefficient ranging from 0.30 to 0.49 indicates a moderate correlation, whereas a correlation coefficient ranging from 0.50 to 1.00 indicates a strong correlation.

Table 4: Correlation Analysis (Pearson Correlation Coefficient) between the S&P Green Bond Index, the S&P Municipal Bond Index, and the Yield on the U.S. 10-Year Treasury Bond for the period: 2016 - 2025

		S&P Green Bond U.S. Dollar Select Index	S&P Municipal Bond Index	U.S.10Y_Y
S&P Green Bond U.S. Dollar Select Index	Pearson Correlation	1.000	0.906	-0.069
	Sig. (2-tailed)	-	0.000	0.001
	N	2.481	2.481	2.481
S&P Municipal Bond Index	Pearson Correlation	0.906	1.000	0.203
	Sig. (2-tailed)	0.000	-	0.000
	N	2.481	2.481	2.481
U.S.10Y_Y	Pearson Correlation	-0.069	0.203	1.000
	Sig. (2-tailed)	0.001	0.000	1.000
	N	2.481	2.481	2.481

Source: Author´s calculations

As shown in the previous table, the Pearson correlation coefficient between the S&P Green Bond Index and the S&P Municipal Bond Index is 0.906, indicating a very strong positive relationship between the daily return movements of the two indices. This suggests that the observed indices tend to move in the same direction to a considerable extent. The results indicate that changes in municipal bond returns largely follow changes in green bond returns, confirming a high degree of integration between the two markets. Therefore, these findings suggest that investors considering investments in green municipal bonds can expect return patterns similar to those observed in conventional municipal bonds. Although green bonds are specifically intended to finance environmentally sustainable projects, their market remains highly integrated with the traditional bond market. These findings are consistent with those reported by Gorelick et al. (2024), who argue that green municipal bonds share many characteristics with conventional municipal bonds, including similar return dynamics and investor behaviour. Many green municipal bonds are issued by the same institutions that issue conventional bonds, leading investors to view them as part of the broader fixed-income market. The inverse relationship between interest rates and bond prices has been well documented in the literature, which emphasizes the

[1]*In finance, the term greenium refers to a situation in which investors are willing to accept a lower yield on green bonds compared with comparable conventional bonds issued by the same issuer and having similar maturity and risk characteristics.*

existence of a negative relationship between bond prices and interest rates (Litvinovs & Raiko, 2017). Accordingly, an increase in interest rates leads to a decline in bond prices, explaining the negative correlation between the yield on the U.S. 10-year Treasury bond and the returns of the green and municipal bond indices (-0.069). Although the correlation coefficient is negative, its magnitude is relatively low, indicating that movements in the yield on the U.S. 10-year Treasury bond are not strongly linearly associated with changes in the returns of the analysed indices.

Each variable in the model with a VIF value greater than 3 is considered to exhibit multicollinearity and is therefore excluded from the model. In the presence of multicollinearity, the estimated coefficients become unstable and their standard errors are inflated. Table 5 presents the results of the multicollinearity analysis for the variables included in the model.

Table 5: Multicollinearity Analysis Using the Variance Inflation Factor VIF)

Variables	VIF	1/VIF
S&P Municipal Bond Index	1.04	0.959028
U.S.10Y_Y	1.04	0.959028
Mean VIF	**1.04**	

Source: Author´s calculations

The results presented in Table 5 indicate that the VIF values for all independent variables are well below the threshold value of 3. These findings suggest the absence of multicollinearity, confirming the reliability of the estimated regression model and allowing for a reliable interpretation of the estimated coefficients.

Stationarity Test of Time Series (ADF Test)

The results of the Augmented Dickey–Fuller (ADF) test presented in Table 6 indicate that none of the analysed variables is stationary at the level, as all p>0.05.

Table 6: Results of the Augmented Dickey–Fuller (ADF) Test for Variable Stationarity

Variables	ADF Statistic	p-vvalue	ADF Statistic (First Difference)	p-vvalue	Conclusion
S&P Green Bond Index	1.8016	0.983	-41.555	p<0.001	I(1)
S&P Municipal Bond Index	1.4161	0.961	-26.588	p<0.001	I(1)
U.S.10Y_Y	0.4204	0.804	-49.649	0.001	I(1)

Source: Author´s calculations

Following the first differencing, all variables become stationary, as confirmed by the ADF statistics and $p<0.005$. Based on these results, it can be concluded that all analysed variables are integrated of order one, i.e., I(1). Since all analysed variables are integrated of order one, I(1), the main prerequisite for applying the Engle–Granger cointegration test and examining the existence of a long-run equilibrium relationship among the observed variables is satisfied.

Engle–Granger Cointegration Test

Since all variables are integrated of the same order, the Engle–Granger cointegration test was conducted in the next step to examine the existence of a long-run equilibrium relationship among the observed variables.

Table 7: Results of the Engle–Granger Cointegration Test

Residuals	ADF Statistic	p-value	Conclusion
RESID01	-5.1183	p<0.001	Variables are cointegrated

Source: Author´s calculations

The results of the Engle–Granger test presented in Table 7 indicate that the residuals of the estimated regression model are stationary, as confirmed by the ADF statistic of -5.1183 and a $p<0.05$. These findings indicate the existence of a long-run equilibrium relationship among the analysed variables. Based on the obtained results, it can be concluded that the S&P Green Bond Index, the S&P Municipal Bond Index, and the U.S. 10-Year Treasury bond yield are cointegrated. These findings are consistent with the study by Behlman et al. (2024), who, using the Johansen cointegration test, confirmed the existence of a long-run relationship between the green bond market and international financial markets. Their results revealed the presence of two cointegrating relationships, confirming that these markets move together over the long run. A similar conclusion is reached based on the results of the Engle–Granger test conducted in this study, thereby confirming the first research hypothesis (H1).

Results of the Regression Analysis (OLS)

After verifying the model assumptions, including the absence of multicollinearity and the existence of a cointegration relationship between the analyzed variables, the results of the Ordinary Least Squares (OLS) regression analysis are presented below. Table 8 presents the results of the OLS regression model examining the relationship between the independent variables and the S&P Green Bond U.S. Dollar Select Index. The F-statistic is statistically significant (Table 8), with $p < 0.05$, indicating that the overall model is highly statistically significant.

Table 8: Coefficients of the independent variables in the Ordinary Least Squares (OLS) regression for the period 2016–2025

Regression Model	Ordinary Least Squares (OLS) Method		
Dependent variable - S&P Green Bond U.S. Dollar Select Index			
Independent variables	**Koef.**	**Std. Greška**	**Verovatnoća**
C	5.6097	0.80989	p<0.001
S&P Municipal Bond Index	0.4446	0.00318	p<0.001
U.S.10Y_Y	-1.7534	0.04554	p<0.001
Coefficient of Determination $(R)^2$	0.88807	-	-
Adjusted Coefficient of Determination (Adjusted R^2)	0.88798	-	-
F-Statistic	9,831.14	-	-
Prob (F-statistic)	p<0.001	-	-

IZVOR: Proračun autora

By applying Equation (1) to the data obtained using the Ordinary Least Squares method presented in Table 8, the following estimated model is derived:

$$GB_t = 5{,}6097 + 0{,}4446 * MB - 1{,}7534 * U.S.10Y_Y$$

The adjusted coefficient of determination (Adjusted R^2) for the Ordinary Least Squares (OLS) model is 0.88798, indicating that approximately 88.8% of the variation in the daily values of the S&P Green Bond Index is explained by changes in the daily values of the S&P Municipal Bond Index and the yield on the U.S. 10-year Treasury bond (U.S. 10Y_Y). The remaining 11.2% of the variation can be attributed to other factors not included in the model. The F-statistic is 9,831.14, with a p<0.000. confirming that the regression model is statistically significant at the 5% significance level. In the OLS model, the estimated coefficients for the MB and U.S. 10Y_Y variables are 0.4446 and –1.7534, respectively. The positive coefficient of the MB variable indicates that a one-unit increase in the daily value of the S&P Municipal Bond Index is associated with an increase of approximately 0.4446 units in the daily value of the S&P Green Bond Index, holding all other variables constant. Conversely, the coefficient of the U.S. 10Y_Y variable is negative, indicating that a one-unit increase in the yield on the U.S. 10-year Treasury bond leads to a decrease of approximately 1.7534 units in the daily value of the S&P Green Bond Index, ceteris paribus. Based on the obtained results, it can be concluded that there is a statistically significant positive relationship between the S&P Municipal Bond Index and the S&P Green Bond Index, thereby confirming the second research hypothesis (H2). These findings are consistent with the results of Janković et al. (2022), who also identified a strong relationship between the green bond market and the conventional municipal bond market. Furthermore, Marszałek and Sekuła (2024) found statistically significant differences between the returns on green and conventional municipal bonds, however, these differences were generally small and varied over time. Their findings suggest that investors often perceive green and conventional bonds as similar financial instruments, confirming a high degree of

interconnectedness between these two market segments. These findings provide a theoretical basis for expecting a positive relationship between the S&P Municipal Bond Index and the S&P Green Bond Index. The obtained results further confirm that the green bond market does not develop in isolation but rather closely follows the dynamics of the conventional bond market. Furthermore, the results indicate that the yield on the U.S. 10-year Treasury bond (U.S. 10Y_Y) has a statistically significant negative effect on the daily value of the S&P Green Bond Index, thereby confirming the third research hypothesis (H3).

This finding is consistent with the study by Gozgor and Karakas (2023), who identified a negative relationship between U.S. Treasury bond yields and green bond returns. Similar conclusions were reached by Tomczak (2024), who reported that green bond returns are significantly influenced by the performance of conventional government bonds as well as by the overall level of interest rates. These findings confirm that developments in the government bond market represent an important factor affecting the performance of the green bond market. Specifically, an increase in U.S. Treasury bond yields enhances the attractiveness of investing in safe government securities, leading some investors to reallocate funds from green bonds to government bonds. At the same time, higher interest rates increase the discount rate used in bond valuation, resulting in a decline in the market value of outstanding green bonds and their corresponding indices. The conducted analysis indicates that the municipal bond market and movements in U.S. Treasury bond yields were among the key determinants of green bond market performance during the observed period. Although the analyzed period (2016–2025) covers different market regimes, including the COVID-19 pandemic, changes in monetary policy, and the interest rate tightening cycle, the primary objective of this study was to examine the overall relationship between the analyzed variables throughout the entire observation period. Future research may include sub-period analyses, the application of dummy variables for major market events, and coefficient stability tests in order to further assess the robustness of the obtained results.

Conclusion

The green bond market has experienced significant growth in recent years and has become one of the most important segments of sustainable finance. The increasing need to finance projects related to environmental protection, renewable energy sources, and energy efficiency has contributed to growing interest in this financial instrument among investors, financial institutions, and policymakers. At the same time, the development of the green bond market has become increasingly associated with developments in traditional bond markets and changes in the macroeconomic environment, particularly with respect to interest rates. The aim of this study was to examine the relationship between the S&P Green Bond Index, the S&P Municipal Bond Index, and the yield on the 10-year U.S. Treasury bond over the period from 2016 to 2025. To achieve this objective, the study employed descriptive statistics, correlation analysis, ordinary least squares (OLS) regression analysis, the Augmented Dickey–Fuller (ADF) unit root test, and the Engle–Granger cointegration test.

The results of the descriptive analysis indicate that the observed variables exhibited different yield dynamics over the analyzed period. The lowest yields were recorded for both the S&P Municipal Bond Index and the S&P Green Bond Index in 2022, although positive yields had also been observed in certain earlier years. At the same time, 2022 was characterized by a significant increase in the yield on the 10-year U.S. Treasury bond. Following 2022, neither market segment recorded negative yields;

instead, both experienced a recovery, indicating their close interrelationship and sensitivity to changes in interest rates.

The results of the correlation analysis revealed a very strong positive relationship between the S&P Green Bond Index and the S&P Municipal Bond Index, with a correlation coefficient of 0.906. The regression analysis confirmed that the S&P Municipal Bond Index exerts a positive and statistically significant effect on the S&P Green Bond Index, whereas the yield on the 10-year U.S. Treasury bond has a negative and statistically significant effect. Furthermore, the high coefficient of determination (R^2 = 0.888) indicates the substantial explanatory power of the estimated model. The empirical findings confirm that the S&P Municipal Bond Index is a significant determinant of movements in the S&P Green Bond Index, while the yield on the 10-year U.S. Treasury bond has a statistically significant negative impact. These findings are consistent with the stated research objective and confirm the existence of a significant relationship among the analyzed market variables.

The results of the ADF test indicated that all analyzed variables are integrated of order one, i.e., I(1). The application of the Engle–Granger cointegration test confirmed the existence of a long-run equilibrium relationship among the observed variables. Based on these findings, it can be concluded that the green bond market, the municipal bond market, and long-term interest rates are interconnected not only in the short run but also in the long run.

This study has several limitations that should be considered when interpreting the findings. First, the analysis focuses exclusively on the U.S. green bond and municipal bond markets; therefore, the results cannot be fully generalized to other financial markets. Second, the model includes a limited number of variables, namely the S&P Green Bond Index, the S&P Municipal Bond Index, and the yield on the 10-year U.S. Treasury bond, while other potentially important determinants, such as inflation, benchmark interest rates, macroeconomic indicators, and ESG factors, were not incorporated into the analysis. Third, the study is based on daily data covering the period from 2016 to 2025, which may limit the ability to capture long-term structural changes in the bond market. Fourth, the S&P Green Bond Index represents a broad segment of the global green bond market, encompassing sovereign, supranational, agency, corporate, financial, and municipal green bonds.

Therefore, the findings of this study apply to the green bond market represented by this index rather than exclusively to the segment of green municipal bonds. Future research may employ more specialized indices or issue-level data on green municipal bonds to provide a more comprehensive analysis of the specific characteristics of this market segment.

Despite these limitations, this study makes a valuable contribution to the understanding of the relationship between the green bond and municipal bond markets. The findings indicate the existence of significant relationships among the analyzed variables, with the municipal bond market and long-term interest rates playing an important role in explaining developments in the green bond market. These results may be useful for investors, policymakers, and other participants in financial markets when making investment decisions and assessing risk. Given the growing importance of sustainable finance, future research should focus on identifying additional factors that influence the development and long-term stability of the green bond market.

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ANALIZA MEĐUNARODNE INVESTICIONE POZICIJE REPUBLIKE SRBIJE U KONTEKSTU EKSTERNE ODRŽIVOSTI

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Rezime: *Rad se bavi analizom dinamike i strukture međunarodne investicione pozicije Srbije. S obzirom na činjenicu da se tokom posmatranog perioda neto dužnička pozicije zemlje pogoršava, osnovni cilj istraživanja je da se utvrdi koji oblici finansijske aktive i pasive imaju presudnu ulogu u njenom formiranju. Posebna pažnja usmerena je na strukturu obaveza prema inostranstvu, budući da najveći deo pasive i dalje proizilazi po osnovu direktnih investicija, pre svega u formi vlasničkog kapitala i reinvestirane dobiti. Istovremeno, rezultati ukazuju na rast dužničkih obaveza, naročito kroz zaduživanje države po osnovu emisije dužničkih hartija od vrednosti i finansijskih kredita. U tom kontekstu, naglašava se značaj usmeravanja dužničkih izvora finansiranja ka produktivnim ulaganjima koja mogu povećati buduće devizne prilive i kapacitet zemlje za servisiranje obaveza prema inostranstvu.*

Ključne reči: međunarodna investicija pozicija, strani kapital, direktne investicije.

JEL klasifikacija: F21, F34

Uvod

Prilikom procene eksterne pozicije nacionalne ekonomije, pored analize platnog bilansa i indikatora eksterne likvidnosti, solventnosti, odnosno izloženosti finansijskom riziku, jedan od najznačajnijih segmenata je i analiza međunarodne investicione pozicije (MIP). Najjednostavnije posmatrano, MIP predstavlja razliku između domaće finansijske aktive u inostranstvu i strane finansijske pasive u zemlji (Stanišić, et.al, 2014). Pritom, bitno je napomenuti da se radi o pokazatelju stanja (stoka), budući da međunarodna investiciona pozicija prikazuje vrednosti finansijske aktive i pasive u određenom trenutku, najčešće na kraju godine (Dugalić, et.al, 2023). Za razliku od platnog bilansa koji evidentira transakcije tokom određenog perioda, MIP predstavlja presek akumuliranih potraživanja i obaveza prema inostranstvu. Zbog toga, njena promena nije uslovljena samo tekućim transakcijama već i promenama deviznog kursa, cena finansijske aktive, kamatnih stopa i drugim korekcijama vrednosti (Todorović & Đorđević, 2024).

U zavisnosti od odnosa između finansijske aktive i pasive određuje se i neto pozicija zemlje prema inostranstvu. Ukoliko su obaveze rezidenata prema nerezidentima veće od potraživanja prema inostranstvu, zemlja ima negativnu neto MIP i posmatra se kao neto dužnik prema ostatku sveta (Kovačević, 2020). Suprotno tome, ukoliko su potraživanja rezidenata prema nerezidentima veća od njihovih obaveza, neto MIP zemlje je pozitivna, odnosno ona ima status neto poverioca.
Zemlje u razvoju se, usled relativno skromne domaće akumulacije, često oslanjanju na priliv stranog kapitala kao važan izvor finansiranja investicija. U tom smislu, njihova pozicija neto uvoznica kapitala može se posmatrati kao očekivana posledica potrebe da se nedostatak domaćih izvora finansiranja nadomesti eksternim sredstvima. Razvojna logika ovakvog modela zasniva se na pretpostavci da priliv stranog kapitala može finansirati produktivne investicije, podstaći ekonomski rast, proširiti izvozne kapacitete i povećati devizne prilive. Ukoliko se takvi efekti zaista ostvare, rast proizvodnje i izvoza mogao bi doprineti jačanju domaće akumulacije i postepenom smanjenju zavisnosti od eksternog finansiranja. U krajnjoj instanci, navedeno bi trebalo da doprinese poboljšanju eksterne pozicije ovih zemalja, jednim delom i kroz smanjenje njihove dužničke pozicije.

Imajući u vidu poziciju Srbije kao neto uvoznice kapitala, predmet ovog istraživanja je analiza njene MIP sa ciljem da se identifikuju ključne promene u njenoj strukturi, kao i implikacije na održivost ukupne eksterne pozicije nacionalne ekonomije. Period posmatranja je od 2013. zaključno sa 2025. godinom, pri čemu je izbor analiziranog vremenskog okvira determinisan potrebom da se obuhvati dovoljno dug interval za sagledavanje dugoročnih promena u obimu i strukturi MIP. Izbor 2013. godine kao početne omogućava da se analizom obuhvati period koji prethodi značajnijim promenama domaćeg makroekonomskog ambijenta uključujući fiskalnu konsolidaciju, rast priliva stranih direktnih investicija i postepeno jačanje makroekonomske stabilnosti. Istovremeno, posmatrani period obuhvata i godine izraženih poremećaja u globalnom okruženju poput pandemije virusa Covid 19, energetske krize, geopolitičkih tenzija i zaoštravanje globalnih monetarnih uslova. Na taj način moguće je sagledati ne samo dugoročne tendencije, već i osetljivost MIP Srbije na promene u domaćem i međunarodnom ekonomskom okruženju. Saglasno definisanom predmetu i cilju istraživanja, u prvom delu dat je pregled literature u vezi sa MIP, u drugom delu posmatrana je dinamika MIP Srbije u apsolutnom i relativnom smislu uz kratak komparativni osvrt u odnosu na zemlje Centralne, Istočne i Jugoistočne Evrope. Dinamika i struktura finansijske aktive i pasive predstavljene su u trećem i četvrtom delu istraživanja, dok su zaključna razmatranja data u poslednjem delu rada.

Pregled literature

Položaj zemalja u razvoju u svetskoj privredi i međunarodnoj podeli rada izuzetno je delikatan. Njihova akumulacija je značajno manja od njihovih razvojnih i investicionih potreba, što determiniše njihovu usmerenost ka eksternim izvorima finansiranja. Analogno tome, ove ekonomije se u procesu smanjivanja razvojnih dispariteta i konvergenciji ka razvijenim zemljama više oslanjanju na tuđu nego na sopstvenu akumulaciju. Uvoz kapitala može doprineti unapređenju ekonomskih performansi nacionalnih ekonomija, podstičući modernizaciju privrede, povećanje zaposlenosti, transfer tehnologije, rast izvoza i bolju uključenost domaćih preduzeća u globalne lance vrednosti. Ipak, u praksi neretko se može desiti da ostvareni ishodi budu niži od željenih i potencijalno mogućih (Malović, 2019). Zbog toga je važno na koji način se strani kapital koristi i kakve su makroekonomske i institucionalne performanse okruženja u kome se on plasira (Arsić, et.al, 2019; Arsov & Naumovski, 2024; Tmušić, 2025). Ovu konstataciju nesumnjivo potvrđuju iskustva pojedinih tranzicionih evropskih zemalja u kojima je strani kapital bio znatno delotvorniji u dinamiziranju ekonomskih performansi i ostvarenju razvojnih ciljeva. Drugim rečima, ključno pitanje nije samo da li je zemlja uspešna u privlačenju stranog kapitala, već da li taj kapital doprinosi strukturnoj transformaciji privrede, jačanju izvozne baze i rastu domaće dodate vrednosti, ili prevashodno produbljuje njenu „zavisnost" od spoljnih izvora finansiranja.

Nezavisno da li se priliv stranog kapitala realizuje posredstvom različitih vidova investicija (stranih direktnih, portfolio ili ostalih investicija), ili zaduživanjem u inostranstvu, suština je da se uvoz kapitala iskoristi na produktivan način, u smislu doprinosa rastu izvoza i povećanju kapaciteta nacionalne ekonomije da autonomno generiše devizne prilive. U suprotnom, eksterna pozicija zemlje može biti „ranjiva" na smanjenje ili iznenadni prekid priliva kapitala, odnosno zemlja može teže dolaziti do novih sredstava zaduživanjem na međunarodnom tržištu kapitala.

I u pogledu kapaciteta zaduživanja, asimetričan je položaj zemalja u razvoju u odnosu na razvijene zemlje (Reinhart, et.al, 2003). Navedeno je razumljivo s obzirom da su ekonomski kapaciteti zemalja u razvoju (poput bruto domaćeg proizvoda ili izvoza) po pravilu manji u odnosu na razvijene zemlje. Na taj način zemlje u razvoju mogu znatno brže preći granicu visoke zaduženosti u poređenju sa razvijenim zemljama. Pravi primer toga su Sjedinjene Američke Države (SAD), kao najveći svetski neto dužnik i zemlja sa najvećim deficitom tekućeg računa (Janković, 2018; Aliber, 2020). Uprkos negativnoj MIP i deficitima ogromnih razmera, položaj SAD-a je znatno manje delikatan u poređenju sa Srbijom ili ostalim zemljama Zapadnog Balkana, prvenstveno zahvaljujući dolaru kao svetskoj rezervnoj valuti i dubini i likvidnosti američkog finansijskog tržišta (Kovačević, 2011; Kovačević, 2014). Neto dužnička pozicija zemlje implicira da je obim stranog kapitala u zemlji viši u poređenju sa nivoom domaćeg kapitala u inostranstvu. Međutim, neto vrednost MIP ne pruža detaljnije informacije izuzev podataka o finansijskom položaju zemlje prema ostatku sveta. Stoga se vrednost MIP-a iskazuje i u relativnom iskazu, najčešće u odnosu na bruto domaći proizvod nacionalne ekonomije. Navedeno je i razumljivo s obzirom da isti nivo neto finansijske pasive nema podjednak značaj za ekonomije različite veličine. Ipak, ni ovaj pokazatelj ne pruža dovoljno informacija kreatorima ekonomske politike, poveriocima i ostalim zainteresovanim stranama koliko je eksterna pozicija nacionalne ekonomije ugrožena usled negativnih vrednosti MIP. Saglasno navedenom, stepen eksterne izloženosti nacionalne ekonomije ne zavisi samo od toga da li je zemlja neto dužnik i koliki je odnos neto obaveza prema BDP-u, već i od toga na kojim oblicima finansiranja je ta pozicija zasnovana. Negativna neto MIP ima drugačije implikacije ukoliko je pasiva pretežno formirana kroz

stabilnije oblike kapitala poput stranih direktnih investicija, nego u slučaju dominantne zastupljenosti dužničkog kapitala, portfolio obaveza odnosno ostalih instrumenata osetljivih na promene finansijskih uslova (Catao & Milesi Ferretti, 2014). Zbog toga je za ocenu održivosti i izloženosti eksterne pozicije neophodno sagledati funkcionalnu, ročnu i sektorsku strukturu aktive i pasive MIP.

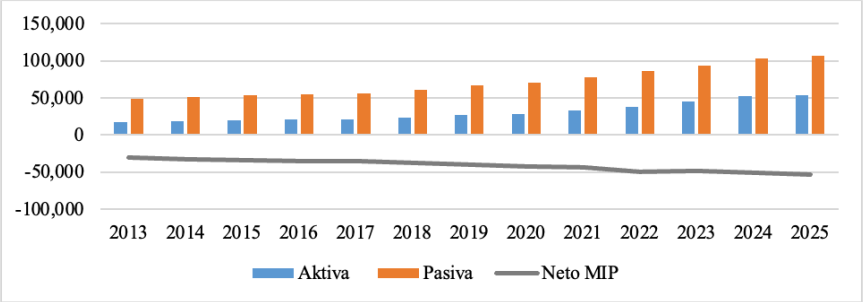
Identično kao i kod deficita tekućeg računa, tako i u pogledu neto MIP ne postoji opšteprihvaćena numerička granica na osnovu koje bi se mogla nedvosmisleno oceniti održivost eksterne pozicije zemlje. Drugim rečima, deficit tekućeg računa ispod određenog procenta BDP-a ne mora nužno biti održiv kao što ni negativna neto MIP iznad određenog praga ne mora automatski značiti da je zemlja neposredno suočena sa nastankom spoljne krize. Analogno tome, ocena održivosti zavisi od šireg makroekonomskog konteksta, strukture finansiranja, dinamike rasta, izvoznih kapaciteta, ročne i valutne strukture obaveza kao i sposobnosti zemlje da uredno servisira spoljne obaveze. Stoga se u prilikom procene veličine neto dužničke pozicije zemlje koriste referentne vrednosti koje imaju ulogu signalnih pokazatelja. Kada je reč o MIP-u jedna od najpoznatijih referentnih vrednosti primenjuje se u okviru mehanizma Evropske unije za nadzor makroekonomskih neravnoteža, prema kome neto dužnička pozicije zemlje ne bi trebalo da prevazilazi prag od 35% njenog BDP-a (Bobeva, 2013). Pritom, više vrednosti od referentne ne ukazuju nužno da je neto dužnička pozicija zemlje neodrživa, već da se zemlja potencijalno suočava sa ozbiljnijom neravnotežom. Zbog toga ovaj prag ima signalnu funkciju, s obzirom da ukazuje na potrebu detaljnijeg sagledavanja strukture i dinamike MIP-a, izvora finansiranja i rizika koji proizilaze iz ročne, valutne i sektorske strukture obaveza. Ukoliko se takvom analizom utvrdi postojanje izraženih ili prekomernih makroekonomskih neravnoteža, formulišu se preporuke za ekonomsku politiku, koje mogu podrazumevati i aktivaciju korektivnih mehanizama usmerenih ka postepenom otklanjanju neravnoteže (Koll & Watt, 2022).

U ekonomskoj literaturi, MIP Srbije je retko izolovano posmatrana, već je ona dopunski analizirana u kontekstu ocene ukupne eksterne pozicije zemlje ili u kontekstu sa drugim makroekonomskim varijablama (Zildžović, 2015; Durkalić & Čurčić, 2019; Kovačević, 2021). Detaljniju analizu MIP Srbije sproveli su Bumbić & Kovačević (2021), koji su identifikovali pogoršanje neto MIP zemlje, ali i istovremeno pozitivne (dominantnost SDI posredstvom vlasničkih ulaganja i reinvestirane dobiti) i negativne aspekte promena u strukturi MIP (rast učešća dužničkih instrumenata, finansijskih kredita i rastuće zaduženje države emisijom dugoročnih HoV). Stanišić (2020) je u sklopu analize eksterne ekonomske neravnoteže srpske privrede, sproveo komparativnu analizu MIP Srbije i bivših tranzicionih zemalja, odnosno novih članica Evropske unije. Rezultati njegovog istraživanja potvrđuju znatno nepovoljniju dužničku poziciju Srbije, uz činjenicu da se neto MIP Srbije pogoršava, dok su ostale odabrane zemlje Centralne i Istočne Evrope (izuzev Slovačke) uspele da ostvare smanjenje neto dužničke pozicije prema ostatku sveta. Saglasno navedenom u ovom radu nastoji se izvršiti dopuna postojećih istraživanja kroz analizu aktuelnih kretanja MIP Srbije sa posebnim osvrtom na period nakon izraženih poremećaja i promena u međunarodnom finansijskom okruženju.

Međunarodna investiciona pozicija Srbije

Reformski procesi početkom novog milenijuma stvorili su stimulativne uslove za rast priliva stranog kapitala u srpskoj privredi. Otvaranje zemlje ka inostranstvu, normalizacija odnosa sa međunarodnim ekonomskim institucijama, liberalizacija tržišta kao i proces privatizacije predstavljali su inicijalni korak koji je rezultovao time da količina inostranog kapitala u zemlji bude znatno viša od domaćih potraživanja ka inostranstvu. Istovremeno, to je pozicioniralo zemlju kao neto dužnika prema ostatku sveta. Slični trendovi nastavljeni su i u kasnijem periodu, s obzirom na to da je rast obaveza prema inostranstvu bio izraženiji u poređenju sa vrednošću finansijske aktive zemlje. U odnosu na kraj 2013. godine, vrednost finansijske pasive povećana je za 58,1 milijardu evra, odnosno za približno 2,2 puta. Sa druge strane, u istom vremenskom periodu rast finansijske aktive iznosio je 35,5 milijardi evra, što se odrazilo na pogoršanje neto MIP zemlje za 22,6 milijardi evra na kraju 2025. godine. Interesantno je primetiti da su u 2025. godini obaveze prema inostranstvu bilo gotovo dvostruko više u odnosu na potraživanja, tako da su finansijska aktiva i neto MIP zemlje bile gotovo izjednačene (Slika 1).

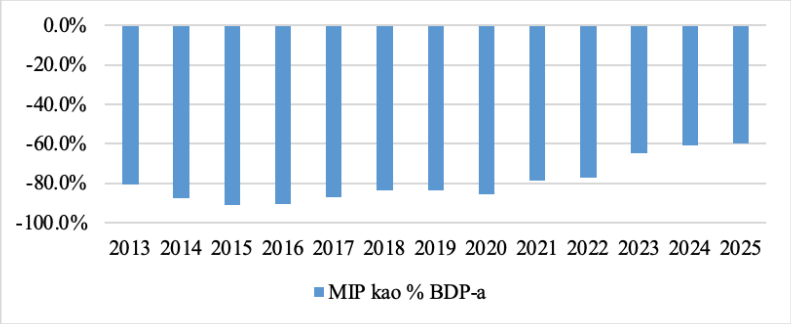
Slika 1 - Neto međunarodna investiciona pozicija Srbije (u milionima evra)



Izvor: Narodna banka Srbije (2026)

Za razliku od apsolutnih vrednosti, posmatrano u odnosu na veličinu ekonomije može se uočiti poboljšanje neto MIP Srbije. U poređenju sa 2015. i 2016. godinom kada je neto dužnička pozicija iznosila preko 90% BDP-a srpske ekonomije, na kraju posmatranog perioda vrednost ovog pokazatelja iznosi 60% BDP-a, što predstavlja najniži nivo u analiziranom vremenskom intervalu (Slika 2). Imajući u vidu činjenicu da se neto MIP Srbije u apsolutnom smislu kontinuirano pogoršava, ovakvo kretanje ukazuje da je rast nominalnog BDP-a bio izraženiji od neto spoljnih obaveza zemlje, prvenstveno nakon 2022. godine. Dakle unapređenje MIP u relativnom smislu posledica je prvenstveno dinamike nominalnog BDP-a, a ne smanjenja neto dužničke pozicije u apsolutnom smislu. S obzirom da rast nominalnog BDP-a može biti delom rezultat inflacionih kretanja, a ne isključivo rasta proizvodnje poboljšanje neto MIP Srbije u relativnom smislu treba sa rezervom tumačiti. Pored toga, uprkos smanjenja u relativnom smislu u odnosu na prethodne godine, neto MIP Srbije je i dalje visoka i nalazi se iznad referentnih vrednosti koje podrazumevaju primenu određenih mera u pravcu njene redukcije.

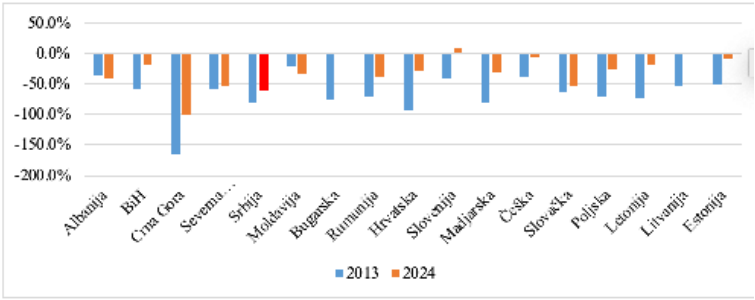
Slika 2 - Neto dužnička pozicija Srbije kao % BDP-a



Izvor: Kalkulacija autora na osnovu podataka Ministarstva finansija i NBS (2026)

Zaključci o veličini neto dužničke pozicije Srbije prema inostranstvu mogu se potvrditi u odnosu na ostale zemlje Centralne, Istočne i Jugoistočne Evrope (Slika 3). Kao što se može uočiti, Srbija je nakon Crne Gore najveći neto dužnik u posmatranom uzorku zemalja. U poređenju sa 2013. godinom, sve zemlje izuzev Albanije i Moldavije su uspele da ostvare poboljšanje neto MIP na kraju posmatranog perioda, dok su Slovenija i Bugarska prešle iz statusa neto dužnika u položaj neto poverioca prema ostatku sveta. Istovremeno, zemlje poput Hrvatske i Mađarske koje su imale izraženiju neto dužničku poziciju u odnosu na Srbiju u 2013. godini uspele su da ostvare daleko značajnije poboljšanje MIP na kraju posmatranog perioda.

Slika 3 - MIP kao % BDP-a zemalja Centralne, Istočne i Jugoistočne Evrope[1]

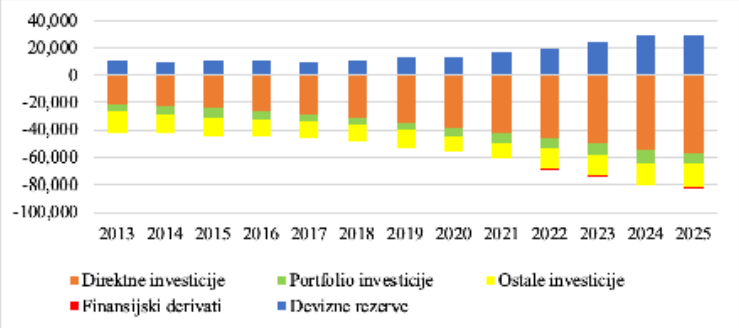


Izvor: Kalkulacija autora na osnovu podataka MMF-a i Svetske banke (2026)

Pogoršanju MIP u apsolutnom smislu u najvećoj meri doprineo je rast obaveza po osnovu direktnih investicija. Tokom posmatranog perioda negativna neto pozicija direktnih investicija pogoršana je za 35,9 milijardi evra, sa rekordnom vrednošću u 2025. godini 56,6 milijardi evra (Slika 4). Istovremeno, pogoršanje neto pozicije zabeleženo je kod portfolio investicija (2,4 milijardi evra) odnosno ostalih investicija (1,9 milijardi evra). Najskromnije pogoršanje neto pozicije beleži se kod finansijskih derivata i opcija na akcija za zaposlene (270 miliona evra), koji su do 2022. godine imali pozitivnu neto poziciju. Pogoršanje neto pozicije prikazanih stavki, delimično je kompenzovano poboljšanjem neto pozicije deviznih rezervi za 17,8 milijardi evra tokom posmatranog perioda.

[1]*Za Crnu Goru, inicjalna godina posmatranja je 2016., a ne 2013. godina, s obzirom na nedostupnost podataka u međunarodnoj statistici MIP.*

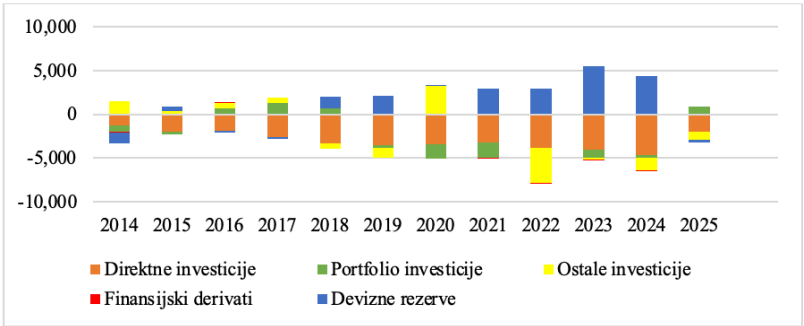
Slika 4 - Struktura međunarodne investicione pozicije Srbije (u milionima evra)



Izvor: Narodna banka Srbije (2026)

Posmatrajući međugodišnje promene MIP Srbije, može se uočiti da je tokom 2022. godine zabeleženo najizraženije pogoršanje budući da je u odnosu na 2021. godinu MIP pogoršana za 5 milijardi evra (Slika 5). Pogoršanje MIP u ovom periodu u najvećoj meri doprinelo je pogoršanje pozicije ostalih investicija (4 milijarde evra), odnosno direktnih investicija (3,8 milijardi evra). Jedino skromno poboljšanje MIP, beleži se 2023. godine, kada je neto dužnička pozicija Srbije bila niža za 246 miliona evra, prvenstveno zahvaljujući izraženijem poboljšanju pozicije deviznih rezervi u poređenju sa ostalim pozicijama MIP. Kao što se može uočiti, direktne investicije su tokom posmatranog perioda kontinuirano doprinosile pogoršanju neto dužničke pozicije Srbije, s obzirom na konstantan rast neto finansijske pasive. Pozicija deviznih rezervi je pretežno imala pozitivan doprinos izuzev u nekoliko inicijalnih godina posmatranog perioda kao i u 2025. godini, kada se beleži njihovo međugodišnje smanjenje.

Slika 5 - Doprinos komponenti saldu međunarodne investicione pozicije Srbije (u milionima evra)



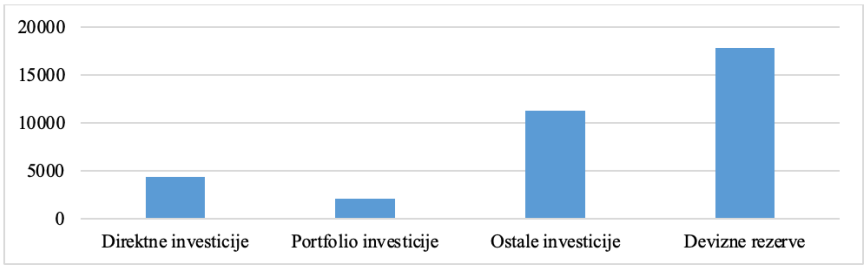
Izvor: Kalkulacija autora na bazi NBS (2026)

Kod pozicije portfolio investicija pozitivan doprinos evidentan je samo u periodu između 2016. i 2018. godine, kao i na kraju posmatranog perioda s obzirom na smanjenje neto finansijske pasive po ovom osnovu. Poboljšanje pozicije ostalih investicija zabeleženo u između 2014. i 2017. godine takođe je imalo pozitivne efekte na redukciju neto dužničke pozicije, zemlje dok se od 2018. godine beleži rast neto finansijskih obaveza po ovom osnovu. Kao što se može uočiti, najmanji doprinos u profilisanju dinamike MIP Srbije imala je pozicija finansijski derivati, s obzirom na znatno skromnije vrednosti u poređenju sa ostalim komponentama MIP.

Struktura finansijske aktive

U odnosu na početak posmatranog perioda finansijska aktive Srbije uvećana je za tri puta, odnosno u apsolutnom iznosu za 35,5 milijardi evra. Nešto više od polovine ovog povećanja rezultat je rasta deviznih rezervi, koje su povećane za 17,8 milijardi evra (Slika 6). Rast aktive po osnovu ostalih investicija, takođe je bio značajan, ali nešto manjeg obima 11,3 milijarde evra, dok je u okviru direktnih i portfolio investicija ostvareno skromnije povećanje (4,3 i 2,1 milijardu evra respektivno). Istovremeno, ostvaren je rast finansijske aktive i po osnovu finansijskih derivata u iznosu od 19 miliona evra.

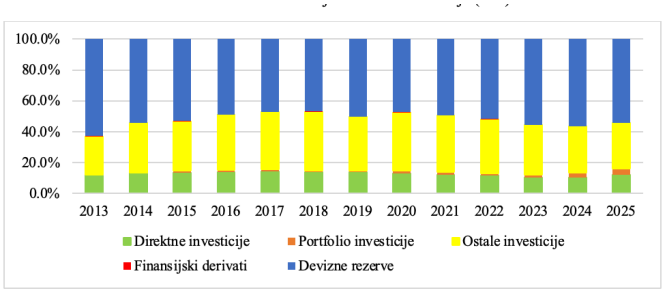
Slika 6 - Doprinos komponenti rastu finansijske aktive u odnosu na početak posmatranog perioda (u milionima evra)



Izvor: Kalkulacija autora na osnovu NBS (2026)

Uprkos ostvarenom apsolutnom rastu, učešće deviznih rezervi u strukturi finansijske aktive beleži pad za 8,4 procentnih poena, pri čemu one i dalje ostaju najznačajnija komponenta finansijske aktive zemlje sa učešćem od 54,3% na kraju posmatranog perioda (Slika 7). Smanjenje učešća deviznih rezervi, prvenstveno je posledica rasta učešća ostalih investicija (4,4 p.p.) odnosno portfolio investicija (3,7 p.p.). Sa druge strane, direktne investicije su zadržale relativno stabilno učešće kao sa početka posmatranog perioda uz blagi rast (0,4 p.p.), dok je učešće finansijskih derivata marginalno.

Slika 7 - Struktura finansijske aktive MIP Srbije (u %)



Izvor: Kalkulacija autora na osnovu NBS (2026)

Rast portfolio aktive evidentan je kako kod vlasničkih, tako i kod dužničkih hartija od vrednosti, pri čemu je povećanje izraženije u segmentu dužničkih instrumenata. Pored toga, važno je ukazati da rast portfolio aktive nije bio sektorski ravnomerno raspoređen, budući da je u slučaju vlasničkih hartija od vrednosti i jedinica investicionih fondova rast portfolio aktive prevashodno koncentrisan u okviru ostalih sektora, odnosno nedepozitnih finansijskih institucija (Tabela 1). Sa druge strane, najznačajniju ulogu u rastu portfolio aktive po osnovu dužničkih hartija od vrednosti imale su depozitne institucije.

Tabela 1 - Dekompozicija portfolio aktive (u milionima evra)

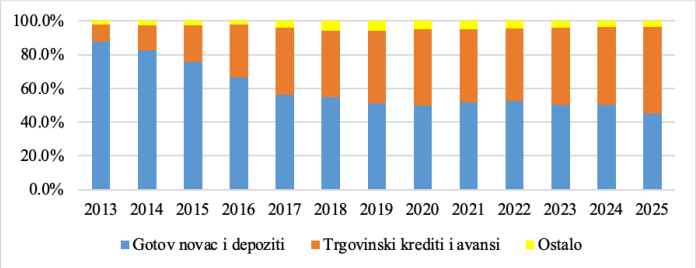
Godina	Vlasničke HOV	Vlasničke HOV: ostali sektori	Dužničke HOV	Dužničke HOV: depozitne institucije	Portfolio aktiva
2013.	19,7	17,7	32,6	31,3	52,3
2014.	32,4	31,7	105,0	104,9	137,4
2015.	27,7	24,7	171,7	169,6	199,4
2016.	53,8	24,2	251,8	247,9	305,6
2017.	82,1	31,1	155,2	149,2	237,2
2018.	101,2	41,4	147,4	142,7	248,6
2019.	154,2	57,5	135,8	127,0	290,0
2020.	222,5	86,3	215,1	208,2	437,6
2021.	269,8	115,8	348,1	337,7	618,0
2022.	151,6	137,4	432,7	421,8	584,2
2023.	233,8	233,8	486,8	455,9	720,6
2024.	543,6	526,3	1.197,1	969,8	1.740,7
2025.	759,3	680,6	1.383,4	1.121,2	2.142,6

Izvor: Narodna banka Srbije (2026)

Najizraženije promene u strukturi finansijske aktive evidentne su kod pozicije ostalih investicija. Kao što se može uočiti struktura aktive u ovom segmentu je izuzetno koncentrisana u kategorijama gotov novac i depoziti i trgovinski krediti i avansi na koje se odnosi preko 90% (a u većem delu perioda i preko 95%) ukupne aktive ostalih investicija (Slika 8). Uprkos rastu aktive gotovog novca i depozita (približno 3,2 milijarde evra), rast aktive trgovinskih kredita i avansa u istom periodu bio je izraženiji (7,6 milijardi evra). Ovakve tendencije odrazile su se na promenu u strukturi aktive kroz pad učešća gotovog novca i depozita odnosno rasta učešća trgovinskih kredita i avansa. Učešće kategorije gotov novac i depoziti je gotovo prepolovljeno tokom posmatranog perioda, budući da se na njih odnosilo 45% aktive ostalih investicija u 2025. godini, što predstavlja smanjenje za 42,7 procentnih poena. Sa druge strane učešće trgovinskih kredita i avansa tokom posmatranog perioda beleži rast za 41,4 procentna poena, tako da oni postaju najznačajnija komponenta aktive ostalih investicija sa učešćem od 51,3%. Sektorski posmatrano, u strukturi aktive po osnovu gotovog novca i depozita dominiraju potraživanja ostalih sektora i depozitnih institucija osim centralne banke, što ukazuje da se ova stavka pre svega odnosi na depozite i likvidna sredstva domaćih preduzeća, stanovništva i banaka kod nerezidentnih finansijskih institucija.

Trgovinski krediti i avansi u okviru MIP predstavljaju specifičan oblik finansiranja spoljnotrgovinskih transakcija, koji proizilazi iz vremenske neusklađenosti između isporuke robe i usluga i njihovog plaćanja. Za razliku od bankarskih kredita, ovaj oblik finansiranja nastaje direktno između odnosa kupca i prodavca, pri čemu se plaćanje realizuje naknadno najčešće u roku od 30, 60 i 90 dana nakon isporuke robe (Kovačević, 2013). Rast aktive po ovom osnovu ukazuje da rezidenti imaju neto potraživanja prema inostranstvu u okviru spoljnotrgovinskih odnosa. Drugim rečima, domaća preduzeća u većoj meri finansiraju strane partnere kroz odložena odnosno avansna plaćanja, nego što se sama finansiraju od strane nerezidenata po istom osnovu. Istovremeno, kod većine preostalih komponenti ostalih investicija poput finansijskih kredita, programa osiguranja, penzija i standardizovanih garancijskih programa beleži se rast finansijske aktive, pri čemu je on daleko skromniji u poređenju sa ranije pomenutim komponentama.

Slika 8 - Struktura aktive ostalih investicija (u %)

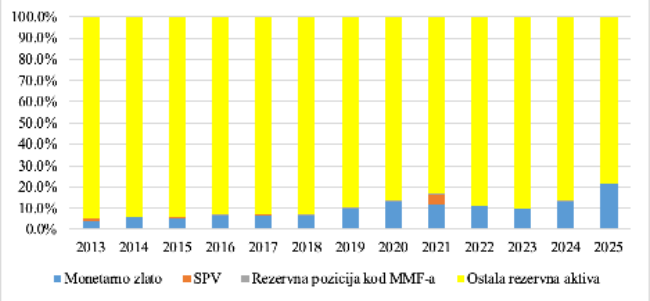


Izvor: Kalkulacija autora na osnovu NBS (2026)

Struktura deviznih rezervi Srbije u posmatranom periodu pokazuje da je njihovo jezgro i dalje bilo koncentrisano u okviru ostale rezervne aktive, u kojoj dominiraju hartije od vrednosti kao i gotov novac i depoziti (Slika 9). Ovakva struktura je očekivana, imajuću u vidu da centralne banke najčešće najveći deo rezervi drže u likvidnim i relativno sigurnim instrumentima, pre svega u vidu dužničkih hartija od vrednosti i depozitnim plasmanima kod inostranih finansijskih institucija. Istovremeno, moguće je uočiti postepeno smanjenje relativnog učešća ostale rezervne aktive, što nije posledica njenog smanjenja u apsolutnom smislu, već pre svega rasta učešća monetarnog zlata u ukupnim rezervama, što ukazuje na izvesnu diversifikaciju rezervne aktive.

[2]*Prema aktuelnoj metodologiji Međunarodnog monetarnog fonda kategoriju ostali sektor čine ostale finansijske institucije izuzev depozitnih institucija i centralne banke, kao i nefinansijske institucije, domaćinstva i neporfitne institucije koje pružaju usluge domaćinstvima.*

Slika 9 - Struktura deviznih rezervi (u %)



Izvor: Kalkulacija autora na osnovu NBS (2026)

Ovakva kretanja delimično ilustruju postepenu promenu u strukturi rezervne aktive, pri čemu monetarno zlato dobija sve značajniju ulogu kao instrument diversifikacije. Za razliku od hartija od vrednosti i depozita, monetarno zlato ne predstavlja potraživanje prema drugom institucionalnom sektoru, pa samim tim ne nosi kreditni rizik emitenta, odnosno depozitne institucije. Njegov rastući značaj u rezervama, može se tumačiti kao nastojanje da se u uslovima povećane globalne neizvesnosti, promenljivih kamatnih stopa i izraženijih geopolitičkih rizika ojača stabilnost i otpornost rezervne aktive.

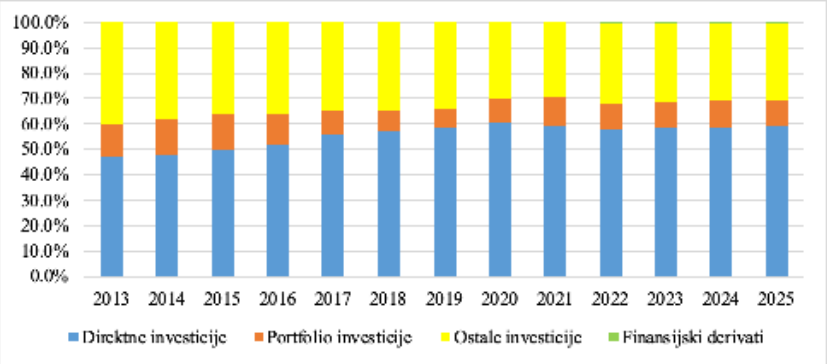
Pregled finansijske pasive

Srbija je od početka novog milenijuma značajne napore ulagala u pravcu privlačenja stranog kapitala. Pritom, pažnja kreatora ekonomske politike dominantno je bila usmerena ka stranim direktnim investicijama, s obzirom na brojne potencijalne prednosti koje zemlja uvoznica kapitala može imati od ovog oblika priliva kapitala (Jovanović-Gavrilović, 2013; Đorđević, 2015). Ukupan neto priliv stranih direktnih investicija u privredi Srbije tokom posmatranog perioda iznosio je 37,4 milijarde evra. Među ključnim investitorima u Srbiji izdvajaju se zemlje Evropske unije, koje su ujedno i njen najznačajniji trgovinski partner (Glišić & Manić, 2025; Kovačević, 2025; Lojanica, 2026). Istovremeno, od pristupa Srbije inicijativi „Pojas i put" Kina je postala sve značajniji investitor u srpskoj privredi (Stojanović – Višić, et. al, 2023; Ivanović & Zakić, 2023).

Rast priliva kapitala u srpskoj privredi posredstvom stranih direktnih investicija pozicionirao je ovaj oblik kretanja kapitala kao najznačajniji segment finansijske pasive. Od 2015. godine na obaveze po osnovu direktnih investicija odnosilo se više od 50% vrednosti finansijske pasive, pri čemu je njihovo učešće u strukturi obaveza prema inostranstvu tokom posmatranog perioda povećano za 12 procentnih poena (Slika 10). Rast obaveza po osnovu direktnih investicija odrazio se na smanjenje učešća portfolio investicija za 2,7 procentnih poena, odnosno ostalih investicija za 9,6 procentnih poena. Istovremeno, u strukturi finansijske pasive zabeleženo je relativno skromno povećanje učešća finansijskih derivata za 0,3 procentnih poena.

[3]*Kategorija ostalo obuhvata: ostali vlasnički kapital, kredite, programe osiguranja, penzija i standardizovanih garancijskih programa kao i ostala potraživanja.*

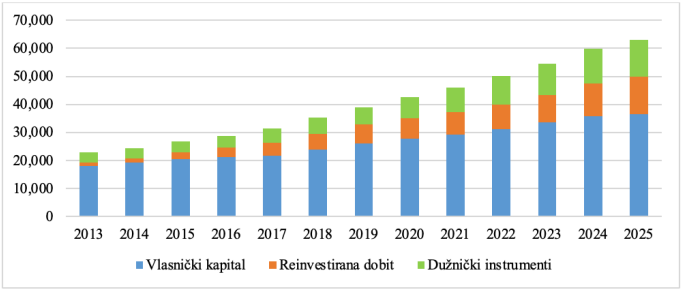
Slika 10 - Struktura finansijske pasive (u %)



Izvor: Kalkulacija autora na bazi NBS (2026)

Posmatrajući strukturu obaveza po osnovu direktnih investicija može se uočiti dominantno učešće vlasničkog kapitala u odnosu na reinvestiranu dobit i dužničke instrumente (Slika 11). Navedeno ukazuje da je prisustvo stranog kapitala u domaćoj privredi pretežno ostvareno posredstvom vlasničkih ulaganja, a u manjoj meri po osnovu kreditnih odnosa između povezanih poslovnih subjekata. Pritom, može se primetiti da od druge polovine posmatranog perioda reinvestirana dobit i dužnički instrumenti beleže intenzivniji rast učešća, uz smanjenje obaveza po osnovu vlasničkog kapitala. Sa aspekta stabilnosti eksterne pozicije, dominantno učešće vlasničkog kapitala (uključujući reinvestiranu dobit) je povoljnije, od dominacije dužničkih instrumenata, budući da vlasnički kapital ne podrazumeva fiksne rokove otplate i obavezu plaćanja kamate. Ipak, ovakva struktura istovremeno stvara osnov za buduće odlive kapitala po osnovu isplate dividendi, tako da krajnji efekti ovih ulaganja zavise od toga u kojoj meri ona doprinose rastu proizvodnje, izvoza, zaposlenosti i domaće dodate vrednosti.

Slika 11 - Obaveze po osnovu direktnih investicija (u milionima evra)



Izvor: Narodna banka Srbije (2026)

Uprkos smanjenju učešća u strukturi obaveza prema inostranstvu, u apsolutnom smislu beleži se rast obaveza po osnovu portfolio investicija za 4,5 milijardi evra. Navedeno je razumljivo s obzirom na brži rast obaveza po osnovu direktnih investicija u poređenju sa ostalim segmentima MIP. Kao što se može uočiti iz Tabele 2, rast portfolio obaveza prema inostranstvu dominantno proizilazi po osnovu emisije dužničkih hartija od vrednosti, budući da je zaduživanje po ovom osnovu povećano za 4,6 milijarde evra tokom posmatranog perioda. Istovremeno, obaveze po osnovu vlasničkih hartija od vrednosti beleže smanjenje za 94 miliona evra. Sektorski posmatrano rast portfolio obaveza se dominantno odnosi na zaduživanje države na međunarodnom tržištu kapitala, uz nešto izraženiju ulogu nefinansijskih institucija i domaćinstava tokom poslednje dve godine posmatranog perioda. Sa aspekta eksterne solventnosti prihvatljivo je što se radi o dugoročnom zaduživanju, pri čemu bi bilo poželjno da su sredstva usmerena u produktivne svrhe u cilju njihovog lakšeg servisiranja.

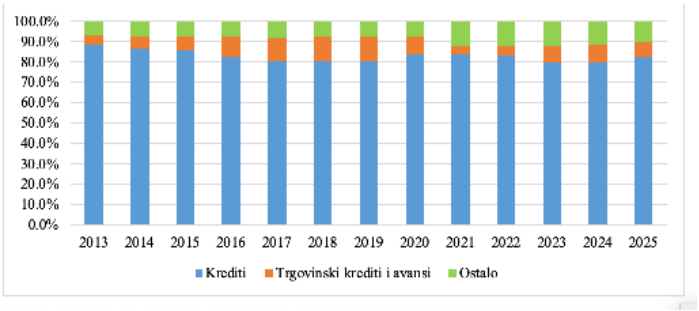
Tabela 2 - Portfolio pasiva (u milionima evra)

Godina	Portfolio pasiva – ukupno	Portfolio pasiva – dužničke HoV	Dugoročno zaduživanje države emisijom HoV
2013.	6.182	6.054	6.054
2014.	7.052	6.940	6.940
2015.	7.346	7.308	7.308
2016.	6.759	6.731	6.731
2017.	5.421	5.393	5.393
2018.	4.749	4.729	4.729
2019.	5.126	5.106	5.101
2020.	6.955	6.932	6.927
2021.	8.796	8.763	8.763
2022.	8.789	8.764	8.757
2023.	9.849	9.818	9.806
2024.	11.176	11.146	10.253
2025.	10.684	10.651	9.738

Izvor: Narodna banka Srbije (2026)

Najznačajniji segment kod obaveza po osnovu ostalih investicija su krediti (Slika 12). Procentualno, oni predstavljaju preko 80% obaveza u okviru ovog segmenta MIP, sa prosečnim učešćem na nivou posmatranog perioda od 83%. Istovremeno, obaveze po osnovu trgovinskih kredita i avansa su prosečno predstavljale 8% pasive ostalih investicija, dok je prosečno učešće svih ostalih komponenti iznosilo 9%. Pritom, u okviru preostalih komponenti ostalih investicija, posebno se izdvajaju obaveze po osnovu gotovog novca i depozita, čije je prosečno učešće u pasivi ostalih investicija iznosilo 5,2%. Obaveze po ovom osnovu dominantno su koncentrisane kod depozitnih institucija izuzev centralne banke.

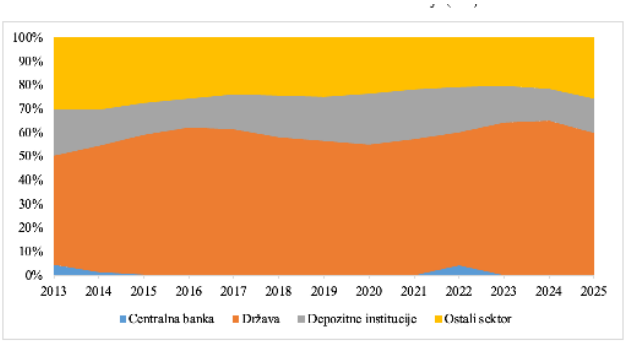
Slika 12 - Struktura pasive ostalih investicija (u %)



Izvor: Kalkulacija autora na bazi NBS (2026)

Osvrtom na sektorsku strukturu kredita, najznačajniji zajmoprimac je država budući da se na dugoročno zaduživanje države odnosi više od polovine uzetih kredita. Manje učešće beleže ostali sektor i depozitne institucije, pri čemu se njihovo učešće smanjuje u odnosu na početak posmatranog perioda, dok se učešće države povećava (Slika 13). Kao i u slučaju portfolio investicija, u potpunosti je reč o dugoročnom zaduživanju države.

Slika 13 - Struktura kredita kod ostalih investicija (u %)



Izvor: Kalkulacija autora na bazi NBS (2026)

Sumirajući pregled pasive MIP Srbije, svakako zabrinjava njen rast tokom posmatranog perioda, kao i njen nivo na kraju posmatranog perioda u odnosu na potraživanja prema inostranstvu. Povoljnijom okolnošću može se smatrati činjenica da se najveći deo obaveza prema inostranstvu odnosi na direktne investicije, pre svega u formi vlasničkog kapitala i reinvestirane dobiti, budući da ove komponente ne predstavljaju klasične dužničke obaveze sa unapred definisanim rokovima otplate i pripadajućim kamatama. Ipak, to ne znači da one ne generišu buduće odlive, s obzirom da rast profitabilnosti stranih investicija može povećati isplate po osnovu dividendi i reinvestirane dobiti. Sa druge strane, izraženiji razlog za oprez predstavlja rast spoljnog zaduživanja države, kako po osnovu emisije dugoročnih dužničkih hartija od vrednosti, tako i po osnovu finansijskih kredita. Iako je u oba slučaja reč o dugoročnim izvorima finansiranja, „cena“ ovakvog zaduživanja u uslovima viših

[4]*Kategorija ostalo obuhvata: ostali vlasnički kapital, gotov novac i depozite, programe osiguranja, penzija i standardizoanih garancijskih programa, ostala dugovanja i alokaciju SPV.*

kamatnih stopa na međunarodnom tržištu kapitala može postati značajno veći teret za javne finansije i eksternu poziciju zemlje. Zbog toga je od presudnog značaja da se ovakav oblik zaduživanja ne koristi za finansiranje tekuće potrošnje, već da bude usmeren ka razvojnim i produktivnim ulaganjima koja mogu povećati proizvodni potencijal, izvozne kapacitete i buduće devizne prilive.

Zaključak

Analiza međunarodne investicione pozicije Srbije pokazuje da je zemlja tokom posmatranog perioda zadržala negativnu neto eksternu poziciju, što potvrđuje njen status neto dužnika prema ostatku sveta. Iako je u relativnom izrazu, došlo do izvesnog poboljšanja neto međunarodne investicione pozicije, navedeno treba rezervisano tumačiti, budući da je u apsolutnom smislu neto pozicija nastavila da se pogoršava. To konkretno implicira da je relativno smanjenje neto dužničke pozicije zemlje u značajnoj meri rezultat bržeg rasta nominalnog bruto domaćeg proizvoda, u odnosu na rast neto spoljnih obaveza, a ne suštinskog smanjenja zavisnosti zemlje od stranog kapitala.

Struktura finansijske pasive pokazuje da najveći deo obaveza Srbije prema inostranstvu proizilazi iz direktnih investicija, pre svega u formi vlasničkog kapitala i reinvestirane dobiti, uz takođe rast dužničkih instrumenata po osnovu direktnih investicija. Ovakva struktura je povoljnija u odnosu na dominaciju dužničkih obaveza, budući da vlasnički oblici finansiranja ne podrazumevaju unapred definisane rokove otplata i obaveze po osnovu plaćanja kamata. Međutim, njihova dominacija ne eliminiše eksternu izloženost, s obzirom da akumulirana strana ulaganja vremenom generišu odlive po osnovu dohotka od investicija, prvenstveno kroz isplatu dividendi stranim investitorima i reinvestiranu dobit. Zbog toga stabilniji karakter obaveza po osnovu direktnih investicija ne treba izjednačavati sa odsustvom negativnih efekata po eksternu poziciju. S tim u vezi, jako je važno u budućem periodu uložiti dodatne napore ka kreiranju povoljnog investicionog ambijenta, koji bi podstakao motivisanost stranih investitora da veći deo profita reinvestiraju u srpskoj privredi.

Poseban izvor opreza predstavlja rast dužničkih oblika pasive, naročito zaduživanja države po osnovu dugoročnih dužničkih hartija od vrednosti i finansijskih kredita u okviru ostalih investicija. Iako dugoročni karakter ovog zaduživanja ublažava neposredan rizik po eksternu poziciju zemlje, on ne eliminiše mogućnost da se u uslovima viših globalnih kamatnih stopa poveća teret ukupnog servisiranja duga. Zbog toga je od suštinskog značaja da se pozajmljena sredstva usmeravaju ka produktivnim i razvojnim ulaganjima.

Na strani aktive, rast deviznih rezervi predstavlja važan stabilizacioni element eksterne pozicije Srbije. Rezervna aktiva ostaje dominantna komponenta finansijske aktive, što je očekivano za ekonomiju sa ograničenim domaćim akumulacionim kapacitetom i visokim stepenom eksterne izloženosti. Istovremeno, postepeni rast učešća monetarnog zlata ukazuje na diversifikaciju rezervne aktive i nastojanje da se njihova struktura učini otpornijom na rizike u globalnom okruženju.

Posmatrano u celini, Srbija nije suočena isključivo sa problemom visokog nivoa neto finansijske pasive, već prvenstveno sa pitanjem kvaliteta i razvojne upotrebe stranog kapitala. Sa jedne strane, struktura pasive je u značajnoj meri zasnovana na relativno stabilnijim oblicima kapitala, dok rast deviznih rezervi predstavlja važan zaštitni amortizer u uslovima eksternih poremećaja. Sa druge strane, nastavak pogoršanja neto pozicije u apsolutnom smislu i njen visok nivo u relativnom pogledu, uz povećanje dužničkih izvora finansiranja ukazuju da eksterna ranjivost zemlje nije otklonjena.

Stoga, jedan od ključnih izazova za kreatore ekonomske politike u narednom periodu ne ogleda se isključivo u obezbeđivanju daljih priliva stranog kapitala, već u tome da oni budu usmereni ka aktivnostima koje povećavaju domaću dodatu vrednost, obezbeđuju rast i jačanje izvoznog sektora i produktivnosti. Jedino u takvim okolnostima, strani kapital može doprineti postepenom smanjenju neto dužničke i unapređenju eksterne pozicije zemlje u celini.

Buduća istraživanja mogla bi biti usmerena na kvantitativno ispitivanje faktora koji determinišu dinamiku međunarodne investicione pozicije Srbije. Primenom odgovarajućih ekonometrijskih metoda bilo bi moguće potpunije sagledati relativni značaj domaćih i eksternih činilaca, kao i utvrditi u kojoj meri uočena kretanja odražavaju specifičnosti srpske privrede, a u kojoj predstavljaju deo širih regionalnih i globalnih tendencija. Dodatno, buduća istraživanja mogla bi da obuhvate stres-testove i izradu alternativnih scenarija kretanja međunarodne investicione pozicije u uslovima promene deviznog kursa, kamatnih stopa, priliva stranih direktnih investicija i dinamike privrednog rasta. Na taj način bi se analiza proširila sa sagledavanja ostvarenih promena na procenu buduće eksterne održivosti i otpornosti domaće privrede na međunarodne finansijske i geopolitičke poremećaje.

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ANALYSIS OF THE INTERNATIONAL INVESTMENT POSITION OF THE REPUBLIC OF SERBIA IN THE CONTEXT OF EXTERNAL SUSTAINABILITY

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Abstract: *This paper analyses the dynamics and structure of Serbia's international investment position. Given that the country's net debtor position deteriorated during the observed period, the main objective of the research is to identify which forms of financial assets and liabilities played a decisive role in its formation. Particular attention is devoted to the structure of liabilities to non-residents, since the largest part of total liabilities still arises from foreign direct investment, primarily in the form of equity capital and reinvested earnings. At the same time, the results indicate an increase in debt-creating liabilities, particularly through government borrowing based on the issuance of debt securities and financial loans. In this context, the paper emphasizes the importance of directing debt-based sources of financing toward productive investments that can increase future foreign exchange inflows and strengthen the country's capacity to service its external obligations.*

Keywords: international investment position, foreign capital, foreign direct investment.

JEL klasifikacija: F21, F34

Introduction

When assessing the external position of a national economy, in addition to the analysis of the balance of payments and indicators of external liquidity, solvency and exposure to financial risk, one of the most important segments is the analysis of the international investment position (IIP). In the simplest terms, the IIP represents the difference between domestic financial assets held abroad and foreign financial liabilities in the domestic economy (Stanišić et al., 2014). It is important to note that this is a stock indicator, since the international investment position shows the value of financial assets and liabilities at a given point in time, most often at the end of the year (Dugalić et al., 2023). Unlike the balance of payments, which records transactions over a certain period, the IIP represents a cross-section of accumulated claims on and liabilities to non-residents. Therefore, changes in the IIP are not determined solely by current transactions, but also by changes in the exchange rate, prices of financial assets, interest rates and other valuation adjustments (Todorović & Đorđević, 2024).
Depending on the relationship between financial assets and liabilities, a country's net external position is determined. If residents' liabilities to non-residents exceed their claims on non-residents, the country has a negative net IIP and is considered a net debtor vis-à-vis the rest of the world (Kovačević, 2020). Conversely, if residents' claims on non-residents exceed their liabilities, the country's net IIP is positive, meaning that it has the status of a net creditor.

Due to relatively modest domestic accumulation, developing countries often rely on foreign capital inflows as an important source of investment financing. In this sense, their position as net importers of capital may be viewed as an expected consequence of the need to compensate for the shortage of domestic sources of financing through external funds. The developmental logic of such a model rests on the assumption that foreign capital inflows can finance productive investment, stimulate economic growth, expand export capacities and increase foreign exchange inflows. If such effects are actually achieved, the growth of production and exports could contribute to the strengthening of domestic accumulation and the gradual reduction of dependence on external financing. Ultimately, this should contribute to an improvement in the external position of these countries, partly through a reduction in their net debtor position.

Given Serbia's position as a net capital-importing economy, this paper analyses its IIP with the aim of identifying the principal changes in its size and structure and assessing their implications for the sustainability of the country's overall external position. The analysis covers the period from 2013 through 2025, providing a sufficiently long time horizon to capture longer-term developments in Serbia's IIP. The choice of 2013 as the starting year makes it possible to examine the period preceding significant changes in the domestic macroeconomic environment and to trace subsequent developments, including fiscal consolidation, increased foreign direct investment inflows, and the gradual strengthening of macroeconomic stability. At the same time, the selected period encompasses major disruptions in the global environment, including the COVID-19 pandemic, the energy crisis, geopolitical tensions, and the tightening of global monetary conditions. It therefore enables an assessment not only of long-term trends but also of the sensitivity of Serbia's IIP to changes in the domestic and international economic environment. Accordingly, the first section reviews the relevant literature on the IIP, while the second examines the evolution of Serbia's IIP in both absolute and relative terms and provides a brief comparison with the countries of Central, Eastern, and Southeastern Europe. The third and fourth sections analyse the dynamics and structure of external financial assets and liabilities, respectively, while the final section presents the main conclusions.

Literature Review

The position of developing countries in the world economy and in the international division of labour is highly delicate. Their domestic accumulation is significantly lower than their development and investment needs, which determines their orientation towards external sources of financing. Accordingly, in the process of reducing development disparities and converging towards developed countries, these economies rely more heavily on foreign than on domestic accumulation. Capital imports can contribute to the improvement of the economic performance of national economies by encouraging economic modernisation, employment growth, technology transfer, export growth and the stronger integration of domestic enterprises into global value chains. However, in practice, the outcomes achieved may often be below those desired and potentially attainable (Malović, 2019). For this reason, it is important how foreign capital is used and what macroeconomic and institutional conditions prevail in the environment in which it is invested (Arsić et al., 2019; Arsov & Naumovski, 2024; Tmušić, 2025). This observation is undoubtedly confirmed by the experience of some European transition countries, where foreign capital was considerably more effective in stimulating economic performance and achieving development objectives. In other words, the key question is not only whether a country is successful in attracting foreign capital, but also whether that capital contributes to the structural transformation of the economy, the strengthening of the export base and the growth of domestic value added, or whether it primarily deepens the country's "dependence" on external sources of financing.

Regardless of whether foreign capital inflows are realised through different forms of investment, such as foreign direct investment, portfolio investment or other investment, or through external borrowing, the essence is that capital imports should be used productively, in terms of contributing to export growth and increasing the capacity of the national economy to autonomously generate foreign exchange inflows. Otherwise, the country's external position may become "vulnerable" to a reduction or sudden stop in capital inflows, while access to new borrowing on the international capital market may become more difficult.

Developing countries also occupy an asymmetric position in relation to developed countries with regard to borrowing capacity (Reinhart et al., 2003). This is understandable, given that the economic capacities of developing countries, such as gross domestic product or exports, are generally smaller than those of developed countries. As a result, developing countries may cross the threshold of high indebtedness much faster than developed economies. A clear example is the United States of America (USA), the world's largest net debtor and the country with the largest current account deficit (Janković, 2018; Aliber, 2020). Despite its negative IIP and deficits of enormous proportions, the position of the USA is considerably less delicate than that of Serbia or other Western Balkan countries, primarily owing to the role of the dollar as the world's reserve currency and the depth and liquidity of the US financial market (Kovačević, 2011; Kovačević, 2014).

A country's net debtor position implies that the volume of foreign capital in the country is higher than the level of domestic capital invested abroad. However, the net value of the IIP does not provide more detailed information beyond indicating the country's financial position vis-à-vis the rest of the world. Therefore, the value of the IIP is also expressed in relative terms, most often in relation to the gross domestic product of the national economy. This is understandable, since the same level of net financial liabilities does not have the same significance for economies of different sizes.

Nevertheless, this indicator also does not provide sufficient information to economic policy makers, creditors and other interested parties regarding the extent to which the external position of the national economy is threatened by negative IIP values. Accordingly, the degree of external exposure of the national economy does not depend solely on whether the country is a net debtor and on the ratio of net liabilities to GDP, but also on the forms of financing on which that position is based. A negative net IIP has different implications if liabilities are predominantly formed through more stable forms of capital, such as foreign direct investment, than if debt capital, portfolio liabilities or other instruments sensitive to changes in financial conditions are dominant (Catão & Milesi-Ferretti, 2014). For this reason, assessing the sustainability and exposure of the external position requires an examination of the functional, maturity and sectoral structure of IIP assets and liabilities.

As in the case of the current account deficit, there is no generally accepted numerical threshold for the net IIP on the basis of which the sustainability of a country's external position could be unequivocally assessed. In other words, a current account deficit below a certain percentage of GDP is not necessarily sustainable, just as a negative net IIP above a certain threshold does not automatically mean that the country is immediately facing the emergence of an external crisis. Accordingly, the assessment of sustainability depends on the broader macroeconomic context, the structure of financing, growth dynamics, export capacities, the maturity and currency structure of liabilities, as well as the country's ability to service its external obligations regularly. Therefore, when assessing the size of a country's net debtor position, reference values are used as signalling indicators. In the case of the IIP, one of the best-known reference values is applied within the European Union's mechanism for monitoring macroeconomic imbalances, according to which a country's net debtor position should not exceed the threshold of 35% of its GDP (Bobeva, 2013). However, values above the reference threshold do not necessarily indicate that the country's net debtor position is unsustainable, but rather that the country may potentially be facing a more serious imbalance. For this reason, this threshold has a signalling function, as it points to the need for a more detailed examination of the structure and dynamics of the IIP, the sources of financing and the risks arising from the maturity, currency and sectoral structure of liabilities. If such an analysis identifies pronounced or excessive macroeconomic imbalances, economic policy recommendations are formulated, which may also include the activation of corrective mechanisms aimed at the gradual elimination of the imbalance (Koll & Watt, 2022).

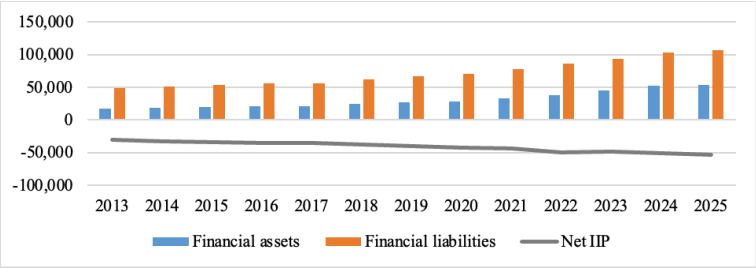
In the economic literature, Serbia's IIP has rarely been analysed in isolation; rather, it has usually been examined additionally in the context of assessing the country's overall external position or in relation to other macroeconomic variables (Zildžović, 2015; Durkalić & Čurčić, 2019; Kovačević, 2021). A more detailed analysis of Serbia's IIP was conducted by Bumbić and Kovačević (2021), who identified a deterioration in the country's net IIP, but also pointed to both positive aspects, such as the dominance of FDI through equity investment and reinvested earnings, and negative aspects of changes in the IIP structure, including the rising share of debt instruments and financial loans, as well as the growing indebtedness of the government through the issuance of long-term securities. As part of his analysis of the external economic imbalance of the Serbian economy, Stanišić (2020) conducted a comparative analysis of Serbia's IIP and that of former transition countries, namely the new member states of the European Union. The results of his research confirm Serbia's considerably less favourable debtor position, along with the fact that Serbia's net IIP has deteriorated, while the other selected countries of Central and Eastern Europe, with the exception of Slovakia, managed

to reduce their net debtor position vis-à-vis the rest of the world. In line with the above, this paper seeks to complement the existing research by analysing recent developments in Serbia's IIP, with particular attention to the period following pronounced disruptions and changes in the international financial environment.

The International Investment Position of Serbia

Reform processes at the beginning of the new millennium created favourable conditions for the increase in foreign capital inflows into the Serbian economy. The country's opening towards the rest of the world, the normalisation of relations with international economic institutions, market liberalisation and the privatisation process represented the initial steps that resulted in the amount of foreign capital in the country becoming significantly higher than domestic claims on non-residents. At the same time, this positioned the country as a net debtor vis-à-vis the rest of the world. Similar trends continued in the subsequent period, as the growth of liabilities to non-residents was more pronounced than the increase in the country's financial assets. Compared with the end of 2013, the value of financial liabilities increased by 58.1 billion euros, or approximately 2.2 times. On the other hand, over the same period, financial assets increased by 35.5 billion euros, which led to a deterioration of the country's net IIP by 22.6 billion euros by the end of 2025. It is interesting to note that in 2025 liabilities to non-residents were almost twice as high as claims on non-residents, so that the country's financial assets and net IIP were almost equal in absolute terms (Figure 1).

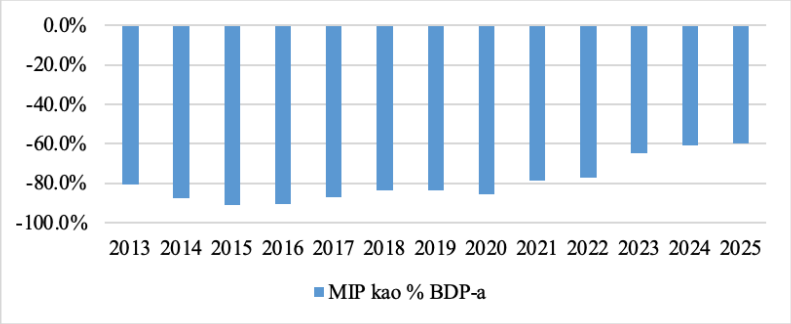
Figure 1 - Serbia's Net International Investment Position (mln eur)



Source: National Bank of Serbia (2026)

In contrast to absolute values, when observed in relation to the size of the economy, an improvement in Serbia's net IIP can be observed. Compared with 2015 and 2016, when the net debtor position exceeded 90% of Serbia's GDP, at the end of the observed period the value of this indicator stood at 60% of GDP, representing the lowest level in the analysed time interval (Figure 2). Bearing in mind that Serbia's net IIP has continuously deteriorated in absolute terms, such developments indicate that nominal GDP growth was more pronounced than the increase in the country's net external liabilities, particularly after 2022. Therefore, the improvement in the IIP in relative terms is primarily the result of nominal GDP dynamics, rather than a reduction in the net debtor position in absolute terms. Since nominal GDP growth may partly reflect inflationary developments, and not exclusively an increase in production, the improvement in Serbia's net IIP in relative terms should be interpreted with caution. In addition, despite its relative decline compared with previous years, Serbia's net IIP remains elevated and above the reference values that imply the need for certain measures aimed at its reduction.

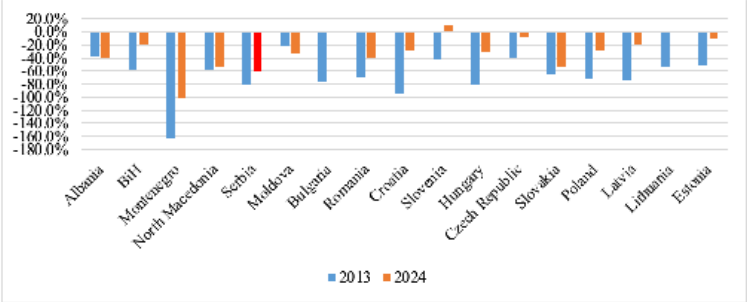
Figure 2 - Serbia's Net Debtor Position as a Percentage of GDP



Source: Author's calculation based on data from the Ministry of Finance and the NBS (2026)

Conclusions regarding the size of Serbia's net debtor position vis-à-vis the rest of the world can also be confirmed in comparison with other countries of Central, Eastern and Southeastern Europe (Figure 3). As can be observed, after Montenegro, Serbia is the largest net debtor in the analysed sample of countries. Compared with 2013, all countries except Albania and Moldova managed to improve their net IIP by the end of the observed period, while Slovenia and Bulgaria moved from the status of net debtors to the position of net creditors vis-à-vis the rest of the world. At the same time, countries such as Croatia and Hungary, which had a more pronounced net debtor position than Serbia in 2013, managed to achieve a far more significant improvement in their IIP by the end of the observed period.

Figure 3 - IIP as a Percentage of GDP in Central, Eastern and Southeastern European Countries[1]

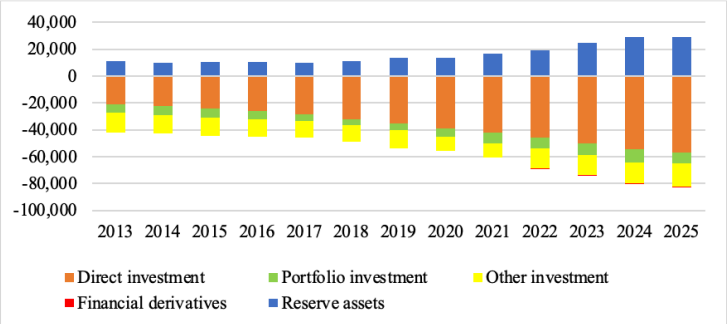


Source: Author's calculation based on data from the IMF and World Bank (2026)

The deterioration of the IIP in absolute terms was mainly driven by the increase in liabilities arising from direct investment. During the observed period, the negative net direct investment position deteriorated by 35.9 billion euros, reaching a record value of 56.6 billion euros in 2025 (Figure 4). At the same time, a deterioration in the net position was also recorded in portfolio investment, amounting to 2.4 billion euros, and in other investment, amounting to 1.9 billion euros. The smallest deterioration in the net position was recorded in financial derivatives and employee stock options, amounting to 270 million euros; this category had maintained a positive net position until 2022. The deterioration in the net position of the presented items was partially offset by an improvement in the net position of reserve assets, which increased by 17.8 billion euros during the observed period.

[1]*Note: For Montenegro, the initial year of observation is 2016 rather than 2013, due to the unavailability of IIP data in international statistics.*

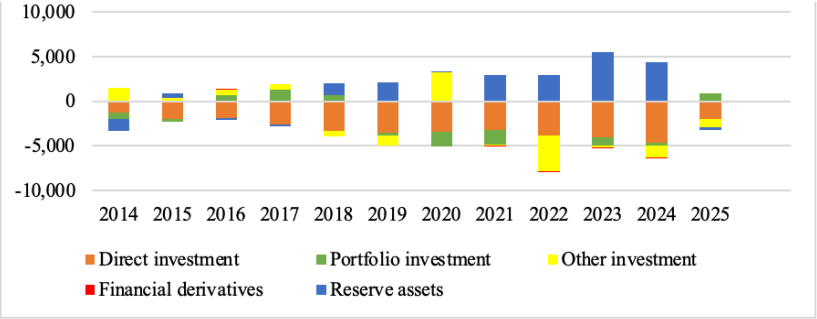
Figure 4 - Structure of Serbia's International Investment Position (mln eur)



Source: National Bank of Serbia (2026)

Observing year-on-year changes in Serbia's IIP, it can be noted that the most pronounced deterioration was recorded in 2022, when the IIP deteriorated by 5 billion euros compared with 2021 (Figure 5). The deterioration of the IIP in this period was mainly driven by the worsening of the other investment position, amounting to 4 billion euros, and the direct investment position, amounting to 3.8 billion euros. The only modest improvement in the IIP was recorded in 2023, when Serbia's net debtor position was lower by 246 million euros, primarily owing to a more pronounced improvement in the reserve assets position compared with other IIP positions. As can be observed, during the analysed period, direct investment continuously contributed to the deterioration of Serbia's net debtor position, given the constant increase in net financial liabilities. The reserve assets position mostly had a positive contribution, except in several initial years of the observed period, as well as in 2025, when a year-on-year decline in reserve assets was recorded.

Figure 5 - Contribution of Components to Serbia's International Investment Position Balance (mln eur)



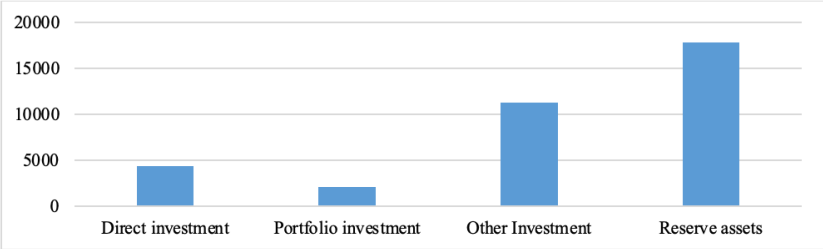
Source: Authors' calculation based on NBS (2026)

In the portfolio investment position, a positive contribution is evident only in the period between 2016 and 2018, as well as at the end of the observed period, due to the reduction in net financial liabilities on this basis. The improvement in the other investment position recorded between 2014 and 2017 also had positive effects on the reduction of the country's net debtor position, while since 2018 an increase in net financial liabilities has been recorded on this basis. As can be observed, the financial derivatives position had the smallest contribution to shaping the dynamics of Serbia's IIP, given its significantly lower values compared with other IIP components.

Structure of Financial Assets

Compared with the beginning of the observed period, Serbia's financial assets increased threefold, or by 35.5 billion euros in absolute terms. Slightly more than half of this increase was the result of the growth of reserve assets, which rose by 17.8 billion euros (Figure 6). The increase in assets under other investment was also significant, although somewhat smaller in scale, amounting to 11.3 billion euros, while more modest increases were recorded within direct investment and portfolio investment, amounting to 4.3 billion euros and 2.1 billion euros, respectively. At the same time, financial assets also increased on the basis of financial derivatives, by 19 million euros.

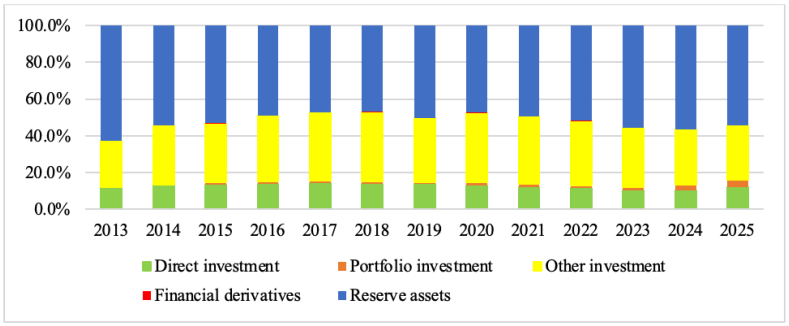
Figure 6 - Contribution of Components to the Growth of Financial Assets Compared with the Beginning of the Observed Period (mln eur)



Source: Authors' calculation based on NBS (2026)

Despite the recorded absolute increase, the share of reserve assets in the structure of financial assets declined by 8.4 percentage points, although they still remained the most important component of the country's financial assets, accounting for 54.3% at the end of the observed period (Figure 7). The decline in the share of reserve assets was primarily the result of an increase in the share of other investment, by 4.4 percentage points, and portfolio investment, by 3.7 percentage points. On the other hand, direct investment maintained a relatively stable share compared with the beginning of the observed period, with a slight increase of 0.4 percentage points, while the share of financial derivatives remained marginal.

Figure 7 - Structure of Serbia's IIP financial assets (in %)



Source: Authors' calculation based on NBS (2026)

The growth of portfolio assets is evident in both equity and debt securities, with the increase being more pronounced in the segment of debt instruments. In addition, it is important to point out that the growth of portfolio assets was not evenly distributed across sectors, since in the case of equity securities and investment fund shares or units, the increase in portfolio assets was primarily concentrated within other sectors, namely non-deposit financial institutions (Table 1). On the other hand, deposit-taking corporations played the most significant role in the growth of portfolio assets arising from debt securities.

Table 1 - Decomposition of Portfolio Assets (mln eur)

Year	Equity securities	Equity securities: other sectors [2]	Debt securities	Debt securities: deposit taking corporations	Portfolio assets
2013	19.7	17.7	32.6	31.3	52.3
2014	32.4	31.7	105.0	104.9	137.4
2015	27.7	24.7	171.7	169.6	199.4
2016	53.8	24.2	251.8	247.9	305.6
2017	82.1	31.1	155.2	149.2	237.2
2018	101.2	41.4	147.4	142.7	248.6
2019	154.2	57.5	135.8	127.0	290.0
2020	222.5	86.3	215.1	208.2	437.6
2021	269.8	115.8	348.1	337.7	618.0
2022	151.6	137.4	432.7	421.8	584.2
2023	233.8	233.8	486.8	455.9	720.6
2024	543.6	526.3	1,197.1	969.8	1,740.7
2025	759.3	680.6	1,383.4	1,121.2	2,142.6

Source: National Bank of Serbia (2026)

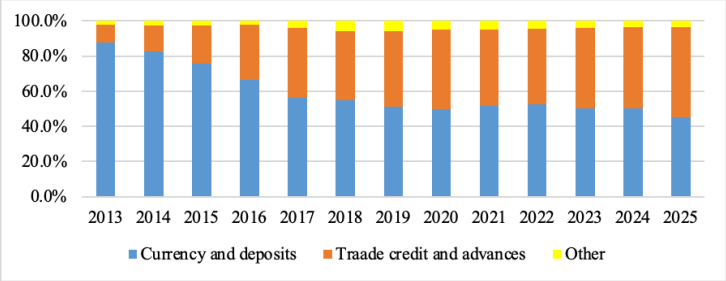
The most pronounced changes in the structure of financial assets are evident in the other investment position. As can be observed, the structure of assets in this segment is highly concentrated in the categories of currency and deposits, and trade credit and advances, which together account for more than 90% of total other investment assets and, during most of the period, more than 95%. (Figure 8) Despite the increase in assets in the form of currency and deposits, amounting to approximately 3.2 billion euros, the increase in trade credit and advances over the same period was more pronounced, amounting to 7.6 billion euros. These tendencies were reflected in a change in the asset structure through a decline in the share of currency and deposits and an increase in the share of trade credit and advances.

[2]*According to the current methodology of the International Monetary Fund, the category of other sectors includes other financial institutions, excluding deposit-taking corporations and the central bank, as well as non-financial corporations, households and non-profit institutions serving households.*

The share of currency and deposits almost halved during the observed period, accounting for 45% of other investment assets in 2025, which represents a decrease of 42.7 percentage points. On the other hand, the share of trade credit and advances increased by 41.4 percentage points during the observed period, making them the most important component of other investment assets, with a share of 51.3%. From a sectoral perspective, claims of other sectors and deposit-taking corporations except the central bank dominate the structure of assets in the form of currency and deposits, indicating that this item primarily refers to deposits and liquid assets of domestic enterprises, households and banks held with non-resident financial institutions.

Within the IIP, trade credit and advances represent a specific form of financing foreign trade transactions, arising from the time mismatch between the delivery of goods and services and their payment. Unlike bank loans, this form of financing arises directly within the buyer-seller relationship, with payment usually being made subsequently, most often within 30, 60 or 90 days after the delivery of goods (Kovačević, 2013). The growth of assets on this basis indicates that residents have net claims on non-residents within foreign trade relations. In other words, domestic enterprises finance foreign partners to a greater extent through deferred or advance payments than they themselves are financed by non-residents on the same basis. At the same time, most of the remaining components of other investment, such as financial loans, insurance, pension and standardised guarantee schemes, also recorded an increase in financial assets, although this increase was far more modest compared with the previously mentioned components.

Figure 8 - Structure of Other Investment Assets (in %) [3]

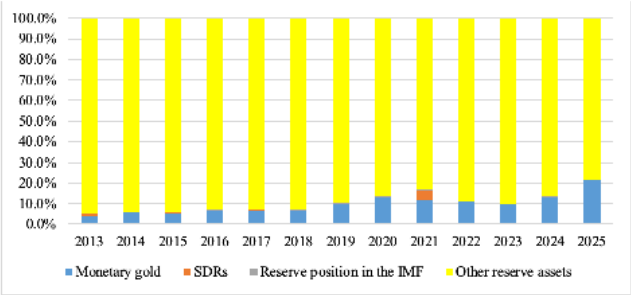


Source: Authors' calculation based on NBS (2026)

The structure of Serbia's reserve assets during the observed period shows that their core remained concentrated within other reserve assets, dominated by securities, as well as currency and deposits (Figure 9). Such a structure is expected, bearing in mind that central banks usually hold the largest part of their reserves in liquid and relatively safe instruments, primarily in the form of debt securities and deposit placements with foreign financial institutions. At the same time, a gradual decline in the relative share of other reserve assets can be observed. This was not the result of their decrease in absolute terms, but primarily of the rising share of monetary gold in total reserves, indicating a certain diversification of reserve assets.

[3]*Note: The "Other" category includes other equity, loans, insurance, pension and standardised guarantee schemes, and other claims.*

Figure 9 - Structure of Reserve Assets (in %)



Source: Authors' calculation based on NBS (2026)

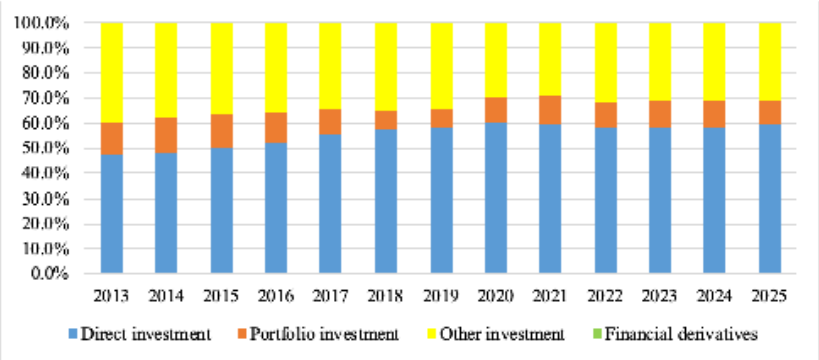
Such developments partly illustrate the gradual change in the structure of reserve assets, with monetary gold assuming an increasingly important role as an instrument of diversification. Unlike securities and deposits, monetary gold does not represent a claim on another institutional sector and therefore does not carry the credit risk of an issuer or a deposit-taking institution. Its growing importance within reserves may be interpreted as an effort to strengthen the stability and resilience of reserve assets in conditions of increased global uncertainty, changing interest rates and more pronounced geopolitical risks.

Overview of Financial Liabilities

Since the beginning of the new millennium, Serbia has made significant efforts to attract foreign capital. In this regard, the attention of economic policy makers has been predominantly directed towards foreign direct investment, given the numerous potential advantages that a capital-importing country may derive from this form of capital inflow (Jovanović-Gavrilović, 2013; Đorđević, 2015). The total net inflow of foreign direct investment into the Serbian economy during the observed period amounted to 37.4 billion euros. Among the key investors in Serbia, European Union countries stand out, as they are also Serbia's most important trading partners (Glišić & Manić, 2025; Kovačević, 2025; Lojanica, 2026). At the same time, since Serbia joined the Belt and Road Initiative, China has become an increasingly important investor in the Serbian economy (Stojanović-Višić et al., 2023; Ivanović & Zakić, 2023).

The increase in capital inflows into the Serbian economy through foreign direct investment has positioned this form of capital movement as the most important segment of financial liabilities. Since 2015, direct investment liabilities have accounted for more than 50% of total financial liabilities, while their share in the structure of liabilities to non-residents increased by 12 percentage points during the observed period (Figure 10). The increase in direct investment liabilities was reflected in a decline in the share of portfolio investment by 2.7 percentage points and other investment by 9.6 percentage points. At the same time, the structure of financial liabilities recorded a relatively modest increase in the share of financial derivatives, by 0.3 percentage points.

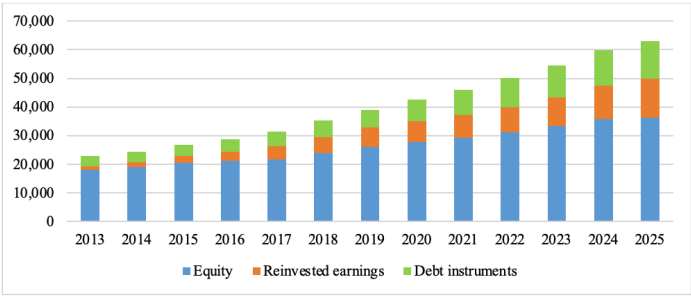
Figure 10 - Structure of Financial Liabilities (in %)



Source: Authors' calculation based on NBS (2026)

Observing the structure of direct investment liabilities, the dominant share of equity capital can be identified relative to reinvested earnings and debt instruments (Figure 11). This indicates that the presence of foreign capital in the domestic economy has been achieved predominantly through equity investment, and to a lesser extent through credit relations between affiliated business entities. At the same time, it can be observed that, from the second half of the analysed period, reinvested earnings and debt instruments recorded a more intensive increase in their shares, accompanied by a decline in liabilities arising from equity capital. From the perspective of external position stability, the dominant share of equity capital, including reinvested earnings, is more favourable than the dominance of debt instruments, since equity capital does not imply fixed repayment deadlines or interest payment obligations. Nevertheless, such a structure simultaneously creates the basis for future capital outflows through dividend payments, so the ultimate effects of these investments depend on the extent to which they contribute to the growth of production, exports, employment and domestic value added.

Figure 11 - Direct Investment Liabilities (mln eur)



Source: National Bank of Serbia (2026)

Despite the decline in their share in the structure of liabilities to non-residents, portfolio investment liabilities increased in absolute terms by 4.5 billion euros. This is understandable given the faster growth of direct investment liabilities compared with other segments of the IIP. As can be observed from Table 2, the increase in portfolio liabilities to non-residents predominantly arises from the issuance of debt securities, since borrowing on this basis increased by 4.6 billion euros during the observed period. At the same time, liabilities arising from equity securities declined by 94 million euros. From a sectoral perspective, the increase in portfolio liabilities predominantly relates to government borrowing on the international capital market, with a somewhat more pronounced role of non-financial corporations and households during the last two years of the observed period. From the perspective of external solvency, it is favourable that this represents long-term borrowing, although it would be desirable for the funds to be directed towards productive purposes in order to facilitate their servicing.

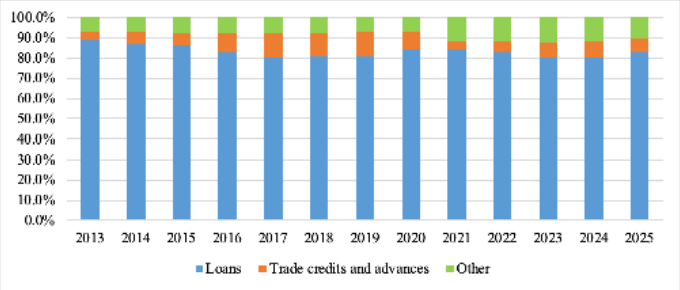
Table 2 - Portfolio Liabilities (mln eur)

Year	Total portfolio liabilities	Portfolio liabilities – debt securities	General government long term debt securities
2013	6,182	6,054	6,054
2014	7,052	6,940	6,940
2015	7,346	7,308	7,308
2016	6,759	6,731	6,731
2017	5,421	5,393	5,393
2018	4,749	4,729	4,729
2019	5,126	5,106	5,101
2020	6,955	6,932	6,927
2021	8,796	8,763	8,763
2022	8,789	8,764	8,757
2023	9,849	9,818	9,806
2024	11,176	11,146	10,253
2025	10,684	10,651	9,738

Source: National Bank of Serbia (2026)

The most important segment of other investment liabilities is loans (Figure 12). In percentage terms, they account for more than 80% of liabilities within this IIP segment, with an average share of 83% over the observed period. At the same time, liabilities arising from trade credit and advances accounted, on average, for 8% of other investment liabilities, while the average share of all other components amounted to 9%. Within the remaining components of other investment, liabilities arising from currency and deposits stand out in particular, with an average share of 5.2% in other investment liabilities. Liabilities on this basis are predominantly concentrated among deposit-taking corporations except the central bank.

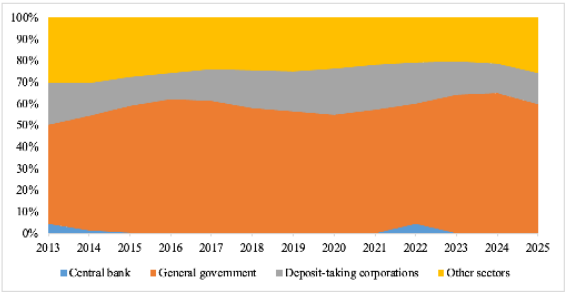
Figure 12 - Structure of Other Investment Liabilities (in %) [4]



Source: Authors' calculation based on NBS (2026)

Looking at the sectoral structure of loans, the government is the most important borrower, since more than half of total loans refer to long-term government borrowing. Other sectors and deposit-taking corporations account for smaller shares, while their shares declined compared with the beginning of the observed period, whereas the government's share increased (Figure 13). As in the case of portfolio investment, this is entirely long-term government borrowing.

Figure 13 - Structure of Other Investment Loans (in %)



Source: Authors' calculation based on NBS (2026)

Summarising the overview of Serbia's IIP liabilities, their increase during the observed period, as well as their level at the end of the observed period relative to claims on non-residents, is certainly a matter of concern. A more favourable circumstance is the fact that the largest part of liabilities to non-residents relates to direct investment, primarily in the form of equity capital and reinvested earnings, since these components do not represent conventional debt obligations with predefined repayment schedules and associated interest payments. However, this does not mean that they do not generate future outflows, since the growth in the profitability of foreign investment may increase payments arising from dividends and reinvested earnings. On the other hand, a more pronounced reason for caution is the increase in government external borrowing, both through the issuance of long-term debt securities and through financial loans. Although in both cases these are long-term sources of financing, the "cost" of such borrowing may become a significantly greater burden for public finances and the country's external position under conditions of higher interest rates on the

[4]*Note: The "Other" category includes other equity, currency and deposits, insurance, pension and standardised guarantee schemes, other liabilities and SDR allocations.*

international capital market. For this reason, it is of crucial importance that this form of borrowing should not be used to finance current consumption, but should rather be directed towards development-oriented and productive investments that can increase production potential, export capacities, and future foreign exchange inflows.

Conclusion

The analysis of Serbia's international investment position shows that, during the observed period, the country maintained a negative net external position, confirming its status as a net debtor vis-à-vis the rest of the world. Although there was a certain improvement in the net international investment position in relative terms, this should be interpreted with caution, since in absolute terms the net position continued to deteriorate. More specifically, this implies that the relative decline in the country's net debtor position was largely the result of faster growth in nominal gross domestic product compared with the growth of net external liabilities, rather than a substantial reduction in the

The composition of Serbia's external financial liabilities indicates that the largest share of its liabilities to non-residents arises from direct investment, primarily in the form of equity capital and reinvested earnings, alongside the growing importance of debt instruments associated with direct investment. From the perspective of external sustainability, such a structure is generally more favourable than one dominated by debt liabilities, since equity financing does not entail predetermined repayment schedules or contractual interest payments. Nevertheless, the predominance of direct investment does not eliminate external exposure, as accumulated foreign investment generates investment income payable to non-resident investors over time, primarily in the form of dividends and reinvested earnings. The relatively stable nature of direct investment liabilities should therefore not be equated with the absence of potentially adverse implications for the country's external position. In this regard, further efforts should be directed towards fostering a favourable investment environment that encourages foreign investors to retain and reinvest a larger proportion of their earnings in the Serbian economy.

A particular source of caution is the increase in debt-based forms of liabilities, especially government borrowing through long-term debt securities and financial loans within other investment. Although the long-term nature of this borrowing mitigates the immediate risk to the country's external position, it does not eliminate the possibility that, under conditions of higher global interest rates, the burden of total debt servicing may increase. For this reason, it is of essential importance that borrowed funds be directed towards productive and development-oriented investment.

On the assets side, the growth of foreign exchange reserves represents an important stabilising element of Serbia's external position. Reserve assets remain the dominant component of financial assets, which is expected for an economy with limited domestic accumulation capacity and a high degree of external exposure. At the same time, the gradual increase in the share of monetary gold indicates the diversification of reserve assets and an effort to make their structure more resilient to risks in the global environment.

The findings suggest that Serbia is not faced solely with the problem of a high level of net financial liabilities, but primarily with the issue of the quality and development use of foreign capital. On the

one hand, the structure of liabilities is largely based on relatively more stable forms of capital, while the growth of foreign exchange reserves represents an important protective buffer in conditions of external disturbances. On the other hand, the continued deterioration of the net position in absolute terms and its still elevated level in relative terms, together with the increase in debt-based sources of financing, indicate that the country's external vulnerability has not been eliminated. Therefore, one of the key challenges for economic policy makers in the coming period is not reflected solely in securing further inflows of foreign capital, but in ensuring that such inflows are directed towards activities that increase domestic value added, growth, the strengthening of the export sector and productivity. Only under such circumstances can foreign capital contribute to the gradual reduction of the net debtor position and to the improvement of the country's external position as a whole.

Future research could focus on quantitatively examining the factors that shape the dynamics of Serbia's international investment position. The application of appropriate econometric methods would allow for a more comprehensive assessment of the relative importance of domestic and external drivers, as well as an evaluation of the extent to which the observed developments reflect country-specific characteristics or form part of broader regional and global trends. Future research could also incorporate stress testing and the construction of alternative scenarios for the evolution of Serbia's international investment position under changing exchange rates, interest rates, foreign direct investment inflows, and economic growth trajectories. Such an approach would extend the analysis beyond observed historical developments towards a forward-looking assessment of external sustainability and the resilience of the Serbian economy to international financial and geopolitical shocks.

Acknowledgements

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DINAMIKA SISTEMSKOG ZNAČAJA BANAKA NA TRŽIŠTU REPUBLIKE SRBIJE: ANALIZA KLASTERSKE MIGRACIJE I STRUKTURNOG PRILAGOĐAVANJA

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Apstrakt: *Predmet ovog rada je analiza strukturne transformacije i strateškog pozicioniranja banaka u Republici Srbiji u periodu od 2017. do 2024. godine. Osnovni cilj istraživanja je naučna analiza dinamike bankarskog sektora primenom metodologije strateških grupa, kako bi se identifikovale ključne migracije između tržišnih kvadranata i ocenio stepen strukturnog prilagođavanja sektora na makroekonomske šokove. Metodologija obuhvata deskriptivnu statistiku, komparativnu analizu i vizuelizaciju na dvodimenzionalnoj matrici, sa fokusom na uzorak od 11 banaka. Rezultati istraživanja potvrđuju da je intenzivan proces konsolidacije doveo do značajnog ukrupnjavanja tržišta, pri čemu je prosečno tržišno učešće u ukupnoj aktivi vodećih banaka poraslo sa 5,49% na 8,38%. Analiza pokazuje visok stepen otpornosti sektora, koji je zadržao primarnu funkciju kreditiranja privrede i stanovništva sa udelom kredita iznad 60%. Utvrđeno je da je pad profitabilnosti (ROA) i kapitalne baze (E/A) tokom krizne 2020. godine bio privremenog karaktera, nakon čega je usledila stabilizacija performansi na zdravim osnovama.*

Ključne reči: konsolidacija tržišta, bankarski sektor Srbije, finansijska stabilnost, klaster analiza, strateške grupe

JEL klasifikacija: G21, G34, G01

Uvod

Savremeni bankarski sistem Republike Srbije u periodu od 2017. do 2024. godine predstavlja primer duboke strukturne transformacije i strateškog prilagođavanja. Ovaj period obeležen je intenzivnim procesom konsolidacije, gde je tržište evoluiralo iz stanja umerene fragmentacije ka visoko koncentrisanom ambijentu. Glavni pokretači ovih promena bili su talasi akvizicija vodećih bankarskih grupacija, digitalna transformacija i neophodnost povećanja operativne efikasnosti u uslovima globalnih neizvesnosti, kao i potreba za očuvanjem stabilnosti u uslovima globalnih ekonomskih šokova.

Tokom posmatranog perioda, sektor se suočio sa heterogenim izazovima – od perioda niskih kamatnih stopa, preko globalne zdravstvene krize 2020. godine, do aktuelne restriktivne monetarne politike. Kroz analizu ključnih indikatora poput profitabilnosti ROA (engl. Return on Asset), strukture aktive kroz udeo kredita i stabilnosti kapitalne baze E/A (engl. Equity to Assets), rad nastoji da dokumentuje kako su se ovi faktori odrazili na konkurentsku poziciju banaka. Poseban značaj pridaje se činjenici da je proces ukrupnjavanja doveo do rasta prosečnog tržišnog učešća pojedinih banaka, što jasno ukazuje na formiranje snažnih tržišnih lidera. Fokus rada je na analizi promena i njihovog uticaja na performanse i strateško pozicioniranje banaka, sa posebnim osvrtom na otpornost sektora tokom pandemijske 2020. godine.

Predmet istraživanja je analiza finansijskih performansi i tržišne pozicije banaka u Srbiji. Osnovni cilj istraživanja je naučna analiza dinamike strateškog pozicioniranja banaka u Srbiji primenom metodologije strateških grupa. Rad teži da klasifikuje banke na bazi njihove tržišne snage i performansi kako bi se identifikovale ključne migracije između strateških kvadrata. Dodatni cilj je utvrđivanje stepena otpornosti sektora na bazi kretanja indikatora profitabilnosti i kvaliteta aktive u uslovima makroekonomske neizvesnosti.

Na bazi postavljenih ciljeva, definisane su sledeće hipoteze:
H1: Proces strukturne konsolidacije bankarskog tržišta u Srbiji doveo je do značajnog rasta prosečnog tržišnog učešća vodećih banaka i smanjenja ukupne fragmentacije sektora.
H2: Bankarski sektor pokazuje visok stepen rezistentnosti u domenu svoje osnovne funkcije - kreditiranja privrede i stanovništva, održavajući stabilnost tradicionalnog modela kreditiranja uprkos uticajima cikličnih eksternih šokova.
H3: Pad stope prinosa na aktivu (ROA) i učešća sopstvenog kapitala (E/A) tokom krizne 2020. godine bio je privremenog karaktera, dok dugoročni trendovi ukazuju na visoku adaptivnu sposobnost sektora da stabilizuje performanse na održivim osnovama.

Za potrebe rada korišćen je kombinovani pristup koji obuhvata:
1. Deskriptivnu statističku analizu koja je primenjena na ključne indikatore (ROA, E/A, udeo kredita) kako bi se utvrdili prosečni trendovi na nivou celog sektora;
2. Komparativna analiza kako bi se uporedila stanja iz 2017. godine i stanja iz 2024. godine, radi identifikacije dugoročnih promena;
3. Vizuelizacija banaka na dvodimenzionalnoj matrici (Tržišni udeo naspram ROA) kako bi se banke klasifikovale u grupe kao što su „Lideri", „Specijalisti" i „Izvođači";
4. Analiza migracija odnosi se na praćenje kretanja pojedinačnih banaka unutar strateških grupa na osnovu njihovih relativnih performansi.

Pregled literature i metodologija istraživanja

Analiza strateškog pozicioniranja banaka zahteva čvrst teorijski okvir koji omogućava transformaciju finansijskih podataka u relevantne zaključke. U tom smislu, primena koncepta strateških grupa u ovom radu opravdana je nalazima Portera (1980), koji ističe da unutar jedne industrije kompanije nisu homogeni entiteti, već se grupišu oko sličnih strateških dimenzija. U savremenim uslovima, autori poput Bikker i Bos (2008) naglašavaju da procesi konsolidacije, kojima svedočimo i na tržištu Srbije, direktno menjaju konkurentsku dinamiku, favorizujući banke koje kroz ekonomiju obima uspevaju da optimizuju svoje troškovne strukture. Prema nalazima koje navode Casu i ostali (2015); (Gegenheimer, 2007) ukrupnjavanje sektora dovodi do redistribucije tržišne moći, pri čemu veći entiteti koriste prednosti diversifikacije aktive kako bi ostvarili stabilnije prihode u uslovima makroekonomske neizvesnosti.

Koncept strateških grupa, kao srednji nivo analize između celog sektora i pojedinačne banke, omogućava identifikaciju unutrašnje strukture tržišta. Prema istraživanjima koja su sproveli Halaj i Zochowski (2009); Schildbach i Schneider, (2017) banke unutar iste strateške grupe ne dele samo slične vizuelne pozicije na matrici, već i slične profile rizika i odgovore na regulatorne promene. Ovaj koncept implicira postojanje „barijera mobilnosti" koje sprečavaju tranziciju banaka između grupa, čime se objašnjava zašto određene institucije godinama zadržavaju poziciju „specijalista" ili „lidera" uprkos promenama u tržišnom ambijentu.

U tom kontekstu, varijabla ROA u literaturi se dosledno koristi kao superiorno merilo operativne efikasnosti, jer izoluje profitnu snagu banke od efekata finansijske poluge, što je od presudnog značaja za poređenje banaka različitih veličina unutar istog sektora (Rose, Hudgins, 2015); (Wagdi i ostali, 2019); (Budhathoki i ostali, 2020). Za razliku od prinosa na sopstveni kapital (engl. Return On Equity ROE), ROA omogućava analitičarima da utvrde koliko menadžment efikasno koristi ukupne resurse za generisanje dobiti, što je ključno za objektivno mapiranje banaka na strateškoj matrici.

Poseban segment literature bavi se stabilnošću bankarskog poslovanja kroz analizu kvaliteta aktive i adekvatnosti kapitala. Autori poput Berger i Bouwman (2013) ističu da je uloga kapitala, merena kroz E/A, ključna u fazama tržišnih turbulencija, jer deluje kao „amortizer" eksternih šokova. U radovima koji analiziraju bankarska tržišta u razvoju, često se ističe dualitet između potrebe za visokom kapitalizacijom i težnje ka maksimizaciji profitabilnosti (Güngör, 2023; Casu i ostali, 2015). Ovaj teorijski konflikt direktno je primenljiv na analizu domaćeg tržišta u periodu 2017–2024, gde se kroz migraciju banaka između strateških grupa može pratiti transformacija od tradicionalno visoko kapitalizovanih institucija ka efikasnijim, ali potencijalno izloženijim modelima poslovanja. Autori poput Mishkin i Eakins (2018); Berger i Bouwman (2011) naglašavaju da adekvatno kapitalizovane banke imaju veću verovatnoću opstanka tokom sistemskih kriza, jer sopstveni kapital predstavlja prvu liniju odbrane od gubitaka u kreditnom portfoliju, što direktno utiče na dugoročno strateško pozicioniranje institucije.

Analiza promena u strukturi i tržišnog učešća predstavlja ključnu determinantu stabilnosti finansijskih sistema u ekonomijama u tranziciji. Domaća i regionalna empirijska praksa nudi dragocene uvide u ove procese. Lončar i Rajić (2012) ukazuju na rane faze restrukturiranja i uticaj makroekonomskih faktora na stabilnost plasmana, dok Bukvić (2017, 2020) detaljno dokumentuje evoluciju koncentracije i naglašava da ukrupnjavanje sektora neminovno menja strateške prioritete banaka. Kaličanin i Terzić (2023) kroz analizu tržišne strukture ističu da pojačano grupisanje oko nekoliko vodećih bankarskih

grupacija stvara specifične barijere mobilnosti, primoravajući manje aktere na defanzivne strategije ili nišno pozicioniranje. Korišćenje metodologije strateških grupa, koja nalazi korene iz postavki Portera (1980) i Granta (2010), omogućava premošćavanje jaza između agregatne makroanalize i individualnog ponašanja banaka, dok Huizinga i Demirgüç-Kunt (2000) podsećaju da finansijska struktura i veličina tržišnog učešća direktno opredeljuju dugoročne raspone profitabilnosti.

S tim u vezi, metodološki okvir ovog rada zasnovan je na kombinaciji kvantitativne analize finansijskih pokazatelja i kvalitativne interpretacije strateškog pozicioniranja. Primena modela strateških grupa omogućava prevazilaženje ograničenja koja nameće posmatranje sektora kao homogene celine, pružajući uvid u specifičnu dinamiku unutar tržišta Srbije u periodu od 2017. do 2024. godine.

Istraživanje je fokusirano na reprezentativni uzorak od 11 banaka na tržištu Srbije, koje su odabrane na osnovu dostupnosti podataka u posmatranom osmogodišnjem periodu i značaja za formiranje proseka sektora. Takođe, ove banke u kontinuitetu pokrivaju preko 90% ukupne aktive celokupnog bankarskog sektora tokom posmatranog osmogodišnjeg perioda. Uključivanje ovako širokog uzorka je neophodna za precizno izračunavanje aritmetičkih sredina koje definišu koordinatni početak (tzv. „krst") na matricama strateških grupa. Iako je u kreiranju matrica uključeno 11 banaka, i to Aik banka, Adriatic banka, Banka Intesa, Banka Poštanska štedionica, Erste banka, Eurobank, Halk bank, Nlb Komercijalna banka, OTP banka, Raiffeisen banka i Unicredit banka, fokus dubinske analize i praćenja strateških migracija stavljen je na reprezentativni uzorak od pet sistemski značajnih banaka (Banca Intesa, OTP, Raiffeisen, NLB Komercijalna i UniCredit). Ovakav metodološki dualizam koji podrazumeva posmatranje celog tržišta uz fokus na lidere opravdan je teorijom o tržišnoj koncentraciji i ekonomiji obima koju zastupaju Bikker i Bos (2008); Hac (2021) koji naglašavaju da dominantni akteri diktiraju tempo tehnoloških i operativnih promena u sektoru. S obzirom na to da ove banke kontrolišu preko 80% aktive, one predstavljaju jezgro celokupnog sektora. Ovaj pristup omogućava da se dobijeni rezultati i uočeni trendovi sa visokim stepenom pouzdanosti generalizuju na celokupan bankarski sistem Srbije.

Centralni merni instrument u radu je matrica strateških grupa, gde su banke mapirane u koordinatnom sistemu na osnovu njihovih performansi u odnosu na prosek sektora. Centralna tačka preseka na grafikonu određena je na osnovu prosečne vrednosti sektora za svaku posmatranu godinu. Ova tehnika vizuelizacije, koju su popularizovali Hitt, Ireland i Hoskisson (2013), omogućava klasifikaciju banaka u četiri kvadranta: Lideri, Specijalisti, Izvođači i Banke u transformaciji. Primarni podaci su prikupljeni iz revidiranih godišnjih finansijskih izveštaja banaka i statističkih biltena Narodne banke Srbije. Za obradu podataka korišćeni su deskriptivna statistika i komparativna analiza, čime je omogućeno testiranje postavljenih hipoteza kroz identifikaciju strateških migracija banaka u osmogodišnjem periodu.

Za potrebe formiranja strateških grupa, definisane su dve ključne varijable koje čine ose naše matrice: 1. Tržišni udeo (engl. Market Share): Tržišno učešće u ukupnoj aktivi koristimo kao indikator tržišne snage, prateći stavove (Berger i Bouwman, 2011) da veličina aktive direktno utiče na konkurentsku prednost kroz niže troškove finansiranja. Fokus na tržišno učešće kao ključnu determinantu snage banke opravdan je nalazima Mester i ostali (2003) da veći tržišni udeo u post-kriznim periodima često korelira sa većom stabilnošću neto kamatnih margina i boljom pregovaračkom moći.

$$\text{Tržišni udeo} = \text{Ukupna aktiva_banke} / \text{Ukupna aktiva_sektora} * 100$$

2. Prinos na aktivu ROA: Kao primarni indikator profitabilnosti i efikasnosti upravljanja imovinom ROA je odabran kao mera performansi jer, prema Golin i Delhaise (2013), Parvin i ostali (2019), Wagdi i ostali (2019) ovaj indikator najbolje pokazuje sposobnost menadžmenta da generiše profit iz raspoložive imovine, bez obzira na način finansiranja.

ROA=Neto dobit/Ukupna aktiva*100

Pored primarnih varijabli strateškog pozicioniranja, u radu su analizirani i pomoćni indikatori koji pružaju uvid u profil rizika i stabilnosti banaka. Prema navodima Hull-a (2015) i Kagecha (2014), u modernom bankarstvu performanse se ne mogu posmatrati izolovano od adekvatnosti kapitala i kvaliteta aktive. U skladu sa tim uvodimo dve pomoćne varijable:

3. Udeo kredita u ukupnoj aktivi: Ova varijabla služi kao indikator strateške usmerenosti banke ka realnom sektoru. Kako ističu Casu i ostali (2015), visok udeo kredita ukazuje na tradicionalni model posredovanja, ali nosi i veći nivo kreditnog rizika.
4. Odnos sopstvenog kapitala i ukupne aktive (E/A): Korišćen je kao mera finansijske poluge i solventnosti. Savremeni autori poput Mishkina i Eakinsa (2018) naglašavaju da nivo kapitala određuje kapacitet banke da apsorbuje gubitke. Pad ovog pokazatelja na 5,95% u 2020. godini analiziran je kroz prizmu regulatornih zahteva i upravljanja kapitalom u kriznim uslovima, što je ključno za testiranje hipoteze H3.

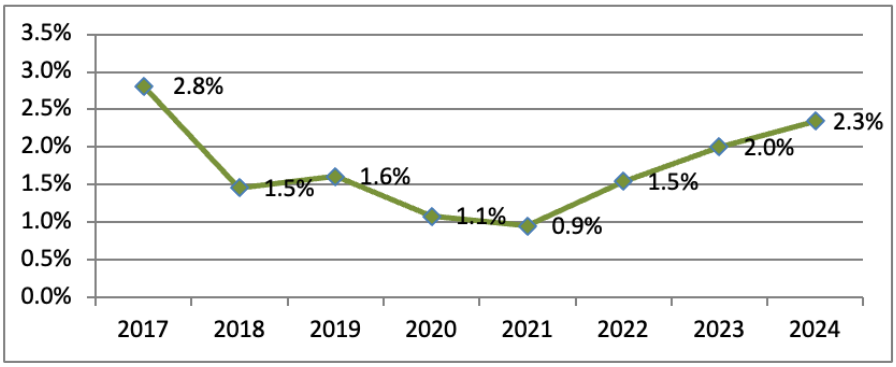
Analiza rezultata i diskusija

U ovom poglavlju interpretiramo ključne nalaze istraživanja, fokusirajući se na dinamiku profitabilnosti, stabilnost aktive i strateške migracije na primeru banaka unutar bankarskog sektora Republike Srbije u periodu 2017–2024. godine.

Analiza trendova profitabilnosti

Osnovni indikator uspešnosti svake bankarske strategije je njena sposobnost da generiše prinos iz raspoložive imovine. Prateći metodologiju Rose i Hudgins (2015), fokus stavljamo na ROA pokazatelj.

Grafikon 1 - Trend kretanja prosečnog ROA analiziranih banaka za period 2017-2024. god.

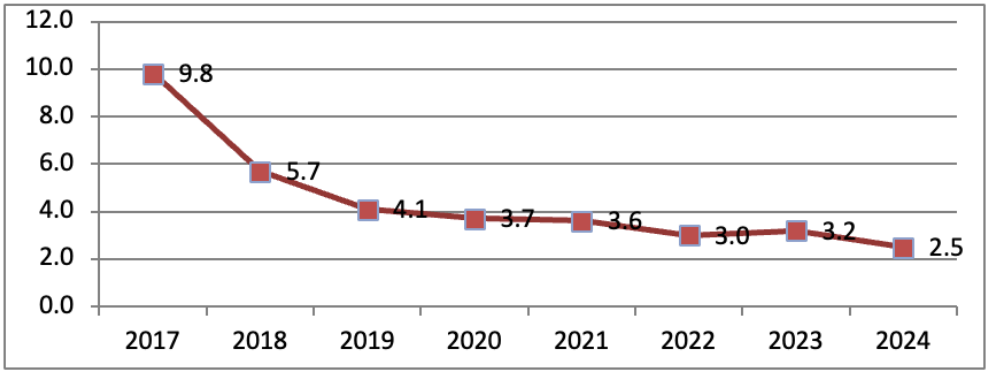


Izvor: Autor na osnovu podataka iz Bilansa uspeha odabranih banaka

Kao što se vidi na Grafikonu 1, prosečna vrednost ROA odabranih banaka u bankarskom sektoru Republike Srbije na početku posmatranog perioda iznosio je 2,81%. Međutim, uočljiv je trend erozije prinosa koji dostiže svoj minimum u 2021. godini 0,95%. Ovaj pad profitabilnosti korelira sa globalnim makroekonomskim poremećajima, ali i sa procesom čišćenja bilansa. Ipak, snažan oporavak na 2,34% u 2024. godini potvrđuje hipotezu o privremenom karakteru pada i uspešnom prilagođavanju banaka novim kamatnim ciklusima. U skladu sa nalazima Bikker i Bos (2008), ovaj oporavak se može pripisati efektima konsolidacije - veće banke su kroz optimizaciju troškova uspele da brže povrate profitabilnost u uslovima rasta kamatnih stopa.

Da bismo razumeli ovaj oporavak profitabilnosti, neophodno je istovremeno analizirati kretanje problematičnih kredita koji su godinama opterećivali bilanse. Grafikon 2 prati kretanje NPL-a (engl. Non-Performing Loans) celokupnog bankarskog sektora.

Grafikon 2 - Trend učešća problematičnih kredita NPL-a u ukupnim kreditima bankarskog sektora Srbije (2017–2024)



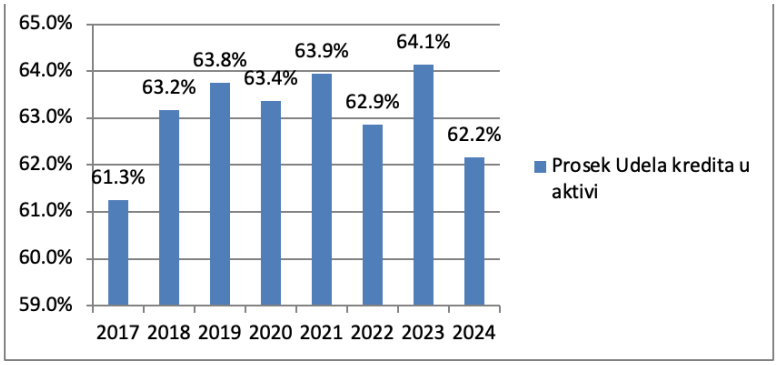
Izvor: Autor na osnovu zvaničnih podataka i izveštaja Narodne banke Srbije

Kao što možemo da vidimo, kontinuirani pad NPL-a direktno je uticao na oslobađanje rezervisanja za gubitke. Prema nalazima Hull (2018), smanjenje kreditnog rizika je primarni pokretač rasta ROA, jer omogućava bankama da efikasnije alociraju kapital u profitabilne plasmane.

Dinamika aktive i kapitalne baze

Drugi segment analize fokusira se na stabilnost kroz odnos kreditne aktivnosti i učešća sopstvenog kapitala. Nakon analize prinosa, fokus pomeramo na strukturu bilansa, gde testiramo stabilnost tradicionalnog bankarskog modela (Hipoteza H2) i otpornost kapitala.

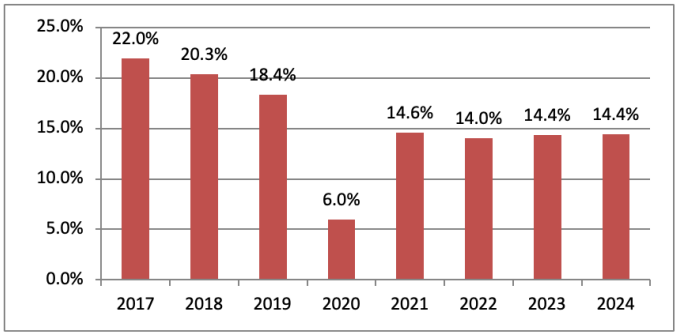
Grafikon 3 - Prosečno učešće neto kredita u ukupnoj aktivi odabranih banka (u %) po godinama za period 2017-2024. god.



Izvor: Autor na osnovu podataka iz Bilansa stanja odabranih banaka

Uprkos intenzivnoj digitalizaciji, Grafikon 3 pokazuje da udeo kredita ostaje stabilan iznad nivoa od 60%. Ovo je ključni dokaz da banke u Srbiji nisu značajno menjale svoj model poslovanja, već su ostale fokusirane na kreditiranje realnog sektora i stanovništva. Paralelno sa stabilnošću kredita, na Grafikonu 4 posmatramo kretanje sopstvenog kapitala kao glavnog apsorbera rizika.

Grafikon 4 - Prosek sopstvenog kapitala i ukupne aktive E/A odnos u % po godinama za period 2017-2024. god.



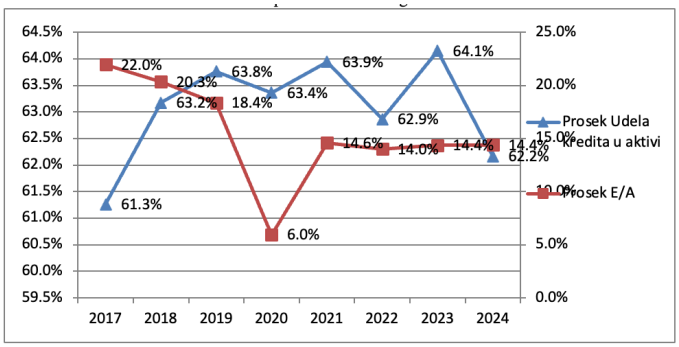
Izvor: Autor na osnovu podataka iz Bilansa stanja odabranih banaka

Ovde uočavamo najdramatičniju promenu – pad prosečnog E/A na svega 5,95% u 2020. godini. Sa stanovišta Berger i Bouwman (2013), ovo ukazuje na ekstremno visoku finansijsku polugu u kriznoj godini. Ipak, rast na 14,39% u 2024. pokazuje povratak konzervativnijoj politici kapitalizacije, što povećava stabilnost celog sistema.

Privremeni karakter pogoršanja performansi tokom 2020. godine ne može se posmatrati izolovano od pravovremene reakcije Narodne banke Srbije. Ključnu ulogu u očuvanju stabilnosti imali su propisani moratorijumi na otplatu obaveza, koji su sprečili nagli skok NPL-a u jeku pandemije, kao i regulatorna popuštanja u pogledu klasifikacije aktive. Ove mere su omogućile bankama da očuvaju likvidnost i kreditni potencijal, što je, uz kasniju stabilizaciju kamatnih stopa, rezultiralo brzim oporavkom ROA na 2,34% do 2024. godine.

Da bismo sumirali ove trendove, koristimo sledeći uporedni prikaz:

Grafikon 5 - Korelacija proseka kreditne aktivnosti i kapitalne baze posmatranih banaka za period 2017-2024. god.

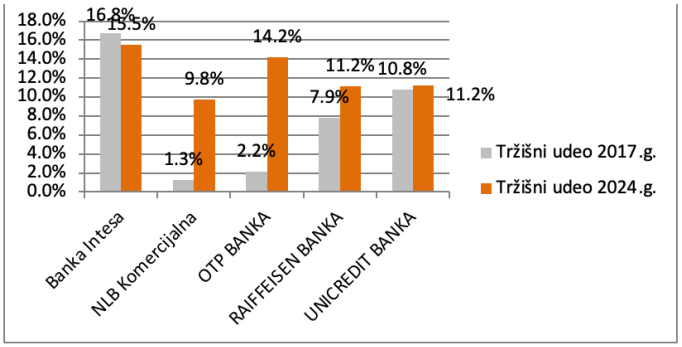


Izvor: Autor na osnovu podataka iz Bilansa uspeha odabranih banaka

Podaci pokazuju izuzetnu stabilnost udela kredita u aktivi, koji se kreće oko 62%. Ovo potvrđuje Hipotezu H2 - banke u Srbiji su zadržale fokus na tradicionalnom bankarstvu uprkos digitalizaciji i krizama. Posebno je interesantan pad E/A odnosa na 5,95% u 2020. godini. Sa stanovišta diskusije, ovaj nalaz reflektuje ono što Berger i Bouwman (2013) nazivaju „upravljanjem kapitalnom efikasnošću". Banke su iskoristile krizni momenat za povećanje finansijskog leveridža, što je kasnije 2024. godine rezultiralo stabilizacijom na 14,3%. Svi prethodno navedeni trendovi koji podrazumevaju rast profitabilnosti i stabilizacija kapitala, odvijali su se u kontekstu intenzivnog ukrupnjavanja tržišta.

Nakon analize strukturnog balansa između kreditne aktivnosti i kapitalne baze, neophodno je ispitati kako su se ove interne performanse reflektovale na eksternu konkurentsku poziciju vodećih igrača. Dok su stabilnost udela kredita i rekapitalizacija sektora osigurali sistemsku otpornost, procesi merdžera i akvizicija su iz korena izmenili mapu tržišne moći. Kako bi se precizno kvantifikovao efekat konsolidacije na najznačajnije institucije, u nastavku sledi uporedni prikaz tržišnog učešća pet vodećih banaka. Ovaj uvid nam omogućava da identifikujemo „strateški nukleus" sektora koji je kroz ekonomiju obima, opisanu u radovima Bikker i Bos (2008), uspeo da apsorbuje manje konkurente i značajno poveća svoj uticaj na tržištu u periodu od 2017. do 2024. godine.

Grafikon 6 - Komparativni prikaz tržišnog učešća pet sistemski najznačajnijih banaka (2017. i 2024. godina)



Izvor: Autor na osnovu podataka iz Bilansa stanja odabranih banaka i Godišnjeg izveštaja o stabilnosti bankarskog sektora

Grafikon 6 direktno potvrđuje Hipotezu H1 o intenzivnom ukrupnjavanju banaka. Posebno je indikativan rast tržišnog učešća kod banaka koje su bile nosioci integracionih procesa, gde vidimo da se jaz između lidera i ostatka tržišta produbio, čime su formirane visoke barijere mobilnosti za manje bankarske institucije. Prosečno učešće po banci poraslo je sa 5,49% na 8,38%, što je rezultat akvizicija (OTP, NLB Komercijalna). Kako navode Bikker i Bos (2008), veće učešće donosi ekonomiju obima koja je bila neophodna da bi se postigli ROA rezultati iz 2024. godine. Svi ovi podaci sumirani su u Tabeli 1 koja predstavlja osnovu za kreiranje matrica strateških grupa.

Tabela 1- Sumarni pregled proseka ključnih indikatora odabranih banaka u bankarskom sektoru za period 2017–2024. god.

Godina	Prosek Tržišnog udela	Prosek ROA	Prosek E/A	Prosek Udela kredita u aktivi
2017	5,49%	2,81%	21,96%	61,26%
2018	5,58%	1,46%	20,35%	63,17%
2019	5,89%	1,61%	18,35%	63,76%
2020	5,95%	1,08%	5,95%	63,36%
2021	6,84%	0,95%	14,58%	63,94%
2022	8,05%	1,55%	14,01%	62,86%
2023	8,29%	2,00%	14,36%	64,15%
2024	8,38%	2,34%	14,39%	62,17%

Izvor: Autor na osnovu podataka iz Bilansa stanja i Bilansa uspeha odabranih banaka

Rast prosečnog tržišnog udela vodećih banaka sa 5,5% u 2017. godini na 8,4% u 2024. godini, posmatrano kroz prizmu ukupne bilansne aktive, pruža direktan i jasan dokaz za potvrdu Hipoteze H1. Ovi podaci nedvosmisleno ukazuju na to da je proces konsolidacije doveo do opipljivog ukrupnjavanja domaćeg tržišta u korist sistemski značajnih učesnika. Kada je reč o stabilnosti kapitalne baze (Hipoteza H3), podaci pokazuju da je odnos sopstvenog kapitala i aktive (E/A) u kriznoj 2020. godini zabeležio pad na 5,95%, što reflektuje visok nivo finansijskog leveridža u jeku pandemije. Ovaj kratkotrajni pad bio je direktna posledica svesnog i kontrolisanog rasta bilansne aktive banaka radi pružanja neophodne likvidnosti privredi i stanovništvu kroz propisane moratorijume i olakšice, a ne pokazatelj ugroženosti solventnosti samog sektora. Već od 2021. godine ovaj pokazatelj se naglo stabilizuje na nivou od preko 14%, demonstrirajući izuzetno visoku adaptivnu sposobnost i sposobnost domaćeg bankarskog sektora da u kratkom roku obnovi i očuva kapitalne amortizere, što pruža pouzdan dokaz za potvrdu Hipoteze H3.

Strateško pozicioniranje i migracije

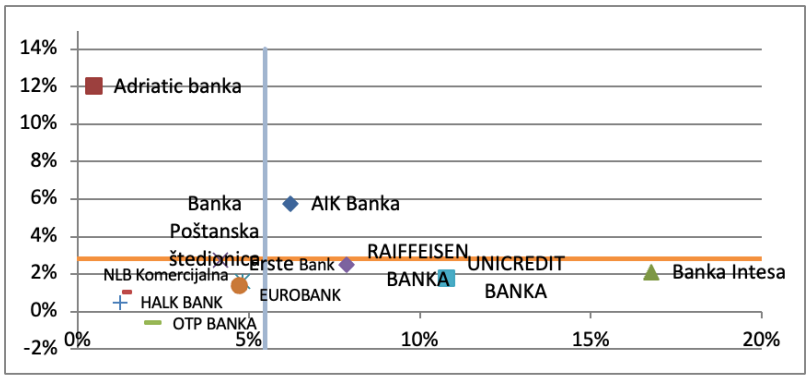
Nakon detaljne analize pojedinačnih indikatora profitabilnosti i strukture aktive, ključni korak u istraživanju predstavlja integracija ovih varijabli u jedinstveni strateški prostor. Primenom matrice strateških grupa, identifikujemo kako su se banke repozicionirale u odnosu na proseke sektora, koji su se, kako je Tabela 1 pokazala, značajno pomerali tokom posmatranih osam godina. Finalni deo analize predstavlja mapiranje banaka na matrici strateških grupa za 2017. i 2024. godinu. U cilju precizne identifikacije konkurentskih pozicija, banke su klasifikovane u četiri strateške grupe na osnovu njihove pozicije u odnosu na aritmetičku sredinu (prosek) sektora. Kao kriterijumi za podelu korišćeni su tržišno učešće kao mera tržišne snage i ROA kao mera operativne efikasnosti. Na taj način definisani su sledeći kvadranti:

1. Lideri tržišta - Gornji desni kvadrant: Banke koje ostvaruju natprosečno tržišno učešće uz natprosečnu profitabilnost. Ove banke koriste ekonomiju obima i dominantnu tržišnu poziciju za maksimizaciju prinosa. To su sistemski značajne banke koje diktiraju standarde konkurentske utakmice.
2. Specijalisti - Donji desni kvadrant: Banke koje imaju manje tržišno učešće od proseka, ali ostvaruju visoku profitabilnost.
3. Izvođači (Operativci) - Gornji levi kvadrant: Banke sa visokim tržišnim učešćem čija je profitabilnost ispod proseka sektora. Ove institucije često žrtvuju kratkoročni profit zarad očuvanja tržišne pozicije ili se nalaze u fazi visokih troškova nakon akvizicija, gde se efekti sinergije još uvek čekaju.
4. Banke u fazi transformacije - Donji levi kvadrant: Institucije koje se nalaze ispod proseka po oba kriterijuma. Ove banke obično se suočavaju sa strateškim izazovima, ili su premale da bi bile efikasne Najčešće su mete akvizicija ili se nalaze u procesu dubokog restrukturiranja poslovanja. Dugoročni opstanak u ovom kvadrantu bez strateške promene je otežan.

U kontekstu tržišta Srbije, barijere mobilnosti koje sprečavaju prelazak manjih banaka u grupu „Lidera" postale su višestruke. Pored regulatornih zahteva za kapitalom koji su postali rigorozniji, ključnu barijeru predstavljaju visoki fiksni troškovi digitalne transformacije i neophodnost ekonomije obima za održavanje konkurentnosti. Primeri OTP banke i NLB Komercijalne banke najbolje ilustruju ove barijere; ove institucije su putem strateških akvizicija premostile jaz u tržišnom učešću, koristeći sinergiju i optimizaciju operativnih troškova kako bi se trajno pozicionirale u strateškom nukleusu sektora, što je za manje aktere bez značajnih kapitalnih injekcija gotovo neizvodljivo.

Ova metodologija omogućava praćenje kretanja banaka između kvadranata tokom posmatranog perioda (2017-2024), što direktno ukazuje na uspešnost njihovih poslovnih strategija. U nastavku su prikazane dve ključne tačke u vremenu: Grafikon 7 prikazuje početnu 2017. godinu, obeleženu fragmentacijom, dok Grafikon 8 prikazuje poslednju 2024. godinu, posmatranja i pozicioniranja analiziranih banaka u bankarskom sektoru. Cilj ovog uporednog prikaza je uočiti promene položaja i kretanje banaka iz klastera u klaster tokom perioda.

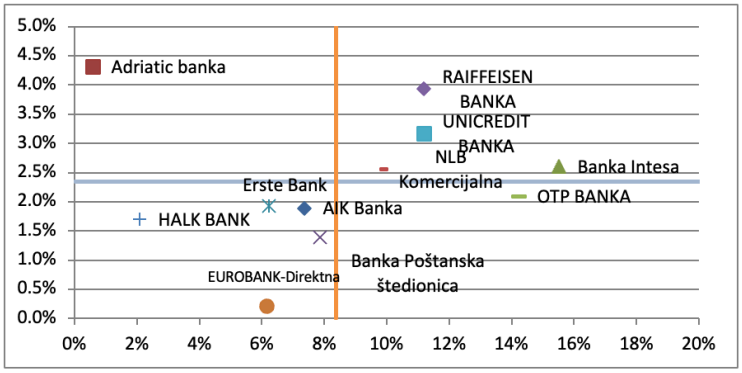
Grafikon 7 - Matrica strateških grupa bankarskog sektora Srbije za 2017. godinu



Izvor: Autor na osnovu podataka iz Bilansa stanja i Bilansa uspeha odabranih banaka

U 2017. godini uočavamo disperziju banaka, gde značajan broj aktera zauzima pozicije „Specijalista" (visok ROA, ali malo učešće) ili se nalazi u fazi transformacije. Prosečno učešće od 5,49% ostavljalo je prostor za veliki broj srednjih banaka.

Grafikon 8 - Matrica strateških grupa bankarskog sektora Srbije za 2024. godinu



Izvor: Autor na osnovu podataka iz Bilansa stanja i Bilansa uspeha odabranih banaka

Uporedni prikaz Grafikona 7 i Grafikona 8 otkriva duboku transformaciju tržišne arhitekture. Dok je 2017. godina bila obeležena umerenom disperzijom, gde su banke bile raspoređene u različitim strateškim „džepovima", 2024. godina pokazuje jasnu strateško polarizaciju.

Pomeranje nultog koordinatnog početka na matrici za 2024. godinu u odnosu na 2017. godinu direktna je posledica strukturnih promena u sektoru. Činjenica da je prosečno tržišno učešće poraslo sa 5,49% na 8,38% ukazuje na to da je aritmetička sredina sektora postala „pokretna meta". Ovakav metodološki pristup omogućava identifikaciju banaka koje su uspele da nadmaše opšti trend rasta tržišta. To implicira značajno podizanje barijera mobilnosti: u uslovima visoke koncentracije, bankarske institucije moraju generisati znatno veći obim aktive i nivo operativne efikasnosti samo da bi zadržale status prosečnog tržišnog učesnika, što dodatno marginalizuje manje i neefikasne aktere.

Konsolidacija u kvadratu Lidera: Najdominantniji trend je kretanje sistemski značajnih banaka ka gornjem desnom kvadratu. Banke koje su kroz procese merdžera i akvizicija apsorbovale manje konkurente, poput OTP banke i NLB Komercijalne, nisu samo povećale svoje tržišno učešće, već su uspele da tu veličinu pretvore u operativnu efikasnost. Ovo potvrđuje stavove Bikker i Bos (2008) da ekonomija obima u bankarstvu direktno doprinosi stabilizaciji profitne pozicije.

Pomeranje proseka sektora: Primetno je da je „krst" u 2024. godini postavljen na znatno višim nivoima u odnosu na 2017. godinu. Prosečno tržišno učešće je poraslo sa 5,49% na 8,38%, što je jasan indikator smanjenja ukupnog broja učesnika i ukrupnjavanja kapitala. To implicira da su barijere mobilnosti postale znatno više - banka danas mora imati mnogo veći nivo aktive i prinosa samo da bi ostala u proseku tržišta.

Strateška otpornost: Migracija banaka iz levih kvadranata (niža profitabilnost) ka desnim u 2024. godini služi kao finalni dokaz za Hipotezu H3. Iako je krizni period 2020. godine privremeno narušio performanse, bankarski sektor je u 2024. ušao homogeniji i profitabilniji, sa jasnije definisanim liderima koji diktiraju tempo tržišne utakmice.

Nalazi ovog istraživanja otvaraju pitanje korelacije između veličine banke i njene suštinske rezilijentnosti. Iako rezultati potvrđuju da 'Lideri' pokazuju viši stepen stabilnosti performansi nakon krize, ostaje otvoreno pitanje da li je to posledica njihove unutrašnje otpornosti na rizike ili isključivo sposobnosti da kroz ekonomiju obima i dominantnu tržišnu poziciju lakše amortizuju eksterne šokove. Kontinuirano visok udeo kredita iznad 60% kod sistemski značajnih banaka sugeriše da njihova stabilnost direktno determiniše stabilnost celokupnog finansijskog sistema, što potvrđuje važnost bankarske strukture kao ključnog faktora rezilijentnosti u Republici Srbiji.

Zaključak

Istraživanje sprovedeno u ovom radu pružilo je sveobuhvatan uvid u dinamiku bankarskog sektora Republike Srbije u periodu od 2017. do 2024. godine. Korišćenjem metodologije strateških grupa, analizirane su ključne promene u profitabilnosti, tržišnoj snazi i kapitalnoj strukturi, čime su testirane i potvrđene postavljene istraživačke hipoteze. Na osnovu sprovedene analize, mogu se izvući sledeći ključni zaključci:

Potvrda Hipoteze H1: Procesi konsolidacije i akvizicija su fundamentalno izmenili arhitekturu tržišta. Rast prosečnog tržišnog učešća vodećih banaka sa 5,49% na 8,38% i njihova migracija u kvadrant „Lidera" nedvosmisleno potvrđuju da je ukrupnjavanje kapitala postalo primarna strategija za opstanak i rast. Formiranje snažnog nukleusa oko „Top 5" banaka podiglo je barijere mobilnosti, otežavajući poziciju manjim igračima.

Potvrda Hipoteze H2: Uprkos digitalnoj transformaciji i eksternim šokovima, bankarski sektor u Srbiji je zadržao visok stepen vernosti tradicionalnom modelu posredovanja. Stabilno učešće neto kredita u aktivi iznad 60% ukazuje na to da kreditiranje realnog sektora i stanovništva ostaje glavni generator prihoda i osnova biznis modela većine banaka.

Potvrda Hipoteze H3: Analiza je pokazala da je pad performansi u 2020. i 2021. godini bio privremenog i cikličnog karaktera. Dramatičan pad E/A odnosa na 5,95% bio je trenutak ekstremne finansijske poluge, ali je sektor do 2024. godine uspeo da povrati stabilnost ROA na nivo od 2,34% uz zdravu dokapitalizaciju. Ovo ukazuje na visoku adaptivnu sposobnost i stratešku rezistentnost sektora.

Nalazi ovog istraživanja otvaraju pitanje korelacije između veličine banke i njene suštinske rezilijentnosti. Iako rezultati potvrđuju da „Lideri" pokazuju viši stepen stabilnosti performansi nakon krize, ostaje otvoreno pitanje da li je to posledica njihove unutrašnje otpornosti na rizike ili isključivo sposobnosti da kroz ekonomiju obima i dominantnu tržišnu poziciju lakše amortizuju eksterne šokove. Kontinuirano visok udeo kredita iznad 60% kod sistemski značajnih banaka sugeriše da njihova stabilnost direktno determiniše stabilnost celokupnog finansijskog sistema, što potvrđuje važnost bankarske strukture kao ključnog faktora rezilijentnosti u Republici Srbiji.

Na osnovu identifikovanih trendova koncentracije i strateških migracija, istraživanje nudi konkretne preporuke za nosioce makroprudencijalne politike i menadžment bankarskih institucija.

- Za kreatore politika (NBS): Neophodno je nastaviti sa pažljivim monitoringom sistemski značajnih banaka koje čine „strateški nukleus" tržišta, budući da njihova visoka korelisanost i slični profili rizika mogu biti izvor sistemske ranjivosti u uslovima ekstremnih šokova. Fokus regulatora treba da ostane na očuvanju kapitalnog „amortizera" (E/A), koji se pokazao kao ključan faktor rezilijentnosti tokom 2020. godine.

- Za menadžment banaka: Rezultati ukazuju na to da puko povećanje tržišnog učešća više nije garancija uspeha ukoliko ga ne prati operativna efikasnost (ROA). Preporuka za manje banke jeste fokus na tržišne niše ili ubrzanu digitalizaciju, kako bi se prevazišle visoke barijere mobilnosti koje su formirane procesom ukrupnjavanja sektora.

Finalni uvid u matrice strateških grupa pokazuje da se sektor kreće ka stanju stabilne oligopolne konkurencije. Banke koje su uspešno prebrodile period transformacije sada fokus prebacuju sa puke veličine aktive na operativnu efikasnost i upravljanje rizicima.

Dobijeni rezultati postavljaju čvrstu osnovu, ali istovremeno ukazuju na smernice za buduća naučna istraživanja. Budući istraživački napori bi trebali biti usmereni ka primeni naprednijih kvantitativnih ekonometrijskih metoda, poput dinamičkih panel modela, kako bi se statistički testirala uzročno-posledična veza između nivoa tržišne koncentracije i pokazatelja stabilnosti banaka u dugom roku. Takođe, s obzirom na ubrzanu digitalizaciju, u naredne analize bi bilo korisno uvrstiti „stepen digitalne zrelosti" kao novu, nefinansijsku varijablu za formiranje strateških grupa na domaćem bankarskom tržištu.

U godinama koje dolaze, može se očekivati dalja tehnološka transformacija, gde će digitalna zrelost postati nova varijabla koja će razdvajati lidere od pratilaca. Ipak, rezultati ovog rada sugerišu da će stabilna kapitalna baza i čvrsta povezanost sa realnim sektorom ostati neprikosnoveni stubovi uspeha na bankarskom tržištu Srbije.

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DYNAMICS OF THE SYSTEMIC IMPORTANCE OF BANKS IN THE MARKET OF THE REPUBLIC OF SERBIA: ANALYSIS OF CLUSTER MIGRATION AND STRUCTURAL ADJUSTMENT

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Abstract: *The subject of this work is the analysis of the structural transformation and strategic positioning of banks in the Republic of Serbia in the period from 2017 to 2024. The main goal of the research is a scientific analysis of the dynamics of the banking sector using the methodology of strategic groups, in order to identify key migrations between market quadrants and assess the degree of structural adjustment of the sector to macroeconomic shocks. The methodology includes descriptive statistics, comparative analysis and visualization on a two-dimensional matrix, with a focus on a sample of 11 banks. The results of the research confirm that the intensive consolidation process led to a significant consolidation of the market, whereby the average market share in the total assets of the leading banks increased from 5.49% to 8.38%. The analysis shows a high degree of resilience of the sector, which retained the primary function of lending to the economy and the population with a share of loans above 60%. It was found that the decline in profitability (ROA) and capital base (E/A) during the crisis year 2020 was of a temporary nature, which was followed by a stabilization of performance on a healthy basis.*

Keywords: market consolidation, banking sector of Serbia, financial stability, cluster analysis, strategic groups

JEL classification: G21, G34, G01

Introduction

The modern banking system of the Republic of Serbia in the period from 2017 to 2024 represents an example of deep structural transformation and strategic adjustment. This period was marked by an intense process of consolidation, where the market evolved from a state of moderate fragmentation to a highly concentrated environment. The main drivers of these changes were the waves of acquisitions of leading banking groups, digital transformation and the necessity of increasing operational efficiency in conditions of global uncertainties, as well as the need to preserve stability in conditions of global economic shocks.

During the observed period, the sector faced heterogeneous challenges - from the period of low interest rates, through the global health crisis in 2020, to the current restrictive monetary policy. Through the analysis of key indicators such as profitability ROA, structure of assets through the share of loans and stability of the capital base E/A, the work tries to document how these factors were reflected on the competitive position of banks. Particular importance is attached to the fact that the consolidation process led to an increase in the average market share of individual banks, which clearly indicates the formation of strong market leaders. The focus of the work is on the analysis of changes and their impact on the performance and strategic positioning of banks, with special reference to the resilience of the sector during the pandemic year 2020.

The subject of the research is the analysis of financial performance and market position of banks in Serbia. The main goal of the research is a scientific analysis of the dynamics of the strategic positioning of banks in Serbia using the methodology of strategic groups. The paper seeks to classify banks based on their market strength and performance in order to identify key migrations between strategic squares. An additional goal is to determine the degree of resilience of the sector based on the movement of indicators of profitability and asset quality in conditions of macroeconomic uncertainty.

Based on the set goals, the following hypotheses were defined:
H1: The process of structural consolidation of the banking market in Serbia led to a significant increase in the average market share of the leading banks and a decrease in the overall fragmentation of the sector.
H2: The banking sector shows a high degree of resistance in the domain of its basic function - lending to the economy and the population, maintaining the stability of the traditional lending model despite the effects of cyclical external shocks.
H3: The decline in return on assets (ROA) and equity participation (E/A) during the crisis year 2020 was of a temporary nature, while long-term trends indicate a high adaptive capacity of the sector to stabilize performance on a sustainable basis.

For the purposes of this paper, a combined approach was used, which includes: 1. Descriptive statistical analysis applied to key indicators (ROA, E/A, loan share) in order to determine average trends at the level of the entire sector; 2. Comparative analysis to compare the situation in 2017 and the situation in 2024, in order to identify long-term changes; 3. Visualization of banks on a two-dimensional matrix (Market Share vs. ROA) to classify banks into groups such as "Leaders", "Specialists" and "Performers"; 4. Migration analysis refers to monitoring the movement of individual banks within strategic groups based on their relative performance.

Literature Review and Research Methodology

Analysis of the strategic positioning of banks requires a solid theoretical framework that enables the transformation of financial data into relevant conclusions. In this sense, the application of the concept of strategic groups in this paper is justified by the findings of Porter (1980), who points out that within an industry, companies are not homogeneous entities, but are grouped around similar strategic dimensions. In modern conditions, authors such as Bikker and Bos (2008) emphasize that consolidation processes, which we witness in the Serbian market, directly change competitive dynamics, favoring banks that manage to optimize their cost structures through economies of scale. According to the findings cited by Casu et al. (2015); (Gegenheimer, 2007) sector consolidation leads to a redistribution of market power, with larger entities taking advantage of asset diversification to achieve more stable revenues in conditions of macroeconomic uncertainty.

The concept of strategic groups, as an intermediate level of analysis between the entire sector and an individual bank, enables the identification of the internal structure of the market. According to research conducted by Halaj and Zochowski (2009); Schildbach and Schneider, (2017) banks within the same strategic group not only share similar visual positions on the matrix, but also similar risk profiles and responses to regulatory changes. This concept implies the existence of "mobility barriers" that prevent the transition of banks between groups, which explains why certain institutions retain the position of "specialists" or "leaders" for years despite changes in the market environment.

In this context, the ROA variable is consistently used in the literature as a superior measure of operational efficiency, because it isolates the bank's profitability from the effects of financial leverage, which is of crucial importance for comparing banks of different sizes within the same sector (Rose, Hudgins, 2015); (Wagdi et al., 2019); (Budhathoki et al., 2020). Unlike the return on equity (ROE), ROA allows analysts to determine how efficiently management is using total resources to generate profits, which is key to objectively mapping banks on the strategic matrix.

A special segment of the literature deals with the stability of banking operations through the analysis of asset quality and capital adequacy. Authors such as Berger and Bouwman (2013) point out that the role of capital, measured through E/A, is crucial in phases of market turbulence, because it acts as an "absorber" of external shocks. In works that analyze emerging banking markets, the duality between the need for high capitalization and the pursuit of profitability maximization is often highlighted (Güngör, 2023; Casu et al., 2015). This theoretical conflict is directly applicable to the analysis of the domestic market in the period 2017-2024, where through the migration of banks between strategic groups, the transformation from traditionally highly capitalized institutions to more efficient, but potentially more exposed business models can be followed. Authors like Mishkin and Eakins (2018); Berger and Bouwman (2011) emphasize that adequately capitalized banks are more likely to survive during systemic crises, because own capital represents the first line of defense against losses in the loan portfolio, which directly affects the long-term strategic positioning of the institution.

Analysis of changes in structure and market participation is a key determinant of the stability of financial systems in economies in transition. Domestic and regional empirical practice offers valuable insights into these processes. Lončar and Rajić (2012) point to the early stages of restructuring and the impact of macroeconomic factors on placement stability, while Bukvić (2017, 2020) documents the evolution of concentration in detail and emphasizes that consolidation of the sector inevitably

changes the strategic priorities of banks. Through an analysis of the market structure, Kaličanin and Terzić (2023) point out that increased grouping around several leading banking groups creates specific barriers to mobility, forcing smaller actors to adopt defensive strategies or niche positioning. Using the methodology of strategic groups, which finds its roots in the statements of Porter (1980) and Grant (2010), enables bridging the gap between aggregate macroanalysis and individual behavior of banks, while Huizinga and Demirgüç-Kunt (2000) remind that the financial structure and the size of the market share directly determine long-term profitability ranges.

In this regard, the methodological framework of this paper is based on a combination of quantitative analysis of financial indicators and qualitative interpretation of strategic positioning. The application of the model of strategic groups makes it possible to overcome the limitations imposed by observing the sector as a homogeneous whole, providing an insight into the specific dynamics within the Serbian market in the period from 2017 to 2024.

The research is focused on a representative sample of 11 banks on the Serbian market, which were selected based on the availability of data in the observed eight-year period and importance for the formation of the sector average. Also, these banks continuously cover over 90% of the total assets of the entire banking sector during the observed eight-year period. The inclusion of such a wide sample is necessary for the precise calculation of the arithmetic means that define the coordinate origin (the so-called "cross") on the matrices of strategic groups. Although 11 banks were included in the creation of the matrices, namely Aik banka, Adriatic banka, Banka Intesa, Postal Savings Bank, Erste banka, Eurobank, Halk bank, NLB Komercijalna banka, OTP banka, Raiffeisen banka and Unicredit banka, the focus of in-depth analysis and monitoring of strategic migrations was placed on a representative sample of five systemically significant banks (Banca Intesa, OTP, Raiffeisen, NLB Komercijalna and UniCredit). Such methodological dualism, which implies observing the entire market with a focus on leaders, is justified by the theory of market concentration and economies of scale advocated by Bikker and Bos (2008); Hatz (2021) who emphasize that dominant actors dictate the pace of technological and operational changes in the sector. Given that these banks control over 80% of assets, they represent the core of the entire sector. This approach makes it possible to generalize the obtained results and observed trends with a high degree of reliability to the entire banking system of Serbia.

The central measuring instrument in the work is the matrix of strategic groups, where banks are mapped in the coordinate system based on their performance in relation to the sector average. The central point of intersection on the graph is determined based on the average value of the sector for each observed year. This visualization technique, popularized by Hitt, Ireland and Hoskisson (2013), allows banks to be classified into four quadrants: Leaders, Specialists, Performers and Banks in Transformation. Primary data were collected from audited annual financial reports of banks and statistical bulletins of the National Bank of Serbia. Descriptive statistics and comparative analysis were used for data processing, which made it possible to test the set hypotheses through the identification of strategic bank migrations in the eight-year period.

For the purpose of mapping strategic groups, two key variables were defined as the axes of the matrix:
1. **Market Share**: Used as an indicator of market power, following the views of Berger & Bouwman (2011) that asset size directly impacts competitive advantage through lower financing costs. The focus on market share is further justified by Mester & Berger (2003), who found that larger market shares in

post-crisis periods often correlate with greater stability in net interest margins and better bargaining power.

$$\text{Market Share}=\text{Total Asset_bank}/\text{Total Asset_sector}*100$$

2. **Return on Assets (ROA)**: Selected as the primary indicator of profitability and asset management efficiency. According to Golin & Delhaise (2013), Parvin et al. (2019), and Wagdi et al. (2019), this indicator best demonstrates management's ability to generate profit from available assets, regardless of the financing method.

$$\text{ROA}=(\text{Net Income})/(\text{Total Asset})*100$$

In addition to the primary variables, auxiliary indicators were analyzed to provide insight into risk profiles and stability. According to Hull (2015) and Kagecha (2014), performance in modern banking cannot be viewed in isolation from capital adequacy and asset quality. Consequently, two auxiliary variables were introduced:

3. **Share of Loans in Total Assets**: Acts as an indicator of a bank's strategic focus on the real sector. As noted by Casu et al. (2015), a high share of loans indicates a traditional mediation model but also carries a higher level of credit risk.
4. **Equity-to-Assets Ratio (E/A)**: Used as a measure of financial leverage and solvency. Modern authors like Mishkin and Eakins (2018) emphasize that capital levels determine a bank's capacity to absorb losses. The decline of this indicator to 5.95% in 2020 is analyzed through the prism of regulatory requirements and capital management in crisis conditions, which is crucial for testing Hypothesis H3.

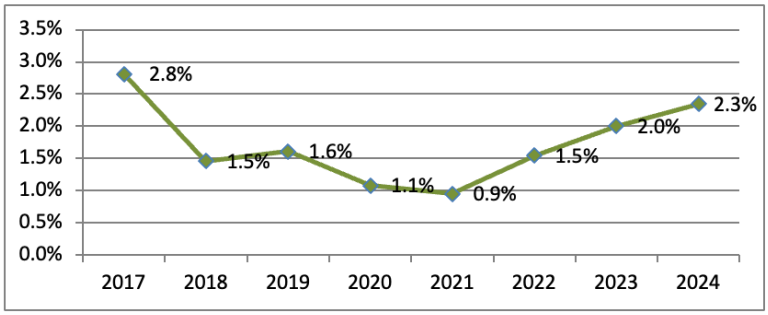
Analysis of Results and Discussion

In this chapter, we interpret the key findings of the research, focusing on profitability dynamics, asset stability and strategic migration on the example of banks within the banking sector of the Republic of Serbia in the period 2017-2024.

Analysis of Profitability Trends

The basic indicator of the success of any banking strategy is its ability to generate returns from available assets. Following the methodology of Rose and Hudgins (2015), we focus on the ROA indicator. Graph 1 shows the trend of the average value of ROA of the analyzed banks in the period from 2017 to 2024.

Figure 1 - Trend of Average ROA for the Analyzed Banks for the Period 2017–2024.

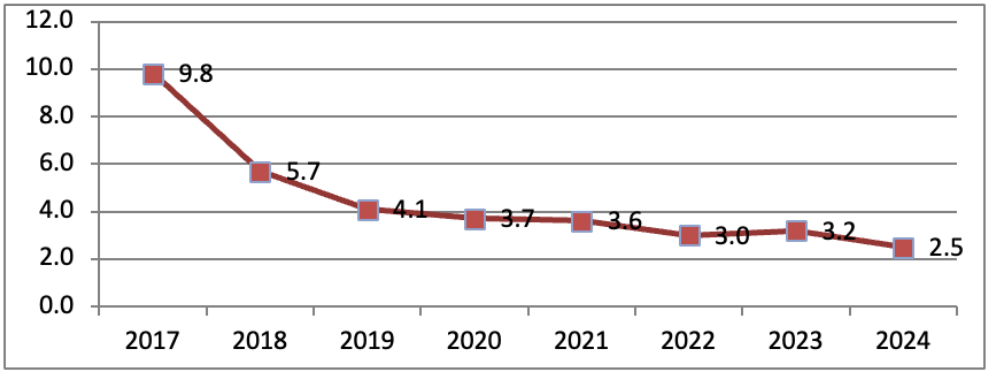


Source: Author's calculation based on the Income Statement data of the selected banks

As can be seen in Chart 1, the average value of ROA of selected banks in the banking sector of the Republic of Serbia at the beginning of the observed period was 2.81%. However, the yield erosion trend is noticeable, reaching its minimum in 2021 at 0.95%. This drop in profitability correlates with global macroeconomic disturbances, but also with the process of cleaning up the balance sheet. Nevertheless, the strong recovery to 2.34% in 2024 confirms the hypothesis about the temporary nature of the decline and the successful adaptation of banks to new interest cycles. In accordance with the findings of Bikker and Bos (2008), this recovery can be attributed to the effects of consolidation - larger banks, through cost optimization, managed to recover profitability faster in conditions of rising interest rates.

In order to understand this recovery of profitability, it is necessary to simultaneously analyze the movement of problem loans that have burdened balance sheets for years. Chart 2 follows the movement of NPL (Non-Performing Loans) of the entire banking sector.

Figure 2 - Trend of the Share of Non-Performing Loans (NPLs) in the Total Loans of the Serbian Banking Sector (2017–2024)



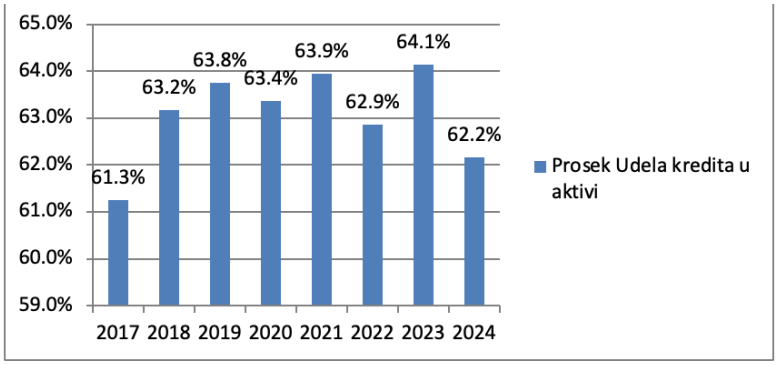
Source: Author's calculation based on the Income Statement data of the selected banks

As we can see, the continuous decline in NPLs has directly affected the release of loss provisions. According to the findings of Hull (2018), the reduction of credit risk is the primary driver of ROA growth, as it allows banks to more efficiently allocate capital to profitable placements.

Dynamics of Assets and Capital Base

The second segment of the analysis focuses on stability through the relationship between credit activity and the participation of own capital. After analyzing the returns, we shift the focus to the balance sheet structure, where we test the stability of the traditional banking model (Hypothesis H2) and the resilience of capital. Graph 3 follows the trend of the average share of loans in the total assets of selected banks in the sector.

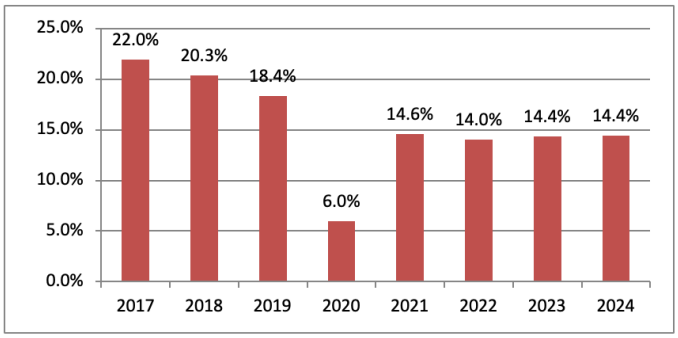
Figure 3 - Average Share of Net Loans in Total Assets of Selected Banks (in %) by Year for the Period 2017–2024



Source - Author's calculation based on the Balance Sheet data of the selected banks

Despite intensive digitization, Graph 3 shows that the share of loans remains stable above the level of 60%. This is the key evidence that banks in Serbia have not significantly changed their business model, but have remained focused on lending to the real sector and the population. In parallel with the stability of loans, in Graph 4 we observe the movement of own capital as the main risk absorber.

Figure 4 - Average Equity-to-Assets (E/A) Ratio in % by Year for the Period 2017–2024

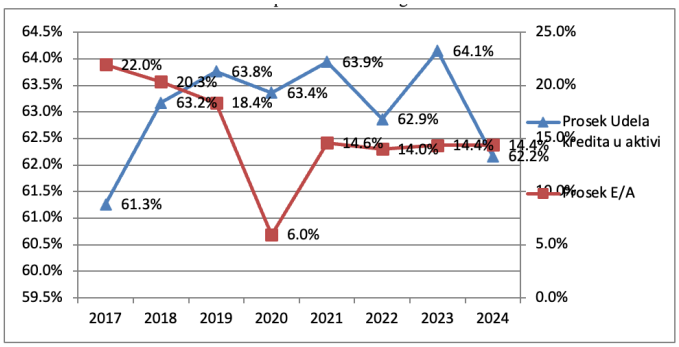


Source: Author's calculation based on the Balance Sheet data of the selected banks

Here we see the most dramatic change – the drop in average E/A to just 5.95% in 2020. From the point of view of Berger and Bouwman (2013), this indicates extremely high financial leverage in the crisis year. Nevertheless, growth to 14.39% in 2024 shows a return to a more conservative capitalization policy, which increases the stability of the entire system.

The temporary nature of the performance deterioration during 2020 cannot be viewed in isolation from the timely reaction of the National Bank of Serbia. A key role in preserving stability was played by the prescribed moratoriums on the repayment of obligations, which prevented a sudden jump in NPLs in the midst of the pandemic, as well as regulatory concessions regarding the classification of assets. These measures enabled banks to preserve liquidity and credit potential, which, with the subsequent stabilization of interest rates, resulted in a rapid recovery of ROA to 2.34% by 2024.
To summarize these trends, we use the following comparative view:

Figure 5 - Correlation Between the Average Lending Activity and the Capital Base of the Observed Banks for the Period 2017–2024

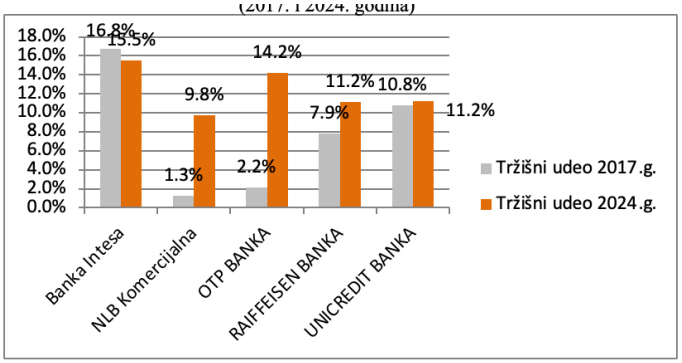


Source: Author's calculation based on the Income Statement data of the selected banks

The data show an exceptional stability of the share of loans in assets, which is around 62%. This confirms Hypothesis H2 - banks in Serbia have maintained their focus on traditional banking despite digitization and crises. Particularly interesting is the drop in the E/A ratio to 5.95% in 2020. From a discussion point of view, this finding reflects what Berger and Bouwman (2013) call "capital efficiency management". Banks used the crisis moment to increase financial leverage, which later in 2024 resulted in stabilization at 14.3%. All the previously mentioned trends, which imply growth of profitability and the stabilization of capital, took place in the context of intense consolidation of the market.

After analyzing the structural balance between credit activity and the capital base, it is necessary to examine how these internal performances were reflected on the external competitive position of the leading players. While the stability of the loan share and the recapitalization of the sector ensured systemic resilience, the processes of mergers and acquisitions fundamentally changed the map of market power. In order to precisely quantify the effect of consolidation on the most important institutions, below is a comparative presentation of the market share of the five leading banks. This insight allows us to identify the 'strategic nucleus' of the sector which, through economies of scale, described in the works of Bikker and Bos (2008), managed to absorb smaller competitors and significantly increase its influence on the market in the period from 2017 to 2024.

Figure 6 - Comparative Overview of the Market Share of the Five Most Systemically Important Banks (2017 and 2024)



Source: Author's calculation based on the Balance Sheet data of the selected banks and the Annual Financial Stability Report

Graph 6 directly confirms Hypothesis H1 about the intensive consolidation of banks. The growth of the market share of banks that were the bearers of the integration process is particularly indicative, where we see that the gap between the leaders and the rest of the market has deepened, thus creating high mobility barriers for smaller banking institutions. The average participation per bank increased from 5.49% to 8.38%, which is the result of acquisitions (OTP, NLB Komercijalna). As Bikker and Bos (2008) state, greater participation brings economies of scale that were necessary to achieve the 2024 ROA results. All these data are summarized in Table 1, which represents the basis for creating matrices of strategic groups.

Table 1 - Summary of the Average Key Indicators for Selected Banks in the Banking Sector for the Period 2017–2024

Year	Average Market Share	Average ROA	Average E/A ratio	Average Loan-to-Asset ratio
2017	5.49%	2.81%	21.96%	61.26%
2018	5.58%	1.46%	20.35%	63.17%
2019	5.89%	1.61%	18.35%	63.76%
2020	5.95%	1.08%	5.95%	63.36%
2021	6.84%	0.95%	14.58%	63.94%
2022	8.05%	1.55%	14.01%	62.86%
2023	8.29%	2.00%	14.36%	64,.5%
2024	8.38%	2.34%	14.39%	62.17%

Source: Author's calculation based on the Balance Sheet and Income Statement data of the selected banks

The growth of the average market share of leading banks from 5.5% in 2017 to 8.4% in 2024, viewed through the prism of total balance sheet assets, provides direct and clear evidence to confirm Hypothesis H1. These data unequivocally indicate that the consolidation process led to a tangible consolidation of the domestic market in favor of systemically important participants. When it comes to the stability of the capital base (Hypothesis H3), the data show that the ratio of own capital and assets (E/A) in the crisis year 2020 recorded a drop to 5.95%, which reflects the high level of financial leverage in the midst of the pandemic. This short-term decline was a direct consequence of the conscious and controlled growth of banks' balance sheet assets in order to provide the necessary liquidity to the economy and the population through prescribed moratoriums and reliefs, and not an indicator of the threat to the solvency of the sector itself. Already from 2021, this indicator stabilizes sharply at the level of over 14%, demonstrating an extremely high adaptive capacity and the ability of the domestic banking sector to restore and preserve capital buffers in the short term, which provides reliable evidence to confirm Hypothesis H3.

Strategic Positioning and Migrations

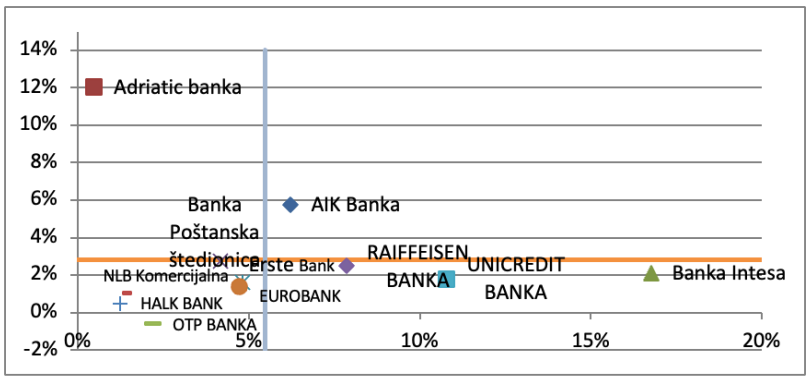
After a detailed analysis of individual indicators of profitability and asset structure, the key step in the research is the integration of these variables into a unique strategic space. By applying the matrix of strategic groups, we identify how the banks repositioned themselves in relation to the averages of the sector, which, as Table 1 showed, moved significantly during the observed eight years. The final part of the analysis presents the mapping of banks on the matrix of strategic groups for 2017 and 2024. In order to accurately identify competitive positions, banks are classified into four strategic groups based on their position in relation to the arithmetic mean (average) of the sector. Market share as a measure of market power and ROA as a measure of operational efficiency were used as criteria for division. In this way, the following quadrants were defined:

1. Market Leaders - Upper Right Quadrant: Banks achieving above-average market share with above-average profitability. These banks use economies of scale and dominant market position to maximize returns. These are systemically significant banks that dictate the standards of the competitive game.
2. Specialists - Lower Right Quadrant: Banks that have a smaller than average market share but achieve high profitability.
3. Performers (Operatives) - Upper left quadrant: Banks with a high market share whose profitability is below the sector average. These institutions often sacrifice short-term profits for the sake of preserving market position or are in a high-cost phase after acquisitions, where synergy effects are still pending.
4. Banks in the transformation phase - Lower left quadrant: Institutions that are below the average in both criteria. These banks usually face strategic challenges, or are too small to be efficient. Most often, they are the targets of acquisitions or are in the process of deep business restructuring. Long-term survival in this quadrant without strategic change is difficult.

In the context of the Serbian market, the barriers to mobility that prevent the transition of smaller banks to the "Leader" group have become multiple. In addition to regulatory capital requirements that have become more rigorous, a key barrier is the high fixed costs of digital transformation and the necessity of economies of scale to maintain competitiveness. The examples of OTP banka and NLB Komercijalna banka best illustrate these barriers; these institutions bridged the gap in market share through strategic acquisitions, using synergy and optimization of operating costs in order to permanently position themselves in the strategic nucleus of the sector, which is almost impossible for smaller actors without significant capital injections.

This methodology allows monitoring the movement of banks between quadrants during the observed period (2017-2024), which directly indicates the success of their business strategies. Two key points in time are shown below: Graph 7 shows the initial year 2017, marked by fragmentation, while Graph 8 shows the last year 2024, of observation and positioning of the analyzed banks in the banking sector. The aim of this comparative presentation is to observe changes in the position and movement of banks from cluster to cluster during the period.

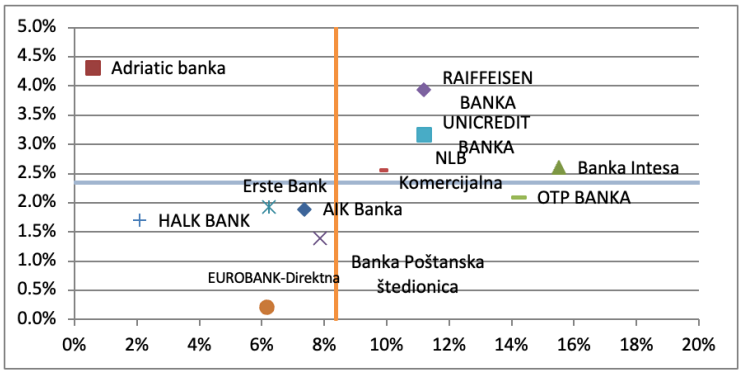
Figure 7 - Strategic Group Matrix of the Serbian Banking Sector for 2017



Source: Author's calculation based on the Balance Sheet and Income Statement data of the selected banks

In 2017, we observe the dispersion of banks, where a significant number of actors occupy "Specialist" positions (high ROA, but low participation) or are in the transformation phase. The average share of 5.49% left room for a large number of medium-sized banks.

Figure 8 - Strategic Group Matrix of the Serbian Banking Sector for 2024



Source: Author's calculation based on the Balance Sheet and Income Statement data of the selected banks

A comparative view of Chart 7 and Chart 8 reveals a profound transformation of the market architecture. While the year 2017 was marked by moderate dispersion, where banks were distributed in different strategic "pockets", the year 2024 shows a clear strategic polarization.

The shift of the zero-coordinate beginning on the matrix for 2024 compared to 2017 is a direct consequence of structural changes in the sector. The fact that the average market share increased from 5.49% to 8.38% indicates that the arithmetic means of the sector has become a 'moving target'. This methodological approach enables the identification of banks that managed to surpass the general trend of market growth. This implies a significant increase in mobility barriers: in conditions of high concentration, banking institutions must generate a significantly higher volume of assets and a level of operational efficiency just to maintain the status of an average market participant, which further marginalizes smaller and inefficient actors.

Consolidation in the Leader square: The most dominant trend is the movement of systemically important banks towards the upper right square. Banks that absorbed smaller competitors through mergers and acquisitions, such as OTP banka and NLB Komercijalna, not only increased their market share, but also managed to turn that size into operational efficiency. This confirms the views of Bikker and Bos (2008) that economies of scale in banking directly contribute to the stabilization of the profit position.
Strategic resilience: The migration of banks from the left quadrants (lower profitability) to the right in 2024 serves as the final evidence for Hypothesis H3. Although the crisis period of 2020 temporarily impaired performance, the banking sector entered 2024 more homogeneous and profitable, with more clearly defined leaders dictating the pace of the market game.

The findings of this research raise the question of the correlation between the size of a bank and its essential resilience. Although the results confirm that the "Leaders" show a higher degree of performance stability after the crisis, it remains an open question whether this is a consequence of their internal resistance to risks or solely the ability to more easily amortize external shocks through economies of scale and a dominant market position. The continuously high share of loans above 60% at systemically important banks suggests that their stability directly determines the stability of the entire financial system, which confirms the importance of the banking structure as a key factor of resilience in the Republic of Serbia.

Conclusion

The research conducted in this paper provided a comprehensive insight into the dynamics of the banking sector of the Republic of Serbia in the period from 2017 to 2024. Using the methodology of strategic groups, key changes in profitability, market power and capital structure were analyzed, which tested and confirmed the set research hypotheses. Based on the analysis, the following key conclusions can be drawn:

Confirmation of Hypothesis H1: Consolidation and acquisition processes have fundamentally changed the architecture of the market. The growth of the average market share of the leading banks from 5.49% to 8.38% and their migration to the "Leader" quadrant unequivocally confirm that capital accumulation has become the primary strategy for survival and growth. The formation of a strong nucleus around the "Top 5" banks has raised mobility barriers, making the position of smaller players more difficult.

Confirmation of Hypothesis H2: Despite the digital transformation and external shocks, the banking sector in Serbia has maintained a high degree of fidelity to the traditional mediation model. The stable participation of net loans in assets above 60% indicates that lending to the real sector and the population remains the main generator of income and the basis of the business model of most banks.

Confirmation of Hypothesis H3: The analysis showed that the decline in performance in 2020 and 2021 was temporary and cyclical in nature. The dramatic drop in the E/A ratio to 5.95% was a moment of extreme financial leverage, but the sector managed to regain ROA stability at 2.34% by 2024 with healthy recapitalization. This indicates a high adaptive capacity and strategic resilience of the sector.

The findings of this research raise the question of the correlation between the size of a bank and its essential resilience. Although the results confirm that the "Leaders" show a higher degree of performance stability after the crisis, it remains an open question whether this is a consequence of their internal resistance to risks or solely the ability to more easily amortize external shocks through economies of scale and a dominant market position. The continuously high share of loans above 60% at systemically important banks suggests that their stability directly determines the stability of the entire financial system, which confirms the importance of the banking structure as a key factor of resilience in the Republic of Serbia.

Based on the identified trends of concentration and strategic migrations, the research offers specific recommendations for macroprudential policy holders and management of banking institutions.

- For policymakers (NBS): It is necessary to continue careful monitoring of systemically important banks that form the 'strategic nucleus' of the market, since their high correlation and similar risk profiles can be a source of systemic vulnerability in conditions of extreme shocks. The regulator's focus should remain on preserving the capital 'shock absorber' (E/A), which has proven to be a key factor in resilience during 2020.

- For bank management: The results indicate that a mere increase in market share is no longer a guarantee of success if it is not accompanied by operational efficiency (ROA). The recommendation for smaller banks is to focus on market niches or accelerated digitization, in order to overcome the high mobility barriers that were formed by the consolidation of the sector.

A final insight into the matrices of strategic groups shows that the sector is moving towards a state of stable oligopolistic competition. Banks that have successfully weathered the transformation period are now shifting their focus from mere asset size to operational efficiency and risk management.

The obtained results lay a solid foundation, but at the same time indicate guidelines for future scientific research. Future research efforts should be directed towards the application of more advanced quantitative econometric methods, such as dynamic panel models, in order to statistically test the causal relationship between the level of market concentration and indicators of bank stability in the long run. Also, considering the accelerated digitization, it would be useful to include the "degree of digital maturity" as a new, non-financial variable for the formation of strategic groups on the domestic banking market in the following analyses.

In the coming years, further technological transformation can be expected, where digital maturity will become the new variable that will separate the leaders from the followers. Nevertheless, the results of this paper suggest that a stable capital base and a solid connection with the real sector will remain undisputed pillars of success in the banking market of Serbia.

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PROGRAM USKLAĐENOSTI POSLOVANJA BANAKA SA PROPISIMA O ZAŠTITI KONKURENCIJE: NOVI TREND JAČANJA KONKURENCIJE U SRBIJI ILI REGULATORNI TROŠAK?

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Rezime: *Objavljivanjem Smernica za izradu programa usklađenosti poslovanja i Modela programa usklađenosti, Komisija za zaštitu konkurencije je učinila značajan iskorak u razvoju okvira usklađenosti poslovanja sa pravom konkurencije, približavajući ga rešenjima koja su već prisutna u pravu konkurencije Evropske unije. U radu se postavlja pitanje u kojoj meri je taj normativni iskorak praćen praktičnim rezultatima i da li postojeći institucionalni i regulatorni uslovi omogućavaju efektivnu primenu programa usklađenosti poslovanja u domaćem sektoru bankarstva. Posebna pažnja je posvećena analizi uporednopravnih rešenja u državama članicama Evropske unije, gde postoje podsticajni mehanizmi koji mogu dovesti do umanjenja kazni za povredu prava konkurencije u slučaju postojanja programa usklađenosti. Zaključuje se da, u odsustvu adekvatnih institucionalnih podsticaja i efikasne primene prava konkurencije u bankarskom sektoru, programi usklađenosti poslovanja nemaju značajan potencijal da ojačaju konkurenciju, a njihovo usvajanje može predstavljati regulatorni trošak.*

Ključne reči: Zaštita konkurencije; Komisija za zaštitu konkurencije; Program usklađenosti poslovanja; Bankarski sektor; Podsticajne mere.

JEL klasifikacija: K21, K23, G21

Uvod

Usvajanje internih programa usklađenosti poslovanja sa propisima o zaštiti konkurencije na osnovu takozvanog mekog prava (engl. soft law), predstavlja novi trend u zemljama članicama EU. Ti programi su interni pravni akti tržišnih učesnika u vidu internih pravila i procedura koje su zasnovane na proceni rizika povrede prava konkurencije, sa ciljem poštovanja propisa o zaštiti konkurenciji i minimiziranja rizika koji mogu da nastanu u slučaju njihove povrede (npr. regulatorni, reputacioni, finansijski rizik). U skladu sa tim, Komisija za zaštitu konkurencije u Srbiji (KZK) je 2021. godine usvojila opšte Smernice za izradu programa usklađenosti poslovanja sa propisima o zaštiti konkurencije (Smernice), a zatim i prateći Model programa usklađenosti poslovanja (Model) 2022. godine, namenjen svim učesnicima na tržištu.

U radu se razmatra da li bi usvajanje i primena tih programa usklađenosti, po uzoru na države članice EU, moglo da ima značajan efekat na jačanje konkurencije u sektoru bankarstva, ili bi u praksi moglo da ostane bez značajnijih rezultata, svodeći se na regulatorni zahtev koji predstavlja dodatni trošak za učesnike na tržištu i koji u krajnjem efektu može da umanji konkurentnost.

Rad se, između ostalog, u jednom delu oslanja na rad Ilića (2026) koji razmatra ulogu i odnos usklađenosti poslovanja (compliance) i zaštite konkurencije u načelu. Ovim radom se dalja analiza usmerava na pomenute koncepte u bankarskom sektoru. Naime, razmatraju se regulatorni okvir Narodne banke Srbije (NBS), postojeća praksa KZK kada su banke u pitanju, ali i pitanje njihove institucionalne saradnje. Dodatno, rad obuhvata sektorsku analizu usklađenosti poslovanja banaka sa pravilima zaštite konkurencije, sa fokusom na mogućnost da funkcija usklađenosti poslovanja banaka identifikuje i uključi rizik povrede konkurencije u postojeće sisteme upravljanja rizicima.

Struktura rada prati postavljeno istraživačko pitanje tako da se u drugom delu rada analizira sadržina i svrha programa usklađenosti poslovanja, dok treći deo rada sadrži uporednopravni prikaz relevantnih normativnih rešenja i sudske prakse, sa posebnim osvrtom na iskustva država članica EU. Četvrti deo rada je posvećen analizi postojećeg institucionalnog i pravnog okvira u Srbiji, uključujući podzakonske akte KZK i NBS, kao i poslovnu praksu banaka u pogledu izrade i primene programa usklađenosti poslovanja sa propisima o zaštiti konkurencije. U završnom delu rada slede zaključna razmatranja.

Sadržina i svrha programa usklađenosti poslovanja sa propisima o zaštiti konkurencije

Propisi o zaštiti konkurencije, između ostalog, uređuju ponašanje privrednih subjekata na relevantnom tržištu tako što načelno zabranjuju restriktivne sporazume i zloupotrebu dominantnog položaja i omogućavaju kontrolu koncentracija. Ristić i Trifunović (2022) smatraju da je osnovni cilj tih propisa uvećanje konkurentskog pritiska na tržištu i samim tim uvećanje ekonomskog napretka i naročito blagostanja potrošača. Usklađenost sa tim propisima podrazumeva organizovanje poslovanja učesnika na tržištu tako da se rizik od povrede konkurencije svede na najmanju moguću meru, što je direktno povezano sa efikasnijim ostvarivanjem osnovnih ciljeva prava konkurencije. Dodatno, ta usklađenost poslovanja može da doprinese uvećanju pravne sigurnosti u poslovanju, sprečavanju finansijskih i reputacionih posledica povrede zakona i očuvanju poverenja i tržišne pozicije.

U skladu sa tendencijama koje su uočljive u okviru OECD-a i Evropske unije, posebno u pogledu jačanja primene prava konkurencije, KZK je u decembru 2021. godine izdala Smernice za izradu programa usklađenosti poslovanja sa propisima o zaštiti konkurencije između ostalog, sa ciljem podizanja svesti o značaju primene prava konkurencije i razvoja kulture zaštite konkurencije u Srbiji, o čemu govori i Dobrić (2023). Dodatno, u junu 2022. godine Komisija je objavila i Model programa usklađenosti poslovanja sa propisima o zaštiti konkurencije.

I pored toga što izrada programa usklađenosti poslovanja nije zakonska obaveza za učesnike na domaćem tržištu, ona predstavlja preporuku Komisije, imajući u vidu da interni akti tog tipa predstavljaju pomoć učesnicima na tržištu da se pridržavaju propisa o zaštiti konkurencije u svom poslovanju, po ugledu na praksu nacionalnih tela za zaštitu konkurencije zemalja članica EU.

Smernice su namenjene svim tržišnim učesnicima, odnosno svim subjektima koji učestvuju u prometu dobara i usluga na domaćem tržištu. U skladu sa Smernicama, osnovni cilj izrade programa usklađenosti poslovanja je smanjenje rizika povrede konkurencije, što se postiže blagovremenom identifikacijom rizika i utvrđivanjem aktivnosti za njihovo otklanjanje. Na taj način, pored zaštite konkurencije, učesnici na tržištu značajno smanjuju verovatnoću da će im biti izrečene novčane kazne (do 10% ukupnog godišnjeg prihoda), građanske i krivične sankcije, naneta reputaciona šteta ili da će protiv njih biti podnete tužbe za naknadu štete. Drugim rečima, prednosti izrade i primene programa usklađenosti su višestruke i odnose se na smanjivanje rizika zaključivanja restriktivnih sporazuma, zloupotrebe dominantnog položaja i nedozvoljenih koncentracija.

Efikasan program usklađenosti treba da zadovolji kriterijume koji se odnose na adekvatnu identifikaciju rizika od povrede propisa, definisanje mera za njihovo ublažavanje, definisanje proceduralnog okvira i nadležnih lica, obezbeđivanje obuke zaposlenih, dostupnost pravne pomoći, uvođenje obaveze internog prijavljivanja povreda i informisanje Komisije o povredama konkurencije.
Takođe, Smernice imaju za cilj podizanje svesti o potrebi usklađivanja sa propisima o zaštiti konkurencije, razvoj kulture konkurencije, jednostavniju izradu internih programa (posebno za preduzeća sa ograničenim resursima) i jačanje fer konkurencije na tržištu, što ima za rezultat efikasnije tržište, niže cene i kvalitetnija dobra i usluge za potrošače.
KZK je, pored objavljenih Smernica, otišla korak dalje objavljivanjem Modela programa usklađenosti poslovanja sa propisima o zaštiti konkurencije. Model predstavlja skup uputstava namenjenih

učesnicima na tržištu za kreiranje i implementaciju programa usklađenosti. Model je komplementaran sa Smernicama i ima za cilj da olakša izradu i implementaciju programa usklađenosti poslovanja posebno za mala i srednja privredna društva, pri čemu data forma programa nije obavezujuća, već naprotiv, formu programa je neophodno prilagoditi specifičnostima tržišta i poslovanja datog učesnika na tržištu.

Iako su Smernice i Model programa usklađenosti poslovanja osmišljeni tako da učesnicima na tržištu pruže jasan okvir za identifikaciju i upravljanje rizicima od povrede propisa o zaštiti konkurencije, njihova primena u domaćem pravnom okviru ostaje ograničena na preporučenom soft-law nivou, odnosno na nivou mekog prava. Naime, domaći propisi ne predviđaju dodatne podsticaje niti olakšice za usvajanje i primenu programa usklađenosti poslovanja, pa u slučaju povrede propisa o zaštiti konkurencije postojanje adekvatnog i efikasnog programa usklađenosti ne predstavlja pravno relevantnu okolnost prilikom odmeravanja sankcija. Shodno tome, uspostavljanje programa usklađenosti interpretira se kao akt samoregulacije tržišnih učesnika, dok se prateći izdaci tretiraju troškovima samoregulacije. Upravo taj normativni jaz između sadržine programa i njegovog pravnog značaja i pravnih posledica predstavlja polazište za uporednopravnu analizu koja sledi.

Program usklađenosti poslovanja sa propisima o zaštiti konkurencije u uporednom pravu

U poslednje vreme brojne su inicijative usmerene na povećanje efikasnosti u sprovođenju propisa o zaštiti konkurencije, koje su rezultirale pojačanim kontrolama i povećanjem broja utvrđenih povreda i izrečenih novčanih kazni na nivou EU. Uz to, mnoge zemlje članice EU su takođe uvele i značajne podsticajne mere na nacionalnom nivou, za učesnike na tržištu koji su izradili i primenjuju programe usklađenosti poslovanja, o čemu govori i Ilić (2026), sa posebnim osvrtom na značajan napredak u definisanju podsticajnih mera u okviru nacionalnih pravnih okvira u Italiji, Španiji i Nemačkoj.

Italijanska agencija za zaštitu konkurencije (it. Autorità Garante della Concorrenza e del Mercato – AGCM) je u septembru 2018. godine usvojila Smernice o programima usklađenosti sa propisima o zaštiti konkurencije, koje definišu sadržinu tih programa i pružaju značajne podsticaje za njihovo usvajanje i primenu, propisujući da adekvatan i efikasan program može da posluži kao pravni osnov za ublažavanje sankcija. Dodatno, AGCM je u Smernicama eksplicitno navela i da samo formalno usvajanje programa nije dovoljno, već da agencija za zaštitu konkurencije očekuje i dokaze o njegovoj efikasnoj primeni u praksi (npr. angažovanje menadžmenta, procena rizika, obuka zaposlenih, praćenje i/ili revizija) kako bi se takav program mogao uzeti u obzir kao olakšavajuća okolnost. U slučaju da učesnik na tržištu dokaže da je program adekvatan i efikasan, može se kvalifikovati za smanjenje kazne u rasponu od 5% do 15% od ukupnog novčanog iznosa kazne. Do sada su AGCM i nadležni sudovi u Italiji u nekoliko slučajeva već primenili ublažavanje izrečenih sankcija zasnovanih na programu usklađenosti poslovanja. Najznačajnije, u slučaju Ondulati Nordest, AGCM je prvobitno odobrila smanjenje kazne od 5%, koje je naknadno revidirano 2024. godine i nakon sudske odluke preinačeno na 10%.
Špansko nacionalno telo za zaštitu konkurencije (esp. Comisión Nacional de los Mercados y la Competencia – CNMC) usvojilo je Smernice za program usklađenosti sa propisima o zaštiti konkurencije u junu 2020. godine. U skladu sa tim Smernicama, učesnicima na tržištu neće biti omogućeno smanjivanje kazne samom činjenicom da su usvojili program usklađenosti poslovanja. Taj program mora biti efikasan, što znači da mora da uključuje ključne elemente kao što su pravilan dizajn,

implementacija, praćenje i kanali za uzbunjivanje. Dodatno, poželjno je da program bude usvojen ex ante, odnosno pre konkretne povrede propisa o zaštiti konkurencije. Međutim, i u slučajevima kada je efikasan program usvojen ex post, kompanija takođe može očekivati da će joj kazna biti umanjena, iako će takvo smanjenje najverovatnije biti manje ili će biti podložno dodatnim uslovima. Iako španski Zakon o zaštiti konkurencije ne predviđa izričito usvajanje programa usklađenosti poslovanja kao olakšavajuću okolnost, u pravnoj praksi se postojanje efikasnog programa uzima u obzir prilikom odmeravanja sankcija. U slučaju Consulting Firms CNMC je kaznila 22 konsultantske firme sumom od ukupno 6,3 miliona evra zbog kartelskog sporazuma i odobrila smanjenje izrečene kazne od 10% jednoj od njih (Indra Consultoras), na osnovu toga što je implementirala efikasan program usklađenosti pre i tokom postupka.

Nemačka Savezna kancelarija za kartele (nem. Bundeskartellamt) smatrala je da je usklađenost poslovanja sa propisima o zaštiti konkurencije pravna obaveza, zbog čega nije uzimala u obzir ni postojanje ni kvalitet programa usklađenosti kao olakšavajuću okolnost prilikom utvrđivanja kazni. Međutim, došlo je do značajnih promena 2021. godine, kada je usvojen amandman na Nemački zakon o zaštiti konkurencije (GCA), kojim se odstupilo od tradicionalnog konzervativnog stava i kada su uvedeni značajni podsticaji za usvajanje programa usklađenosti poslovanja.

Najčešće finansijske aktivnosti kojima banke vrše povredu propisa o zaštiti konkurencije manifestuju se u vidu manipulacija referentnim kamatnim stopama. Jedan od najpoznatijih primera takve prakse je skandal sa manipulacijom Londonskom međubankarskom ponuđenom stopom (engl. LIBOR) i deviznim referentnim vrednostima iz 2012. godine. Slučaj sa LIBOR-om i deviznim tržištem usledio je neposredno nakon finansijske krize iz 2007/2008. godine i uključivao je bankarske službenike različitih banaka koji su zajednički radili na manipulisanju to jest dogovornom određivanju referentnih kamatnim stopama radi sopstvene koristi.

Za razliku od SAD, u Ujedinjenom Kraljevstvu nije bilo krivičnog gonjenja banaka kao pravnih lica u vezi sa optužbama za manipulaciju LIBOR-om i deviznim referentnim stopama. Razlog su regulatorna ograničenja koja se odnose na kažnjavanje pravnih lica i definisanja odgovarajućeg krivičnog dela za pravna lica. Reformom regulatornog okvira nadležnim telima bi se obezbedila mogućnost pokretanja krivičnih postupaka protiv banaka kao pravnih lica, kao što je to slučaj sa banaka koje stupaju u zabranjene dogovore radi manipulisanja referentnim stopama u cilju sticanja protivpravne koristi. U nedostatku odgovarajućeg krivičnog dela za pravna lica koje bi se primenilo na buduće manipulacije referentnim vrednostima, zakon o zaštiti konkurencije mogao bi pružiti osnov za izricanje visokih novčanih kazni bankama učesnicama. U slučaju utvrđivanja povrede konkurencije, učesnicima na tržištu (u ovom slučaju bankama) bi se mogle izreći i druge mere koje su strožije od same novčane kazne. Primer bi bile mere zabrane obavljanja delatnosti odgovornom licu (direktoru) i određivanje mera otklanjanja povrede. Jedna od mera otklanjanja povrede odnosila bi se na obavezu uvođenja programa usklađenosti poslovanja radi sprečavanja budućih manipulacija, uz sistem praćenja od strane regulatornih tela.
Dodatno, u junu 2012.godine Barclays banka je postigla poravnanje u iznosu od 453 miliona dolara sa regulatornim telima Ujedinjenog kraljevstava i SAD zbog manipulacije LIBOR-om u periodu od 2005. do 2009. godine. Tom prilikom postojeći (doduše neadekvatan) program usklađenosti bio je ključna tačka u pregovorima o poravnanju i predstavljao je osnovu za umanjenje kazne. Kako bi tržišni učesnik svoj program usklađenosti učinio adekvatnim i efikasnim može se odlučiti da samostalno sprovede

istragu postojanja kartela kako bi osigurao efikasnost svojih sistema kontrole. Ukoliko se interno otkrije nezakonito ponašanje ostvariće se pogodnosti postojanja programa usklađenosti i korišćenje programa oslobađanja.

Između ostalog, zbog toga i Evropska komisija (EK) podržava uvođenje programa usklađenosti poslovanja. EK ima značajnu ulogu u finansijskom i bankarskom sektoru EU u oblasti zaštiti konkurencije. Prema zvaničnim podacima EK u periodu od 2013. do 2023. godine novčane kazne u ukupnom iznosu od 3,9 milijardi evra izrečene su u sedam slučajeva. Prema istom izvoru, novčane kazne izrečene bankama predstavljaju čak 20% od ukupnog iznosa izrečenih kazni (19,3 milijarde evra). Na primer, 2013. godine EK je kaznila sedam banaka u ukupnom iznosu od 1,49 milijardi evra zbog učestvovanja u kartelu u vezi sa formiranjem EURIBOR-a (engl. Euro Interest Rate Derivatives (EIRD) case). Slično tome, EK je iste godine kaznila pet banaka u iznosu od 6 miliona evra zbog kartelskog sporazuma u vezi sa određivanjem cene finansijskih derivata.

Takođe, u maju 2021. godine EK je kaznila banke sa ukupno 371 miliona evra zbog učešća u kartelu prilikom trgovine evropskim državnim obveznicama. U kartelu je učestvovalo sedam banaka UniCredit, UBS, Bank of America, Natixis, RBS (NatWest) i Portigon (WestLB). Tom prilikom kažnjene su UniCredit (69,4 miliona evra), UBS (172,4 miliona evra) i Nomura (129, 5 miliona evra). Preostale četiri banke nisu kažnjene po različitim osnovama. RBS (NatWest) je dobio potpuni imunitet zbog otkrivanja kartela, čime je izbegnuta ukupna kazna od oko 260 miliona evra, Bank of America i Natixis nisu kažnjene budući da su izašle iz kartela više od pet godina pre nego što je Komisija započela istragu, dok Portigon (WestLB) nije ostvario neto promet u poslednjoj poslovnoj godini. Naknadno, nakon podnetih žalbi kazne su umanjene UniCredit na iznos od 65 miliona i Nomura na 125,6 miliona evra. Između ostalog, u teoriji je jasno istaknuto da bi ti i slični slučajevi u bankarskom sektoru bili predupređeni ili otkriveni znatno ranije da su u bankama postojali odgovarajući interni programi usklađenosti poslovanja.

Na osnovu prethodne analize može se zaključiti da su u većini država članica EU podsticaji usmereni, s jedne strane, na kontinuirano unapređenje i efikasniju primenu propisa o zaštiti konkurencije, a s druge strane, na uvođenje posebnih podsticajnih mera za usvajanje i efektivnu primenu programa usklađenosti poslovanja. Sadržina programa usklađenosti predviđena Smernicama KZK u suštinskom je smislu usklađena sa programima razvijenim u državama članicama EU i usmerena je ka jačanju primene propisa o zaštiti konkurencije. Međutim, pozitivni propisi o zaštiti konkurencije ne predviđaju podsticaje za usvajanje i primenu programa usklađenosti.

Regulatorni okvir, praksa komisije i programi usklađenosti poslovanja u sektoru bankarstva

Programi usklađenosti poslovanja banaka u EU suštinski predstavljaju interne pravne akte dizajnirane da spreče povredu propisa o zaštiti konkurencije, kao što su zaključivanje restriktivnih sporazumima, zloupotreba dominantnog položaja i/ili nedozvoljene koncentracije. Ti programi posebno ublažavaju visokorizične segmente poslovanja banaka poput razmene poslovnih informacija, određivanje naknada i uslova ponuda, obezbeđujući usaglašenost sa regulatornim standardima.

U Srbiji je NBS kao centralna banka ključna regulatorna institucija u okviru finansijskog i bankarskog sektora. Ključne aktivnosti NBS odnose se na: a) kontrolu i nadzor (supervizija) – izdaje dozvole za rad bankama i vrši stalnu kontrolu njihovog poslovanja; i b) regulacija – donosi podzakonske propise i

pravila kojih se banke moraju pridržavati, uključujući i standarde o kapitalu i upravljanju rizicima. Regulatorni okvir NBS, između ostalog, uređuje oblasti kontrole poslovanja banaka i upravljanje rizicima. Te oblasti su u velikoj meri usklađene sa međunarodnim standardima, odnosno Bazel III okvirom. S tim u vezi, NBS propisuje da banke moraju uspostaviti sveobuhvatan sistem upravljanja rizicima koji uključuje i proceduralni okvir, odgovarajuću organizacionu strukturu, kao i sistem unutrašnjih kontrola za praćenje i kontrolu svih rizika u poslovanju.

Uz to, NBS podzakonskim aktima uređuje funkciju usklađenosti poslovanja kao dela sistema unutrašnjih kontrola banke, kao i pojam rizika usklađenosti. Rizik usklađenosti jeste rizik koji nastaje usled neusklađenosti poslovanja banke sa zakonom, podzakonskim aktima, internim propisima, propisima o sprečavanju pranja novca i finansiranja terorizma, kao i sa pravilima struke i poslovne etike. Taj rizik obuhvata mogućnost izricanja regulatornih sankcija, finansijskih gubitaka, kao i narušavanja ugleda banke. U cilju adekvatnog praćenja rizika usklađenosti, podzakonska akta NBS propisuju i obavezu uspostavljanja posebne organizacione jedinice i nadležnih lica (engl. Compliance officer). Nadležnost tih lica se odnosi na definisanje proceduralnog okvira u vezi sa poslovnim aktivnostima (npr. program, metodologiju, plan aktivnosti, izveštavanje i ostale aktivnosti) koji se usvaja na nivou upravnog odbora banke.
Između ostalog, banke svojim programima i planovima usklađenosti poslovanja redovno, a najmanje jednom godišnje, identifikuju i procenjuju rizike poslovanja banke (npr. sankcija regulatornog tela, rizik od finansijskih gubitaka i reputacioni rizik, kao i rizik u vezi pojave novog bankarskog proizvoda odnosno novog procesa/prakse). S tim u vezi, funkcija usklađenosti poslovanja u bankama podrazumeva brojne procedure, od izrade internih akata banke, odnosno proceduralnog okvira u smislu usklađenosti sa zakonskim, podzakonskim i drugim obavezujućim pravnim aktima, uvođenje novih proizvoda i procesa, prigovora i pritužbi klijenata, angažovanje trećih lica, do procedure uspostavljanja poslovnih odnosa sa novim klijentima. U osnovi programa usklađenosti je identifikacija i mapiranje rizika, kao i načina upravljanja tim rizicima, izveštavanje i sankcionisanje nepoželjnog ponašanja u cilju izbegavanja kazni, narušavanja reputacije i kršenja regulatornog okvira. Daljom analizom moguće je povući određene paralele između propisa koji se odnose na zaštitu konkurencije i postojeće prakse u domaćem bankarskom sistemu.

Regulatorni okvir NBS ne prepoznaje rizik povrede konkurencije kao jedan od mogućih rizika. Zbog toga ovaj rizik nije u nadležnosti funkcije usklađenosti, niti bilo koje druge organizacione jedinice u banci poput funkcije upravljanja rizicima. To implicira da stroga zakonska regulativa centralne banke ne zahteva obavezno praćenje rizika povrede konkurencije, već bi ta kategorija rizika mogla da se podvede pod kategoriju ostali rizici. Time se bankama prepušta odluka o praćenju rizika povrede konkurencije i izrada programa usklađenosti poslovanja sa propisima o zaštiti konkurencije.

Domaće banke čine 25% bankarskog sektora, dok 75% tržišta pripada bankama u stranom vlasništvu. Imajući u vidu takvu strukturu, može se očekivati da će banke pristupi uspostavljanju i primeni programa usklađenosti sa popisima o zaštiti konkurencije biti različiti. Kod banaka koje posluju u okviru međunarodnih grupacija razvoj programa usklađenosti tipično je povezan sa politikama matičnih banaka i regulatornim okvirima zemalja porekla, dok su domaće banke u većoj meri samostalne u oblikovanju takvih internih akata. S tim u vezi, u dosadašnjoj praksi domaćih banaka ne može se govoriti o sistemski razvijenim formalizovanim programima usklađenosti sa propisima o zaštiti konkurencije.

Aktivnosti Komisije u bankarskom sektoru u prethodnom periodu odnosile su se na ispitivanje koncentracije i izdavanje rešenja o njihovom odobrenju. Međutim, u javno dostupnim izveštajima i odlukama Komisije ne uočavaju se podaci o obavljanim kontrolama i proverama kršenja konkurencije, niti podaci da su pokretani postupci kada je reč o restriktivnim sporazumima, zloupotrebama dominantnog položaja ili izuzeća restriktivnih sporazuma od kazni u tom sektoru. Dodatno, nema potvrde da su rađene sektorske analize koje su za predmet imale bankarski sektor. Na odsustvo kontrola Komisije u sektoru bankarstva ukazuje i činjenica da je, prema podacima NBS, stepen tržišne koncentracije meren HHI indeksom u segmentu kreditne aktivnosti bio u zoni umerene koncentracije tokom 2024. godine.

Dodatno, banke na domaćem tržištu nemaju značajnije podsticaje za usvajanje programa usklađenosti poslovanja kao što je to slučaj u pojedinim zemljama članicama EU, s obzirom da Komisija i sudovi nemaju pravni osnov da taj program eventualno koriste kao osnovu za umanjenje kazni. Zbog takvih pravnih i institucionalnih rešenja programi usklađenosti poslovanja nisu široko rasprostranjeni i nije u potpunosti iskorišćen njihov potencijal za jačanje konkurencije u sektoru bankarstva.

Podsticajne mere za uvođenje programa usklađenosti ne mogu se posmatrati izolovano, već kao deo šireg sistema zaštite konkurencije. Da bi mere imale stvarni efekat, potrebno je obezbediti određene institucionalne i regulatorne uslove: jačanje kulture konkurencije kroz saradnju Komisije i NBS, razvijanje svesti učesnika na tržištu odnosno banaka o značaju zaštite konkurencije i uključivanje rizika povrede konkurencije u postojeće sisteme upravljanja rizicima u bankama. Institucionalna saradnja Komisije i NBS mogla bi se odnositi na razmenu podataka, savetodavne uloge i aktivnosti na regulatornoj usklađenosti. U tom smislu, ukoliko bi se uspostavila veza između smernica koje preporučuje Komisija i striktne regulative NBS, stvorila bi se institucionalna i regulatorna podrška u procesu uvođenja i primene programa usklađenosti poslovanja u cilju zaštite tržišne konkurencije i obezbeđivanja njenih pozitivnih efekata u sektoru bankarstva.

Takođe, Komisija bi mogla da pojača sopstvenu promociju i primenu propisa kroz preventivne i detektivne kontrole u skladu sa međunarodnim trendovima. U tom slučaju banke bi uvidele potrebu za izradom programa usklađenosti poslovanja kao alata za upravljanje rizikom povrede konkurencije i osnov za poštovanje propisa iz oblasti zaštite konkurencije.
U cilju pronalaženja kompromisnog rešenja za banke, kada je u pitanju primena Smernica Komisije i propisa NBS, potrebno je razmotriti mogućnost prilagođavanja modela koji predlaže Komisija tako da program usklađenosti poslovanja istovremeno pomogne u identifikaciji, praćenju i upravljanju rizika na koje upućuje i NBS ili vice versa. Tako bi se izbegla izrada dva okvira i posebnih procedura za potrebe Komisiju i NBS, odnosno postojala bi mogućnost da jednom procedurom budu ispoštovani regulatorni zahtevi obe institucije kada je reč o adekvatnom upravljanju rizicima iz oblasti zaštite konkurencije. Takođe, na taj način bi se racionalizovala upotreba resursa banaka i značajno uticalo na efikasnost ovih procesa, kao i na celovitost i sveobuhvatnost upravljanja rizicima od mogućih izricanja regulatornih sankcija, finansijskih gubitaka, kao i narušavanja ugleda banke.

Zaključna razmatranja

KZK je izdavanjem Smernica i Modela ostvarila napredak u podizanju svesti o značaju primene prava konkurencije i razvoja kulture zaštite konkurencije u Srbiji, čime se KZK u značajnoj meri usaglasila sa novom praksom u EU. Sadržina programa usklađenosti poslovanja u Smernicama KZK je praktično identična sadržini programa koji su razvijeni u zemljama članicama EU, koji za krajnji cilj imaju jačanje aktivnosti na primeni propisa o zaštiti konkurencije.

Ono što predstavlja jednu od ključnih razlika jeste činjenica da učesnici na domaćem tržištu, a time i banke, nemaju podsticaje za usvajanje i primenu programa usklađenosti poslovanja kao što je to slučaj u pojedinim zemljama članicama EU, jer KZK i Upravni sud nemaju pravni osnov da taj program koriste kao osnov za umanjenje kazni, odnosno da postojanje programa uzimaju u obzir prilikom određivanja sankcija za povredu propisa o zaštiti konkurencije.

Dodatno, s obzirom da učesnici na tržištu EU podležu efikasnim kontrolama koje sprovode tela nadležna za zaštitu konkurencije, povećava se verovatnoća da će i banke biti kažnjene usled eventualnih povreda propisa o zaštiti konkurencije. Na taj način, stvoreni su snažni podsticaji za usvajanje i primenu adekvatnih programa usklađenosti poslovanja, koji mogu da predstavljaju i pravni osnov za umanjenja kazni i imaju značajan uticaj na povećanje konkurentnosti između banaka.

Na osnovu razmatranja u radu, može se zaključiti da je prvenstveno potrebno razviti svest o postojanju rizika od povreda konkurencije u bankarskom sektoru kroz koordiniranu institucionalnu saradnju KZK i NBS, kao i kroz uključivanje rizika od povrede prava konkurencije u okvire za upravljanje rizicima na nivou banaka. Dodatno, potrebno je uvođenje internih i eksternih, preventivnih i detektivnih kontrola od strane KZK, čime bi se posebno dalo na značaju potrebi poštovanja propisa o zaštiti konkurencije. Na taj način dalje, uvođenje podsticajnih mera za usvajanje i primenu programa usklađenosti poslovanja po ugledu na uporedna tela za zaštitu konkurencije dobilo bi svoj puni značaj i predstavljao bi ozbiljan argument za uvođenje i primenu programa usklađenosti u bankama. Proces bi u nastavku podrazumevao kontinuiranu edukaciju zaposlenih u cilju razumevanja konteksta i značaja zaštite konkurencije. Posledično, praćenje i revizija aktivnosti banaka u oblasti zaštite konkurencije, kao i naknadne provere predstavljaju sledeći korak za uspostavljanje efikasnog sistema upravljanja rizikom povrede propisa, a time i jačanja konkurencije u okviru sektora.

Međutim, ukoliko izostanu institucionalna rešenja, kontrolni mehanizmi i podsticaji za usvajanje i primenu programa usklađenosti poslovanja, izrada tih programa bi u velikoj meri predstavljala samo još jednu normu bez efektivne primene, odnosno regulatorni trošak. Taj trošak u praksi može da ima za posledicu potpuno suprotne efekte od nameravanih, odnosno može da umanji konkurentnost učesnika u bankarskom sektoru i da postane prepreka daljem razvoju.

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COMPETITION COMPLIANCE PROGRAMMES IN THE BANKING SECTOR: A NEW TREND IN STRENGTHENING COMPETITION IN SERBIA OR A REGULATORY COST?

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Summary: *The Commission for the Protection of Competition has made a significant step forward in developing the framework for business compliance with competition law by publishing the Guidelines for the Development of Competition Compliance Programs and the Model of Compliance Program, bringing it closer to the European Union competition law. This paper raises the question of the extent to which this normative step has been followed by practical results and whether existing institutional and regulatory conditions enable the effective implementation of competition compliance programs in the domestic banking sector. Special attention is paid to the analysis of comparative legal solutions in the member states of the European Union, where incentive mechanisms exist and can lead to a reduction of penalties for infringement of competition law in the case of compliance programs. It is concluded that, in the absence of adequate institutional incentives and effective enforcement of competition law in the banking sector, competition compliance programs do not have significant potential to strengthen competition, and their adoption may be a regulatory cost.*

Keywords: Competition Protection; Commission for Protection of Competition; Competition Compliance Program; Banking Sector; Incentive Measures.

JEL classification: K21, K23, G21

Introduction

The adoption of internal competition compliance programs based on so-called soft law is a new trend in EU member states. These programs are internal legal acts of market participants in the form of internal rules and procedures based on a risk assessment of potential violations of competition law, aimed at ensuring compliance with competition regulations and minimizing risks that may arise in the case of such violations (e.g., regulatory, reputational, and financial risks). In this context, the Commission for Protection of Competition (CPC) in Serbia adopted the General Guidelines for the Development of Competition Compliance Programs (Guidelines) in 2021, followed by the Model of Competition Compliance Program (Model) in 2022, designed for all market participants.

This paper examines whether the adoption and implementation of these compliance programs, following the example of EU member states, could have a significant impact on enhancing competition in the banking sector, or whether, in practice, it might lead to minimal results, reducing to a mere regulatory requirement that imposes additional costs on market participants and ultimately decreases competitiveness.

The paper, among others, relies on the work of Ilić (2026), which discusses the role and relationship between compliance and competition protection in general. This paper further focuses on these concepts in the banking sector. Namely, the regulatory framework of the National Bank of Serbia (NBS), the existing practice of the CPC when it comes to banks, as well as the issue of their institutional cooperation are being discussed. In addition, the paper includes a sectoral analysis of the compliance of banks' operations with competition rules, with a focus on the possibility for the compliance function of banks to identify and include the risk of competition infringement in existing risk management systems.

The structure of the paper follows the set research question, with the second part analyzing the content and purpose of compliance programs, while the third part provides a comparative legal overview of relevant regulatory solutions and case law, with particular emphasis on the experiences of EU member states. The fourth part is dedicated to the analysis of the existing institutional and legal framework in Serbia, including the secondary legislation of the CPC and the NBS, as well as the business practices of banks regarding the development and implementation of compliance programs with competition law regulations. The final section of the paper contains concluding considerations.

Content and Purpose of Competition Compliance Programs

Competition law regulations, among other things, govern the behavior of economic entities in the relevant market by generally prohibiting restrictive agreements and the abuse of dominant market position, as well as enabling the control of concentrations. Ristić and Trifunović (2022) argue that the primary goal of these regulations is to increase competitive pressure in the market, which in turn promotes economic progress and, particularly, consumer welfare. Compliance with these regulations entails organizing business operations in a way that minimizes the risk of violating competition law, which is directly linked to the more effective realization of the core objectives of competition law.

Furthermore, this compliance can contribute to increasing legal certainty in business, preventing financial and reputational consequences of legal violations, and preserving trust and market position. In line with trends observed within the OECD and the European Union, particularly with regard to strengthening the enforcement of competition law, the CPC in Serbia issued Guidelines for Developing Compliance Programs with Competition Law Regulations in December 2021, with the aim, among other things, of raising awareness about the importance of enforcing competition law and developing a culture of competition protection in Serbia, as discussed by Dobrić (2023). Additionally, in June 2022, the Commission published a Model Compliance Program with Competition Law Regulations. Although the development of a compliance program is not a legal obligation for participants in the domestic market, it is a recommendation from the Commission, given that such internal acts provide assistance to market participants in ensuring compliance with competition law, following the practice of national competition authorities in EU member states.

The Guidelines are intended for all market participants, i.e., all entities engaged in the trade of goods and services in the domestic market. According to the Guidelines, the primary goal of developing a compliance program is to reduce the risk of violating competition law, which is achieved through the timely identification of risks and the implementation of activities to address them. In this way, in addition to protecting competition, market participants significantly reduce the likelihood of incurring fines (up to 10% of their total annual turnover), civil and criminal sanctions, reputational damage, or being subject to damage claims. In other words, the benefits of developing and implementing a compliance program are numerous and relate to reducing the risk of entering into restrictive agreements, abusing a dominant position, and engaging in prohibited concentrations.

An effective compliance program must meet criteria related to the adequate identification of the risks of violating regulations, defining measures to mitigate those risks, establishing procedural frameworks and responsible individuals, providing employee training, ensuring legal assistance availability, implementing internal reporting obligations for violations, and informing the Commission about competition law violations.

Additionally, the Guidelines aim to raise awareness of the need for compliance with competition law, develop a competition culture, simplify the development of internal programs (especially for businesses with limited resources), and enhance fair competition in the market, resulting in a more efficient market, lower prices, and higher-quality goods and services for consumers.

In addition to the Guidelines, the CPC went a step further by publishing the Model of Competition Compliance Program. The Model is a set of instructions intended for market participants to create and

implement their compliance programs. The Model is complementary to the Guidelines and aims to facilitate the development and implementation of compliance programs, particularly for small and medium-sized enterprises, with the form of the program not being mandatory. On the contrary, the form must be adapted to the market and business specifics of each individual market participant.

Although the Guidelines and Model are designed to provide market participants with a clear framework for identifying and managing competition law violation risks, their application within the domestic legal framework remains limited to a soft-law level. That is, domestic regulations do not provide additional incentives or exemptions for adopting and implementing compliance programs, meaning that in the event of a competition law violation, the existence of an adequate and effective compliance program does not constitute a legally relevant circumstance when determining sanctions.

Accordingly, the establishment of a compliance program by market participants is interpreted as act of self-regulation, while the associated costs are treated as costs of self-regulation. This normative gap between the content of the program and its legal significance and legal consequences serves as the basis for the comparative legal analysis that follows.

Competition Compliance Programs in Comparative Law

Recently, numerous initiatives have been aimed at increasing the efficiency of competition law enforcement, leading to tightened controls and an increase in the number of violations identified and financial penalties imposed within the EU. Alongside this, many EU member states have introduced significant incentives at the national level for market participants who develop and implement compliance programs, as discussed Ilić (2026) with the special attention to Italy, Spain, and Germany, since these countries have made significant progress in defining incentive measures within their national legal frameworks.

The Italian Competition Authority (it. Autorità Garante della Concorrenza e del Mercato – AGCM) adopted Guidelines on Compliance Programs with Competition Law Regulations in September 2018. These guidelines define the content of such programs and offer significant incentives for their adoption and implementation, stipulating that an adequate and effective program can serve as a legal basis for reducing sanctions. Furthermore, AGCM explicitly stated in the Guidelines that mere formal adoption of the program is insufficient; the competition authority expects evidence of its effective implementation in practice (e.g., management involvement, risk assessment, employee training, monitoring, and/or auditing) in order for such a program to be considered as a mitigating factor. If a market participant demonstrates that the program is adequate and effective, it may qualify for a reduction of the fine ranging from 5% to 15% of the total penalty. To date, the AGCM and relevant courts in Italy have already applied the reduction of sanctions based on the existence of a compliance program in several cases. Notably, in the Ondulati Nordest case, the AGCM initially approved a 5% reduction in the fine, which was later revised in 2024, following a court ruling, to a 10% reduction.

Spain National Competition Authority (esp. Comisión Nacional de los Mercados y la Competencia – CNMC) adopted Guidelines for Compliance with Competition Law Regulations in June 2020. According to these guidelines, market participants will not be allowed to reduce their fines simply by having adopted a compliance program. The program must be effective, meaning that it must include key elements such as proper design, implementation, monitoring, and whistleblower channels.

Additionally, it is preferable that the program be adopted ex ante, i.e., before the specific violation of competition law occurs. However, even in cases where an effective program was adopted ex post, companies can still expect a reduction in their fine, although this reduction is likely to be smaller or subject to additional conditions. Although Spanish competition law does not explicitly recognize the adoption of a compliance program as a mitigating circumstance, in legal practice, the existence of an effective program is taken into account when determining sanctions. In the Consulting Firms case, when the CNMC fined 22 consulting firms a total of 6.3 million euros for participating in a cartel and granted a 10% reduction in the fine to one of them (Indra Consultoras) because it had implemented an effective compliance program before and during the procedure.

Germany's Federal Cartel Office (ger. Bundeskartellamt) considered business compliance with competition law as a legal obligation, meaning that it did not take the existence or quality of compliance programs into account as a mitigating factor when determining fines. However, significant changes occurred in 2021, when it was adopted amendment to the German Competition Act (GCA), by which Germany has moved further from its traditionally conservative stance and introduced significant incentives for the adoption of compliance programs.

In the banking sector, the most frequent financial activities that lead to competition law violations manifest in the manipulation of reference interest rates. One of the most famous examples of such practices is the 2012 LIBOR (London Interbank Offered Rate) and foreign exchange benchmark manipulation scandal. This case, which followed directly after the 2007/2008 financial crisis, involved bank officers from various institutions collaborating to manipulate, i.e., collectively set, reference interest rates for their own benefit.

Unlike the United States, the United Kingdom did not pursue criminal charges against banks as legal entities for LIBOR and foreign exchange reference rate manipulation. The reason for this was regulatory limitations related to penalizing legal entities and defining a criminal offense for them. Reforming the regulatory framework would allow the relevant authorities to initiate criminal proceedings against banks as legal entities, as is the case with banks entering into prohibited agreements to manipulate reference rates for illicit gain. In the absence of an appropriate criminal offense applicable to legal entities for future manipulation of reference values, the competition law could provide the basis for imposing high fines on participating banks. In the case of a competition law violation, market participants (in this case, banks) could be subjected to other measures that are stricter than a mere fine. An example would be measures prohibiting the responsible person (the director) from engaging in certain activities, along with measures to remedy the violation. One such remedial measure could include the obligation to introduce a business compliance program to prevent future manipulations, with ongoing monitoring by regulatory bodies.

Furthermore, in June 2012, Barclays Bank reached a settlement with regulatory authorities in the United Kingdom and the United States in the amount of 453 million dollars for its role in manipulating LIBOR between 2005 and 2009. At that time, an existing (though inadequate) compliance program played a key role in the settlement negotiations and served as the basis for a fine reduction. To make their compliance programs adequate and effective, market participants may choose to independently investigate the existence of cartels to ensure the efficiency of their control systems. If illegal behavior is discovered internally, the advantages of having a compliance program and using leniency programs will be realized.

In addition, the European Commission (EC) supports the introduction of business compliance programs. The EC plays a significant role in the financial and banking sectors of the EU in terms of competition protection. According to official EC data, between 2013 and 2023, financial penalties amounting to 3.9 billion euros were imposed in seven cases. According to the same source, fines imposed on banks account for nearly 20% of the total amount of fines (19.3 billion euros). For instance, in 2013, the EC fined seven banks a total of 1.49 billion euros for participating in a cartel related to case EURIBOR (Euro Interest Rate Derivatives) setting. Similarly, in the same year, the EC fined five banks a total of 6 million euros for a cartel agreement concerning the pricing of financial derivatives.

In May 2021, the EC fined banks a total of 371 million euros for participating in a cartel involving the trade of European government bonds. The cartel involved seven banks: UniCredit, UBS, Bank of America, Natixis, RBS (NatWest), and Portigon (WestLB). The fines were reduced after appeals, with UniCredit's fine reduced to 65 million euros and Nomura's to 125.6 million euros. In theory, these and similar cases in the banking sector would have been prevented or detected much earlier had the banks had adequate internal compliance programs in place.

Based on the previous analysis, it can be concluded that in most EU member states, incentives are directed, on the one hand, towards continuous improvement and more effective enforcement of competition law and, on the other hand, towards introducing special incentives for adopting and effectively implementing business compliance programs. The content of the compliance program as outlined in the CPC Guidelines is substantially aligned with the programs developed in EU member states and is aimed at strengthening the enforcement of competition law. However, positive competition law regulations do not provide incentives for adopting and implementing compliance programs.

Regulatory Framework, Commission Practice, and Compliance Programmes in the Banking Sector

Compliance programmes of banks within the EU essentially constitute internal legal instruments designed to prevent infringements of competition law, such as the conclusion of restrictive agreements, abuse of a dominant position, and/or unlawful concentrations. These programmes are particularly aimed at mitigating high-risk areas of banking operations, such as the exchange of business information, the setting of fees and offer conditions, thereby ensuring conformity with applicable regulatory standards.

In Serbia, the National Bank of Serbia (NBS), as the central bank, is the key regulatory institution within the financial and banking sector. Its principal activities relate to: (a) control and supervision – issuing banking licences and conducting ongoing oversight of banks' operations; and (b) regulation – adopting by-laws and rules with which banks must comply, including standards relating to capital adequacy and risk management.

The regulatory framework of the NBS, inter alia, governs the areas of banking supervision and risk management. These areas are to a large extent aligned with international standards, notably the Basel III framework. In this regard, the NBS requires banks to establish a comprehensive risk management system, including an appropriate procedural framework, adequate organisational structure, and an internal control system for monitoring and controlling all risks arising from banking operations.

In addition, through its secondary legislation, the NBS regulates the compliance function as part of a bank's internal control system, as well as the concept of compliance risk. Compliance risk is the risk arising from a bank's failure to operate in accordance with laws, by-laws, internal regulations, anti-money laundering and counter-terrorist financing rules, as well as professional standards and business ethics. Such risk encompasses the possibility of regulatory sanctions, financial losses, and reputational damage to the bank. In order to ensure adequate monitoring of compliance risk, NBS by-laws also prescribe the establishment of a dedicated organisational unit and responsible officers (Compliance Officers). Their competences include defining the procedural framework relating to business activities (e.g. programmes, methodologies, action plans, reporting, and related activities), which is adopted at the level of the bank's management board.

Among other matters, banks, through their compliance programmes and plans, regularly—and at least annually—identify and assess operational risks, such as the risk of regulatory sanctions, financial losses, reputational risks, as well as risks connected with the introduction of new banking products or new processes/practices. In this respect, the compliance function within banks encompasses numerous procedures, ranging from the drafting of internal acts and ensuring conformity with statutory, regulatory, and other binding legal instruments, to the launch of new products and processes, handling customer complaints, engaging third parties, and establishing business relationships with new clients. At the core of any compliance programme lies the identification and mapping of risks, the methods for managing such risks, reporting obligations, and the sanctioning of undesirable conduct, all with a view to avoiding penalties, reputational harm, and breaches of the regulatory framework. Further analysis reveals certain parallels between competition law rules and existing practices within the domestic banking system.

The regulatory framework of the NBS does not expressly recognise the risk of competition law infringement as a distinct category of risk. Consequently, this risk does not fall within the formal remit of the compliance function, nor of any other organisational unit within a bank, such as the risk management function. This implies that the strict legal framework established by the central bank does not require mandatory monitoring of competition law risks; rather, such risks could only be subsumed under the residual category of "other risks." Accordingly, banks are left to decide whether to monitor competition law risks and whether to develop compliance programmes relating to competition law.
Domestic banks account for 25% of the banking sector, while 75% of the market belongs to foreign-owned banks. In light of such market structure, differing approaches to the establishment and implementation of competition compliance programmes may reasonably be expected. In banks operating within international banking groups, the development of compliance programmes is typically linked to the policies of parent institutions and the regulatory frameworks of their home jurisdictions, whereas domestic banks enjoy greater autonomy in designing such internal instruments. In this context, the current practice of domestic banks does not indicate the existence of systematically developed and formalised competition compliance programmes.

The activities of the Commission in the banking sector during the previous period have primarily related to merger control and the issuance of decisions approving concentrations. However, publicly available reports and decisions of the Commission reveal no significant data concerning inspections or investigations into competition law infringements, nor evidence of proceedings relating to restrictive agreements, abuses of dominance, or exemptions from fines in this sector. Furthermore, there is no confirmation that sector inquiries concerning the banking sector have been conducted.

The absence of Commission enforcement activity in the banking sector is further illustrated by the fact that, according to NBS data, the level of market concentration measured by the HHI index in the lending segment remained within the zone of moderate concentration during 2024.

Moreover, banks operating in the domestic market do not have substantial incentives to adopt compliance programmes, unlike in certain EU Member States, since neither the Commission nor the courts have a legal basis to use such programmes as grounds for mitigating fines. Owing to these legal and institutional arrangements, compliance programmes are not widely implemented, and their full potential for strengthening competition in the banking sector has not been realised.

Incentive measures for the introduction of compliance programmes cannot be viewed in isolation, but rather as part of a broader competition protection system. For such measures to have genuine effect, certain institutional and regulatory preconditions must be ensured: strengthening the culture of competition through cooperation between the Commission and the NBS, raising awareness among market participants—namely banks—of the importance of competition protection, and incorporating competition law risks into existing banking risk management systems. Institutional cooperation between the Commission and the NBS could include data exchange, advisory functions, and activities aimed at regulatory alignment. In that sense, if a connection were established between the guidelines recommended by the Commission and the strict regulatory framework of the NBS, institutional and regulatory support would be created for the process of introducing and implementing compliance programmes with a view to protecting market competition and ensuring its beneficial effects in the banking sector.

Likewise, the Commission could strengthen its own advocacy and enforcement of competition rules through preventive and detective controls, in line with international trends. In such a case, banks would recognise the need to develop compliance programmes as tools for managing competition law risks and as a basis for ensuring compliance with competition regulations.

In order to identify a balanced solution for banks with regard to the simultaneous application of the Commission's Guidelines and NBS regulations, it is necessary to consider adapting the model proposed by the Commission so that the compliance programme simultaneously assists in identifying, monitoring, and managing the risks recognised by the NBS, or vice versa. In this way, the need to develop two separate frameworks and distinct procedures for the purposes of the Commission and the NBS would be avoided. Instead, a single procedure could satisfy the regulatory requirements of both institutions with respect to the adequate management of competition-related risks. Such an approach would also rationalise the use of banking resources and significantly improve the efficiency of these processes, as well as the coherence and comprehensiveness of risk management concerning possible regulatory sanctions, financial losses, and reputational harm.

Concluding Remarks

By issuing the Guidelines and the Model, the Commission for Protection of Competition (CPC) has made progress in raising awareness of the importance of the enforcement of competition law and the development of a culture of competition protection in Serbia, thereby aligning itself to a significant extent with contemporary practice within the European Union. The substance of the compliance programme set out in the CPC Guidelines is practically identical to the programmes developed in

EU Member States, whose ultimate objective is to strengthen activities relating to the enforcement of competition law rules.
One of the key differences, however, lies in the fact that market participants in the domestic market, including banks, do not have incentives to adopt and implement compliance programmes comparable to those existing in certain EU Member States. This is because the CPC and the Administrative Court lack a legal basis to use such programmes as grounds for reducing fines, or to take their existence into account when determining sanctions for infringements of competition law.

Furthermore, since market participants within the EU are subject to effective inspections and enforcement measures conducted by competition authorities, the likelihood increases that banks will be sanctioned in the event of breaches of competition rules. In this manner, strong incentives have been created for the adoption and implementation of adequate compliance programmes, which may also serve as a legal basis for fine reductions and have a significant impact on increasing competitiveness among banks.

Based on the considerations presented in this paper, it may be concluded that priority should be given to developing awareness of the risk of competition law infringements in the banking sector through coordinated institutional cooperation between the CPC and the National Bank of Serbia (NBS), as well as through the inclusion of competition law risks within banks' risk management frameworks. In addition, the introduction of internal and external, preventive and detective controls by the CPC is necessary, thereby further emphasising the importance of compliance with competition law rules.
Thereafter, the introduction of incentive measures for the adoption and implementation of compliance programmes, modelled on comparative competition authorities, would acquire its full significance and would constitute a serious argument in favour of introducing and applying such programmes in banks. The subsequent phase would entail the continuous education of employees in order to ensure an understanding of the context and significance of competition protection. Consequently, the monitoring and review of banking activities in the field of competition protection, together with follow-up inspections, represent the next step towards establishing an effective system for managing the risk of regulatory infringements and, accordingly, strengthening competition within the sector.

However, in the absence of appropriate institutional solutions, control mechanisms, and incentives for the adoption and implementation of compliance programmes, the drafting of such programmes would largely amount to yet another formal rule without effective application, namely a regulatory cost. In practice, such cost may produce effects entirely contrary to those intended, by reducing the competitiveness of market participants in the banking sector and becoming an obstacle to further development.

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DEFINISANJE PROTOKOLA VEŠTAČKE INTELIGENCIJE U REŠAVANJU NEDOSTAJUĆIH PODATAKA U OBLASTI BANKARSTVA

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Rezime: *U ovome radu se na jedan sistematičan i sveobuhvatan način rešava problematika nedostajućih podataka u bankarstvu. O ovom ozbiljnom i značajnom izazovu, veoma se malo pisalo, i to sporadično nad nekim konkretnim poslovnim problemima, ali nikad na ovaj način – a to je kreiranje tj. definisanje protokola. Uključivanjem modela veštačke inteligencije u proces rešavanja nedostajućih podataka, ovaj i dan danas "nerešiv problem" za analitičare podataka se stavlja pod kontrolu, i počinje da predstavlja rutinu, tj. još jedan od obaveznih koraka u pripremi i analizi podataka.*

Ključne reči: veštačka inteligencija, mašinsko učenje, nedostajući podaci, analitika podataka, bankarstvo.

JEL klasifikacija: C14, G21

Uvod

U bankarskom sektoru, u uslovima sve veće konkurencije i oštrije tržišne utakmice, poslovnim bankama je sve teže da održe dobre poslovne performanse i rezultate. Iz tog razloga, okreću se poslovnoj analitici, koja im može ukazati, koje su im slabe tačke u poslovanju, a koje su im razvojne šanse. Integracija veštačke inteligencije i mašinskog učenja u finansijskim uslugama ubrzano transformiše interne operacije i upravljanje rizicima, stavljajući fokus na neophodnost korišćenja naprednih prediktivnih modela nad internim bazama podataka (Godolja i Domi, 2025). Dakle ključ uspeha, ili uopšte opstanka, su kvalitetni rezultati različitih poslovnih analiza. Međutim, za kvalitetan rezultat važi princip GIGO (garbage in, garbage out), to jest u suštini, kvalitet ulaznih podataka za analizu mora biti visok. Međutim, svi koji se bave prikupljanjem i obradom podataka, vrlo brzo se susretnu sa problemom nedostajućih podataka, i tu dolazimo do suštine ovog rada.

Dosadašnji načini rešavanja problematike nekompletnih podataka

U većini slučajeva, istraživači na ovaj ili onaj način otklanjaju problem nekompletnih podataka, a da pri tome uopšte ne naznačavaju koliko je takvih bilo podataka. Verovatno su neprimetno isključeni nekompletni podaci iz skupa podataka koji se analiziraju. Ovakav postupak je donekle razumljiv, jer istraživači, prilikom pisanja stručnih radova, s pravom strahuju da to može predstavljati ozbiljno ograničenje njihovog istraživanja. S razlogom se plaše da bi recenzenti rada mogli odbiti njihov rad, uz obrazloženje da je istraživanje prilično slabo i nepouzdano, usled značajnog prisustva nekompletnih podataka. Prema tome, šanse za objavljivanje rada znatno se povećavaju ukoliko se problem nekompletnih podataka ne iznese na videlo. Kao što su primetili Orchard i Woodbury (1972), najboji način za suočavanje s nekompletnim podacima jeste jednostavno ne imati ih.

Naravno, u takvim radovima, postojanje nekompletnih podataka nigde se ne naznačava. Tada se podrazumevana metoda rešavanja problema nekompletnosti (to jest uklanjanje nekompletnih podataka) primenjuje bez ikakvog pominjanja. Štaviše, tabele u kojima su prikazani rezultati sprovedenih kvantitativnih analiza tada se zasnivaju na različitim veličinama uzoraka.

Razlog zbog kojeg istraživači pribegavaju zastarelim procedurama za rešavanje nekompletnosti podataka delom leži u tome što su im te procedure teorijski jasne. Te procedure svakako obuhvataju brisanje opservacija s nekompletnim podacima, zatim brisanje opservacija samo u slučaju kada imaju nekompletne podatke za promenljive koje se trenutno analiziraju, kao i zamenu nekompletnih podataka aritmetičkom sredinom posmatrane promenljive. Savremene procedure veštačke inteligencije za tretman nekompletnih podataka izuzetno su kompleksne i u većini slučajeva nerazumljive prosečnom istraživaču, te ih stoga izbegavaju.

Protokol veštačke inteligencije

Ukoliko u podacima koji su planirani za analizu postoji prisustvo nekompletnosti, postoji mogućnost da će ocene nepoznatih parametara u kvantitativnoj analizi koja se planira biti pristrasne. Iz tog razloga, od ključne je važnosti pristupiti problemu nekompletnih podataka pažljivo i sveobuhvatno, što bi se, u slobodnijem govoru, moglo nazvati protokolom. U datom protokolu, nulti korak bi predstavljao polaznu tačku u rešavanju problema nekompletnih podataka. U prvom koraku postavilo bi se pitanje:

- Da li posmatrane promenljive, tj. da li u analiziranom skupu podataka postoji prisustvo nekompletnih podataka?

Ukoliko je odgovor da, prelazi se na drugi korak. Ukoliko je odgovor ne, prelazi se direktno na poslednji korak. U drugom koraku, postavlja se pitanje:

- Da li podaci nedostaju potpuno slučajno?

Ukoliko je odgovor pozitivan, prelazi se na treći korak. Ukoliko je odgovor negativan, prelazi se na četvrti korak.

Treći korak predstavlja rešavanje nekompletnih podataka, bilo primenom tradicionalnih tehnika (brisanje opservacija koje sadrže nedostajuće podatke ili umetanje aritmetičke sredine posmatrane promenljive umesto nedostajućih podataka), bilo primenom savremenih metoda. Nakon toga, prelazi se na poslednji korak.

U četvrtom koraku, postavlja se pitanje:

- Da li kvantitativno modelovanje koristi nadgledani ili nenadgledani model veštačke inteligencije?

Ukoliko je odgovor nadgledani, prelazi se na peti korak. Ukoliko je odgovor nenadgledani, prelazi se na osmi korak.

U petom koraku ispituje se:

- Da li je nedostupnost podataka za objašnjavajuće promenljive uzrokovana vrednostima zavisne promenljive?

Ukoliko je odgovor pozitivan, prelazi se na šesti korak. Ukoliko je odgovor negativan, prelazi se na sedmi korak. U šestom koraku konstatuje se da nedostajući podaci to čine prema ne slučajnom mehanizmu. Iz tog razloga, dalja analiza podataka se obustavlja i prelazi na poslednji korak.

U sedmom koraku konstatuje se da podaci koji su nedostupni nedostaju na slučajan način, te da se problem nedostajućih podataka može rešiti isključivo primenom savremenih tehnika. Potom se prelazi na poslednji korak.

U osmom koraku ispituje se:

- Da li nedostupnost podataka za neku promenljivu zavisi od vrednosti sopstvenih podataka, ili od vrednosti podataka ostalih analiziranih promenljivih?

Ukoliko je odgovor od sopstvenih vrednosti, prelazi se na šesti korak. Ukoliko je odgovor od vrednosti ostalih promenljivih, prelazi se na sedmi korak. U poslednjem koraku zaključuje se da je rešavanje problema nekompletnosti podataka završeno.

Tipovi mehanizama

U većini slučajeva, podaci koji treba statistički da se analiziraju imaju, u većoj ili manjoj meri, problem nekompletnosti. Sam taj nedostatak naizgled nije ozbiljan, međutim, ukoliko je mehanizam nekompletnosti određenog tipa, može doći do ozbiljnog problema. Iz tog razloga, od ključne je važnosti uvek ispitati tip mehanizma koji dovodi do nekompletnih podataka. Za sada je definisano da postoje tri tipa mehanizama koji dovode do nekompletnosti podataka (Allison, 2002), a to su: potpuno slučajan, slučajan i neslučajan.

Da bi se mogli opisati dati tipovi mehanizma, promenljiva s nedostajućim podacima označava se sa Y. Zatim, njen raspoloživi deo označava se sa Yo, dok se nedostupni deo označava sa Ym. Sada se može definisati indikatorska promenljiva nedostupnosti, koja uzima vrednosti nula za one opservacije koje su raspoložive za promenljivu Y, i vrednost jedan za one opservacije koje su nedostupne za promenljivu Y. Data indikatorska promenljiva može se označiti sa M. Ukoliko u analiziranom skupu podataka postoje promenljive koje nemaju nedostajuće vrednosti, označavaju se sa X.

Prema tome, kaže se da je mehanizam nedostajućih podataka za promenljivu Y potpuno slučajan ako podaci nedostaju na potpuno slučajan način, te stoga ne zavise ni od dela promenljive Ym, ni od dela promenljive Yo, ni od ostalih prisutnih promenljivih X. Korišćenjem indikatora verovatnoće nedostupnosti, dati mehanizam nedostajućih podataka (Fitzmaurice i sar., 2015) može se iskazati kao:

$$P(M|Y,X) = P(M) \tag{1}$$

Kaže se da je mehanizam nedostajućih podataka za promenljivu Y slučajan ako nedostajući podaci ne zavise od samih nedostajućih vrednosti (Ym). Korišćenjem indikatora verovatnoće nedostupnosti, dati mehanizam može se iskazati kao:

$$P(M|Y,X) = P(M|Y^o,X) \tag{2}$$

Konačno, kaže se da je mehanizam nedostajućih podataka za promenljivu Y neslučajan, ako nedostajući podaci zavise i od vrednosti nedostajućih podataka (Ym). Korišćenjem indikatora nedostupnosti i njegove verovatnoće, dati mehanizam može se prikazati kao:

$$P(M|Y,X) = P(M|Y^o,Y^m,X) \tag{3}$$

Tradicionalni načini tretiranja nekompletnih podataka, kao što su isključivanje opservacije koja nema kompletne podatke ili procenjivanje nedostajuće vrednosti aritmetičkom sredinom date promenljive, prikladni su jedino u slučaju kada je mehanizam nekompletnosti podataka potpuno slučajan. Ukoliko je mehanizam nekompletnosti podataka slučajan, rešavanje problema nekompletnosti podataka je ispravno isključivo primenom savremenih procedura, kao što su: algoritam ekspektacije i maksimizacije (EM algoritam), metoda kompletnih informacija sa maksimalnom verodostojnošću, algoritam specifikacije potpune uslovljenosti, algoritam augmentovanih podataka, kao i ostale savremene procedure. Važno je napomenuti da se navedene procedure mogu koristiti umesto tradicionalnih procedura i u slučaju kada podaci nedostaju potpuno slučajno.

Nadgledani model veštačke inteligencije

Dakle, kada je reč o nadgledanim modelima veštačke inteligencije, priroda nedostajućih podataka utvrđuje se na sledeći način (Tabachnick i Fidell, 2014): najpre se testira da li nedostajući podaci nedostaju na potpuno slučajan način (Little i Rubin, 2002). Ukoliko se data hipoteza odbaci, vrši se naredno testiranje, kojim se testira da li nedostajući podaci nedostaju na slučajan ili neslučajan način. U zavisnosti od odbacivanja ili neodbacivanja date hipoteze, donosi se zaključak da podaci nedostaju na neslučajan ili slučajan način.

U literaturi je već uobičajeno testirati da li nedostajući podaci nedostaju potpuno slučajno korišćenjem Littleovog testa (IBM, 2017). Zatim, ukoliko se testirana nulta hipoteza odbaci, prelazi se na testiranje da li nedostajući podaci nedostaju na slučajan način. Dato testiranje (uz pomoć statističkog softvera) sprovodi se uz pomoć jednodimenzionalnih statističkih t-testova. Suština je ispitati da li raspoloživi podaci predstavljaju slučajan uzorak iz planiranog uzorka (koji je postavljen na početku istraživanja). Ukoliko je to ispunjeno, tada nedostajući podaci imaju istu raspodelu kao i raspoloživi podaci (Enders, 2010).

Jednakost raspodela podrazumeva da grupa raspoloživih podataka i grupa nedostajućih podataka imaju jednake aritmetičke sredine i varijanse. Kim i Bentler (2002) nazvali su tu osobinu homogenošću aritmetičkih sredina i kovarijansnih matrica. Neki autori proveravali su homogenost aritmetičkih sredina i varijansnih komponenti (Thommes i Enders, 2007), dok su drugi autori smatrali da je teško pretpostaviti da su podaci homogeni u pogledu aritmetičke sredine, a heterogeni u pogledu varijanse. Iz tog razloga, oni su ispitivali isključivo homogenost aritmetičkih sredina (IBM, 2017). Prema tome, testiranje homogenosti aritmetičkih sredina sprovedeno je korišćenjem jednodimenzionalnih t-testova.

Model veštačke inteligencije zasnovan na neparametarskoj statistici

Kao što je naznačeno, pri ispitivanju da li podaci nedostaju slučajno, koristi se jednodimenzionalni t-test, kojim se ispituje jednakost aritmetičkih sredina dva nezavisna uzorka (implementiran u većini kvantitativnih softvera koji poseduju modul za analizu nedostajućih podataka). Dva nezavisna uzorka za svaku promenljivu u analizi formiraju se na osnovu nedostupnosti podataka za neku drugu promenljivu u analizi. Naime, ukoliko neka promenljiva (označena sa Xi, i = 1,...,n) ima nedostajuće podatke, za nju se kreira indikatorska promenljiva nedostupnosti (označena sa Mi), koja uzima vrednost 1 ako je dati podatak nedostupan, i vrednost 0 ako je dati podatak raspoloživ. Dati indikator nedostupnosti može se predstaviti u

$$M_i = \begin{cases} 0, ukoliko\ je\ X_i\ raspoloživo \\ 1, ukoliko\ X_i\ nedostaje \end{cases},\ i = 1, \dots, n \qquad (4)$$

Dakle, da bi se ispitalo da li neka promenljiva (Xi) ima nedostajuće podatke na slučajan način, najpre se za datu promenljivu formira indikator nedostupnosti (Mi), a zatim se on koristi za podelu svake ostale promenljive u analizi na dva nezavisna uzorka, nakon čega se primenjuje jednodimenzionalni t-test radi testiranja jednakosti aritmetičkih sredina.

Dati test ima određene nedostatke; na primer, nezavisni uzorci mogu biti veoma neuravnoteženi (Enders, 2010) (u smislu da je uzorak koji predstavlja raspoložive podatke znatno veći od uzorka koji predstavlja nedostajuće podatke). Takođe, nezavisni uzorak koji predstavlja nedostajuće podatke može imati svega par elemenata. Uz to, ono što se može pripisati ograničenju testiranja aritmetičkih sredina dva nezavisna uzorka jeste i činjenica da čak i ako podaci nedostaju neslučajno, dva nezavisna uzorka formirana na osnovu indikatora nedostupnosti mogu imati jednake aritmetičke sredine.

Iz tog razloga, mnogo je bolje predložiti neki drugi način provere da li nedostajući podaci nedostaju slučajno. Upravo to je predmet ovog dela rada – predložiti alternativni način provere. Drugi način testiranja, da li je mehanizam nedostajućih podataka slučajan, mogao bi biti neparametarski test, Mann-Whitney U test dva nezavisna uzorka. Velika prednost ovog neparametarskog testa u poređenju s parametarskim jednodimenzionalnim t-testom jeste u tome što Mann-Whitney test ne testira jednakost aritmetičkih sredina, već upravo ono što je potrebno – da li su dve raspodele jednake. Dakle, nema potrebe za zaobilaznim pristupom kojim bi se sugerisalo da ako su dve raspodele jednake, onda su im jednake i aritmetičke sredine i varijanse; naprotiv, jednakost dve raspodele testira se direktno neparametarskim Mann-Whitney testom dva nezavisna uzorka.

Dalje unapređenje predstavljalo bi korišćenje egzaktne metode za izračunavanje p-vrednosti neparametarskog Mann-Whitney testa, umesto opšteprihvaćene asimptotske metode. Prednost primene egzaktne metode pri računanju p-vrednosti je u tome što (Mehta i Patel, 2017) ona izračunava pouzdane vrednosti čak i u situacijama kada uslovi za primenu t-testa nisu ispunjeni, bez obzira na veličinu nezavisnih uzoraka, kao i na uravnoteženost podataka. Dakle, primena egzaktne metode računanja p-vrednosti u neparametarskom Mann-Whitney testu, pri testiranju da li je mehanizam nedostajućih podataka slučajan, prevazišla bi sve nedostatke i ograničenja t-testa koji se koristi u praksi.

Naravno, pored očiglednih prednosti koje predložena procedura pruža, postoje i određene teškoće. Naime, primena metode egzaktnog računanja p-vrednosti izuzetno je zahtevna, tj. računarski intenzivna, zasnovana na svim mogućim permutacijama realizovanog skupa dva nezavisna uzorka koji treba testirati.
Zbog toga ćemo početi lagano, sa teorijskim objašnjenjem predložene procedure. Dakle, kada je reč o neparametarskom Mann-Whitney testu dva nezavisna uzorka, pretpostaviće se da su dva nezavisna uzorka veličina n1 i n2. Nulta hipoteza koja se testira predstavlja se kao

$$H_0: F_1(x) = F_2(x) \tag{5}$$

što znači da data dva nezavisna uzorka imaju iste raspodele.

U Mann-Whitney testu, originalne realizovane vrednosti zamenjuju se rangiranim vrednostima, tj. vrednost xi zamenjuje se sa rang(xi). Štaviše, radi izračunavanja egzaktne p-vrednosti, neophodno je poznavati egzaktnu verovatnoću realizacije dva nezavisna uzorka s rangiranim vrednostima (Mehta i Patel, 2017). Data verovatnoća zadaje se izrazom

$$h(w) = \frac{\prod_{i=1}^{2} n_i!}{(n_1+n_2)!} \tag{6}$$

gde n1 i n2 predstavljaju veličine prvog i drugog nezavisnog uzorka, a dizajn w predstavlja realizaciju data dva nezavisna uzorka s rangiranim umesto originalnim vrednostima (ili bilo koju permutaciju toga). Nadalje, zakon verovatnoće Mann-Whitney statistike U da uzme egzaktnu vrednost u jeste

$$Pr(U = u) = \sum_{U=u} h(w) \tag{7}$$

gde se sumiranje vrši po svim mogućim permutacijama dizajna w. Egzaktna p-vrednost (i to za desni rep raspodele statistike U) je

$$p_1 = Pr(U \geq u) = \sum_{U \geq u} h(w) \tag{8}$$

Prethodno definisane formule predstavljaju opšte formule za dobijanje egzaktne p-vrednosti za neparametarske testove dva nezavisna uzorka. Naravno, za svaki specifični neparametarski test (dva nezavisna uzorka) postoji poseban numerički algoritam, uz čiju se pomoć računa egzaktna p-vrednost. Time se bavi i nastavak ovog dela.

Stoga će biti prikazana metodologija za egzaktno računanje p-vrednosti za neparametarski Mann-Whitney test dva nezavisna uzorka. Korišćenjem date izračunate p-vrednosti, moguće je testirati nultu hipotezu da nedostajući podaci nedostaju slučajno.

Na početku izračunavanja potrebno je najpre izračunati zbir rangova. To se postiže spajanjem oba uzorka u jedan uzorak, čiji se elementi sortiraju po veličini. Zatim se elementima objedinjenog uzorka dodeljuju rangovi. Ukoliko postoje jednaki elementi, uzima se prosečan rang za njih. Nakon toga (IBM, 2017), izračunavaju se zbirovi rangova za dva nezavisna uzorka (grupa 1 (ili G1) i grupa 2 (ili G2)):

i

$$\begin{aligned} S_1 &= \sum_{i \in G_1 \geq u} rank(x_i; D_1 \cup D_2) \cdot I(x_i \in D_1) \\ S_2 &= \sum_{i \in G_2 \geq u} rank(x_i; D_1 \cup D_2) \cdot I(x_i \in D_2) \end{aligned} \tag{9}$$

gde Di predstavlja opservacije iz i-tog nezavisnog uzorka (i = 1, 2), dok I(·) predstavlja indikator koji uzima vrednost 0 ukoliko izraz u zagradama nije tačan, i vrednost 1 ukoliko izraz u zagradama jeste tačan.

Naredni korak je izračunavanje test statistike kao i odgovarajuće p-vrednosti. Mann-Whitney U test statistika za prvi nezavisni uzorak (ili za grupu 1) zadaje se izrazom

$$\begin{aligned} U &= \sum_{i \in G_1} \sum_{j \in G_2} I(x_i < x_j) + \frac{1}{2} \cdot \sum_{i \in G_1} \sum_{j \in G_2} I(x_i = x_j) \\ &= n_1 \cdot n_2 + \frac{n_1 \cdot (n_1+1)}{2} - S_1 = S_2 - \frac{n_2 \cdot (n_2+1)}{2} \end{aligned} \tag{10}$$

gde n1 i n2 predstavljaju veličine prvog i drugog nezavisnog uzorka.

Nakon definisanja U test statistike, prelazi se na izračunavanje p-vrednosti. Za izračunavanje p-vrednosti, biće potrebna frekvencijska raspodela uzorkovanja test statistike U za vrednost u i za veličine uzoraka i i j za dva nezavisna uzorka (u oznaci fi,j(u)). Nadalje, koristiće se sledeće svojstvo, pomoću kojeg se frekvencijska raspodela test statistike U može izraziti kroz zbir raspodela nižeg reda, kao

$$f_{n_1,n_2}(u) = f_{n_1-1,n_2}(u-n_2) + f_{n_1,n_2-1}(u). \qquad (11)$$

Svaka raspodela nižeg reda je simetrična u odnosu na različite vrednosti test statistike U. Takođe, zbir raspodela nižeg reda daje rezultat koji je takođe simetričan.

Izračunavanje frekvencijske raspodele za test statistiku U (označenu sa fn1,n2(u)) počinje od poznate raspodele test statistike U za i = 1. (Ukoliko se želi, rezultat je isti i kada se počne s raspodelom test statistike U za j = 1.) Zatim se koristi svojstvo zadato izrazom (11), kao i svojstvo simetrije, da bi se izvela frekvencijska raspodela za i = 2. Ova procedura se ponavlja sve dok se ne izvede frekvencijska raspodela za i = n1.

Nakon izračunavanja frekvencijske raspodele za U test statistiku (IBM, 2017), moguće je izračunati (dvostranu) egzaktnu p-vrednost, korišćenjem sledećih obrazaca:

$$p_1 = \begin{cases} \sum_{u=0}^{trunc(U)} f_{n_1,n_2}(u), \text{ukoliko je } U \le \frac{n_1 \cdot n_2 + 1}{2} \\ 1 - \sum_{u=0}^{trunc(U)} f_{n_1,n_2}(u), \text{ukoliko je } U > \frac{n_1 \cdot n_2 + 1}{2} \end{cases}$$

$$p - value = 2 \cdot p_1$$

gde trunc(U) predstavlja celobrojnu vrednost realizovane vrednosti test statistike U.

Podaci banke i poslovna implementacija

Podaci korišćeni u ovom delu predstavljaju odgovore potencijalnih klijenata jedne od vodećih stranih banaka u Republici Srbiji. Istraživanje je sprovedeno u maju 2019. godine u glavnoj poslovnici date banke za grad Novi Sad. Svim potencijalnim klijentima banke koji su se raspitivali o uslovima za dobijanje gotovinskog kredita od strane zaposlenih u poslovnici, ponuđena je anonimna, veoma kratka anketa u vezi s proizvodom gotovinskog kredita. Naime, analitičari odeljenja za upravljanje odnosima s klijentima nameravali su da ispitaju (analiziraju) koji period otplate gotovinskog kredita potencijalne klijente banke najviše zanima. Interesovalo ih je i da li na broj meseci otplate gotovinskog kredita mogu uticati osnovne socioekonomske karakteristike klijenata. Iz tog razloga, sama anketa imala je 6 pitanja, koja glase: „Odgovarajući period otplate gotovinskog kredita" (označeno Y), „Godine starosti (u godinama)" (označeno X1), „Godine stanovanja na trenutnoj adresi" (označeno X2), „Ukupan prihod domaćinstva (u 000 RSD)" koji su logaritamski transformisani (označeno X3), „Godine radnog staža kod trenutnog poslodavca" (u oznaci X4) i „Broj članova domaćinstva" (u oznaci X5).

Za ovo istraživanje, planirana veličina uzorka bila je 200; toliko je i prikupljeno popunjenih upitnika. Međutim, nisu svi klijenti odgovorili na sva pitanja u anketi, te imamo problem nekompletnih podataka. U Tabeli 1 prikazan je broj i procenat nedostajućih podataka, gde su promenljive sortirane u rastućem redosledu u odnosu na procenat nedostajućih podataka.

Tabela 1. Raspoloživost podataka analiziranih promenljivih

		X3	X2	X4	X1	Y	X5
Missing	N	37	29	22	7	7	4
	Percent	18.5%	14.5%	11.0%	3.5%	3.5%	2.0%
Valid N	27.7	163	171	178	193	193	196

Izvor: Rezultat analize autora sproveden uz upotrebu IBM SPSS Statistics 26 softvera.

Može se primetiti da ispitanici u najvećoj meri nisu odgovorili na pitanje označeno X3, i to u iznosu od 18,5%, dok pitanje u anketi, označeno X5, ima najmanji broj nedostajućih odgovora, svega 2%.

Inicijalni korak u statističkoj analizi podataka bio bi ispitivanje prirode nedostajućih podataka. U takvom ispitivanju, prvi korak bi bio testiranje nulte hipoteze, a to je da je mehanizam nekompletnih podataka potpuno slučajan. Kao što je već naznačeno, za testiranje ove hipoteze koristi se Littleov MCAR test. Za sprovođenje ovog testa, kao i svih ostalih statističkih izračunavanja, korišćen je domenski specifičan jezik softvera IBM SPSS Statistics 26 (IBM, 2019). Rezultati sprovedenog testiranja su:

$$\textit{Chi-Square} = 95.465,\ \textit{DF} = 72,\ \textit{Sig.} = 0.034$$

te se nulta hipoteza, da je mehanizam nekompletnosti podataka potpuno slučajan, odbacuje. Iz toga se zaključuje da bi klasično rešavanje problema nedostajućih podataka, kao što je brisanje nekompletnih opservacija ili umetanje aritmetičke sredine, bilo pogrešno.

Tabela 2. Statistike testa i egzaktne p-vrednosti

	Y	X1	X2	X3	X4	X5
Grouping Variable: M_X1						
Mann-Whitney U	549.500	-	281.000	454.000	507.000	661.500
Exact Sig. (2-tailed)	0.935	-	0.227	0.886	0.945	1.000
Grouping Variable: M_X2						
Mann-Whitney U	2074.500	1861.000	-	1384.000	1959.000	2244.500
Exact Sig. (2-tailed)	0.391	0.159	-	0.185	0.749	0.690
Grouping Variable: M_X3						
Mann-Whitney U	2435.000	1860.000	2142.000	-	2169.000	2672.000
Exact Sig. (2-tailed)	0.197	0.001	0.747	-	0.223	0.371
Grouping Variable: M_X4						
Mann-Whitney U	1858.000	1635.000	1366.000	1390.000	-	1344.500
Exact Sig. (2-tailed)	0.927	0.484	0.492	0.842	-	0.073
Grouping Variable: M_X5						
Mann-Whitney U	193.500	296.500	124.000	199.500	99.000	-
Exact Sig. (2-tailed)	0.097	0.476	0.139	0.213	0.319	-

Izvor: Rezultat analize autora sproveden uz upotrebu IBM SPSS Statistics 26 softvera.

Nakon prethodno odbačene hipoteze, prelazi se na testiranje naredne nulte hipoteze, a to je da li je mehanizam nekompletnosti podataka slučajan ili neslučajan. Kao što je predloženo (gde smo ukazali na prednosti predložene procedure u poređenju s postojećom), koristiće se neparametarski Mann-Whitney test s egzaktnim računanjem p-vrednosti, umesto t-testa. Rezultati serije testova prikazani su u Tabeli 2. Za svaku promenljivu koja ima nedostajuće podatke, kreiran je indikator nedostajućih podataka, u oznaci M_X#. Takođe, za svaku promenljivu, testiranje je primenjeno u odnosu na preostalih 5 promenljivih u nadgledanom statističkom modelu. Ovo se naznačava zbog potrebe korekcije alfa-rizika za broj testova po promenljivoj. Dakle, nivo značajnosti umesto 0,05 biće 0,05/5 = 0,01.

Analizom realizovanih egzaktnih p-vrednosti u odnosu na korigovani nivo značajnosti, zaključuje se da mehanizam nekompletnosti podataka nije slučajan, jer nedostupnost podataka za nezavisne promenljive nije povezana sa zavisnom promenljivom (analizirati isključivo prvu kolonu Y u tabeli 2).

Ova analiza pokazala je da je mehanizam nekompletnosti podataka slučajan, te da pri ocenjivanju nepoznatih parametara posmatranog statističkog modela mora biti korišćen savremeni način rešavanja problema nekompletnih podataka. Ukoliko bi se, slučajno, problem nekompletnih podataka rešavao tradicionalnim procedurama, ocene nepoznatih parametara posmatranog statističkog modela bile bi pristrasne.

Drugi model veštačke inteligencije zasnovan na veličini efekta

Dakle, ukoliko mehanizam nekompletnosti podataka nije potpuno slučajan, i ukoliko je statistički model nadgledani, tada višestruka primena t-testa dva nezavisna uzorka (Tabachnick i Fidell, 2014) može utvrditi na koji način podaci nedostaju. Međutim, ukazano je na nedostatke t-testa u ovoj situaciji. Jedan od njih bio bi da će dva nezavisna uzorka biti veoma neuravnotežena (u smislu da, na primer, raspoloživi podaci mogu biti 95%, a nedostajući 5%). Predlog rešenja za nedostatke t-testa dat je u prethodnom delu. Ova procedura pripada oblasti neparametarske statistike. Međutim, ovi nedostaci mogu se prevazići korišćenjem statistike veličine efekta.

Stoga predlažemo da se umesto t-testa koristi statistika veličine efekta ω^2. Donekle sličan pristup može se naći kod Endersa (2010), s tim što on, kada je reč o t-testu dva nezavisna uzorka, koristi statistiku veličine efekta (označenu d), koja nije baš najprikladnija (Sheskin, 2011). U svakom slučaju, mnogo je bolje koristiti praktičnu umesto statističke značajnosti u ovom pitanju (zbog naznačenih nedostataka).

Stoga je, pre primene predložene statistike veličine efekta, neophodno kreirati indikatorske promenljive nedostupnosti. Naime, ukoliko neka promenljiva (označena Xi, i = 1,...,K) ima nedostajuće podatke, za nju se kreira indikatorska promenljiva nedostupnosti (označena Mi), koja uzima vrednost 1 ukoliko je dati podatak nedostupan, i vrednost 0 ukoliko je dati podatak raspoloživ.

Nakon formiranja indikatora nedostupnosti, moguće je izračunati predloženu statistiku veličine efekta, korišćenjem sledećeg obrasca (Sheskin, 2011):

$$\tilde{\omega}^2 = \frac{t^2-1}{t^2+n_1+n_2-1} \qquad (12)$$

gde n1 predstavlja veličinu poduzorka koji se odnosi na raspoložive podatke, a n2 veličinu poduzorka koji se odnosi na nedostupne podatke, dok t2 predstavlja realizovanu vrednost t-testa. Formula za datu statistiku veličine efekta može se prikazati na drugi način, kao što je pokazao Sakai (2018). Intenzitet statistike veličine efekta dat je sledećim obrascem (Cohen, 1988):

$$intezitet\ statistike\ veličina\ efekta = \begin{cases} mali, za\ 0.0099 < \tilde{\omega}^2 \leq 0.0588 \\ srednji, za\ 0.0588 < \tilde{\omega}^2 \leq 0.1379 \\ veliki, za\ \tilde{\omega}^2 > 0.1379 \end{cases} \quad (13)$$

Poslovna implementacija

Podaci koji se analiziraju prikazani su u prethodnom odeljku. Više detalja o ovom istraživanju, kao i o samoj svrsi ankete, dato je u Vasiću (2019). Veličina uzorka bila je oko 200 ispitanika, a naravno, deo ispitanika nije odgovorio na neka od pitanja u anketi.

Tabela 3. Statistike testa

	Y	X_1	X_2	X_3	X_4	X_5
promenljiva indikator neraspoloživosti u odnosu na koju se kreiraju dva nezavisna uzorka M_X1						
t	0	.	1.1	0.2	0	-0.1
n_1	187	193	166	157	172	189
n_2	6	0	5	6	6	7
$\tilde{\omega}^2$	-0.0052		0.0012	-0.0059	-0.0056	-0.0051
promenljiva indikator neraspoloživosti u odnosu na koju se kreiraju dva nezavisna uzorka M_X2						
t	-0.9	-1.4	.	1.4	-0.2	0.9
n_1	165	166	171	139	151	168
n_2	28	27	0	24	27	28
$\tilde{\omega}^2$	-0.0010	0.0049		0.0059	-0.0054	-0.0010
promenljiva indikator neraspoloživosti u odnosu na koju se kreiraju dva nezavisna uzorka M_X3						
t	-1.3	-2.9	-0.6	.	-1.6	-0.5
n_1	157	157	139	163	143	159
n_2	36	36	32	0	35	37
$\tilde{\omega}^2$	0.0036	0.0370	-0.0038		0.0087	-0.0038
promenljiva indikator neraspoloživosti u odnosu na koju se kreiraju dva nezavisna uzorka M_X4						
t	0.1	1	-0.4	0.4	.	-1.6
n_1	171	172	151	143	178	176
n_2	22	21	20	20	0	20
$\tilde{\omega}^2$	-0.0052	0.0000	-0.0049	-0.0052		0.0079

promenljiva indikator neraspoloživosti u odnosu na koju se kreiraju dva nezavisna uzorka M_X_5						
t	-1.6	-1	-4.1	-2.6	-0.8	.
$\mathbf{n_1}$	189	189	168	159	176	196
$\mathbf{n_2}$	4	4	3	4	2	0
$\tilde{\omega}^2$	0.0080	0.0000	0.0846	0.0341	-0.0020	

Izvor: Rezultat analize autora sproveden uz upotrebu IBM SPSS Statistics 26 softvera.

Kao što ukazuje procedura za rešavanje nedostajućih podataka, najpre se proverava da li nedostajući podaci nedostaju potpuno slučajno. Testiranje, sprovedeno u prethodnom odeljku, ukazalo je da mehanizam nekompletnosti podataka nije potpuno slučajan. Stoga dolazimo do zaključka da ukoliko bi se nedostajući podaci rešili na tradicionalan način, ocene parametara posmatranog modela veštačke inteligencije (koji se namerava koristiti) bile bi pristrasne.

Nakon prethodnog utvrđivanja, prelazi se na određivanje da li nedostajući podaci nedostaju na slučajan ili neslučajan način. U te svrhe, koristiće se formula (12), kao i pravilo odlučivanja zadato izrazom (13). Kompletno testiranje prikazano je u Tabeli 3, koja ukazuje da podaci nedostaju slučajno, budući da ne postoji asocijacija između zavisne promenljive (označene Y) i nedostajućih podataka u nezavisnim promenljivima. Da bi se videla data konstatacija, neophodno je posmatrati prvu kolonu Y u tabeli 3 i analizirati vrednosti statistike $\tilde{\omega}^2$. Kao što se može videti, sve vrednosti statistike $\tilde{\omega}^2$ su po apsolutnoj vrednosti manje od ili jednake 0,0099.

Dakle, nedostajući podaci u ovom primeru nedostaju slučajno, što dalje znači da, ukoliko se želi da u nadgledanom modelu veštačke inteligencije ocene parametara budu nepristrasne, problem nedostajućih podataka treba rešiti savremenim pristupom, koji je, na primer, kada je reč o upotrebi softvera IBM SPSS Statistics, primena algoritma ekspektacije i maksimizacije.

Zaključak

Ovim radom konačno je rešen problem „šta raditi" kada se susretnemo sa izazovom nedostajućih podataka. Definisanjem protokola, kao i upotrebom modela veštačke inteligencije, analitičari podataka su u mogućnosti da reše problem nedostajućih podataka, i to na jedan kvalitetan način, i time izbegnu, već pominjani u uvodu, princip GIGO. Na ovaj način omogućeno je da se dobiju pouzdani rezultati analitike podataka, koja je neophodna da bi poslovna banka mogla da postigne dobre poslovne rezultate i ciljeve.

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DEFINING THE PROTOCOL OF ARTIFICIAL INTELLIGENCE IN SOLVING MISSING DATA IN THE FIELD OF BANKING

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Summary: *In this paper, the problem of missing data in banking is addressed in a systematic and comprehensive manner. Very little has been written about this serious and significant challenge, sporadically about some specific business problems, but never in this way - namely, the creation, or rather the definition of protocols. By including artificial intelligence models in the process of solving missing data, this "unsolvable problem" for data analysts is brought under control, and begins to represent a routine, i.e. another mandatory step in data preparation and analysis.*

Keywords: artificial intelligence, machine learning, missing data, data analytics, banking.

JEL classification: C14, G21

Introduction

In the banking sector, in conditions of increasing competition and increasingly fierce market competition, commercial banks are finding it increasingly difficult to maintain good business perfor-mance and results. For this reason, they are turning to business analytics, which can show them what their weak points in business are, and what their development opportunities are. The integration of artificial intelligence and machine learning in financial services is rapidly transforming internal operations and risk management, putting a strong focus on the necessity of utilizing advanced predictive models over internal databases (Godolja and Domi, 2025). Therefore, the key to success, or survival in general, is in the quality results of various business analyses. However, for a quality result, the GIGO principle (garbage in, garbage out) applies, that is, in essence, the quality of the input data for analysis must be high. However, anyone who is involved in collecting and pro-cessing data very quickly encounters the problem of missing data, and this is where we come to the essence of this business.

Current Ways to Address the Problem of Incomplete Data

In most cases, researchers remedy the problem of incomplete data in some way, without even indicating how much such data there was. They have probably silently excluded incomplete data from the data set they are analyzing. This procedure is understandable to some extent, because researchers, when writing professional papers, are justifiably afraid that this may represent a major limitation of their research. They justifiably fear that the reviewers of their work could reject their work, with the explanation that the research is quite weak and unreliable, due to the serious presence of incomplete data. Therefore, the chances of publishing a professional work are greatly increased, if the problem of incomplete data is not presented. As noted by Orchard and Woodbury (1972), the best way to deal with incomplete data is simply not to have it.

Of course, in such works, the existence of incomplete data is not indicated anywhere. Then, the default method of solving the incompleteness problem (that is, removing incomplete data) was applied without even being mentioned anywhere. Furthermore, the tables in which the results of the conducted quantitative analyzes are presented, are then based on different sample sizes.

The reason why researchers resort to the use of outdated procedures for solving data incompleteness is to some extent because these procedures are theoretically clear to them. Those procedures certainly include deleting observations with incomplete data, then deleting observations only if they have incomplete data for the variables currently being analyzed, as well as replacing the incomplete data with the arithmetic mean of the observed variable. Modern artificial intelligence procedures for treating data incompleteness are quite complex, and in most cases, incomprehensible to the average researcher, and therefore they avoid using them.

Artificial Intelligence Protocol

If there is a presence of incompleteness in the data that is planned to be analyzed, there is a possibility that the estimates of unknown parameters in the quantitative analysis that is planned to be used will be biased. For this reason, it is important to approach the problem of incomplete data carefully, in a comprehensive way, which, colloquially, could be called a protocol.

In a given protocol, step zero would be the start of solving the problem of incomplete data. In the first step, they would ask the question:

• Whether the observed variables, i.e. in the analyzed data set, is there a presence of incomplete data?

If the answer is yes, they would go to the second step. If the answer is no, they would not go to the last step. In the second step, they would ask the question:

• Is the data missing completely at random?

If the answer is positive, they would go to the third step. If the answer is negative, they would go to the fourth step.

The third step represents solving incomplete data, either by applying traditional techniques (deleting observations that contain missing data; or by inserting the arithmetic mean of the observed variable in place of missing data), or by applying modern methods. Then they would go to the last step.

In the fourth step, they would ask the question:

• Does quantitative modeling use a supervised or unsupervised artificial intelligence model?

If the answer is supervised, go to the fifth step. If the answer is unsupervised, go to the eighth step.

In the fifth step, it examines:

• Is the unavailability of data on the explanatory variables caused by the values of the dependent variable?

If the answer is positive, go to the sixth step. If the answer is negative, go to the seventh step. In the sixth step, it is stated that the missing data do so by a non-random mechanism. For this reason, further data analysis is stopped, and the last step is taken.

In the seventh step, it is stated that data that are unavailable are missing in a random way, so the problem of missing data can only be solved by applying modern techniques. Then we go to the last step. In the eighth step, it examines:

• Does the unavailability of data for any variable depend on the value of its own data, or on the data value of the other variables being analyzed?

If the answer is from own values, go to the sixth step. If the answer is from the value of the other variables, go to the seventh step. In the last step, we conclude that solving the data incompleteness problem is complete.

Of course, in such works, the existence of incomplete data is not indicated anywhere. Then, the default method of solving the incompleteness problem (that is, removing incomplete data) was applied without even being mentioned anywhere. Furthermore, the tables in which the results of the conducted quantitative analyzes are presented, are then based on different sample sizes.

The reason why researchers resort to the use of outdated procedures for solving data incompleteness is to some extent because these procedures are theoretically clear to them. Those procedures certainly include deleting observations with incomplete data, then deleting observations only if they have incomplete data for the variables currently being analyzed, as well as replacing the incomplete data with the arithmetic mean of the observed variable. Modern artificial intelligence procedures for treating data incompleteness are quite complex, and in most cases, incomprehensible to the average researcher, and therefore they avoid using them.

Types of Mechanisms

Mostly, the data that needs to be statistically analyzed have the problem of incompleteness, to a greater or lesser extent. A given defect does not seem serious in itself, however, if the incompleteness mechanism is of a certain type, there may be a serious problem. For this reason, it is important to always examine the type of mechanism that leads to incomplete data. For now, it is defined that there are three types of mechanisms that lead to data incompleteness (Allison, 2002), and they are: completely random, random, and non-random.

In order to be able to describe the given types of mechanism, the variable with missing data is marked with Y. Then, its available part is marked with Yo, while the unavailable part is marked with Ym. Now an unavailability indicator variable could be defined, which takes the values of zero, for those observations, which are available at variable Y; and the value one, for those observations that are unavailable for variable Y. The given indicator variable can be marked with M. If in the analyzed data set, there are variables that do not have missing values, they are marked with X.

Therefore, the mechanism of missing data for the variable Y is said to be completely random, if the missing data do so in a completely random way, and therefore, neither depends on the part of the variable Ym, nor on the part of the variable Yo, nor on the other present variables X. Using the probability indicator of unavailability, a given mechanism of missing data (Fitzmaurice et al., 2015) can be expressed as:

$$P(M|Y,X) = P(M) \tag{1}$$

The mechanism of missing data for variable Y is said to be random if the missing data do not depend on the missing values (Ym) themselves. Using the probability of unavailability indicator, the given mechanism can be expressed as:

$$P(M|Y,X) = P(M|Y^{o},X) \tag{2}$$

Finally, the mechanism of missing data for the variable Y is said to be non-random, if the missing data also depend on the values of the missing data (Ym). Using the unavailability indicator and its probability, the given mechanism can be represented as:

$$P(M|Y,X) = P(M|Y^{o},Y^{m},X) \tag{3}$$

Traditional ways of dealing with incomplete data, such as excluding an observation that does not have complete data, or estimating a missing value by the arithmetic mean of a given variable, are appropriate, only if the mechanism of data incompleteness is completely random. If the mechanism of data incompleteness is random, then solving the problem of data incompleteness is correct,

only by using modern procedures, such as: the expectation-maximization algorithm, the method of complete information with maximum likelihood, the algorithm of specification of complete conditionality, the algorithm of augmented data, as well as other modern procedures. Note that the given procedures can be used instead of traditional procedures, when the data is missing completely by chance.

Supervised Model of Artificial Intelligence

Thus, when it comes to supervised AI models, the nature of missing data was determined as follows (Tabachnick and Fidell, 2014): first, it is tested whether the missing data are missing in a completely random way (Little and Rubin, 2002). If the given hypothesis is rejected, the following testing is performed, which tests whether the missing data are missing in a random or non-random way. Depending on the rejection or non-rejection of the given hypothesis, a conclusion is made, that the data are missing in a non-random way, or that the data are missing in a random way.

In the literature, it is already common to test whether missing data is missing completely at random with Little's test (IBM, 2017). Then, if the tested null hypothesis is rejected, we move on to testing whether the missing data is missing in a random way. Given testing (with statistical software) is carried out with the help of univariate statistical t-tests. The essence is to examine whether the available data represents a random sample from the planned sample (which was set at the beginning of the research). If this is fulfilled, then the missing data have the same distribution as the available data (Enders, 2010).

Equality of distributions implies that the group of available data and the group of missing data have equal arithmetic means and variances. Kim and Bentler (2002) called this feature the homogeneity of arithmetic means and covariances. Some authors checked the homogeneity of arithmetic means and variances (Thommes and Enders, 2007), while other authors considered that it is difficult to assume that the data are homogeneous in terms of arithmetic mean and heterogeneous in terms of variance. For this reason, they only examined the homogeneity of arithmetic means (IBM, 2017). Therefore, testing the homogeneity of arithmetic means was carried out using univariate t-tests.

Artificial Intelligence Model Based on Non-Parametric Statistics

As mentioned, when conducting, whether data are missing by chance, the univariate t-test is used, which examines the equality of the arithmetic means of two independent samples (implemented in most quantitative software, which have a missing data analysis module). Two independent samples for each variable in the analysis are formed based on the unavailability of data for some other variable in the analysis. Namely, if a variable (labeled Xi, i = 1,...,n) has missing data, an unavailability variable indicator (labeled Mi) is created for it, which takes the value 1 if the given data is unavailable, and the value 0 if the given data is available. A given indicator of unavailability can be presented in the form

$$M_i = \begin{cases} 0, if\ X_i\ is\ available \\ 1, if\ X_i\ is\ missing \end{cases},\ i = 1, \dots, n \qquad (4)$$

So, in order to examine whether some variable (Xi) has missing data in a random way, first an indicator of unavailability (Mi) is formed for a given variable, and then it is used to divide each other variable in the analysis into two independent samples, and then apply a univariate t-test to test the equality of arithmetic means.

The given test has certain disadvantages, for example, independent samples can be very unbalanced (Enders, 2010) (in the sense that the sample representing the available data is much larger than the sample representing the missing data). Also an independent sample, representing missing data, can have only a pair of elements. Furthermore, what can be attributed to the limitation of testing the arithmetic means of two independent samples is the fact that even if the data are missing non-randomly, two independent samples formed on the basis of the unavailability indicator can have equal arithmetic means.

For this reason, it is much better to propose some other way of checking whether the missing data is missing by chance. This is precisely the subject of this section, to suggest another way of checking. Another way of testing, whether the mechanism of missing data is random, could be a non-parametric test, two independent samples Mann-Whitney U test. The great advantage of this non-parametric test, compared to the parametric univariate t-test, is that the Mann-Whitney test does not test the equality of arithmetic means; but just what is needed; that is, whether the two distributions are equal. So there is no need to take a detour, to suggest that if two distributions are equal, then their arithmetic means and variances are also equal; rather, we test the equality of two distributions directly with the non-parametric, two-independent-samples Mann-Whitney test.

A further improvement would be to use the exact method for calculating the p-value of the non-parametric Mann-Whitney test, instead of the generally accepted asymptotic method. The advantage of using the exact method when calculating the p-value is that (Mehta and Patel, 2017) it calculates reliable values, even in situations where the conditions for applying the t-test are not met, regardless of the size of independent samples, as well as the balance of the data. So, using the exact method of calculating the p-value in the non-parametric Mann-Whitney test - when testing whether the mechanism of missing data is random - would overcome all the shortcomings and limitations of the t-test, which is used in practice.

Of course, apart from the obvious advantages provided by the proposed procedure, there are also certain difficulties. Namely, the application of the exact p-value calculation method is very demanding, i.e. computationally intensive, based on all possible permutations of the realized set of two independent samples that need to be tested.

That is why we will start slowly, with a theoretical explanation of the proposed procedure. So, when it comes to the non-parametric, two independent samples Mann-Whitney test, it will be assumed that the two independent samples are of size n1 and n2. The null hypothesis to be tested is represented as

$$H_0: F_1(x) = F_2(x) \tag{5}$$

which means that given two independent samples have the same distributions.

In the Mann-Whitney test, the original realized values are replaced with ranked values, i.e. value xi are replaced by rank(xi). Furthermore, to calculate the exact p-value, it is necessary to know the exact probability of the realization of two independent samples with ranked values (Mehta and Patel, 2017). The given probability is given by the expression

$$h(w) = \frac{\prod_{i=1}^{2} n_i!}{(n_1+n_2)!} \tag{6}$$

where n1 and n2 represent the sizes of the first and second independent samples; and the design w represents the realization of the given two independent samples with ranked values instead of the original values (or any permutation thereof). Further, the probability law of the Mann-Whitney statistic U to take the exact value u, is

$$Pr(U = u) = \sum_{U=u} h(w) \tag{7}$$

where the summation is performed over all possible design permutations w. The Mann-Whitney statistic U is defined by formula (10). Similarly, the exact p-value (and that for the right tail of the distribution of the U statistic) is

$$p_1 = Pr(U \geq u) = \sum_{U \geq u} h(w) \tag{8}$$

The previously defined formulas are general formulas for obtaining the exact p-value for two independent samples of non-parametric tests. Of course, for each specific (two independent samples) non-parametric test there is a special numerical algorithm, with the help of which the exact p-value is calculated. This is also dealt with in the continuation of this section.

Therefore, the methodology for the exact calculation of the p-value for two independent samples of the non-parametric Mann-Whitney test will be presented. Using the given calculated p-value, it will be possible to test the null hypothesis that the missing data are missing at random.

At the beginning of the calculation, it is necessary to first calculate the sum of the ranks. This is done by combining both samples into one sample, the elements of which are sorted by size. Then the elements in the unified sample are ranked. If there are equal elements, we take the average rank for them. After that (IBM, 2017), the sum of ranks for two independent samples (group 1 (or G1) and group 2 (or G2)) is calculated.

i

$$\begin{aligned} S_1 &= \sum_{t \in G_1 \geq u} rank(x_t; D_1 \cup D_2) \cdot I(x_t \in D_1) \\ S_2 &= \sum_{t \in G_2 \geq u} rank(x_t; D_1 \cup D_2) \cdot I(x_t \in D_2) \end{aligned} \tag{9}$$

where Di represents observations from the i-th independent sample (i = 1, 2), while I(·) represents an indicator that takes the value 0 if the expression in parentheses is not true, and the value 1 if the expression in parentheses is true.

The next step is to calculate the test statistic as well as the corresponding p-value. The Mann-Whitney U test statistic for the first independent sample (or for group 1) is given by the expression

$$\begin{aligned} U &= \sum_{i \in G_1} \sum_{j \in G_2} I(x_i < x_j) + \frac{1}{2} \cdot \sum_{i \in G_1} \sum_{j \in G_2} I(x_i = x_j) \\ &= n_1 \cdot n_2 + \frac{n_1 \cdot (n_1+1)}{2} - S_1 = S_2 - \frac{n_2 \cdot (n_2+1)}{2} \end{aligned} \tag{10}$$

where n1 and n2 represent the sizes of the first and second independent samples.

After defining the U test statistic, one moves to calculating the p-value. To calculate the p-value, one will need the sampling frequency distribution of the test statistic U for the value u, and for the

sample sizes i and j for two independent samples (in fi,j(u) notation). Furthermore, the following property will be used, by means of which the frequency distribution of the test statistic U can be expressed via the sum of the lower-order frequency distributions, as

$$f_{n_1,n_2}(u) = f_{n_1-1,n_2}(u-n_2) + f_{n_1,n_2-1}(u). \qquad (11)$$

Each lower-order distribution is symmetric with respect to various values of the test statistic U. Also, the sum of the lower-order distributions gives a result that is also symmetric.

The calculation of the frequency distribution for the test statistic U (denoted fn1,n2(u)) starts with the known distribution of the test statistic U for i = 1. (If desired, the result is the same, one can also start with the distribution of the test statistic U for j = 1). Then the property given by expression (11) is used, as well as the symmetry property, to derive the frequency distribution for i = 2. This procedure is repeated until the frequency distribution for i = n1 is derived.

After calculating the frequency distribution for the U test statistic (IBM, 2017), it is possible to calculate the (two-sided) exact p-value, using the following patterns

$$p_1 = \begin{cases} \sum_{u=0}^{trunc(U)} f_{n_1,n_2}(u), ukoliko\ je\ U \le \frac{n_1 \cdot n_2 + 1}{2} \\ 1 - \sum_{u=0}^{trunc(U)} f_{n_1,n_2}(u), ukoliko\ je\ U > \frac{n_1 \cdot n_2 + 1}{2} \end{cases}$$

$$p - value = 2 \cdot p_1$$

where trunc(U) represents the integer value of the realized value of the test statistic U.

Bank's Data and Business Implementation

The data used in this part represent the responses of potential clients in one of the leading foreign banks in the Republic of Serbia. The survey was conducted in May 2019 in the main branch of the given bank for the city of Novi Sad. All potential clients of the bank who inquired about the conditions for obtaining a cash loan from the staff employed in the branch were offered an anonymous, very short survey regarding the cash loan product. Namely, the analysts of the customer relations management department intended to examine (analyze) which cash loan repayment period the bank's potential clients are most interested in. They were also interested in whether the number of months of repayment of the cash loan might be influenced by the basic socio-economic characteristics of the clients. For this reason, the survey itself had 6 questions, which read: "Appropriate cash loan repayment period" (marked Y), "Age (in years)" (marked X1), "Years of residence at the current address" (marked X2), "Total household income (in 000 RSD)" which were logarithmically transformed (marked X3). Then "Years of employment with the current employer" (labelled X4) and "Number of household members" (labelled X5).

For this research, the sample size was planned to be 200; how many completed questionnaires were collected. However, not all clients responded to all survey questions, so we have the problem

of incomplete data. Table 1 shows the number and percentage of missing data, where the variables are sorted in ascending order, in relation to the percentage of missing data.

Table 1. Data Availability of Analyzed Variables

		X3	X2	X4	X1	Y	X5
Missing	N	37	29	22	7	7	4
	Percent	18.5%	14.5%	11.0%	3.5%	3.5%	2.0%
Valid N	27.7	163	171	178	193	193	196

Source: Result of the author's analysis conducted using IBM SPSS Statistics 26 software.

We can notice that the respondents mostly did not answer the question marked X3, in the amount of 18.5%, while the question in the survey, marked X5, has the fewest missing answers, namely only 2%.

The initial step in statistical data analysis would be to examine the nature of missing data. In such an examination, the first step would be to test the null hypothesis, which is that the mechanism of incomplete data is completely random. As already mentioned, to test this hypothesis, Little's MCAR test is used. To perform this test, as well as all other statistical calculations, the domain-specific language of the IBM SPSS Statistics 26 software was used (IBM, 2019). The results of the conducted testing are:

$$\textit{Chi-Square} = 95.465,\ \textit{DF} = 72,\ \textit{Sig.} = 0.034$$

so the null hypothesis, that the mechanism of data incompleteness is completely random, is rejected. This concludes that the classic solution to the problem of missing data, such as deleting incomplete observations or inserting the arithmetic mean, would be wrong.

Table 2. Test Statistics and Exact P-Values

	Y	X1	X2	X3	X4	X5
Grouping Variable: M_X1						
Mann-Whitney U	549.500	-	281.000	454.000	507.000	661.500
Exact Sig. (2-tailed)	0.935	-	0.227	0.886	0.945	1.000
Grouping Variable: M_X2						
Mann-Whitney U	2074.500	1861.000	-	1384.000	1959.000	2244.500
Exact Sig. (2-tailed)	0.391	0.159	-	0.185	0.749	0.690
Grouping Variable: M_X3						
Mann-Whitney U	2435.000	1860.000	2142.000	-	2169.000	2672.000
Exact Sig. (2-tailed)	0.197	0.001	0.747	-	0.223	0.371
Grouping Variable: M_X4						
Mann-Whitney U	1858.000	1635.000	1366.000	1390.000	-	1344.500
Exact Sig. (2-tailed)	0.927	0.484	0.492	0.842	-	0.073
Grouping Variable: M_X5						
Mann-Whitney U	193.500	296.500	124.000	199.500	99.000	-
Exact Sig. (2-tailed)	0.097	0.476	0.139	0.213	0.319	-

Source: Result of the author's analysis conducted using IBM SPSS Statistics 26 software

After the previously rejected hypothesis, we move on to testing the next null hypothesis, that is, that the mechanism of data incompleteness is random or non-random. As suggested (where we pointed out the advantages of the proposed procedure compared to the existing one), the non-parametric Mann-Whitney test with exact p-value calculation will be used, instead of the t-test. The results of the series of tests are shown in Table 2. For each variable that has missing data, a missing data indicator was created, in the label M_X#. Also, for each variable, testing was applied in relation to the remaining 5 variables in the supervised statistical model. This is noted because of the need to correct the alpha-risk for the number of tests, per variable. So, the significance level instead of 0.05 will be 0.05/5 = 0.01.

By analyzing the realized exact p-value in relation to the corrected level of significance, it is concluded that the mechanism of data incompleteness is not accidental, because the unavailability of data for independent variables is not related to the dependent variable (analyze only the first column Y in table 2).

This analysis showed that the mechanism of data incompleteness is random, and that when evaluating the unknown parameters of the monitored statistical model, a modern way of solving the problem of data incompleteness must be used. If, by any chance, the problem of data incompleteness would be solved by traditional procedures, the evaluations of the unknown parameters of the monitored statistical model would be biased.

The Second Artificial Intelligence Model Based on Effect Size

Therefore, if the mechanism of data incompleteness is not completely random, and if the statistical model is supervised, then multiple application of the t-test of two independent samples (Tabachnick and Fidell, 2014) can determine how the data are missing. However, they pointed out the shortcomings of the t-test in this situation. One of them would be that the two independent samples will be very unbalanced (in the sense that, for example, the available data may be 95% and the missing data 5%). A proposal for a solution to the shortcomings of the t-test was given in the previous section. This procedure belongs to the field of non-parametric statistics. However, these shortcomings can be overcome by using effect size statistics.

Therefore, we suggest that instead of the t-test, the effect size statistic – –^2 should be used. A somewhat similar approach can be found in Enders (2010), with the fact that, when it comes to the t-test of two independent samples, he uses the statistic of the effect size (labeled d), which is not exactly the most appropriate (Sheskin, 2011). In any case, it is much better to use practical instead of statistical significance in this issue (due to the indicated shortcomings).

Therefore, before applying the proposed effect size statistics, it is necessary to create variable indicators of unavailability. Namely, if a variable (labeled Xi, i = 1,...,K) has missing data, we create an unavailability indicator variable for it (labeled Mi), which takes the value 1 if the given data is unavailable, and the value 0 if the given data is available.

After forming the unavailability indicator, it is possible to calculate the proposed effect size statistics, using the following formula (Sheskin, 2011):

$$\tilde{\omega}^2 = \frac{t^2-1}{t^2+n_1+n_2-1} \quad (12)$$

where n1 represents the size of the subsample related to the available data, and n2 represents the size of the subsample related to the unavailable data. t2 represents the resulting t-test value. The formula for a given effect size statistic can be presented in another way, as shown by Sakai (2018). The intensity of effect size statistics is given by the following formula (Cohen, 1988):

$$intensity\ of\ effect\ size\ statistics = \begin{cases} small, za\ 0.0099 < \tilde{\omega}^2 \leq 0.0588 \\ medium, za\ 0.0588 < \tilde{\omega}^2 \leq 0.1379 \\ large, za\ \tilde{\omega}^2 > 0.1379 \end{cases} \quad (13)$$

Business Implementation

The data to be analyzed are presented in the previous section. More details about this research, as well as the purpose of the survey itself, are given in Vasić (2019). The sample size was about 200 respondents, and of course, some respondents did not answer some of the survey questions.

Table 3. Test Statistics

	Y	X_1	X_2	X_3	X_4	X_5
variable unavailability indicator against which two independent samples are created						
M_X1						
t	0	.	1.1	0.2	0	-0.1
n_1	187	193	166	157	172	189
n_2	6	0	5	6	6	7
$\tilde{\omega}^2$	-0.0052		0.0012	-0.0059	-0.0056	-0.0051
variable unavailability indicator against which two independent samples are created						
M_X2						
t	-0.9	-1.4	.	1.4	-0.2	0.9
n_1	165	166	171	139	151	168
n_2	28	27	0	24	27	28
$\tilde{\omega}^2$	-0.0010	0.0049		0.0059	-0.0054	-0.0010
variable unavailability indicator against which two independent samples are created						
M_X3						
t	-1.3	-2.9	-0.6	.	-1.6	-0.5
n_1	157	157	139	163	143	159
n_2	36	36	32	0	35	37
$\tilde{\omega}^2$	0.0036	0.0370	-0.0038		0.0087	-0.0038
variable unavailability indicator against which two independent samples are created						
M_X4						
t	0.1	1	-0.4	0.4	.	-1.6
n_1	171	172	151	143	178	176
n_2	22	21	20	20	0	20
$\tilde{\omega}^2$	-0.0052	0.0000	-0.0049	-0.0052		0.0079

variable unavailability indicator against which two independent samples are created

M_X_5						
t	-1.6	-1	-4.1	-2.6	-0.8	.
$\mathbf{n_1}$	189	189	168	159	176	196
$\mathbf{n_2}$	4	4	3	4	2	0
$\tilde{\omega}^2$	0.0080	0.0000	0.0846	0.0341	-0.0020	

Source: Result of the author's analysis conducted using IBM SPSS Statistics 26 software.

As indicated by the procedure for solving missing data, it is first checked whether the missing data is missing completely by chance. The testing, which was carried out in the previous section, indicated that the mechanism of data incompleteness is not completely random. Therefore, we come to the conclusion that if the missing data are solved in a traditional way, the parameter estimates of the monitored artificial intelligence model (which is intended to be used) will be biased.

After the preliminary determination, we move on to determining whether the missing data is missing in a random or non-random way. For these purposes, formula (12) will be used as well as the decision rule given by expression (13). Complete testing is shown in Table 3, which indicates that data are missing at random, as there is no association between the dependent (labeled Y) variable and missing data in the independent variables. In order to see this statement, it is necessary to observe the first column Y in table 3, and analyze the values of the statistic $\tilde{\omega}^2$. As can be seen, all values of the statistic $\tilde{\omega}^2$ are less than or equal to 0.0099 in absolute value.

Therefore, the missing data in this example are missing by chance, which further means that if it is desired that in the supervised model of artificial intelligence, parameter estimates are unbiased, then the problem of missing data should be solved with a modern approach, which is, for example, when it comes to the use of the IBM SPSS Statistics software, the use of the expectation-maximization algorithm.

Conclusion

This work has finally solved the problem of "what to do" when faced with the challenge of missing data. By defining a protocol, as well as using artificial intelligence models, data analysts are able to solve the problem of missing data, in a qualitative way, and thus avoid the GIGO principle already mentioned in the introduction. In this way, it is possible to obtain reliable data analysis results, which are necessary for a commercial bank to achieve good business results and goals.

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BEOGRADSKA BERZA
BELGRADE STOCK EXCHANGE

BAROMETAR / BAROMETER

Februar 2026 – Septembar 2026.
February 2026 – September 2026

1. PROMET (RSD) / TURNOVER (RSD)

Mesec/ Month	Listing	Open Market	Regulisano tržište/ Regulated market	MTP/ MTF	Ukupno/ Total	Broj transakcija/ Number of transactions
Feb 2026	3.237.642.213	36.941.185	3.274.583.398	0	3.274.583.398	723
Mar 2026	325.958.452	81.834.331	407.792.783	47.943.673	455.736.456	1019
Apr 2026	1.312.662.738	61.918.683	1.374.581.421	23.159.082	1.397.740.503	880
May 2026	1.295.337.350	26.458.276	1.321.795.626	1.363.824	1.323.159.450	813
Jun 2026	1.490.977.117	91.320.489	1.582.297.606	74.475.520	1.656.773.126	817
Jul 2026	2.577.430.682	69.586.904	2.647.017.586	0	2.647.017.586	774
Aug 2026	831.370.312	87.067.055	918.437.367	0	918.437.367	638
Sept 2026	158.955.031	98.315.484	257.270.515	8.022.743	265.293.258	969
Ukupno/Total	11.230.333.894	553.442.407	11.783.776.301	154.964.842	5.128.060.357	6.633

2. INDEKSI / INDICES

Feb 2026 – Sept 2026		BELEX15	BELEXline
	Poslednja vrednost / Last value	1.370,14	2.776,61
	Promena (abs) / Change (abs)	91,69	-73,37
	Promena (%) / Change (%)	7,17%	-2,57%
	Najviša vrednost / Maximum Value	1.379,6	2.855,52
	Najniža vrednost / Minimum Value	1.182,66	2.561,71
	Istorijski max / History Maximum Value	3.335,2	5007,34
	Istorijski min / History Minimum Value	347,46	841,99
	Vrednost prometa RSD/ Value of Turnover RSD	656.102.230	699.477.927

3. TRŽIŠNA KAPITALIZACIJA – AKCIJE (EUR) / MARKET CAPITALIZATION – SHARES (EUR)

	Ukupna tržišna kapitalizacija/ Total market capitalization	Regulisano tržište/ Regulated Market	Listing	Open Market	MTP/ MTF	BELEX15	BELEXline
Feb 2026	4.190.953.393	4.121.580.380	1.787.171.358	2.334.409.022	69.373.013	1.452.837.921	1.686.211.933
Mar 2026	4.190.618.633	4.122.450.542	1.823.743.718	2.298.706.825	68.168.091	1.488.827.566	1.721.939.425
Apr 2026	4.197.945.701	4.129.761.758	1.831.810.434	2.297.951.324	68.183.943	1.493.647.746	1.696.410.282
May 2026	4.215.450.504	4.149.854.425	1.856.330.197	2.293.524.228	65.596.080	1.514.647.432	1.717.845.627
Jun 2026	4.185.398.205	4.119.788.859	1.859.279.348	2.260.509.510	65.609.346	1.494.413.187	1.686.575.906
Jul 2026	4.161.582.761	4.096.422.041	1.856.469.099	2.239.952.942	65.160.720	1.501.374.619	1.663.596.629
Aug 2026	4.379.866.480	4.314.681.772	1.859.242.088	2.455.439.685	65.184.707	1.720.234.791	1.883.585.668
Sept 2026	4.364.108.300	4.302.043.470	1.859.132.336	2.442.911.134	62.064.830	1.716.838.147	1.867.129.466

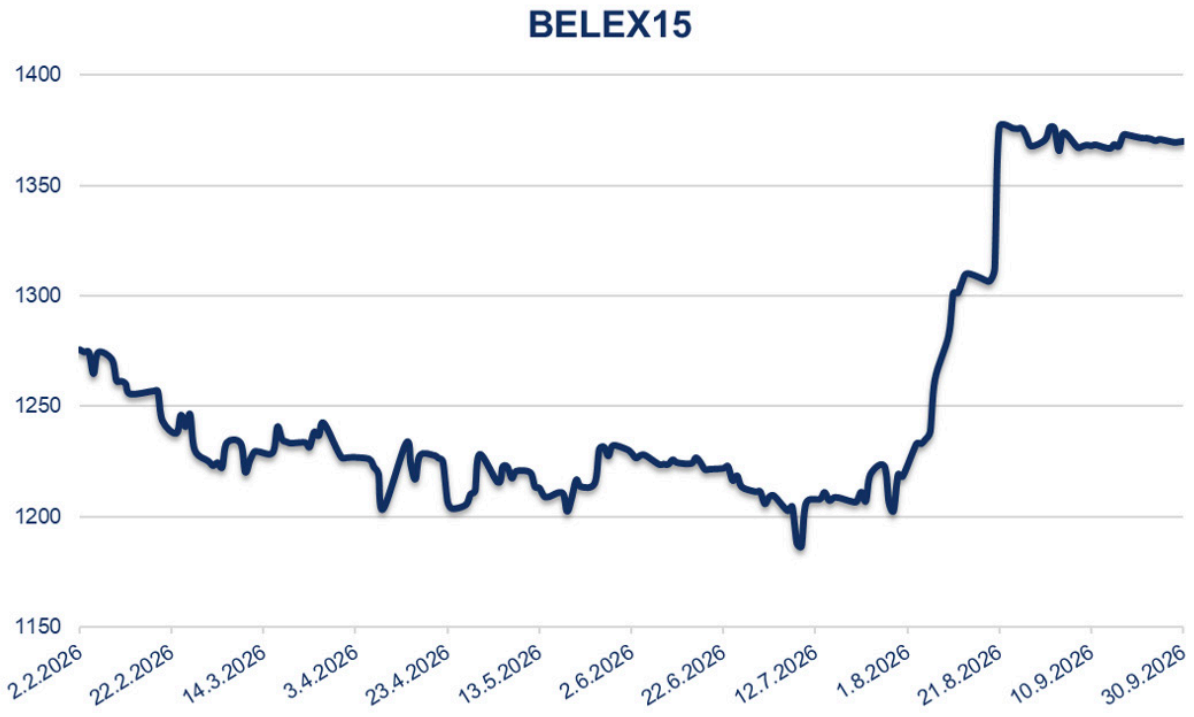
4. UČEŠĆE STRANIH INVESTITORA / FOREIGN INVESTORS PARTICIPATION

Feb 2026 – Sept 2026

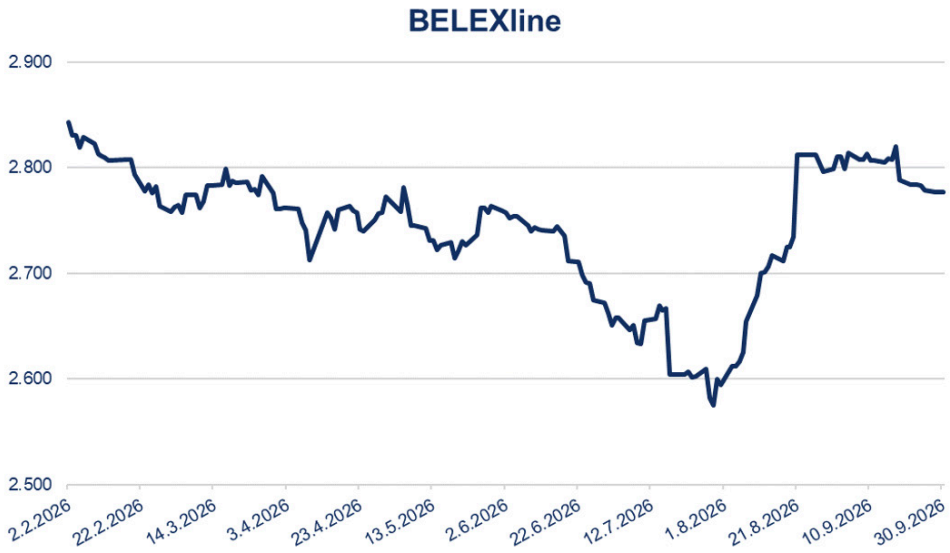
Učešće stranih investitora / Foreign Investors Participation		
FIS	total	1,70%
	b-FIS	1,96%
	s-FIS	1,45%
FIB		1,05%
FIT		1,09%

FIS - Učešće stranih investitora u ukupnom prometu akcijama
b-FIS - Učešće stranih investitora u ukupnom prometu akcijama - kupovna strana
s-FIS - Učešće stranih investitora u ukupnom prometu akcijama - prodajna strana
FIB - Učešće stranih investitora u ukupnom prometu obveznicama
FIT - Učešće stranih investitora u ukupnom prometu

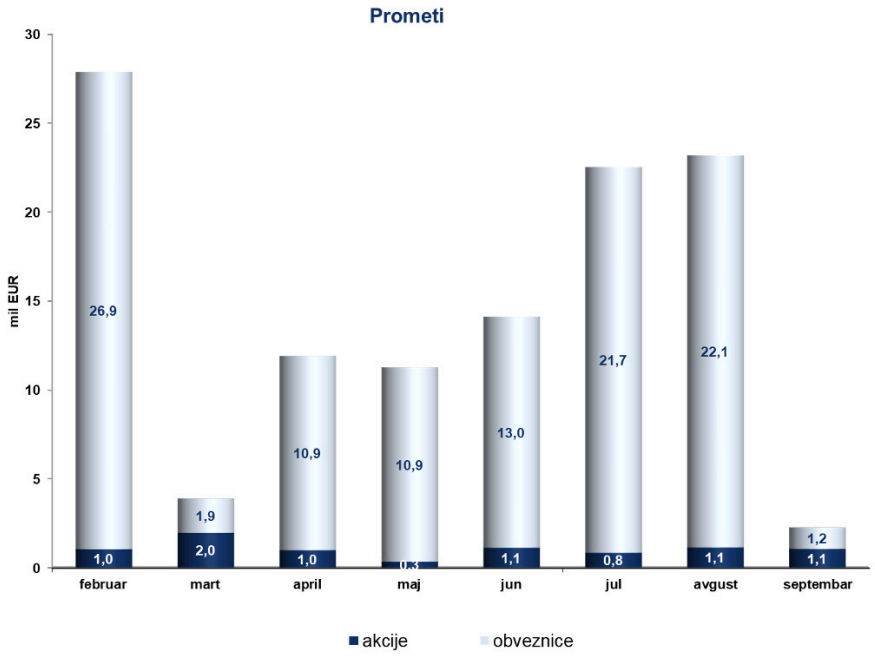
BELEX15 kretanje februar 2026 – sept 2026



BELEXline kretanje februar 2026 – sept 2026



Prometi februar 2026 – sept 2026



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- References should be given in the text by stating the author's surname and the year of publication in parentheses. Any cited text should be followed by indicating the author's surname, the year of publication and the page number of the quote in parentheses.

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- The literature should be grouped at the end of the paper according to the following principle:
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