UTICAJ ODRŽIVOG RAZVOJA NA UPRAVLJANJE RIZIKOM U PORTFOLIJU NPL-A U ZEMLJAMA ZAPADNOG BALKANA

***Tamara Vesić*[47]*, Miljana Barjaktarović*[48]*, Vladan Cogoljević*[49]

doi: 10.59864/Oditor32307V

Pregledni rad
UDK: 005.334:336.77(497-15)
336.717.137.1:502.1

Apstrakt

Koncept održivog bankarstva zasnovan je na principu ostvarivanja rasta i profita za banku i akcionare, ali samo uz postizanje socijalnih ciljeva, kao i brigu o očuvanju životne sredine. Pružanje novih bankarskih usluga i kreiranje novih (zelenih) bankarskih poslova, kojima se osim profitnih, ostvaruju i širi društveni i ekološki ciljevi, šanse su sa stvaranje konkurentske prednosti, kako u zemljama Zapadnog Balkana posmatranim u radu, tako i u svim zemljama sveta. U ovom radu ćemo se fokusirati na analizu makroekonomskih parametara u zemaljama Zapadnog Balkana radi ispitivanja uticaja odabranih pokazatelja na performanse bankarskog sistema, sa posebnim osvrtom na društvenu i komponentu zaštite životne sredine. Rezultati ukazuju na to da je stopa nezposlenosti najznačajniji pokazatelj potencijalno rizičnih događaja za bankare, kao i banke nisu prepoznate u nacionalnim strategijama o očuvanju životne sredine koje su u zemljama ZB trenutno na snazi. Shodno tome, prvo je neophodno vršiti edukaciju stranovništva, a paraleleno promovisati zelene kredite kao odžive i na dug rok povoljnije od tradicionalnih kredita, uz ažuriranje postojećeg regulatornog okvira u domenu zaštite životne sredine.

Ključne reči*: zelene finansije, zeleni krediti, održivo bankarstvo, problemqtični krediti, Zapadni Balkan.*

JEL*: N10, E44, G21*

Uvodna razmatranja

Savremene tendencije u oblasti bankarstva vode ka tome da tradicionalno bankarstvo sve više gubi na značaju, a svakodnevno se pojavljuju novi rizici poslovanja (Direktiva EU, 2011), posebno kada govorimo o ciljevima nacionalnih

[47] Docent dr Tamara Vesić, Visoka škola za poslovnu ekonomiju i preduzetništvo, Mitropolita Petra 8, Beograd, Srbija, Telefon: +381 11 2762 194, E-mail: tamara.vesic@vspep.edu.rs
[48] Redovni profesor dr Miljana Barjaktarović, Visoka škola za poslovnu ekonomiju i preduzetništvo, Mitropolita Petra 8, Beograd, Srbija, Telefon: +381 11 2762 194, E-mail: miljana.barjaktarovic@vspep.edu.rs
[49] Docent dr Vladan Cogoljević, Visoka škola za poslovnu ekonomiju i preduzetništvo, Mitropolita Petra 8, Beograd, Srbija, Telefon: +381 11 2762 194, E-mail: vlada.cogoljevic@vspep.edu.rs

strategija u oblasti održivog IKT-a kroz razvoj razvoj e-trgovine, e-obrazovanja, e-zdravlja, e-bankarstva, e-plaćanja i dr (Nacionalna strategija održivog razvoja Republike Srbije, 2008 Neoboriva je pretpostavka da kroz bankarski sektor cirkuliše novac svake privrede, od suficitarnog ka deficitarnom sektoru. Shodno tome, banka kao posrednik trebalo bi da ima značajniju ulogu u sprovođenju politike održivog razvoja, implementiranjem „zelene" komponente u sve svoje poslovne aktivnosti (Baietti et al., 2012; Jeucken, 2004). Da bi se podstakao dalji razvoj zelenog finansijskog sistema, i podržalo zeleno bankarstvo neophodno je, pre svega, usvajanje regulatornih mera i odgovarajućih pravnih propisa (Rakić, Mitić, 2012). Banke su svoje poslovanje proširile van granica svoje zemlje tako što su otvarala svoja predstavništva tj. filijale širom sveta (Radojević, 2019; Serrasquiero, Silva, 2007). S druge strane, dolazi do globalizacije privrednih tokova i stalnih inovacija u oblasti finansijskih usluga. Sve ovo zajedno nameće potrebu upravljanja procesima i pojavama u bankama, što je nezamislivo bez analize performansi poslovnog bankarstva. Međutim, uprkos inovacijama, u području finansijskih usluga, kreditni rizik je još najznačajniji pojedinačni uzrok stečaja banaka (Cvetinović, 2009). Dosadašnja istraživanja su pokazala da je uspešnost bankarskog sektora je uslovljena kretanjima makroekonomskih indikatora i shodno tome, brojna istraživanja poput: (Alihodžić, 2015; Račić, 2014; Vodová, 2013; Trenca et al., 2012), dokazala su da postoji uticaj makroekonomskih indikatora ekonomskog razvoja na performanse bankarskog sektora. U literaturi, kao najznačajniji indikatori mogu se izdvojiti: a) bruto domaći proizvod (BDP), b) inflacija tj. indeks potrošačkih cena (CPI) i c) nezaposlenost. Nedovoljno brz oporavak privrede (Ranosavljević, Vuković, 2015), delimično uspešna privatizacija državnih preduzeća, svetska ekonomska kriza i globalna politička nestabilnost, samo su neki od faktora koji su pretili da ugroze stabilnost domaćeg bankarskog sektora (Račić, Barjaktarović, 2016). Na sve pobrojano, treba dodati i sve češće pominjani koncept održivog razvoja u bankarstvu (Stojanović, 2020), budući da su problemi sa lokalnog i regionalnog preneti na globalni nivo (Zhang et al., 2011; Kostadnović, Radojičić, 2017), pa se nameće "zeleno bankarstvo" kao pojam navodi kao dobro rešenje za postizanje sistemske i finansijske stabilnosti (Yao et al., 2021). U trenutku pisanja rada, svet je pogodila i globalna pandemija virusa Covid–19 koja je dodatno prouzrokovala globalnu tržišnu nestabilnost (Đuričin, Herceg-Vuksanović, 2022). Usled paketa ekonomskih mera koje su donele Vlade analiziranih zemalja, banke su bile prinuđene da odobravaju moratorijume na kredite, ali očekivano je bilo da će one biti dovoljno likvidne da izdrže više meseci bez dosadašnjih priliva (Sun et al., 2019; Remeikienė, 2021), uprkos likvidnim bilansima, do tada. To je uslovilo politiku poskupljenja novca (Božović, Božović, 2022) i već je rezultiralo povećanjem kamatnih stopa i dodatno, potrebama za adekvatnim upravljanjem kreditnim rizikom (Yhang, 2021). Jedna od potencijalnih pretnji po likvidnost, sigurnost poslovanja i profitabilnost banke upravo jesu problematični krediti (skr.

NPL) koji sve češće u naučnoj i stručnoj literaturi zaokupljuju pažnju akademske javnosti, ali i bankarskih menadžera (Xing, 2020).

Ovaj rad se sastoji iz 5 delova. Nakon uvodnih razmatranja na početku rada, dat je metodološki okvir, a potom razvijen Mertonov model u trećem delu rada, nakon kojeg slede rezultati istraživanja, sa diskusijom. Na kraju su zaključna razmatranja i celokupna rekapitulacija rada, sa najznačajnicim highlights-ima.

Metodološki okvir rada

U radu se polazi od opštih ciljeva bankarskog sistema koji se ogledaju u stvaranju mogućnosti za postojanje i održavanje zdravog, stabilnog i održivog finansijskog sistema, zasnovanog na sigurnom i dobrom poslovanju svake banke i dostizanju odgovarajućeg nivoa zaštite korisnika finansijskih usluga. Naučni cilj istraživanja je pokazati da li i u kolikoj meri stanje makroekonomskih komponenti utiče na performanse bankarskog sistema u zemljama Zapadnog Balkana čije su odlike porast konkurencije, diverzifikacija, liberalizacija kretanja kapitala i sve više okretanje za "zelenom" kreditiranju (Noh, 2018). Posledično, društveni cilj rada je dokazati efikasnost primene urađenog modela kojim se tvrdi da kretanje problematičnih kredita se može predvideti na osnovu kretanja kombinacije određenih indikatora. Predmet rada predstavlja analizu makroekonomskog okruženja u zemljama Zapadnog Balkana radi ispitivanja uticaja odabranih pokazatelja na performanse bankarskog sistema, sa posebnim osvrtom na društvenu i komponentu zaštite životne sredine. Kao najznačajniji indikator biće korišćen indikator problematičnih kredita. Posebno ističemo istraživanje važnim, shodno tome da zemljama u razvoju, koje koračaju ka razvijenim zemljama Evrope, ekološka svest nije ni postojala, ili joj se posvećivala veoma mala pažnja i u obrazovanju i u vaspitanju (Vujičić i dr., 2022).

Prema podacima Svetske banke (2017), pod državama Zapadnog Balkana definisane su sledeće države: Albanija, Bosna i Hercegovina, Republika Kosovo, Crna Gora, Republika Severna Makedonija, Republika Srbija. Međutim, kako su Ustavom Republike Srbije Kosovo i Metohija definisani kao Autonomna pokrajina Republike Srbije, podaci koji se odnose na Kosovo, kao nezavisnu državu, nisu uzeti u razmatranje u ovom radu (Ustav Republike Srbije, 2006). Vremenski aspekt istraživanja indikatora u radu obuhvatiće period od poslednjeg kvarta-la 2010. godine, zaključno poslednjim kvartalom 2019. godine. Shodno navedenom, na temu indikatora koji utiču na performanse bankarskog sistema, njegov razvoj, ali i predviđanja budućih kretanja problematičnih kredita, može se postaviti više hipoteza. U nastavku biće izdvojeno nekoliko najvažnijih:

H0: Banke imaju značajnu ulogu u sprovođenju politike održivog razvoja, implementiranjem „zelene" komponente u svoje poslovne aktivnosti.

H1: U zemljama sa boljim makroekonomskim indikatorima, banke imaju prilike da ostvare bolje performanse;

H2: Moguće je upravljati rizicima u bankarstvu kreiranjem prediktivnih modela koji kao osnovu imaju kombinaciju makroekonomskih pokazatelja i pokazatelja performansi bankarskog sistema;

H3: Eksterni faktori, posebno stopa nezaposlenosti, imaju uticaj na kretanje NPL-a.

Nakon deskriptivne analize pomenutih vremenskih serija, biće razvijeni modeli koji svoju primenu mogu pronaći u predikciji kretanja stope problematičnih kredita na osnovu pokazatelja za koje će se u radu pokazati da imaju najveći uticaj na kretanje pomenute stope. (Vesić i dr., 2021). Drugo, za predstavnike vlasti, od velikog je značaja da makroekonomske podatke iskažu da pravi način, kako bi javnost imala volje da ih u narednom periodu podrži. S obzirom na to da je svet tokom 2020. godine pogodila pandemija virusa Covid–19, kao i da se posledice po ekonomiju celog sveta očekuju u narednom periodu, ovim radom smatramo da će se dati osnovu za dalja istraživanja široj akademskoj zajednici, pogotovo što su dosadašnja istraživanja objavljena u domaćoj i međunarodnoj literaturi u najvećoj meri posmatrala zemlje ZB pojedinačno, dok u ovom radu će se raditi na komparaciji dobijenih rezultata. Konačno, istaćiće se značaj uvođenja novih metoda i tehnologija, koje imaju za cilj kreiranje specifičnih bankarskih proizvoda i usluga, uzimajući u obzir zaštitu životne sredine, energetsku efikasnost, reciklažu, očuvanje biodiverziteta itd The research will also explore significant environmental protection risks associated with client lending, as the environmental risk associated with a bank's client can become a direct generator of financial risk for that bank.

Ističemo da je empirijska analiza istraživanja započeta je pregledom dostupnih podataka za odabrane zemlje: Albaniju, Bosnu i Hercegovinu, Crnu Goru, Republiku Srbiju i Republiku Severnu Makedoniju. Pretragom vladinih sajtova, sajtova centralnih banaka, statističkih agencija i sličnih relevantnih institucija, uz pregled domaće i strane literature, napravljena je baza makroekonomskih podataka.

Materials and Methods

U cilju određivanja finalnog modela i indikatora koji će na najprecizniji način opisati ciljnu promenljivu, koristiće se statističke metode analize podataka i metode finansijske matematike. Dostupni podaci biće analizirani na osnovu vremenske komponente i ispitivaće se njihova primenljivost na rešavanje početnog problema. Takođe, u skladu sa ciljem ovog istraživanja, biće korišćene metode razvoja prediktivnih statističkih modela (Mertonov model) i testovi njihove prediktivnosti. Među najznačajnijim statističkim metodama koje će biti korišćene u okviru rada su: linearna regresija, reziduali, koeficijent determinacije R^2 (R–squared) i korigovani koeficijent determinacije AJD R^2 (adjusted R–squared), kao i korelacija između promenljivih kroz matrice. U obradi će se

koristiti savremena informatička sredstva za obradu tekstova i podataka (tabela, grafikona, slika, histograma, itd.) u programskom paketu Microsoft Excel, a razvoj modela vršiće se u statističkom alatu *R*. Autori su pristupili i međunarodnoj bazi podataka *CEIC data*, kao i podacima *Moody's* rejting agencije, kao i podrazumevano, naučnoj i stručnoj literaturi.

Svi podaci su posmatrani na kvartalnom nivou, a preuzeti su iz baze podataka CEIC data za sledeće makroekonomske pokazatelje: rast nominalnog BDP–a; rast realnog BDP–a; investicije (u % BDP–a); industrijska proizvodnja; indeks potrošačkih cena; indeks proizvođačkih cena; ukupan izvoz; ukupan uvoz; stopa nezaposlenosti. Pored navedenih, prikupljeni su podaci značajni za bankarski sektor: racio problematičnih kredita; godišnju promenu rasta ukupnih depozita; godišnju promenu rasta ukupnih kredita; racio adekvatnosti kapitala; racio likvidnosti i pokazatelji profitabilnosti ROA i ROE. Radi preglednosti rada, podaci su prikazani kao prilog rada. Cilj dela rada je proveriti verodostojnost dobijenih prediktivnih podataka za kretanje NPL–a, kako bi usledio razvoj Mertonovog modela. Za početak, u nastavku će biti prikazani posmatrani makroekonomski i bankarski parametri za svaku zemlju, koji će kasnije, ući u model.

Model development

Asymptotic Single Risk Factor (ASRF) pristup je proistekao iz adaptacije Mertonovog modela koji je prvi put kreiran 1974. godine (Merton, 1974). U ovom pristupu, zajmovi su modelirani na standardni način u zavisnosti od verovatnoće problematičnih kredita (obično firme). Status NPL–a (neizmirenja obaveza) zajma se dešava ako tržišna vrednost imovine firme padne ispod iznosa zajma. Prema tome, podrazumevana distribucija dužnika je Bernoulijeva distribucija.

Pretpostavimo da je normalizovani povraćaj sredstava $Y_{i,t}$ dužnika i u trenutku t u kreditnom portfoliu, određenjednim sistematskim parametrom rizika Z_t i nesistemskim šumom $\varepsilon_{i,t}$, na osnovu sledeće formule:

$$Y_{i,t} = \sqrt{R_i^2}Z_t + \sqrt{1 - R_i^2}\varepsilon_{i,t}, \quad (1)$$

gde $\mathbf{Z_t}$ i $\boldsymbol{\varepsilon_{i,t}}$ imaju raspodelu N(0,1) i $\mathbf{Y_{i,t}}$ ima standardizovanu Gausovom distribucijom. Komponenta $\boldsymbol{\varepsilon_{i,t}}$ predstavlja specifičan faktor rizika karakterističan za dužnika i, dok je $\mathbf{Z_t}$ sistemski parametar rizika za sve dužnike u portfoliju, i u ovom slučaju predstavlja stanje makroekonomije. Parametar $\mathbf{R_i}$ i predstavlja standardnu stopu korelacije između kapitala dužnika i sistemskog (globalnog) parametra rizika, tako da se korelacija $\mathbf{R_i}$ i takođe tumači i kao osetljivost na sistematski rizik. Prema tome, ako sa B_i označimo minimalni prag za dužnika, zbog koga se aktivira određeni događaj i (npr. NPL), možemo predstaviti "trenutnu verovatnoću NPL–a" (PIT PD) dužnika dužnika i, na sledeći način:

$$PD_{i,t} = Prob\left(Y_{i,t} < B_i \middle| \mathbf{Z_t}\right) = Prob\left(\sqrt{R_i^2}Z_t + \sqrt{\mathbf{1} - R_i^2}\varepsilon_{i,t} < B_i \middle| \mathbf{Z_t}\right) = \Phi\left(\frac{B_i - \sqrt{R_i^2}Z_t}{\sqrt{\mathbf{1} - R_i^2}}\right), \quad (2)$$

Prema (Carlehed & Petrov, 2012), srednja vrednost verovatnoće NPL–a (TTC PD) dužnika i, označena sa CT_i i jeste srednja vrednost verovatnoće NPL–a za sve dostupne periode. To možemo prikazati sledećom formulom:

$$CT_i = \underset{Z_t}{\mathbf{E}}\left[\Phi\left(\frac{B_i - \sqrt{R_i^2}Z_t}{\sqrt{\mathbf{1} - R_i^2}}\right)\right] = \underset{Z_t \varepsilon_{i,t}}{\mathbf{E}}\left[Prob\left(\sqrt{R_i^2}Z_t + \sqrt{\mathbf{1} - R_i^2}\varepsilon_{i,t} < B_i\right)\right] = \underset{Y_{i,t}}{\mathbf{E}}\left[Prob\left(Y_{i,t} < B_i\right)\right] \quad (3)$$

,

Pod pretpostavkom da je portfolio homogen i da ne dolazi do promena portfolija tokom vremena, B_i i $\mathbf{R_i}$ su identični za sve periode i biće označeni sa B i R, dok su PiT PD NPL_t i TTC PD $CT)$ portfolia P iskazani sledećim formulama:

$$NPL_t = \frac{\mathbf{1}}{\#P}\sum_{i \in P} PD_{i,t} = \Phi\left(\frac{B - \sqrt{R^2}Z_t}{\sqrt{1 - R^2}}\right) \quad (4)$$

$$CT = \frac{\mathbf{1}}{\#P}\sum_{i \in P} CT_i = \Phi(B) \quad (5)$$

Eliminišući komponentu B iz obe gore pomenute jednačine, može se izraziti sistematski faktor rizika na osnovu istorijskih vrednost NPL–a za posmatrani portfolio P:

$$\mathbf{Z_t} = \frac{\Phi^{-1}(CT) - \sqrt{\mathbf{1} - R^2}\Phi^{-1}(NPL_t)}{\sqrt{R^2}}, \quad (6)$$

Sledeći korak je pronalaženje makroekonomskog modela za promenljivu Z_t koja može da objasni istorijsko kretanje NPL–a i predvidi buduću vrednost Z_t.

U ovom radu biće korišćen linearni model koji glasi:

$$\widetilde{Z_t} = \beta_0 + \beta_1 M_{1,t} + \cdots + \beta_i M_{i,t}, \quad (7)$$

i gde su $M_{1,t} \dots M_{i,t}$ odabrane makroekonomske varijable koje su specifične za portfolio P.

Sa pretpostavljenim linearnim modelom, može se projektovati buduća vrednost $\widetilde{Z_t}$ i transformisati budući TTC PD u budući PiT PD. Pre nego što se izvede transformacija, treba imati na umu da cilj modela da se odrede buduće vrednosti $\widetilde{Y}_{i,t} = \sqrt{R_i^2}\widetilde{Z_t} + \sqrt{1-R_i^2}\tilde{\varepsilon}_{i,t}$ koja ima sledeću raspodelu:

$$Y_{i,t} = \sqrt{R_i^2}Z_t + \sqrt{1-R_i^2}\varepsilon_{i,t}, \tag{8}$$

i čije komponente takođe imaju normalnu raspodelu:

$$\widetilde{Z_t} \sim N\left(E(\widetilde{Z_t}), Var(\widetilde{Z_t})\right), \qquad \tilde{\varepsilon}_{i,t} \sim N(0,1),$$

Vrednost PiT PD–a u nekom budućem trenutku t tada je:

$$PD_{i,t}^{PiT} = Prob(\widetilde{Y}_{i,t} < B_{i,t}) = \Phi\left(\frac{B_{i,t} - \sqrt{R_i^2}E(\widetilde{Z_t})}{\sqrt{1-R_i^2 + R^2 Var(\widetilde{Z_t})}}\right). \tag{9}$$

Sa druge strane, TTC PD za buduće podatke t izražavamo sledećom formulom:

$$PD_{i,t}^{TTC} = E_{Y_{i,t}}[Prob(Y_{i,t} < B_i)] = E[\Phi(B_{i,t})] = \Phi(B_{i,t}). \tag{10}$$

Kombinovanjem gornje dve jednačine dobije se:

$$PD_{i,t}^{PiT} = \Phi\left(\frac{\Phi^{-1}(PD_{i,t}^{TTC}) - \sqrt{R_i^2}E(\widetilde{Z_t})}{\sqrt{1-R_i^2 + R^2 Var(\widetilde{Z_t})}}\right), \tag{11}$$

koja, konačno, može poslužiti kao formula transformacije TTC PD u PiT PD.

Nakon prikupljanja podataka, a na osnovu makroekonomskog modela za promenljivu Z_t kreirana je ciljna promenljiva za sve moguće periode. S obzirom na to da je u modelu u početku posmatrano više varijabli, ideja je bila pronaći koje varijable u najvećoj meri utiču na kretanje problematičnih kredita u zemljama ZB, sa posledičnim ciljem otkrivanja veza u rastu kreditnog rizika. U nastavku će biti prikazane varijable imaju najveći uticaj na kretanje NPL–a u svakoj posmatranoj državi, kako bi se moglo predvideti kretanje NPL–a u budućnosti, bez postojanja podataka o NPL–u, a uz postojanje definisanih pokazatelja.

Results

Važno je naglasiti da se efekat posmatranih varijabli na privredu ne reflektuje odmah po njihovom pojavljivanju (Nikolić et al, 2013), već nakon određenog proteklog vremena, zbog čega su u analizu uključene dodatne promenljive pravljene korišćenjem lagova na početni set promenljivih. Ove varijable šire

spektar potencijalnih promenljivih tako što se ne gleda trenutna promena, već se analizira efekat makroekonomskih pokazatelja na ciljnu promenljivu nakon narednih kvartala koji dolaze u toku godine. For example, if we consider the impact of unemployment on the movement of non-performing loans (NPLs), Primera radi, ako posmatramo uticaj nezaposlenosti na kretanje problematičnih kredita, povećanje nezaposlenosti na kraju prvog kvartala 20xx godine neće imati uticaj na kretanje NPL–a u prvom kvartalu te godine, već će se efekat smanjenja zaposlenosti videti na kraju drugog, trećeg ili pak, četvrtog kvartala. Kako pojedini makroekonomski podaci nisu bili javno dostupni za određene godine, a pogotovo za prvih 6–7 godina analize, autor je računao tzv. nedostajuće vrednosti, pošto nije dozvoljeno ostaviti prazna polja u korišćenom statističkom paketu R. Procenat nedostajućih vrednosti se dobija tako što se sabere ukupan broj posmatranih vremenskih perioda (u slučaju ovoga rada – kvartala) i podeli sa ukupnim brojem praznih polja u okviru posmatranog indikatora, odnosno nakon računanja aritmetičke sredine pomenute dve varijable. Popunjavanje nedostajućih vrednosti smo vršili za svaku promenljivu sa srednjom vrednošću te promenljive.

Prva eliminacija podataka bilo je uklanjanje podataka koji imaju nedostajuće vrednosti preko 50%. U ovom radu ovaj slučaj postoji u Srbiji i Albaniji gde su eliminisani stopa nezaposlenosti u slučaju Srbije i PPC indeks u slučaju Albanije.

Tabela 1. The indicators were eliminated from further analysis due to missing values.

Država	Indikator
Srbija	Stopa nezaposlenosti
Albanija	Indeks proizvođačkih cena

Kada smo popunili sve vrednosti u kolonama, izračunati su koeficijenti R^2 i ADJ R^2 za svaku pojedinačnu promenljivu, u svakoj posmatranoj državi. Ovi koeficijenti ukazuju procenat varijanse između promenljivih, odnosno koliko neka promenljiva dobro opisuje ciljnu promenljivu. S obzirom na to da mali broj opservacija (u proseku oko 50 po zemlji), fokus je bio na rezultatima dobijenim u koeficijentu ADJ R^2 koji se koristi upravo u situaciji kada je dostupno otprilike do 100 opservacija. Konačno, modeliranjem eliminisane su sve promenljive kojima je ADJ R^2 manji od 15%. Kao mogućnost za dalje modeliranje, indikatori koji su ostavljeni u analizi prikazani su za svaku posmatranu zemlju u narednoj tabeli.

Tabela 2. Skraćen pregled indikatora po zemljama ZB sa R2 i ADJ R2 testovima sa rezultatom od preko 15%

Country	INDICATOR	R^2	ADJ R^2
Srbija	*CAR_L2*	0.492	0.479
	CAR_L1	0.484	0.471
	CAR_L3	0.483	0,470
	InvestPercNominalGDP	0,463	0,450
	InvestPercNominalGDP_L1	0,455	0,441
	InvestPercNominalGDP_L2	0,300	0,282

	RealGDP_L2	0,189	0,169
	RealGDP_L1	0,174	0,152
	RealGDP	0,172	0,151
Albanija	*UNEMPLOYMENT*	0,659	0,648
	UNEMPLOYMENT_L1	0,593	0,579
	UNEMPLOYMENT_L2	0,518	0,503
	UNEMPLOYMENT_L3	0,431	0,413
	TTDEPOSITE_L3	0,339	0,317
	TTDEPOSITE_L2	0,334	0,312
	TTDEPOSITE_L1	0,321	0,299
	CAR	0,300	0,278
	TTLOANS_L3	0,252	0,228
	RealGDP_L2	0,239	0,215
	CAR_L1	0,226	0,201
Bosna i Hercegovina	*TTLOANS_L3*	0,571	0,561
	TTLOANS_L2	0,433	0,420
	InvestPercNominalGDP_L3	0,397	0,382
	CPI_L3	0,320	0,304
	PPI_L3	0,295	0,278
	IMPORT	0,293	0,276
	IndustrialProd	0,261	0,244
	TTDEPOSITE	0,179	0,160
Crna Gora	*UNEMPLOYMENT_L1*	0,663	0,653
	UNEMPLOYMENT	0,646	0,636
	UNEMPLOYMENT_L2	0,570	0,558
	UNEMPLOYMENT_L3	0,505	0,492
	TTLOANS	0,449	0,434
	TTLOANS_L1	0,423	0,408
	TTLOANS_L3	0,406	0,390
	TTLOANS_L2	0,394	0,378
	CAR_L2	0,327	0,309
	CAR_L1	0,327	0,309
	CAR	0,324	0,305
	CAR_L3	0,296	0,277
	InvestPercNominalGDP	0,252	0,232
	NomGDP_L3	0,230	0,209
Severna Makedonija	*UNEMPLOYMENT*	0,471	0,461
	UNEMPLOYMENT_L1	0,424	0,414
	UNEMPLOYMENT_L2	0,384	0,373
	LAR	0,340	0,328
	CAR	0,283	0,270
	CAR_L1	0,232	0,218
	LAR_L1	0,224	0,210
	InvestPercNominalGDP	0,222	0,208

Izvor: Kalkulacija autora

Sledeća faza istraživanja bilo je kreiranje klastera tako što su promenljive istog tipa smeštane u odvojene grupe, naravno sa ADJ R^2 većim od 15%. Iz svakog klastera birana je promenljiva sa najvećim ADJ R^2 i konačno, kreirana je lista koja ulazi u regresiju. U narednoj tabeli prikazana je lista promenljivih za svaku posmatranu državu. Ako poredimo prethodnu i narednu tabelu, možemo zaključiti da tabela sa podacima o listi promenljivih koje ulaze u linearnu regresiju sledi iz prethodne tabele gde su klasteri formirani na osnovu R^2 i ADJ R^2 testova.

Tabela 3. The list of variables for linear regression

Država Zapadnog Balkana	Promenljiva koja je ušla u regresiju	
Srbija	CAR_L2	Srbija
Bosna i Hercegovina	TTLOANS_l3	Bosna i Hercegovina
Crna Gora	Stopa nezaposlenosti_L1	Crna Gora
Severna Makedonija	Stopa nezaposlenosti	Severna Makedonija
Albanija	Stopa nezaposlenosti	Albanija

Izvor: Kalkulacija autora

Prag značajnosti u puštenoj linearnoj regresiji je 5%, kako bi se dobili što odgovarajući rezultati. Dobijena je zavisna varijabla Z (na osnovu formule definisale u potpoglavlju 1.2. ovog poglavlja) za celokupan posmatrani period. Njenim modeliranjem sa indikatorima koji su se za svaku zemlju pojedinačno pokazali kao najznačajniji, dobijena je prediktivna vrednost (PD) koja predstavlja osnovu za kreiranu predikciju kretanja problematičnih kredita.

Na osnovu sprovedenih analiza u prethodnim potpoglavljima rada može se doneti generalni zaključak da prateći kretanje odabranih indikatora, možemo predvideti kretanje stope problematičnih kredita u budućnosti. Prisutan je trend višegodišnjeg povećanja stope NPL–a u godinama koje su pred nama, delom zbog politike poskupljenja novcaproistekle iz povećanja varijabilnog dela kamatne stope. Sprovedena analiza obuhvatila je dve vrste indikatora (makroekonomskih i bankarskih performansi) kako bi se pokazalo koji od odabranih parametara ima najveći uticaj na kretanje problematičnih kredita u zemljama Zapadnog Balkana. Razvijen na Mertonov model koji predstavlja osnovu za dalji rad u softverskom paketu R. Puštena je linearna regresija sa pragom značajnosti od 5% i dobijeni su najznačajniji indikatori koji utiču na kretanje problematičnih kredita, za svaku posmatranu državu. Rezultati su prikazani u narednoj tabeli

Tabela 4. Najznačajniji indikatori za kretanje NPL–a po državama ZB i R^2 i ADJ R^2 (%) i ADJ R^2 (%)

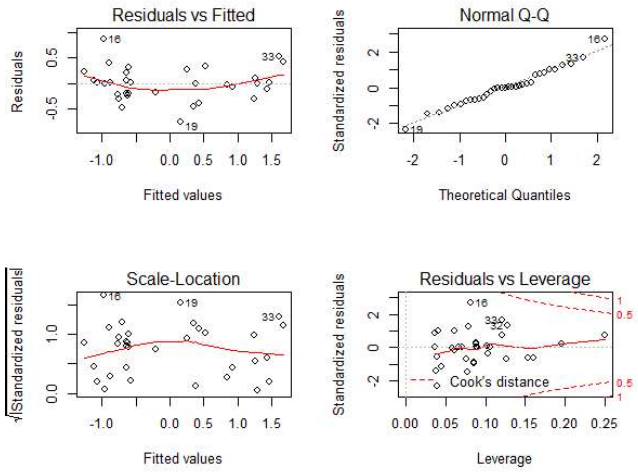
Država	Indikator1	Indikator2	R^2 (%)	ADJ R^2 (%)
ALB	Stopa nezaposlenosti	Rast depozita LAG3	89.4	88.4
BiH	Rast ukupnih kredita LAG3	/	57,15	56,13
CG	Stopa nezaposlenosti LAG1	Rast ukupnih kredita	73	71.6
SRB	CAR LAG2	Investicije (u procentu nominalnog BDP–a)	70.4	68.8
SMAK	Stopa nezaposlenosti	LAR	55.6	53.9

Izvor: Kalkulacija autora

Prilikom formiranja linearnog modela, potrebno je izvršiti analizu reziduala. Cilj ove analize je utvrditi da li je i koliko model odgovarajući. Najčešće je u fokusu provera da li reziduali imaju normalnu raspodelu, kao i upoređivanje sa postojećim vrednostima. Najjednostavnija metoda je u vizuelno upoređivanje koje se vrši crtanjem dijagrama (dijagrami koji se odnose na analizu vide se u okviru

sledećeg grafikona). Kako bismo utvrdili da li kreirani model za svaku promeljivu u posmatranim zemaljama na adekvatan način opisuje ciljnu promenljiu, ostalo je da izvršimo analizu reziduala. Rezultati slede u nastavku rada, za svaku od posmatranih zemalja.

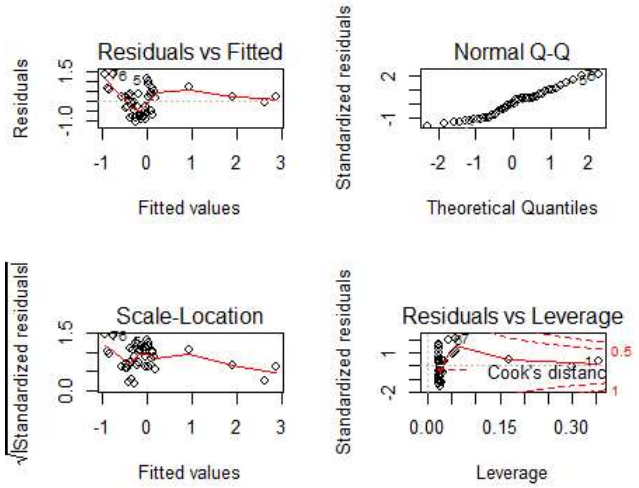
Figura 1. Dijagram rasipanja reziduala za prediktivni NPL (model) bankarskog sektora Albanije.



Prethodni grafikon potvrđuje nezavisnost reziduala jer su tačke nasumično raspoređene u prvom i trećem kvadratu. S obzirom na to da znamo da ako iscrtane tačke ne obrazuju šablon (što u ovom grafikonu nije slučaj), onda možemo reći da su ispunjeni uslovi za osnovne pretpostavke. Drugi kvadrat pokazuje normalnost raspodele što u slučaju Albanije jeste slučaj, dok tzv. Kukova razdaljina (četvrti kvadrat) pokazala je da nema outlier–e, odnosno tačke van predviđenih granica koje bi trebalo odbaciti. Kao zaključak predikcije u slučaju albanskog modela predikcije NPL–a, može se reći da pregledom stope nezaposlenosti i podataka o ukupnim depozitima kao javno dostupnim podacima, može sa velikom sigurnošću predvideti kretanje problematičnih kredita u budućem razvoju bankarskog sektora Albanije.

Dalje, sledi analiza reziduala kako bi se utvrdilo da li je kreirani model zadovoljavajući, i koliko za BiH.

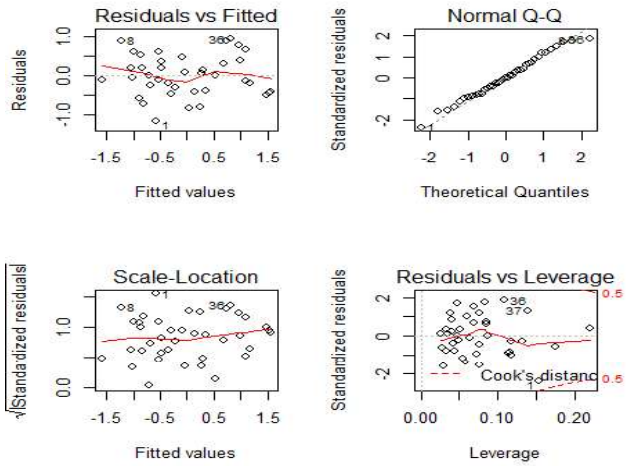
Figura 2. Dijagram rasipanja reziduala za prediktivni NPL (model) bankarskog sektora BiH



Na prethodnom grafikonu vidi se da, u okviru prvog i trećeg kvadrata su nasumično poređane tačke rasipanja, ali veoma koncentrisane u intervalu –1 i 0, što im ipak daju određenu zavisnost. Drugi rezidual je i u slučaju bankarskog sektora BiH normalno raspoređen, duž prave, a četvrti rezidual sa Kukovom razdaljinom, iako koncentrisaniji na samom početku, ne iskače van isprekidanih linija. Ističemo, da su ponovo trendovi kretanja ciljne promenljive Z (NPL–a) i odabranih indikatora slični, odnosno blagi pad NPL–a prati i blagi pad stope nezaposlenosti, a rast ukupno odobrenih kredita posledično će uticati na rast NPL–a u ukupnim plasmanima.

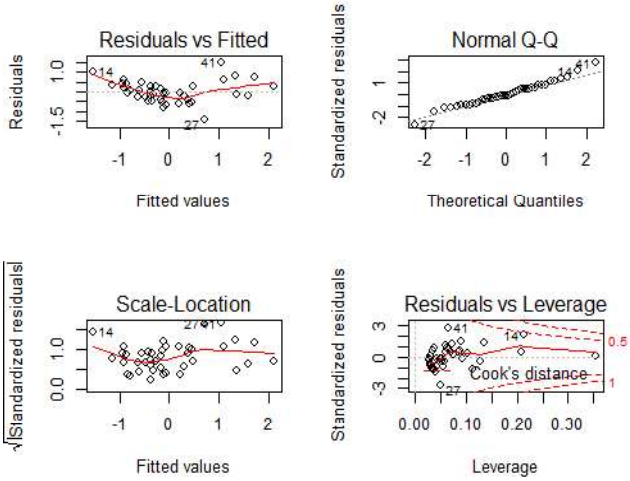
Konačno, ostala je analiza dijagrama rasipanja reziduala u slučajnu Crne Gore koja je prikazana na sledećem grafikonu.

Figura 3. Dijagram rasipanja reziduala za prediktivni NPL (model) bankarskog sektora Crne Gore



I u slučaju Crne Gore, možemo potvrditi nezavisnost reziduala čime još jednom potvrđujemo nepristrasnost pri kreiranju modela korišćenog u radu. U okviru prvog u trećeg kvadrata reziduali su nasumično poređani, drugi kvadrat pokazuje normalnost reziduala jer su poređani duž prave. Ni u ovom slučaju ne pojavljuju se outlier–i jer se sve tačke nalaze između isprekidanih linija.

Figura 4. Dijagram rasipanja reziduala za prediktivni NPL (model) bankarskog sektora RS

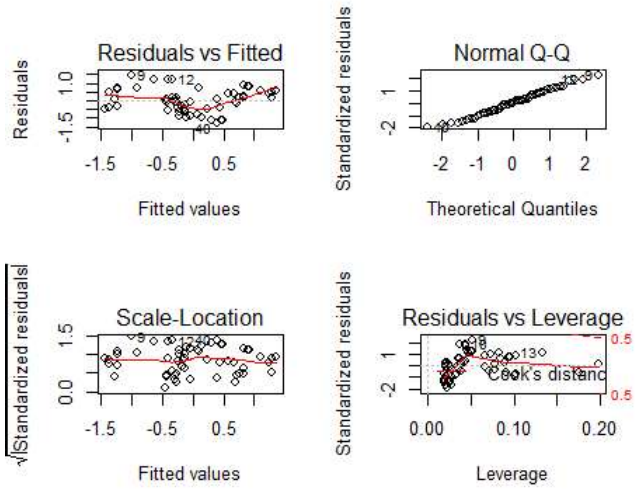


Proveravajući nezavisnost reziduala, prema prethodnom grafikonu, možemo videti da u prvom i trećem kvadratu reziduali deluju nasumični, tačnije nezavisni jedni od drugih. Drugi rezidual pokazuje normalnost raspodele, odnosno da su sve

tačke skoncentrisane oko prave linije. Konačno, četvrti rezuduala pokazuje koliko se tačaka nalazi van isprekidanih linija, što u ovom radu nije slučaj.

Posledično, ostaje analiza reziduala kako bi se konačno utvrdilo da li je model (i u kojoj meri) zadovoljavajući za projektovanje budućih vrednosti NPL–a u bankarskom sektoru Severne Makedonije.

Figura 5. Dijagram rasipanja reziduala za prediktivni NPL (model) bankarskog sektora Severne Makedonije



I na ovom grafikonu vidi se da u okviru prvog i trećeg kvadrata u potpunosti su nasumično poređane tačke rasipanja što daje veoma veliku nepristranosti kreiranom modelu. Drugi rezidual je i u slučaju SMAK normalno raspoređen, duž prave, a četvrti rezidual sa Kukovom razdaljinom, iako koncentrisaniji na samom početku, ne iskače van isprekidanih linija, čime se model može prihvatiti.

Diskusija

Rezultati pokazuju da je, u čak 3 od 5 posmatranih zemalja, jedan od indikatora koji u najvećoj meri utiču na kretanje NPL–a, stopa nezaposlenosti, što ide u prilog hipotezi H3. Kada se prisetimo slika iz svakodnevnog života, ovaj podatak i nije iznenađujući, budući da smanjenje zaposlenosti implicira probleme sa vraćanjem ranije preuzetih dugovanja, usled nedostataka novčanih priliva/sredstava/. Visoki procenti R2 i ADJ R2 testova ukazuju da će veze između modela i zavisne promenljive biti na više nego zadovoljavajućem nivou, budući da se rezultati već od preko 30–ak procenata uzimaju kao prihvatljivi. Sudeći po ovom parametru, predikcija NPL–a u Albaniji daće najtačnije projekcije (R2 i ADJ R2 iznose 89,4% i 88,4%, retrospektivno), dok će predikcija NPL–a u Severnoj Makedoniji biti najnepravilnija (R2 i ADJ R2 iznose 55,6% i 53,9%), sa i dalje adekvatnom interpretacijom projekcija, na osnovu kreiranog

modela. Dalje, pored stope nezaposlenosti, makroekonomski indikator koji se pokazao kao veoma značajan jesu investicije (u % nominalnog BDP–a), i to u Republici Srbiji. Osnovu za ovaj rezultat, i to u Republici Srbiji, možemo pronaći u činjenici da se ova država, u odnosu na ostale posmatrane, najviše otvorila prema inostranim investitorima, kao i da je veliki broj investicionih projekata u najvećoj meri finansiran kreditima (koji su obezbeđeni iz inostranog kapitala ili kreditnih linija), a ne npr. sopstvenim sredstvima. Bankarski indikatori za koje se pokazalo da imaju veliki uticaj na kretanje NPL–a u posmatranim državama su rast depozita tri kvartala unazad (Albanija), rast ukupnih kredita u posmatranom kvartalu (CG) i tri kvartala unazad (BiH), koeficijent adekvatnosti kapitala (SRB) i koeficijent likvidnosti (SMAK). Kvalitet predikcije testirao se proverom predikcije NPL–a u bankarskom sektoru svake zemlje, ponaosob. Izračunata je zavisna varijabla Z, a na osnovu nje prediktivna vrednost Z koja je dalje korišćena kao osnova za predviđanje NPL–a. Analiza reziduala (na osnovu dijagrama rasipanja) potvrđuje njihovu nezavisnost jer su tačke nasumično raspoređene u kvadratima I i III u okviru grafikona 38 (ALB), 41 (BiH), 45 (CG), 49 (SRB), 53 (SMAK). Ono što takođe ide u prilog prihvatanju modela za buduće predikcije jeste grafikon tzv. „Kukove razdaljine“ koja pokazuje odsustvo outlier–a (tačaka koje treba odbaciti) u svim posmatranim zemljama, iako je primećena nešto veća koncentracija tačaka na samom početku analize kod bankarskog sektora BiH.

S obzirom na to da sve navedeno ide u prilog adekvatnoj interpretaciji podataka, kao i zadovoljavajućem kvalitetu dobijenog kretanja problematičnih kredita, predikcija NPL–a urađena je do 2025. godine za bankarski sektor svake zemlje. Ovim je ujedno i potvrđena hipoteza H3. Značajno je napomenuti da prateći gorepomenute indikatore, može se izvšiti predikcija kretanja NPL–a u budućnosti.

Zaključak

U radu je sprovedeno teorijsko i empirijsko istraživanje. Posmatrano je pet zemalja koje je Svetska banka deklarisala kao države Zapadnog Balkana, sa izuzetkom samoproglašene Republike Kosovo sa te liste, zbog poštovanja odredbi Ustava Republike Srbije kojim su Kosovo i Metohija deklarisani kao Autonomna pokrajina Republike Srbije. Predmet rada bila je analiza održivo-bankarskog okruženja u zemljama Zapadnog Balkana i ispitivanje uticaja makroekonomskih pokazatelja na performanse bankarskog sistema, sa posebnim osvrtom na problematične kredite. U zemljama ZB, stabilnost finansijskog sistema uslovljena je stabilnošću bankarskog sektora, budući da zemlje ZB imaju „bankocentrične“ finansijske sisteme što podrazumeva da dominantan udeo ukupne finansijske aktive čine banke preko kojih se obavlja najveći finansijskih transakcija. Tendencija „ozelenjavanja” finansija koja je poslednjih decenija veoma aktuelna u svetu, nastala je iz potrebe da maksimiziranje profita ne bude jedini cilj banaka, već da se paralelno sa sticanjem profita uzme u obzir očuvanje životne sredine i društveno odgovorno poslovanje banaka. Banke koje na vreme prepoznaju i

implementiraju razne forme „zelenih" pravnih poslova u svoje poslovanje, u prilici su da privuku veći broj klijenata, i na taj način povećaju svoj profit, istovremeno doprinoseći održivom razvoju. Imajući u vidu potencijal koji nudi zeleno bankarstvo, zelene bankarske poslove možemo definisati kao one pravne poslove koje banka zaključuje sa svojim klijentima pridodajući im dodatnu, ekološku komponentu gde god je to moguće. Zeleni bankarski poslovi zapravo su klasični bankarski poslovi koji su usled rastućih potreba savremene ekonomije i održivog razvoja, uslovljenog usavršavanjem bankarske tehnike, doživeli određena poboljšanja i modifikacije - poboljšaju zadovoljstvo zaposlenih, lojalnost svojih klijenata, poboljšaju poslovni ugled pozitivnim izveštavanjem u medijima, ojačaju odnose i partnerstva sa ekološki nastrojenim stejkholderima (Vesić et al., 2022).

U posmatranim zemljama Zapadnog Balkana, zeleno bankarstvo je još uvek novi koncept, bez regulatornog okvira koji reguliše ovu veoma važnu temu. Najvećim delom, zeleni krediti dolaze iz linija od strane međunarodnih finansijskih institucija. Možda je baš šansa za "ozelenjavanje" celokupne ekonomije težnja ka harmonizaciji zakonskih propisa zemalja Zapadnog Balkana sa propisima u EU, pre svega u domenu zaštite životne sredine, u okviru poglavlja 27. Takođe, u budućem radu, veoma je bitno nastaviti sa istraživanjem u oblasti problematičnih kredita, budući da su oni jedna od najvećih glavobolja savremenih menadžera i drugih lica zaduženih za ostvarivanje profita banke. Dodavanjem zelene komponete, rezultati pokazuju da se mogu očekivati povećanje tržišnog učešća, profita, zadovoljstva zaposlenih i lojalnosti klijenata… U svakom slučaju, bilo bi dobro i razmeniti naučna saznanja sa istraživačima i drugim stručnjacima iz neposrednog okruženja, ali i razvijenih zemalja, jer samo zajedničkim snagama se može doprineti unapređenju kako metodoloških, tako i praktičnih rešenja, održivih na dugi rok.

Literatura

1. Alihodžić, A. 2015. Interdependence of the performance of the banking and real sector of the Republic of Serbia. Banking, 2/2015: 46-73.
2. Baietti, A., Shlyakhtenko, A., La Rocca, R., Urvaksh, P. 2012. Green Infrastructure Finance: Leading Initiatives and Research. Washington: The World Bank.
3. Barjaktarović, L., Vesić, T. i Balazs, L. 2022. What Can Be Expected in Credit-Risk Management from NPL in the Western Balkans Region in the Future? International Review 1-2: 96-103. https://doi 10.5937/intrev2204100B
4. Božović, J. i Božović, I. 2023. Uticaj pandemije Covid - 19 na digitalizaciju bankarskog sektora Srbije. Oditor Vol. IX, Br. 01/2023: 127-143,
5. Commission Directive 2011/63/EU of 1 June 2011 amending, for the purpose of its adaptation to tehnical progress, Directive 98/70/EC of the European Parliament and of the Council relating to the quality of petrol and diesel fuels.

6. Cvetinović, M. 2009. Managerial economics. Belgrade: Singidunum University.
7. Đuričin, D. i Herceg-Vuksanović, I. 2022. Envisioning a new economic system after the transition from pandemic to endemic: Serbia's perspective. Business Economics, 70(1-2), 1-22. https://doi.org/10.5937/EKOPRE2202001D
8. Gnjatović, D. 2010. 'Greens': The earliest creditors of farmers in Serbia. Banking, 39(1-2): 48-71.
9. Jeucken, M. 2004. Sustainability in Finance. Banking on the Planet. Eburon Academic Publishers
10. Kostadinović, I. i Radijičić, J. 2017. The banking sector in the context of sustainable development. Economics, 1(2): 109–119.
11. Merton, R. 1974. On the pricing of corporate debt: The risk structure of interest rates. Journal of Finance 29: 449-470.
12. Mitić, P., Fedajev, A., Radulescu, M. i Rehman, A. 2023. The relationship between CO2 emissions, economic growth, available energy, and employment in SEE countries, Environmental Science and Pollution Research, (30)6: 16140-16155,
13. Nacionalna strategija održivog razvoja Republike Srbije, Službeni glasnik RS, br.57/2008.
14. Nikolić, R., Urošević, S., Fedajev, A. i Piljušić, M. 2013. Natural resource management as a function of environmental conservation. EMIT, Economics Management Information Technology 2(1): 25-32.
15. Noh Hee, J. 2018. Financial Strategy to Accelerate Green Growth. ADBI Working Paper Series 866: 1–23.
16. Račić, Ž. 2014. The influence of basic macroeconomic indicators on the liquidity of the Serbian banking sector. School of Business 2/2014: 67-76.
17. Račić, Ž., & Barjaktarović, L. 2016. Analysis of empirical determinants of credit risk in the banking sector of the Republic of Serbia. Banking, 45(4), 94-109.
18. Radojević, T. 2019. International economy. Belgrade: Singidunum University.
19. Rakić, S., Mitić, P. 2012. Green Banking – Green Financial Products with Special Emphasis on Retail Banking Products, In: II International scientific conference: 2nd climate change, economic development, environment and people conference. Vydavatel'stvo Prešovskej universitary, Prešov, pp. 54-60. ISBN 978-80-555-0607-4.
20. Ranisavljević, D., i Vuković, D. 2015. Risks of small business lending in the Republic of Serbia. Banking 44(1): 12-25.
21. Remeikienė, R., Gasparėnienė, L., Fedajev, A. i Vėbraitė, V. 2021. The role of ICT development in boosting economic growth in transition economies. Journal of international studies 14(4): 9-22.
22. Serrasquiero, S., Silva, M. 2007. Corporate Sustainability in the Portuguese Financial Institutions. Social Responsibility Journal, 3(2): 82–94.

23. Službeni glasnik RS, b. 4. 2006. Ustav Republike Srbije. Preuzeto 03 10, 2022 sa https://www.paragraf.rs/propisi/ustav_republike_srbije.html
24. Stojanović, D. 2020. Sustainable economic development through green innovative banking and financing. Economics of Sustainable Development 4(1):35-44. https://doi.org/10.5937/ESD2001035S
25. Su, C.W., Li, W., Umar, M. i Lobonţ, O. 2022. Can green credit reduce the emissions of pollutants? Economic Analysis and Policy 74: 205-219, https://doi.org/10.1016/j.eap.2022.01.016
26. Sun, J.,Wang, F., Yin, H. i Zhang, B. 2019. Money Talks: The Environmental Impact of China's Green Credit Policy. Journal of Policy Analysis and Management, 38(3), 653-680, https://doi.org/10.1002/pam.22137
27. Trenca, I., Petria, N., Mutu, S., i Corovei, E. 2012. Evaluating the liquidity determinants in the Central and Eastern European banking system. Finance - Challenges of the Future 14/2021: 85-90.
28. Vesić, T., Đekić, M. i Zimonjić, S. 2021. Funkcionalna analiza najznačajnijih berzanskih karakteristika – studija slučaja Švajcarske berze. Trendovi u poslovanju 18(2):98-106.
29. Vodová, P. 2011. Czech Science Foundation (Project GACR/11/P243): 740-747.
30. Vujičić, S., Cogoljević, M., & Nikitović, Z. (2022). The development of ecological awareness in the Republic of Serbia. International Review 1-2: 51-59. https://doi.org/10.5937/intrev2202059V
31. World Bank Group. 2017. Western Balkans Regular Economic Report No. 12. Preuzeto 06 07, 2021 sa http://documents1.worldbank.org/curated/en/477511510774559876/pdf/121417-WP-PUBLIC.pdf
32. Xing, C., Zhang, Y. i Wang, Y. 2020. Do Banks Value Green Management in China? The Perspective of the Green Credit Policy. Finance Research Letters 35: 101601, https://doi.org/10.1016/j.frl.2020.101601
33. Yao, Sh., Pan Y., Sensoy, A., Uddin, GS. i Cheng, F. 2021. Green credit policy and firm performance: What we learn from China. Energy Economics 10:105415, https://doi.org/10.1016/j.eneco.2021.105415
34. Yhang, D. 2021. Green credit regulation, induced R&D and green productivity: Revisiting the Porter Hypothesis. International Review of Financial Analysis 75:101723, https://doi.org/10.1016/j.irfa.2021.101723
35. Zhang, B., Jun, Y. i Bi, J. 2011. Tracking the implementation of green credit policy in China: Top-down perspective and bottom-up reform. Journal of Environmental Management, 92(4): 1321-1327, https://doi.org/10.1016/j.jenvman.2010.12.019

Datum prijema (Date received): 15.07.2023.
Izvršena prva korekcija (The first correction was made): 08.09.2023.
Datum prihvatanja (Date accepted): 02.10.2023.

THE IMPACT OF SUSTAINABLE DEVELOPMENT ON RISK MANAGEMENT IN THE NPL PORTFOLIO IN THE WESTERN BALKAN COUNTRIES

***Tamara Vesić*[50], *Miljana Barjaktarović*[51], *Vladan Cogoljević*[52]**

Abstract

The concept of sustainable banking is based on the principle of achieving growth and profits for the bank and shareholders, but only by also achieving social goals and caring for environmental preservation. Providing new banking services and creating new (green) banking businesses that not only generate profits but also broader social and environmental objectives present opportunities for creating a competitive advantage, both in the Western Balkan countries observed in this study and in all countries worldwide. In this study, we will focus on analyzing macroeconomic parameters in the Western Balkan countries to examine the impact of selected indicators on the performance of the banking system, with a particular emphasis on the social and environmental protection components. The results indicate that the unemployment rate is the most significant indicator of potentially risky events for bankers, and banks are not recognized in the current environmental preservation strategies in the Western Balkan countries. Therefore, it is necessary to educate the population first and simultaneously promote green loans as sustainable and more favorable in the long term than traditional loans, while updating the existing regulatory framework in the field of environmental protection.

***Keywords**: green finance, green loans, sustainable banking, social responsibility, renewable energy, poverty reduction*

***JEL**: N10, E44, G21*

Introduction

Contemporary trends in the banking sector indicate that traditional banking is increasingly losing its significance, while new business risks emerge daily (Commission Directive, 2011), especially when it comes to the objectives of national strategies in the field of sustainable ICT development, such as the

[50] Associate Professor Tamara Vesić, Ph.D. School of Business Economics and Entrepreneurship, Mitropolita Petra 8, Belgrade, Serbia, Phone: +381 11 2762 194, E-mail: tamara.vesic@vspep.edu.rs

[51] Full professor Miljana Barjaktarović, Ph.D. School of Business Economics and Entrepreneurship, Mitropolita Petra 8, Belgrade, Serbia, Phone: +381 11 2762 194, E-mail: miljana.barjaktarovic@vspep.edu.rs

[52] Assistant professor Vladan Cogoljević, Ph.D. School of Business Economics and Entrepreneurship, Mitropolita Petra 8, Belgrade, Serbia, Phone: +381 11 2762 194, E-mail: vlada.cogoljevic@vspep.edu.rs

development of e-commerce, e-education, e-healthcare, e-banking, e-payments, and others (National strategy of sustainable development of Serbia, 2008). It is undeniable that money circulates through the banking sector of every economy, from surplus to deficit sectors. Therefore, banks, as intermediaries, should have a more significant role in implementing sustainable development policies by incorporating a "green" component into all their business activities (Baietti et al., 2012; Jeucken, 2004). To promote further development of the green financial system and support green banking, the adoption of regulatory measures and appropriate legal frameworks is essential (Rakić, Mitić, 2012). Banks have expanded their operations beyond the borders of their own countries by opening branches and subsidiaries worldwide (Radojević, 2019; Serrasquiero, Silva, 2007). On the other hand, there is a globalization of economic flows and constant innovation in financial services. All of these factors necessitate the management of processes and phenomena within banks, which is inconceivable without analyzing the performance of corporate banking. However, despite innovations in the field of financial services, credit risk remains the most significant individual cause of bank bankruptcies (Cvetinović, 2009). Previous research has shown that the success of the banking sector is influenced by macroeconomic indicators, and numerous studies, such as (Alihodžić, 2015; Račić, 2014; Vodová, 2013; Trenca et al., 2012), have demonstrated the impact of macroeconomic indicators of economic development on the performance of the banking sector. In the literature, the most significant indicators can be identified as follows: a) gross domestic product (GDP), b) inflation or consumer price index (CPI), and c) unemployment. Insufficient economic recovery (Ranosavljević, Vuković, 2015), partially successful privatization of stateowned enterprises, global economic crisis, and global political instability are just some of the factors that posed a threat to the stability of the domestic banking sector (Račić, Barjaktarović, 2016). In addition to these factors, the concept of sustainable development in banking is increasingly mentioned (Stojanović, 2020), as problems that were once local or regional have now become global in nature (Zhang et al., 2011; Kostadnović, Radojičić, 2017), making "green banking" a suggested solution for achieving systemic and financial stability (Yao et al., 2021). At the time of writing this paper, the world was hit by the global pandemic of the Covid19 virus, which further caused global market instability (Đuričin, Herceg-Vuksanović, 2022). Due to the economic measures implemented by the governments of the analyzed countries, banks were forced to approve loan moratoriums (Božović, Božović, 2022). However, it was expected that they would be sufficiently liquid to withstand several months without the usual inflows, despite having liquid balance sheets until then. This led to a tightening of monetary policy (Sun et al., 2019; Remeikienė, 2021), resulting in increased interest rates and the need for adequate credit risk management (Yhang, 2021). One of the potential threats to the liquidity, operational security, and profitability of banks is non-performing loans (NPLs), which are increasingly

attracting attention in academic and professional literature and among banking managers (Xing, 2020).

This paper consists of five parts. After the introductory considerations at the beginning of the paper, the methodological framework is provided, followed by the development of the Merton model in the third part of the paper. The research results, along with the discussion, are presented next. Finally, there are concluding remarks, highlighting the most significant points.

Methodological framework

The paper opens with the general objectives of the banking system, which involve creating opportunities for the existence and maintenance of a healthy, stable, and sustainable financial system based on the safe and sound operation of each bank and achieving an appropriate level of consumer protection in financial services. The scientific objective of the research is to demonstrate whether and to what extent the state of macroeconomic components influences the performance of the banking system in the Western Balkan countries, characterized by increased competition, diversification, liberalization of capital movement, and a growing focus on "green" lending (Noh, 2018). Consequently, the social objective of the paper is to prove the effectiveness of the applied model, which claims that the movement of non-performing loans can be predicted based on the movement of specific indicators. The subject of the paper is the analysis of the macroeconomic environment in the Western Balkan countries to examine the impact of selected indicators on the performance of the banking system, with a particular emphasis on the social and environmental protection component. The most significant indicator used will be the non-performing loan indicator. We particularly highlight the importance of this research, considering that in developing countries transitioning towards developed European countries, environmental awareness either did not exist or received very little attention in education and upbringing (Vujičić et al., 2022).

According to the World Bank data (2017), the following countries are defined as Western Balkan countries: Albania, Bosnia and Herzegovina, Kosovo (as recognized by the World Bank), Montenegro, North Macedonia, and Serbia. However, as per the Constitution of the Republic of Serbia, Kosovo and Metohija are defined as an Autonomous Province of the Republic of Serbia, and data related to Kosovo as an independent state are not considered in this paper (Ustav Republike Srbije, 2006). The temporal aspect of indicator research in this paper will cover the period from the last quarter of 2010 to the end of the last quarter of 2019.

Based on the aforementioned, several hypotheses can be formulated regarding the indicators that influence the performance of the banking system, its development,

and the prediction of future movements of non-performing loans. The following are some of the most significant hypotheses that will be highlighted:

H0: Banks play a significant role in implementing sustainable development policies by incorporating a "green" component into their business activities.

H1: In countries with better macroeconomic indicators, banks have opportunities to achieve better performance.

H2: It is possible to manage risks in banking by creating predictive models based on a combination of macroeconomic indicators and banking system performance indicators.

H3: External factors, especially the unemployment rate, influence the movement of non-performing loans (NPLs).

After conducting a descriptive analysis of the mentioned time series, models will be developed that can be applied to predict the movement of the non-performing loan rate based on indicators that will be shown to have the greatest impact on the rate (Vesić et al., 2021). Additionally, it is of great importance for government representatives to present macroeconomic data in the right way, in order to gain public support in the future. Considering that the world was hit by the Covid-19 pandemic in 2020 and that the consequences for the global economy are expected to continue in the upcoming period, this paper aims to provide a foundation for further research within the wider academic community. Previous studies published in domestic and international literature have predominantly focused on individual countries in the Western Balkans, while this paper will compare the obtained results. Finally, the importance of introducing new methods and technologies will be emphasized, aiming to create specific banking products and services that take into account environmental protection, energy efficiency, recycling, biodiversity preservation, etc. The research will also explore significant environmental protection risks associated with client lending, as the environmental risk associated with a bank's client can become a direct generator of financial risk for that bank.

Empirical analysis of the research began with a review of available data for the selected countries: Albania, Bosnia and Herzegovina, Montenegro, Serbia, and North Macedonia. A database of macroeconomic data was compiled by searching government websites, central bank websites, statistical agencies, and other relevant institutions. In addition, domestic and foreign literature was reviewed to gather relevant information for the analysis.

Materials and Methods

In order to determine the final model and identify the indicators that most accurately describe the target variable, statistical methods of data analysis and financial mathematics will be employed. The available data will be analyzed

based on the time component, and their applicability to solving the initial problem will be examined. Furthermore, in line with the research objective, predictive statistical modeling methods (such as the Merton model) and tests of their predictiveness will be used. Some of the most important statistical methods that will be utilized in this research include linear regression, residuals, the coefficient of determination R^2 (R-squared), adjusted coefficient of determination AJD R^2 (adjusted R-squared), as well as correlation analysis using matrices. Contemporary computer tools for text and data processing, such as tables, graphs, charts, histograms, etc., will be employed using the Microsoft Excel software package. Model development will be conducted using the statistical tool R. The authors have accessed international databases such as CEIC data, as well as data from Moody's rating agency, in addition to relying on scientific and professional literature.

All data were observed at a quarterly level and were obtained from the CEIC data database for the following macroeconomic indicators: nominal GDP growth, real GDP growth, investment as a percentage of GDP, industrial production, consumer price index, producer price index, total exports, total imports, and unemployment rate. In addition to these, data relevant to the banking sector were collected, including the ratio of non-performing loans, annual growth rate of total deposits, annual growth rate of total loans, capital adequacy ratio, liquidity ratio, and profitability indicators (ROA and ROE). To ensure clarity in the paper, the data has been presented as an appendix. The aim of this part of the study is to verify the reliability of the obtained predictive data for the movement of non-performing loans (NPLs), which will be followed by the development of the Merton model. To begin with, the observed macroeconomic and banking parameters for each country, which will later be included in the model, will be presented.

Model development

The Asymptotic Single Risk Factor (ASRF) approach stems from the adaptation of the Merton model, which was initially developed in 1974 (Merton, 1974). In this approach, loans are modeled in a standard manner based on the probability of default (typically for firms). The status of a nonperforming loan (NPL), indicating default, occurs when the market value of the firm's assets falls below the loan amount. Therefore, the underlying distribution of borrowers is assumed to follow a Bernoulli distribution.

Let us assume that the normalized return of the ith borrower's assets, $Y_{i,t}$, at time *t* in the credit portfolio, is determined by a systematic risk parameter, Z_t, and a non-systematic noise term, $\varepsilon_{i,t}$, according to the following formula:

$$Y_{i,t} = \sqrt{R_i^2} Z_t + \sqrt{1 - R_i^2} \varepsilon_{i,t}, \quad (1)$$

where $\mathbf{Z_t}$ and $\boldsymbol{\varepsilon_{i,t}}$ follow a standard normal distribution (N(0,1)), and $\mathbf{Y_{i,t}}$ follows a standardized Gaussian distribution. The component $\boldsymbol{\varepsilon_{i,t}}$ represents the specific risk factor unique to borrower i, while $\mathbf{Z_t}$ is the systematic risk parameter for all borrowers in the portfolio and represents the macroeconomic state. The parameter $\mathbf{R_i}$ represents the standard correlation rate between the borrower's capital and the systemic (global) risk parameter, so $\mathbf{R_i}$ can also be interpreted as sensitivity to systematic risk. Therefore, if we denote B_i as the minimum threshold for a borrower that triggers a specific event i (e.g., NPL), we can represent the "point-in-time probability of default" (PIT PD) for borrower i as follows:

$$PD_{i,t} = Prob\left(Y_{i,t} < B_i \middle| \mathbf{Z_t}\right) = Prob\left(\sqrt{R_i^2}Z_t + \sqrt{\mathbf{1} - R_i^2}\varepsilon_{i,t} < B_i \middle| \mathbf{Z_t}\right) = \Phi\left(\frac{B_i - \sqrt{R_i^2}Z_t}{\sqrt{\mathbf{1} - R_i^2}}\right). \quad (2)$$

According to (Carlehed & Petrov, 2012), the mean value of the probability of default (TTC PD) for borrower, denoted as CT_i, represents the average probability of default over all available periods. This can be represented by the following formula:

$$CT_i = \underset{Z_t}{\mathbf{E}}\left[\Phi\left(\frac{B_i - \sqrt{R_i^2}Z_t}{\sqrt{\mathbf{1} - R_i^2}}\right)\right] = \underset{Z_t\varepsilon_{i,t}}{\mathbf{E}}\left[Prob\left(\sqrt{R_i^2}Z_t + \sqrt{\mathbf{1} - R_i^2}\varepsilon_{i,t} < B_i\right)\right] = \underset{Y_{i,t}}{\mathbf{E}}\left[Prob\left(Y_{i,t} < B_i\right)\right] \quad (3)$$

,

Assuming that the portfolio is homogeneous and there are no changes in the portfolio over time, B_i and $\mathbf{R_i}$ are identical for all periods and will be denoted as B and R, while PiT PD NPL_t and TTC PD CT of portfolio P can be expressed by the following formulas:

$$NPL_t = \frac{\mathbf{1}}{\#P}\sum_{i\in P} PD_{i,t} = \Phi\left(\frac{B - \sqrt{R^2}Z_t}{\sqrt{1 - R^2}}\right) \quad (4)$$

$$CT = \frac{\mathbf{1}}{\#P}\sum_{i\in P} CT_i = \Phi(B) \quad (5)$$

By eliminating the component B from both of the aforementioned equations, the systematic risk factor can be expressed based on the historical values of NPL for the observed portfolio P:

$$\mathbf{Z_t} = \frac{\Phi^{-1}(CT) - \sqrt{1 - R^2}\Phi^{-1}(NPL_t)}{\sqrt{R^2}}, \quad (6)$$

The next step is to find a macroeconomic model for the variable Z_t that can explain the historical movement of NPL and predict the future value of Z_t.

In this study, a linear model will be used, which is formulated as follows:

$$\widetilde{Z_t} = \beta_0 + \beta_1 M_{1,t} + \cdots + \beta_i M_{i,t}, \quad (7)$$

where $M_{1,t} \dots M_{i,t}$ are selected macroeconomic variables that are specific to portfolio P.

With the assumed linear model, the future value of $\widetilde{Z_t}$ can be projected and used to transform the future TTC PD into future PiT PD. Before performing the transformation, it should be noted that the goal of the model is to determine the future values of $\widetilde{Y}_{i,t} = \sqrt{R_i^2}\widetilde{Z_t} + \sqrt{1 - R_i^2}\tilde{\varepsilon}_{i,t}$ which follows the following distribution:

$$Y_{i,t} = \sqrt{R_i^2}Z_t + \sqrt{1 - R_i^2}\varepsilon_{i,t}, \quad (8)$$

and its components also follow a normal distribution:

$$\widetilde{Z_t} \sim N\left(E(\widetilde{Z_t}), Var(\widetilde{Z_t})\right), \qquad \tilde{\varepsilon}_{i,t} \sim N(0,1),$$

The value of PiT PD at some future time *t* is then given by:

$$PD_{i,t}^{PiT} = Prob(Y_{i,t} < B_{i,t}) = \Phi\left(\frac{B_{i,t} - \sqrt{R_i^2}E(Z_t)}{\sqrt{1 - R_i^2 + R^2 Var(Z_t)}}\right). \quad (9)$$

On the other hand, the TTC PD for future time *t* is expressed by the following formula:

$$PD_{i,t}^{TTC} = E_{Y_{i,t}}[Prob(Y_{i,t} < B_i)] = E[\Phi(B_{i,t})] = \Phi(B_{i,t}). \quad (10)$$

By combining the above two equations, we obtain:

$$PD_{i,t}^{PiT} = \Phi\left(\frac{\Phi^{-1}(PD_{i,t}^{TTC}) - \sqrt{R_i^2}E(Z_t)}{\sqrt{1 - R_i^2 + R^2 Var(Z_t)}}\right), \quad (11)$$

which, finally, can serve as the formula for transforming TTC PD into PiT PD.

After collecting the data based on the macroeconomic model for the variable Z_t, the target variable was created for all possible periods. Since the initial model considered multiple variables, the idea was to identify which variables have the greatest impact on the movement of non-performing loans (NPLs) in the WB countries, with the ultimate goal of uncovering relationships in credit risk growth. The following variables will be presented as having the greatest influence on the movement of NPLs in each observed country, allowing for the prediction of NPL movements in the future even in the absence of NPL data, but with the presence of defined indicators.

Results

It is important to note that the effect of the observed variables on the economy is not reflected immediately upon their occurrence (Nikolić et al, 2013), but after a certain time has passed. This is why additional variables created using lags on the initial set of variables are included in the analysis. These variables broaden the range of potential variables by not considering the current change but rather analyzing the effect of macroeconomic indicators on the target variable after the following quarters within the year. For example, if we consider the impact of unemployment on the movement of non-performing loans (NPLs), an increase in unemployment at the end of the first quarter of the year 20xx will not have an immediate effect on the movement of NPLs in the first quarter of that year. Instead, the effect of the decrease in employment will be seen at the end of the second, third, or even fourth quarter. Since certain macroeconomic data were not publicly available for certain years, especially for the first 6-7 years of the analysis, the author calculated the so called missing values, as leaving empty fields in the used statistical software package R is not allowed. The percentage of missing values is obtained by adding up the total number of observed time periods (in the case of this study-quarters) and dividing it by the total number of empty fields within the observed indicator, after calculating the arithmetic mean of these two variables. The missing values were filled in for each variable with the mean value of that variable.

The first data elimination involved removing data with missing values exceeding 50%. In this study, this case occurred in Serbia and Albania, where the unemployment rate for Serbia and the PPC index for Albania were eliminated.

Table 1. The indicators were eliminated from further analysis due to missing values.

Country	Indicator
Serbia	Unemployment rate
Albania	The Producer Price Index

Once all the values in the columns were filled, the coefficients R2 and ADJ R2 were calculated for each individual variable in each observed country. These coefficients indicate the percentage of variance between variables, or how well a variable describes the target variable. Due to the small number of observations (on average around 50 per country), the focus was on the results obtained in the ADJ R2 coefficient, which is used specifically in situations where there are approximately up to 100 observations available. Finally, through modeling, all variables with an ADJ R2 below 15% were eliminated. As a possibility for further modeling, the indicators that were retained in the analysis are presented for each observed country in the following table.

Table 2. A summary of the indicators for the WB countries along with their R2 and ADJ R2 test results that are above 15%

Country	INDICATOR	R^2	ADJ R^2
Serbia	*CAR_L2*	0.492	0.479
	CAR_L1	0.484	0.471
	CAR_L3	0.483	0,470
	InvestPercNominalGDP	0,463	0,450
	InvestPercNominalGDP_L1	0,455	0,441
	InvestPercNominalGDP_L2	0,300	0,282
	RealGDP_L2	0,189	0,169
	RealGDP_L1	0,174	0,152
	RealGDP	0,172	0,151
Albania	*UNEMPLOYMENT*	0,659	0,648
	UNEMPLOYMENT_L1	0,593	0,579
	UNEMPLOYMENT_L2	0,518	0,503
	UNEMPLOYMENT_L3	0,431	0,413
	TTDEPOSITE_L3	0,339	0,317
	TTDEPOSITE_L2	0,334	0,312
	TTDEPOSITE_L1	0,321	0,299
	CAR	0,300	0,278
	TTLOANS_L3	0,252	0,228
	RealGDP_L2	0,239	0,215
	CAR_L1	0,226	0,201
Bosnia and Herzegovina	*TTLOANS_L3*	0,571	0,561
	TTLOANS_L2	0,433	0,420
	InvestPercNominalGDP_L3	0,397	0,382
	CPI_L3	0,320	0,304
	PPI_L3	0,295	0,278
	IMPORT	0,293	0,276
	IndustrialProd	0,261	0,244
	TTDEPOSITE	0,179	0,160
Montenegro	*UNEMPLOYMENT_L1*	0,663	0,653
	UNEMPLOYMENT	0,646	0,636

	UNEMPLOYMENT_L2	0,570	0,558
	UNEMPLOYMENT_L3	0,505	0,492
	TTLOANS	0,449	0,434
	TTLOANS_L1	0,423	0,408
	TTLOANS_L3	0,406	0,390
	TTLOANS_L2	0,394	0,378
	CAR_L2	0,327	0,309
	CAR_L1	0,327	0,309
	CAR	0,324	0,305
	CAR_L3	0,296	0,277
	InvestPercNominalGDP	0,252	0,232
	NomGDP_L3	0,230	0,209
North Macedonia	*UNEMPLOYMENT*	0,471	0,461
	UNEMPLOYMENT_L1	0,424	0,414
	UNEMPLOYMENT_L2	0,384	0,373
	LAR	0,340	0,328
	CAR	0,283	0,270
	CAR_L1	0,232	0,218
	LAR_L1	0,224	0,210
	InvestPercNominalGDP	0,222	0,208

Source: Authors' calculation

The next stage of the research involved creating clusters by grouping variables of the same type together, with an ADJ R^2 greater than 15%. From each cluster, the variable with the highest ADJ R^2 was selected, and ultimately, a list of variables for regression was created. The following table displays the list of variables for each observed country. By comparing the previous and current tables, we can conclude that the table containing the list of variables included in the linear regression follows from the previous table where clusters were formed based on R^2 and ADJ R^2 tests.

Table 3. The list of variables for linear regression

Country	The variable that entered the regression	
Serbia	CAR_L2	Investments (% of nominal GDP)
Bosnia and Herzegovina	TTLOANS_l3	
Montenegro	Unemployment rate_L1	TTLOANS
North Macedonia	Unemployment rate	LAR
Albania	Unemployment rate	TTDEPOSITE_L3

Source: Authors' research

The significance threshold in the conducted linear regression was set at 5% to obtain appropriate results. The dependent variable Z (based on the formula defined in Section 1.2 of this chapter) was obtained for the entire observed period. By modeling it with the indicators that were individually found to be the most significant for each country, a predictive value (PD) was obtained, which serves as the basis for predicting the movement of non-performing loans (NPLs). Based on the analyses conducted in the previous subsections, a general conclusion can be drawn that by monitoring the movement of selected indicators, we can predict the future trends of the NPL rate. There is a persistent trend of increasing NPL

rates in the upcoming years, partly due to the monetary policy of tightening resulting from an increase in the variable portion of the interest rate. The analysis included two types of indicators (macroeconomic and banking performance) to demonstrate which of the selected parameters has the greatest impact on the movement of NPLs in the Western Balkan countries. The analysis was developed based on the Merton model, which serves as the foundation for further work in the R software package. A linear regression was performed with a significance threshold of 5%, and the most significant indicators influencing the movement of NPLs were obtained for each observed country. The results are presented in the following table.

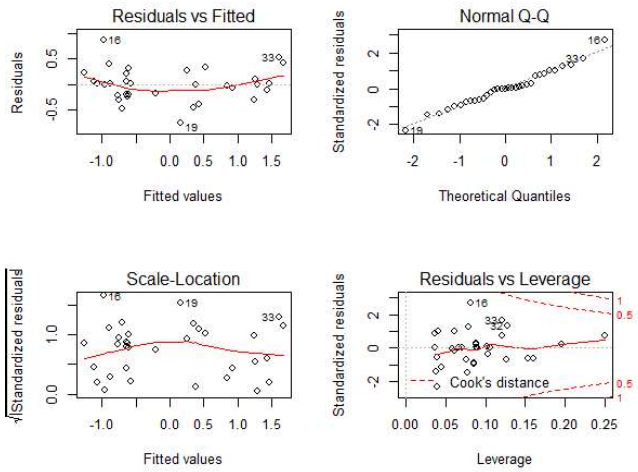
Table 4. The most significant indicators for NPL movement in the Western Balkan countries, along with their R2 and ADJ R2 (%) values

Country	Indicator 1	Indicator 2	R^2 (%)	ADJ R^2 (%)
ALB	Unemployment rate	Deposit growth LAG3	89.4	88.4
BiH	Growth of Total LoansLAG3	/	57,15	56,13
CG	Unemployment rate LAG1	Growth of total loans	73	71.6
SRB	EMPEROR LAG2	Investments (as a percentage of nominal GDP)	70.4	68.8
THE END	Unemployment rate	LAR	55.6	53.9

Source: Authors' research

When forming a linear model, it is necessary to perform a residual analysis. The goal of this analysis is to determine the adequacy of the model. The most common focus is to check if the residuals have a normal distribution and compare them to existing values. The simplest method is visual comparison, which is done by plotting graphs (the graphs related to the analysis can be seen in the following figure). To determine if the created model adequately describes the target variable for each predictor variable in the observed countries, we need to perform a residual analysis. The results are presented below for each of the observed countries.

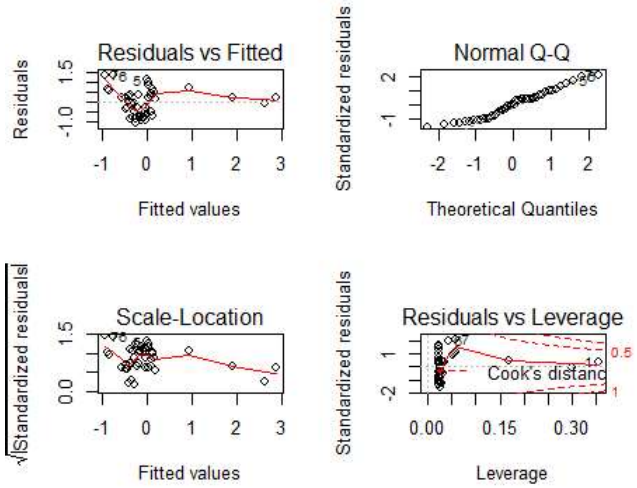
Figure 1. Residual Scatter Diagram for the predictive NPL (model) in the banking sector of Albania.



The previous diagram confirms the independence of residuals as the points are randomly scattered in the first and third quadrants. Knowing that if the plotted points do not form a pattern (which is the case in this diagram), we can conclude that the basic assumptions are met. The second quadrant indicates the normality of the distribution, which holds true for Albania. Additionally, the so-called Cook's distance (fourth quadrant) shows that there are no outliers, meaning there are no points outside the expected boundaries that should be discarded. For the prediction of NPL in the Albanian model, it can be stated that by examining the unemployment rate and total deposit data as publicly available information, it is possible to predict the movement of problematic loans with a high level of confidence in the future development of Albania's banking sector.

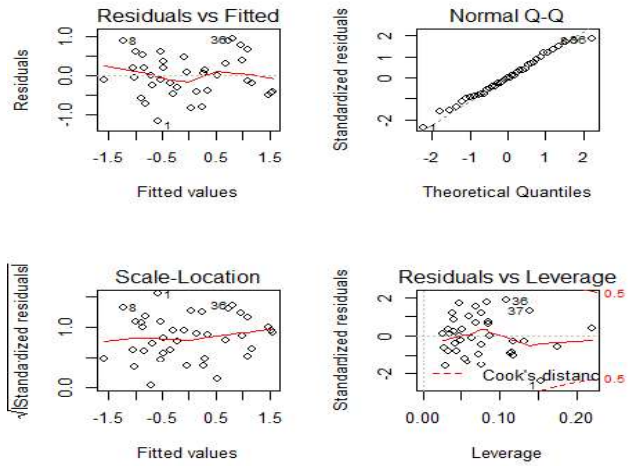
We will proceed with the analysis of residuals to determine whether the created model is satisfactory and to what extent for Bosnia and Herzegovina (BiH).

Figure 2. Residual Scatter Diagram for the predictive NPL (model) in the banking sector of BiH



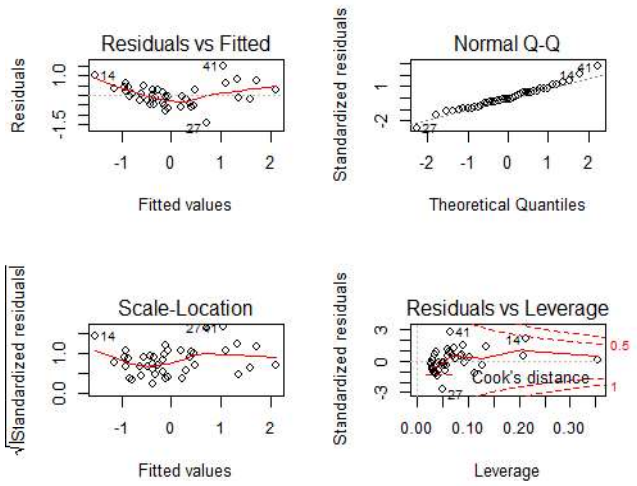
In the previous graph, it can be observed that within the first and third quadrants, the scatter points are randomly distributed but highly concentrated in the range between -1 and 0, indicating a certain dependence. The second residual, in the case of the banking sector of Bosnia and Herzegovina (BiH), follows a normal distribution along the line, while the fourth residual with the Cook's distance, although initially more concentrated, does not deviate beyond the dashed lines. It should be noted that the trends in the target variable Z (NPL) and the selected indicators are similar, with a slight decrease in NPL accompanied by a slight decrease in the unemployment rate, while an increase in total approved loans will consequently affect the growth of NPL in overall placements. Finally, we will proceed with the analysis of the scatter plot of residuals in the case of Montenegro, which is presented in the following graph.

Figure 3. Residual Scatter Diagram for the predictive NPL (model) in the banking sector of MNE.



In the case of Montenegro as well, we can confirm the independence of residuals, once again affirming the unbiasedness in the creation of the model used in the study. Within the first and third quadrants, the residuals are randomly arranged, while the second quadrant indicates the normality of residuals as they align along a straight line. Similarly, no outliers are present in this case, as all points fall within the dashed lines.

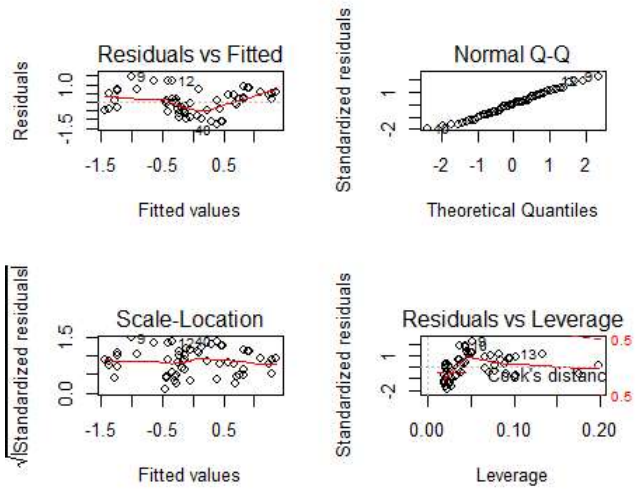
Figure 4. Residual Scatter Diagram for the predictive NPL (model) in the banking sector of RS



By examining the independence of residuals, as shown in the previous graph, we can observe that in the first and third quadrants, the residuals appear random,

indicating their independence from each other. The second residual demonstrates the normality of the distribution, with the points concentrated around a straight line. Finally, the fourth residual indicates the number of points outside the dashed lines, which is not the case in this study. Consequently, the analysis of residuals remains to determine the extent to which the model is satisfactory for projecting future values of NPL in the banking sector of North Macedonia.

Figure 5. Residual Scatter Diagram for the predictive NPL (model) in the banking sector of NMAC



On this graph, we can observe that the points in the first and third quadrants are completely randomly scattered, indicating a high level of impartiality in the created model. The second residual is normally distributed, forming a straight line in the case of North Macedonia. The fourth residual, with the Cook's distance, is more concentrated at the beginning but does not exceed the dashed lines, which suggests that the model is acceptable.

Discussion

The results show that in as many as 3 out of 5 observed countries, one of the indicators that has the greatest impact on NPL movement is the unemployment rate, which supports hypothesis H3. When we consider everyday life situations, this finding is not surprising, as a decrease in employment implies difficulties in repaying previously taken loans due to a lack of financial inflows/resources. High percentages of R^2 and ADJ R^2 tests indicate that the relationships between the model and the dependent variable will be at a satisfactory level, as results above 30% are considered acceptable. Judging by this parameter, the NPL prediction in Albania will provide the most accurate projections (R^2 and ADJ R^2 of 89.4% and 88.4% respectively, retrospectively), while the NPL prediction in North Macedonia will be the least regular (R^2 and ADJ R^2 of 55.6% and 53.9%), but still

with an adequate interpretation of projections based on the created model. Furthermore, in addition to the unemployment rate, another significant macroeconomic indicator is investment (as a percentage of nominal GDP), particularly in the case of Serbia. The basis for this result in Serbia can be found in the fact that this country has opened up the most to foreign investors compared to the others observed, and a large number of investment projects are primarily financed through loans (secured from foreign capital or credit lines) rather than, for example, own funds. Banking indicators that have been shown to have a significant impact on NPL movement in the observed countries are the growth of deposits three quarters back (Albania), the growth of total loans in the observed quarter (Montenegro) and three quarters back (Bosnia and Herzegovina), capital adequacy ratio (Serbia), and liquidity ratio (North Macedonia). The quality of prediction was tested by examining the prediction of NPL in the banking sector of each country individually. The dependent variable Z was calculated, and based on it, the predictive value of Z was derived, which was further used as the basis for predicting NPL. The analysis of residuals (based on scatter plots) confirms their independence as the points are randomly distributed in quadrants I and III in graph 38 (Albania), 41 (Bosnia and Herzegovina), 45 (Montenegro), 49 (Serbia), 53 (North Macedonia). Another factor supporting the acceptance of the model for future predictions is the graph of the so-called "Cook's distance," which shows the absence of outliers (points to be discarded) in all observed countries, although a slightly higher concentration of points was noticed at the beginning of the analysis in the banking sector of Bosnia and Herzegovina.

Considering that all the above supports the adequate interpretation of data and satisfactory quality of the obtained NPL movement, NPL predictions have been made until 2025 for the banking sector of each country. This also confirms hypothesis H3. It is worth noting that by monitoring the aforementioned indicators, future trends in NPL can be predicted.

Conclusion

The paper conducted both theoretical and empirical research. It examined five countries that have been declared as Western Balkan countries by the World Bank, with the exception of the self-proclaimed Republic of Kosovo, which was excluded from the list due to compliance with the provisions of the Constitution of the Republic of Serbia, which declares Kosovo and Metohija as an Autonomous Province of Serbia. The focus of the study was the analysis of the sustainable banking environment in the Western Balkan countries and the investigation of the impact of macroeconomic indicators on the performance of the banking system, with a particular emphasis on non-performing loans (NPLs). In the Western Balkan countries, the stability of the financial system is conditioned by the stability of the banking sector, as these countries have "bank-centric" financial systems where banks constitute the dominant share of the total

financial assets and handle the majority of financial transactions. The trend of "greening" finance, which has been highly relevant globally in recent decades, emerged from the need to consider environmental preservation and socially responsible banking practices alongside profit maximization. Banks that recognize and implement various forms of "green" business practices are able to attract a larger number of clients, thereby increasing their profits while contributing to sustainable development. Given the potential offered by green banking, green banking activities can be defined as the legal transactions that banks undertake with their clients by incorporating an additional environmental component wherever possible. Green banking activities are essentially traditional banking activities that have undergone certain improvements and modifications due to the growing needs of the modern economy and sustainable development, driven by advancements in banking techniques. These activities enhance employee satisfaction, client loyalty, business reputation through positive media coverage, and strengthen relationships and partnerships with environmentally conscious stakeholders (Vesić et al., 2022).

In the observed Western Balkan countries, green banking is still a relatively new concept without a regulatory framework that specifically addresses this important issue. Green loans, for the most part, come from lines of credit provided by international financial institutions. Perhaps the opportunity for "greening" the entire economy lies in the aspiration to harmonize the legal regulations of Western Balkan countries with those of the EU, especially in the field of environmental protection within Chapter 27. Additionally, in future research, it is crucial to continue investigating non-performing loans as they remain one of the major concerns for contemporary bank managers and other individuals responsible for bank profitability. By incorporating a green component, the results indicate that an increase in market share, profitability, employee satisfaction, and client loyalty can be expected. It would also be beneficial to exchange scientific knowledge with researchers and experts from both the immediate environment and developed countries, as only through joint efforts can we contribute to the improvement of both methodological and practical long-term sustainable solutions.

Literature

1. Alihodžić, A. 2015. Interdependence of the performance of the banking and real sector of the Republic of Serbia. Banking, 2/2015: 46-73.
2. Baietti, A., Shlyakhtenko, A., La Rocca, R., Urvaksh, P. 2012. Green Infrastructure Finance: Leading Initiatives and Research. Washington: The World Bank.
3. Barjaktarović, L., Vesić, T. i Balazs, L. 2022. What Can Be Expected in Credit-Risk Management from NPL in the Western Balkans Region in the Future? International Review 1-2: 96-103. https://doi 10.5937/intrev2204100B

4. Božović, J. i Božović, I. 2023. Uticaj pandemije Covid - 19 na digitalizaciju bankarskog sektora Srbije. Oditor Vol. IX, Br. 01/2023: 127-143,
5. Commission Directive 2011/63/EU of 1 June 2011 amending, for the purpose of its adaptation to tehnical progress, Directive 98/70/EC of the European Parliament and of the Council relating to the quality of petrol and diesel fuels.
6. Cvetinović, M. 2009. Managerial economics. Belgrade: Singidunum University.
7. Đuričin, D. i Herceg-Vuksanović, I. 2022. Envisioning a new economic system after the transition from pandemic to endemic: Serbia's perspective. Business Economics, 70(1-2), 1-22. https://doi.org/10.5937/EKOPRE2202001D
8. Gnjatović, D. 2010. 'Greens': The earliest creditors of farmers in Serbia. Banking, 39(1-2): 48-71.
9. Jeucken, M. 2004. Sustainability in Finance. Banking on the Planet. Eburon Academic Publishers
10. Kostadinović, I. i Radijičić, J. 2017. The banking sector in the context of sustainable development. Economics, 1(2): 109–119.
11. Merton, R. 1974. On the pricing of corporate debt: The risk structure of interest rates. Journal of Finance 29: 449-470.
12. Mitić, P., Fedajev, A., Radulescu, M. i Rehman, A. 2023. The relationship between CO2 emissions, economic growth, available energy, and employment in SEE countries, Environmental Science and Pollution Research, (30)6: 16140-16155,
13. Nacionalna strategija održivog razvoja Republike Srbije, Službeni glasnik RS, br.57/2008.
14. Nikolić, R., Urošević, S., Fedajev, A. i Piljušić, M. 2013. Natural resource management as a function of environmental conservation. EMIT, Economics Management Information Technology 2(1): 25-32.
15. Noh Hee, J. 2018. Financial Strategy to Accelerate Green Growth. ADBI Working Paper Series 866: 1–23.
16. Račić, Ž. 2014. The influence of basic macroeconomic indicators on the liquidity of the Serbian banking sector. School of Business 2/2014: 67-76.
17. Račić, Ž., & Barjaktarović, L. 2016. Analysis of empirical determinants of credit risk in the banking sector of the Republic of Serbia. Banking, 45(4), 94-109.
18. Radojević, T. 2019. International economy. Belgrade: Singidunum University.
19. Rakić, S., Mitić, P. 2012. Green Banking – Green Financial Products with Special Emphasis on Retail Banking Products, In: II International scientific conference: 2nd climate change, economic development, environment and

people conference. Vydavatel'stvo Prešovskej universitary, Prešov, pp. 54-60. ISBN 978-80-555-0607-4.

20. Ranisavljević, D., i Vuković, D. 2015. Risks of small business lending in the Republic of Serbia. Banking 44(1): 12-25.
21. Remeikienė, R., Gasparėnienė, L., Fedajev, A. i Vėbraitė, V. 2021. The role of ICT development in boosting economic growth in transition economies. Journal of international studies 14(4): 9-22.
22. Serrasquiero, S., Silva, M. 2007. Corporate Sustainability in the Portuguese Financial Institutions. Social Responsibility Journal, 3(2): 82–94.
23. Službeni glasnik RS, b. 4. 2006. Ustav Republike Srbije. Preuzeto 03 10, 2022 sa https://www.paragraf.rs/propisi/ustav_republike_srbije.html
24. Stojanović, D. 2020. Sustainable economic development through green innovative banking and financing. Economics of Sustainable Development 4(1):35-44. https://doi.org/10.5937/ESD2001035S
25. Su, C.W., Li, W., Umar, M. i Lobonţ, O. 2022. Can green credit reduce the emissions of pollutants? Economic Analysis and Policy 74: 205-219, https://doi.org/10.1016/j.eap.2022.01.016
26. Sun, J.,Wang, F., Yin, H. i Zhang, B. 2019. Money Talks: The Environmental Impact of China's Green Credit Policy. Journal of Policy Analysis and Management, 38(3), 653-680, https://doi.org/10.1002/pam.22137
27. Trenca, I., Petria, N., Mutu, S., i Corovei, E. 2012. Evaluating the liquidity determinants in the Central and Eastern European banking system. Finance - Challenges of the Future 14/2021: 85-90.
28. Vesić, T., Đekić, M. i Zimonjić, S. 2021. Funkcionalna analiza najznačajnijih berzanskih karakteristika – studija slučaja Švajcarske berze. Trendovi u poslovanju 18(2):98-106.
29. Vodová, P. 2011. Czech Science Foundation (Project GACR/11/P243): 740-747.
30. Vujičić, S., Cogoljević, M., & Nikitović, Z. (2022). The development of ecological awareness in the Republic of Serbia. International Review 1-2: 51-59. https://doi.org/10.5937/intrev2202059V
31. World Bank Group. 2017. Western Balkans Regular Economic Report No. 12. Preuzeto 06 07, 2021 sa http://documents1.worldbank.org/curated/en/477511510774559876/pdf/121417-WP-PUBLIC.pdf
32. Xing, C., Zhang, Y. i Wang, Y. 2020. Do Banks Value Green Management in China? The Perspective of the Green Credit Policy. Finance Research Letters 35: 101601, https://doi.org/10.1016/j.frl.2020.101601

33. Yao, Sh., Pan Y., Sensoy, A., Uddin, GS. i Cheng, F. 2021. Green credit policy and firm performance: What we learn from China. Energy Economics 10:105415, https://doi.org/10.1016/j.eneco.2021.105415
34. Yhang, D. 2021. Green credit regulation, induced R&D and green productivity: Revisiting the Porter Hypothesis. International Review of Financial Analysis 75:101723, https://doi.org/10.1016/j.irfa.2021.101723
35. Zhang, B., Jun, Y. i Bi, J. 2011. Tracking the implementation of green credit policy in China: Top-down perspective and bottom-up reform. Journal of Environmental Management, 92(4): 1321-1327, https://doi.org/10.1016/j.jenvman.2010.12.019