

STEČAJNI RIZIK U MALIM POLJOPRIVREDNIM PREDUZEĆIMA SA PODRUČJA AP VOJVODINE: STUDIJA SLUČAJA

Milić Dragan¹, Jocić Bogdan², Novaković Dragana³, Novaković Tihomir⁴

Rezime

U uslovima izražene tržišne nestabilnosti, promena cena inputa, klimatskih poremećaja i opšte ekonomske neizvesnosti, procena stečajnog rizika privrednih društava dobija poseban značaj, naročito u sektoru poljoprivrede. Predmet istraživanja u ovom radu jesu mala preduzeća sa područja Autonomne Pokrajine Vojvodine koja su registrovana za delatnost gajenja žita (osim pirinča), leguminoza i uljarica. Posmatrana preduzeća su bila poslovno aktivna u periodu od 2021. do 2025. godine. Cilj istraživanja jeste ocena stečajnog rizika posmatranih preduzeća primenom Altmanovog Z" skora, modela razvijenih u istraživanjima Dragane Bešlić i saradnika i Denisa Kuštera. Podaci neophodni za sprovođenje analize preuzeti su iz javno dostupnih finansijskih izveštaja objavljenih pri Agenciji za privredne registre Republike Srbije. Rezultati istraživanja ukazuju da je kod pojedinih privrednih društava identifikovan povećan stečajni rizik, dok su druga zadržala stabilnije poslovanje tokom analiziranog perioda.

Ključne reči: stečaj, poljoprivreda, bankrotstvo, Altman EMS skor

¹ Dr Milić Dragan, redovni profesor, Univerzitet u Novom Sadu, Poljoprivredni fakultet, Trg Dositeja Obradovića 8, 21000 Novi Sad, Republika Srbija, e-mail: dragan.milic@polj.edu.rs, ORCID ID: <https://orcid.org/0000-0003-0377-1540>.

² Mast. aecon Jocić Bogdan, koresponding autor, istraživač saradnik, Univerzitet u Novom Sadu, Poljoprivredni fakultet, Trg Dositeja Obradovića 8, 21000 Novi Sad, Republika Srbija, e-mail: bogdan.jocic@polj.edu.rs, ORCID ID: <https://orcid.org/0000-0002-1745-3255>.

³ Dr Novaković Dragana, docent, Univerzitet u Novom Sadu, Poljoprivredni fakultet, Trg Dositeja Obradovića 8, 21000 Novi Sad, Republika Srbija, e-mail: dragana.novakovic@polj.uns.ac.rs, ORCID ID: <https://orcid.org/0000-0002-1924-6196>.

⁴ Dr Novaković Tihomir, docent, Univerzitet u Novom Sadu, Poljoprivredni fakultet, Trg Dositeja Obradovića 8, 21000 Novi Sad, Republika Srbija, e-mail: tihomir.novakovic@polj.uns.ac.rs, ORCID ID: <https://orcid.org/0000-0002-8405-3403>.

1

Uvod

U dinamičnim uslovima poslovanja očuvanje finansijske stabilnosti privrednih društava predstavlja jedno od ključnih pitanja ekonomske analize, naročito u okolnostima izražene tržišne neizvesnosti, rasta troškova inputa, promena kamatnih stopa i poremećaja u lancima snabdevanja. Milić i saradnici (2025) ističu da pravovremeno donošenje poslovnih odluka usmerenih ka sprečavanju narušenosti poslovanja mora biti zasnovano na temeljnoj analizi uticajnih faktora. Ovo pitanje dobija poseban značaj u sektoru poljoprivrede, imajući u vidu da se poslovanje poljoprivrednih preduzeća, pored uobičajenih tržišnih i finansijskih rizika, odvija i pod snažnim uticajem klimatskih faktora, bioloških ciklusa proizvodnje i oscilacija prinosa. Usled navedenog je njihova finansijska pozicija dodatno izložena osetljivosti i promenama (Céu i saradnici, 2022). Pravovremena identifikacija finansijskih poteškoća i procena verovatnoće nastanka stečaja imaju višestruki značaj budući da su relevantne ne samo za vlasnike i menadžment preduzeća, već i za poverioce, investitore, državu i ostale relevantne učesnike u privrednom okruženju (Qu i saradnici, 2019). Modeli za procenu stečajnog rizika, koji se zasnivaju na računovodstvenim i finansijskim pokazateljima, imaju značajnu ulogu u identifikovanju ranih indikatora pogoršanja poslovanja, čime se omogućava blagovremeno preduzimanje odgovarajućih korektivnih mera. Altmanov model koji se zasniva na upotrebi diskriminacione analize (Altman, 1968) u literaturi se najčešće smatra polaznom tačkom razvoja modela za predviđanje stečaja (bankrotstva). Kasnija istraživanja usmerena su ka unapređenju tačnosti klasifikacije kroz primenu savremenijih statističkih tehnika. Iako je oblast predviđanja stečaja metodološki napredovala, brojna istraživanja ukazuju da ne postoji univerzalni model koji bi pokazivao jednaku efikasnost u svim sektorima, državama i institucionalnim okruženjima. Tačnost procene zavisi od strukture uzorka, veličine preduzeća, delatnosti, kvaliteta finansijskog izveštavanja i specifičnosti nacionalnog privrednog ambijenta, zbog čega se u empirijskim istraživanjima naglašava potreba sektorske i regionalne provere primenjenih modela (Mizdraković i Bokić, 2016; Begović i saradnici, 2020; Milić i saradnici, 2025). Ovo je naročito važno u poljoprivredi, gde standardni modeli razvijeni pretežno na uzorcima industrijskih preduzeća, ne moraju u potpunosti obuhvatiti specifičnosti poslovanja agrarnih privrednih društava (Boratynska i saradnici, 2018; Klepáč i Hampel, 2017). Poljoprivredna proizvodnja ima tradicionalno značajno mesto u privrednoj strukturi Republike Srbije zahvaljujući povoljnim agroekološkim uslovima, ali i istorijskim i razvojnim determinantama njenog oblikovanja (Jakšić i saradnici, 2015). Podaci Republičkog zavoda za statistiku ukazuju na to da se oko 38% ukupno korišćenog poljoprivrednog zemljišta u zemlji nalazi na području Autonomne Pokrajine Vojvodine (Republički zavod za statistiku, 2023b). U strukturi setve u Republici Srbiji se ističu žita sa približno 67% učešća u strukturi setve (Republički zavod za statistiku, 2023a). U okviru sektora A – Poljoprivreda, u Autonomnoj Pokrajini Vojvodini su u 2023.

godini dominantno bila zastupljena mikro i mala privredna društva sa učešćem od približno 95% (APR, 2023).

Polazeći od navedenog, predmet istraživanja u ovom radu jesu mala poljoprivredna preduzeća sa područja AP Vojvodine koja su registrovana za delatnost gajenja žita (osim pirinča), leguminoza i uljarica. Cilj rada je da se, na osnovu podataka iz javno dostupnih finansijskih izveštaja, izvrši empirijska analiza stečajnog rizika primenom više modela. Istraživanje nastoji da doprinese literaturi koja se bavi sektorski specifičnom procenom stečajnog rizika, ali i da pruži praktično relevantne uvide o stepenu finansijske ugroženosti malih poljoprivrednih preduzeća u jednom od najznačajnijih agrarnih regiona Republike Srbije.

1.1. Pregled literature

U cilju teorijskog i empirijskog utemeljenja istraživanja, relevantna literatura o proceni stečajnog rizika u Republici Srbiji može se sistematizovati prema nekoliko kriterijuma: primenjenom modelu procene, procentu tačnosti klasifikacije, učestalosti grešaka tipa I i tipa II, vremenskom horizontu predviđanja, kao i najčešće identifikovanim faktorima koji utiču na povećanje stečajnog rizika. Ovakav pristup (prikazan u tabeli 1) omogućava jasnije sagledavanje prednosti i ograničenja pojedinih modela, ali i identifikovanje najpouzdanijih metodoloških rešenja za analizu stečajnog rizika u srpskom privrednom okruženju.

Na osnovu prikazanih istraživanja može se uočiti da se u domaćoj literaturi najčešće primenjuju Altmanovi modeli, posebno Z' i Z'', dok se u novijim radovima sve češće koriste i alternativni pristupi, kao što su Zmijewski model, Kraliček Quick test, Springate model i Beneish M skor. Istraživanja koja prikazuju kvantitativne pokazatelje uspešnosti modela ukazuju da najvišu ukupnu tačnost ostvaruje Zmijewski model, posebno u kraćem vremenskom horizontu predviđanja. Begović i sar. (2020) navode da je ovaj model ostvario tačnost od 91,19% u proceni stečajnog rizika godinu dana pre stečaja, dok je tačnost dve godine pre stečaja iznosila 88,05%. Sa druge strane, Altmanov Z'' model se takođe pokazao relativno pouzdanim, pri čemu je njegova prednost u tome što ne zahteva podatke sa tržišta kapitala, zbog čega je primenljiv i na preduzeća čiji se kapital ne vrednuje na berzi.

Posebno značajan kriterijum za ocenu pouzdanosti modela odnosi se na učestalost grešaka tipa I i tipa II. Greška tipa I podrazumeva pogrešnu klasifikaciju preduzeća koja su u stečaju kao finansijski stabilnih, dok greška tipa II označava pogrešnu klasifikaciju aktivnih preduzeća kao rizičnih. U praktičnom smislu, greška tipa I ima naročito veliki značaj za poverioce, investitore i druge donosioce poslovnih odluka, jer može dovesti do potcenjivanja realnog stečajnog rizika. Sa druge strane, visoka učestalost greške tipa II može dovesti do neopravdanog označavanja finansijski stabilnih preduzeća kao rizičnih, što može negativno

uticati na njihov kreditni potencijal i poslovnu reputaciju. U tom pogledu, rezultati prethodnih istraživanja pokazuju da modeli sa nižim vrednostima obe vrste grešaka imaju veću upotrebnu vrednost u proceni stečajnog rizika.

Tabela 1. Sažet prikaz prethodnih istraživanja o proceni stečajnog rizika u Republici Srbiji

Autori	Modeli	Tačnost / greške	Glavni zaključak
<i>Muminović i sar. (2011)</i>	Altman Z, Z', Z"	Z": tačnost 68,2–77,3%; greška tipa II 4,55–9,09%	Z" model je najpouzdaniji za srpska preduzeća jer ne zahteva berzanske podatke.
<i>Mizdraković i Bokić (2016)</i>	M skor, Altman Z', Z"	M skor: tačnost 74,3%; greška tipa I 34,29%; tipa II 17,4%	M skor je pogodniji za domaće uslove, dok Altmanove modele treba kombinovati sa drugim analizama.
<i>Begović i sar. (2020)</i>	Altman Z", Zmijewski	Zmijewski: 91,19% godinu dana i 88,05% dve godine pre stečaja; Altman Z": 84,9–85,53%	Zmijewski model ostvaruje najvišu tačnost, posebno u kraćem horizontu predviđanja.
<i>Srebro i sar. (2021)</i>	Altman Z, Z', Z", Beneish M skor	M skor ukazuje na manipulacije kod 20%–44% preduzeća	Z i Z" modeli ukazuju na viši stečajni rizik, dok Z' daje povoljniju klasifikaciju.
<i>Milić i sar. (2022)</i>	Altman Z', Kraliček Quick test	Nisu prikazane opšte stope tačnosti	Mikro i mala preduzeća imaju viši rizik, najčešće zbog slabije likvidnosti i niske profitabilnosti.
<i>Jocić i sar. (2024)</i>	Altman Z', Springate, Kraliček Quick test	Nisu prikazane opšte stope tačnosti	Poljoprivredna preduzeća su rizičnija od prehrambenih, prvenstveno zbog slabijih pokazatelja likvidnosti i profitabilnosti.

Izvor: prikaz autora

Pored poređenja modela prema tačnosti klasifikacije, prethodna istraživanja ukazuju i na ponavljanje određenih finansijskih faktora koji povećavaju izloženost preduzeća stečajnom riziku. Kao najznačajniji faktori najčešće se izdvajaju niska profitabilnost, problemi sa likvidnošću, produžen period izmirenja obaveza, nepovoljne kreditne performanse i moguće manipulacije u finansijskom izveštavanju. Kod poljoprivrednih i prehrambenih preduzeća dodatno je izražena razlika prema veličini preduzeća, pri čemu su mikro i mala preduzeća češće izložena umerenom i visokom stečajnom riziku u odnosu na srednja preduzeća. Takođe, pojedina istraživanja ukazuju da prehrambena preduzeća pokazuju viši

nivo finansijske stabilnosti u poređenju sa poljoprivrednim preduzećima, pre svega zbog povoljnijih pokazatelja likvidnosti i profitabilnosti.

U celini, dosadašnja istraživanja pokazuju da ne postoji jedinstven model koji se može smatrati apsolutno superiornim u svim okolnostima. Pouzdanost modela zavisi od strukture uzorka, sektorske pripadnosti preduzeća, dostupnosti finansijskih podataka, veličine preduzeća i vremenskog horizonta predviđanja. Zbog toga se u novijim istraživanjima preporučuje kombinovanje više modela, uz dodatnu analizu ključnih finansijskih pokazatelja i sektorskih specifičnosti. Ovakav pristup je posebno značajan u analizi poljoprivrednih i prehrambenih preduzeća, kod kojih stečajni rizik ne zavisi samo od opštih finansijskih performansi, već i od specifičnosti proizvodnog ciklusa, tržišnih oscilacija i strukture poslovanja.

2 Metod rada i izвори podataka

Istraživanje je usmereno na analizu stečajnog rizika malih poljoprivrednih privrednih društava koja se bave gajenjem žita (osim pirinča), leguminoza i uljarica na području AP Vojvodine u Republici Srbiji. Mala preduzeća obuhvaćena istraživanjem razvrstana su u tu kategoriju u skladu sa kriterijumima propisanim Zakonom o računovodstvu Republike Srbije (član 6). Posmatrana delatnost se prema zvaničnoj klasifikaciji delatnosti vodi pod šifrom 0111.

U radu je sprovedena studija slučaja na uzorku od pet malih poljoprivrednih preduzeća, koja su u analizi označena kao Preduzeće A, Preduzeće B, Preduzeće C, Preduzeće D i Preduzeće E. Nazivi preduzeća nisu prikazani u radu, imajući u vidu da se analiza odnosi na osetljivu temu procene stečajnog rizika, iako su korišćeni podaci javno dostupni. Preduzeća su odabrana na osnovu nekoliko kriterijuma: pripadnosti istoj delatnosti, teritorijalne pripadnosti AP Vojvodini, razvrstavanja u kategoriju malih pravnih lica i dostupnosti kompletnih finansijskih izveštaja za posmatrani period.

Finansijski podaci neophodni za primenu modela, koji se odnose na period od 2021. do 2025. godine, preuzeti su iz javno objavljenih finansijskih izveštaja na internet stranici Agencije za privredne registre Republike Srbije (APR, 2026). Imajući u vidu veličinu i strukturu uzorka, rezultati istraživanja ne mogu se generalizovati na sva mala poljoprivredna preduzeća u AP Vojvodini, već ih treba tumačiti kao indikativne nalaze zasnovane na studiji slučaja. Dobijeni rezultati omogućavaju uvid u finansijsku stabilnost i stečajni rizik analiziranih preduzeća, kao i identifikovanje određenih obrazaca koji mogu biti korisni za buduća istraživanja na većem i reprezentativnijem uzorku.

U cilju analize verovatnoće pokretanja stečajnog postupka primenjeni su sledeća tri modela:

Jedan od prvih modela za procenu stečajnog rizika razvio je *Edward I. Altman* 1968. godine. Autor je primenom diskriminacione analize i rezultata poslovanja 66 proizvodnih preduzeća čijim se akcijama trgovalo na berzi formulisao Z skor model. Od 22 analizirana finansijska pokazatelja, Altman je u finalnu verziju modela uključio pet (Altman, 1968). S obzirom na to da model nije omogućavao procenu mogućnosti nastanka stečaja preduzeća čiji kapital nije bio predmet berzanskog vrednovanja, Altman je kasnije izvršio njegovu korekciju. Novi Z' skor model je bio namenjen oceni stečajnog rizika u proizvodnim preduzećima koja nisu bila listirana na berzi (Altman, 1983). Međutim, ova verzija nije dala zadovoljavajuće rezultate u proceni stečajnog rizika preduzeća iz uslužnog sektora, tako je autor sa saradnicima razvio nove modele. Među formulisanim modelima se nalazio i model namenjen preduzećima koja posluju na tržištima u razvoju koji će biti primenjen u ovom istraživanju. Modifikovani Altmanov Z'' model karakteriše sledeća formulacija:

$$Z'' = 3,25 + 6,56X_1 + 3,26X_2 + 6,72X_3 + 1,05X_4$$

Indikatori u diskriminacionoj funkciji računati su prema:

$Z'' = Z''$ skor;

X_1 = (obrotna imovina-kratkoročne obaveze) / ukupna imovina;

X_2 = neraspoređena dobit (ukupna) / ukupna imovina;

X_3 = bruto rezultat pre oporezivanja i kamata / ukupna imovina i

X_4 = knjigovodstvena vrednost kapitala / ukupne obaveze.

Prema korigovanim graničnim vrednostima Z'' skor modela, vrednosti iznad 5,85 ukazuju na finansijsku stabilnost, interval od 4,50 do 5,85 označava sivu zonu (umereni stečajni rizik) i vrednosti ispod 4,50 upućuju na visok stečajni rizik.

Bešlić i saradnici (2018) razvili su model za procenu stečajnog rizika u privrednim društvima u Republici Srbiji primenom logističke regresije. Empirijska analiza obuhvatila je 126 malih, srednjih i velikih proizvodnih preduzeća koja su u 2010. i 2011. poslovnoj godini bila aktivna ili su se nalazila u stečajnom postupku. U fazi kreiranja modela analizirana su 24 finansijska pokazatelja. Model je izražen sledećom formulacijom:

$$Bis = -5,167 + 3,938X_1 + 2,768X_2 + 0,927X_3 + 3,777X_4 - 5,664X_5$$

Indikatori u logističkoj funkciji računati su prema:

Bis = Bis skor;

X_1 = (obrotna imovina-kratkoročne obaveze) / ukupna imovina;

X_2 = knjigovodstvena vrednost kapitala / ukupna imovina;

X_3 = prihodi od prodaje / (obrotna imovina-kratkoročne obaveze);

X_4 = ukupni prihodi / ukupni rashodi i

X_5 = neto kretanje gotovine iz poslovnih aktivnosti / ukupna imovina.

LR model je u proseku tačno klasifikovao 88,37% preduzeća iz trening uzorka i 82,5% iz uzorka namenjenog validaciji.

Primena stepwise logističke regresije (LR) u modelu za ocenu stečajnog rizika predstavljena je u istraživanju *Kuštera (2023)*. Uzorak je obuhvatio 100 malih i srednjih preduzeća sa poslovnog područja Republike Srbije i činilo ga je 50 aktivnih i 50 stečajnih preduzeća, uz dodatno usklađivanje prema veličini, delatnosti i nivou poslovne aktivnosti. Posmatrana privredna društva bila su aktivna ili u stečajnom postupku u periodu od 2018. do 2021. godine. D model ima sledeći oblik:

$$D = -0,406 + 8,176X_1 + 16,443X_2$$

Indikatori u logističkoj funkciji računati su prema:

D – rezultat po D modelu;

X_1 = neto rezultat / ukupna imovina i

X_2 = novac i novčani ekvivalenti / obrtna imovina.

Model je prvobitno ostvario ukupnu tačnost od 79% pri čemu je ispravno klasifikovao 78% stečajnih i 80% aktivnih preduzeća. Istovremeno, greška tipa I iznosila je 20%, dok je greška tipa II iznosila 22%.

Nivo stečajnog rizika po testiranim LR modelima, posebno formulisanih za poslovno područje Republike Srbije, utvrđuje se primenom sledeće logističke regresione jednačine:

$$P_i (\text{stečaj}) = \frac{1}{1 + e^{-(Bis i D)}}$$

Gde su:

Bis i D – vrednosti dobijene po modelima;

e – prirodni logaritam (2,718281828459) i

P_i – verovatnoća stečaja.

Izračunata vrednost P_i veća od 0,5 klasifikuje preduzeće kao ugroženo odnosno sa visokim rizikom nastanka stečaja. Ukoliko je uslovna verovatnoća izračunate P_i vrednosti jednaka ili manja od 0,5, privredno društvo se ocenjuje finansijski stabilnim (bez stečajnog rizika).

3 Rezultati istraživanja i diskusija

Procena stečajnog rizika predstavlja značajan aspekt analize finansijske stabilnosti preduzeća koja posluju u sektoru gajenja žita (osim pirinča), leguminoza i uljarica. Specifičnosti poljoprivredne proizvodnje, uključujući izraženu izloženost klimatskim uslovima, oscilacijama prinosa i promenama tržišnih cena, dodatno naglašavaju potrebu za primenom pouzdanih modela za ocenu finansijske ugroženosti. Polazeći od prikupljenih podataka o poslovanju analiziranih preduzeća, u radu je najpre primenjen Altmanov Z" skor model (tabela 2).

Tabela 2. Ocena stečajnog rizika primenom Altmanovog Z" skora

<i>Preduzeće</i>	<i>Vrednosti Z" skora</i>				
	<i>2021</i>	<i>2022</i>	<i>2023</i>	<i>2024</i>	<i>2025</i>
<i>A</i>	7,39*	8,67*	10,54*	8,41*	6,12*
<i>B</i>	3,27***	1,97***	1,97***	2,90***	2,81***
<i>C</i>	7,79*	7,52*	7,07*	6,58*	6,85*
<i>D</i>	8,85*	8,93*	7,38*	6,73*	6,98*
<i>E</i>	3,34***	5,02**	5,56**	5,69**	6,37*

*Legenda: *** - visoko ugrožena stečajna zona; ** - zona umerenog stečajnog rizika; * - stabilna zona*

Izvor: obračun autora

Rezultati analize primenom Altmanovog EMS skora ukazuju na izraženu diferencijaciju finansijskog položaja posmatranih preduzeća u periodu od 2021. do 2025. godine. Privredna društva A, C i D bila su tokom celog perioda svrstana u stabilnu zonu poslovanja (bez stečajnog rizika). Vrednosti primenjenog modela koje se odnose na preduzeće B ukazale su na izražen stečajni rizik u analiziranom vremenskom periodu. Nasuprot tome, privredno društvo E je zabeležilo poboljšanje finansijske stabilnosti sa prelaskom iz visoko rizične u zonu umerenog rizika iniciranja stečajnog postupka.

Procena stečajnog rizika u poljoprivrednim preduzećima specijalizovanim za gajenje žitarica (osim pirinča), leguminoza i uljarica, izvršena primenom Bis modela, prikazana je u tabeli 3.

Evaluacija stečajnog rizika primenom Bis skora pokazala je da su preduzeća A, C i D tokom posmatranog perioda od 2021. do 2025. godine bila svrstana u stabilnu zonu poslovanja, s obzirom na to da kod njih nije identifikovana nijedna godina sa izraženim stečajnim rizikom. Za razliku od njih, kod privrednog društva B uočeno je pogoršanje finansijske pozicije, budući da je nakon stabilne 2021. godine, od 2022. do 2025. godine kontinuirano prisutna visoko ugrožena stečajna

zona. Sa druge strane, preduzeće E pokazuje suprotan trend jer je izražen stečajni rizik bio prisutan samo u 2021. godini, dok je u preostalim godinama zabeležena finansijska stabilnost. Ovi nalazi ukazuju na heterogenost finansijskog položaja posmatranih preduzeća pri čemu se izdvajaju privredna društva sa stabilnim poslovanjem (bez stečajnog rizika) ali i ona kod kojih su prisutne izražene promene finansijske stabilnosti.

Tabela 3. Ocena stečajnog rizika primenom Bis skora

<i>Preduzeće</i>	<i>Vrednosti Bis skora</i>				
	2021	2022	2023	2024	2025
<i>A</i>	0,99	0,99	0,99	0,99	0,99
<i>B</i>	0,99	0,01*	0,01*	0,01*	0,01*
<i>C</i>	0,99	0,99	0,99	0,99	0,99
<i>D</i>	0,99	0,99	0,99	0,99	0,99
<i>E</i>	0,01*	0,99	0,99	0,99	0,99

*Legenda: * - visok stečajni rizik*

Izvor: obračun autora

Primena D modela u evaluaciji stečajnog rizika u poljoprivrednim preduzećima, prikazana je u tabeli 4.

Tabela 4. Ocena stečajnog rizika primenom D skora

<i>Preduzeće</i>	<i>Vrednosti D skora</i>				
	2021	2022	2023	2024	2025
<i>A</i>	0,45	0,43	0,40	0,23	0,43
<i>B</i>	0,19	0,13	0,27	0,42	0,41
<i>C</i>	0,76*	0,64*	0,05	0,49	0,66*
<i>D</i>	0,89*	0,83*	0,42	0,42	0,43
<i>E</i>	0,86*	0,59*	0,94*	0,60*	0,63*

*Legenda: * - visok stečajni rizik*

Izvor: obračun autora

Privredna društva A i B su u periodu od 2021. do 2025. godine bila svrstana u stabilnu zonu poslovanja. Vrednosti pokazatelja kretale su se od 0,23 do 0,45 što ukazuje na odsustvo stečajnog rizika u svim posmatranim godinama. Preduzeće C je u 2021. i 2022. godini bilo svrstano u visoko ugroženu stečajnu zonu. U 2023. i 2024. godini dolazi do poboljšanja sa vrednostima modela koje upućuju na privremenu finansijsku stabilizaciju. U posmatranom preduzeću je u 2025. godini ponovo evidentiran rizik pokretanja stečajnog postupka. Privredno društvo D je pokazalo visok stečajni rizik u prve dve godine posmatranja, a u ostalim godinama su vrednosti implementiranog modela ukazale na poboljšanje finansijskog

položaja i prelazak u stabilnije zone poslovanja. Preduzeće E je tokom analiziranog vremenskog perioda bilo izloženo visokom stečajnom riziku.

Na osnovu prikazanih rezultata može se konstatovati da procena stečajnog rizika u posmatranim preduzećima ne daje potpuno jedinstvenu ocenu finansijske stabilnosti. Rezultati su uputili na razlike u evaluaciji rizika nastanka stečaja u privrednim društvima u zavisnosti od primenjenog modela. Ako se rezultati posmatraju komparativno, preduzeća A i D se u najvećoj meri izdvajaju kao finansijski najstabilnija jer kod njih većina modela ukazuje na odsustvo stečajnog rizika. Privredno društvo C je takođe bilo bez stečajnog rizika ali D model pokazuje da njegova stabilnost nije bila konstantna. Preduzeće B je ocenjeno kao preduzeće koje će najverovatnije inicirati stečajni postupak prema rezultatima modela EMS i BIS. Rezultati D modela su uputili na nešto bolje ocene. Značajne oscilacije finansijske stabilnosti zabeležene su kod privrednog društva E gde su EMS i BIS modeli uputili na oporavak, za razliku od D modela koji ga je i dalje svrstao u zonu visokog stečajnog rizika. Razlike između modela mogu se objasniti činjenicom da svaki od njih koristi različite finansijske pokazatelje i različite statističke tehnike. Zbog toga nije neuobičajeno da jedno isto preduzeće bude ocenjeno kao stabilno u jednom, a rizično u drugom modelu. U konkretnom slučaju, to je posebno vidljivo kod privrednih društava B i E, gde se rezultati modela ne poklapaju u potpunosti. Takvo odstupanje ne umanjuje vrednost analize već ukazuje da je za pouzdaniju ocenu stečajnog rizika poželjno koristiti više modela istovremeno. Navedeni rezultati su u najvećoj meri konzistentni sa nalazima prethodnih istraživanja, posebno istraživanjima Jakovčevića i saradnika (2012), Vlaović Begović i saradnika (2014), Srebro i saradnika (2021), Milića i saradnika (2022) i Jocića i saradnika (2024), koja takođe ukazuju na značaj primene modela za procenu stečajnog rizika i postojanje određenog rizika iniciranja stečaja u poljoprivrednim preduzećima. Sličnosti i razlike u rezultatima primenjenih modela mogu se objasniti njihovom metodološkom osnovom. Svaki od modela koristi različitu kombinaciju finansijskih pokazatelja i na različit način vrednuje njihov doprinos proceni stečajnog rizika. To znači da pojedini modeli mogu biti osetljiviji na probleme likvidnosti, drugi na nivo zaduženosti, a treći na sposobnost ostvarivanja dobiti i efikasnost poslovanja. Upravo zato nije neočekivano da se kod istog preduzeća dobiju delimično različite ocene. U ovom istraživanju podudarnost nalaza kod pojedinih društava može se tumačiti kao potvrda jasnije izraženog finansijskog obrasca, dok različito ocenjen stečajni rizik kod drugih društava ukazuje na složeniju strukturu njihove finansijske pozicije. Na taj način, razlike među modelima ne predstavljaju slabost istraživanja, već naprotiv, doprinose potpunijem razumevanju višedimenzionalne prirode stečajnog rizika. Dobijeni nalazi imaju i širi značaj jer potvrđuju da procena stečajnog rizika u poljoprivrednim preduzećima zahteva oprez u interpretaciji rezultata. U sektoru poljoprivrede finansijski pokazatelji često odražavaju posledice faktora koji nisu direktno sadržani u bilansnim pozicijama, kao što su

oscilacije prinosa, sezonalnost proizvodnje, zavisnost od vremenskih uslova i cenovne nestabilnosti na tržištu. To znači da i kada finansijski modeli pruže korisnu sliku ugroženosti, oni ne obuhvataju u potpunosti sve determinante koje oblikuju verovatnoću nastanka stečaja. Upravo u tome se ogleda važnost ovog istraživanja: ono pokazuje da kvantitativni modeli imaju značajnu upotrebnu vrednost, ali i da njihovu interpretaciju treba uvek povezati sa sektorskim karakteristikama i specifičnostima poslovnog okruženja. Nalazi ovog istraživanja u velikoj meri su saglasni sa prethodnim studijama koje ukazuju na korisnost modela za rano prepoznavanje finansijskih poteškoća u poljoprivrednim privrednim društvima. Međutim, važnost podudarnosti sa ranijim istraživanjima ne iscrpljuje se samo u potvrdi da su modeli primenljivi, već i u tome što sugerise postojanje relativno stabilnih obrazaca finansijske ranjivosti u uslovima sličnog institucionalnog i sektorskog okruženja. Drugim rečima, slični rezultati mogu proisticati iz činjenice da se poljoprivredna preduzeća suočavaju sa uporedivim ograničenjima u pogledu tržišne neizvesnosti, finansiranja i izloženosti eksternim šokovima. Time se dobijeni nalazi ne svode samo na deskriptivnu potvrdu ranijih istraživanja, već doprinose boljem razumevanju zašto se stečajni rizik u ovom sektoru ispoljava na specifičan način.

4 Zaključak

Rezultati sprovedene empirijske analize ukazali su na postojanje izražene heterogenosti u nivou stečajnog rizika među analiziranim privrednim društvima iz sektora gajenja žita (osim pirinča), leguminoza i uljarica u periodu od 2021. do 2025. godine. Prednost ove empirijske analize ogleda se u istovremenoj primeni više modela za procenu stečajnog rizika, čime je omogućena komparativna ocena finansijske ugroženosti posmatranih preduzeća. Dodatna vrednost istraživanja proizlazi iz činjenice da je analiza sprovedena nad privrednim društvima iz poljoprivrednog sektora koji je specifičan zbog izražene izloženosti tržišnim, proizvodnim i klimatskim rizicima. Na taj način, dobijeni rezultati imaju poseban značaj za razumevanje finansijske stabilnosti preduzeća u sektorski specifičnim uslovima poslovanja. Istovremeno, određena ograničenja istraživanja treba imati u vidu prilikom interpretacije rezultata. Najpre, analiza je obuhvatila relativno mali broj preduzeća što ograničava mogućnost šire generalizacije nalaza. Pored toga, korišćeni modeli su zasnovani isključivo na finansijskim pokazateljima, pa ne obuhvataju kvalitativne determinante poslovanja, kao što su kvalitet upravljanja, tržišna pozicija, institucionalno okruženje, klimatski uticaji i drugi sektorski faktori koji mogu uticati na verovatnoću nastanka stečaja. Pravci budućih istraživanja trebalo bi da budu usmereni ka proširenju uzorka na veći broj poljoprivrednih preduzeća, kao i na uključivanje dužeg vremenskog perioda posmatranja. Korisno bi bilo i uključivanje dodatnih modela za procenu stečajnog rizika, kao i primena savremenih statističkih metoda. Poseban doprinos budućim istraživanjima moglo bi dati uključivanje kvalitativnih i sektorski specifičnih

pokazatelja, čime bi se obezbedilo sveobuhvatnije sagledavanje uzroka finansijske nestabilnosti i unapredila pouzdanost procene stečajnog rizika u poljoprivredi. U celini posmatrano, istraživanje potvrđuje da je stečajni rizik u analiziranim preduzećima neujednačen i da postoje značajne razlike u njihovoj finansijskoj stabilnosti. Dobijeni rezultati ukazuju na opravdanost primene više modela istovremeno, budući da se tek njihovim kombinovanjem može dobiti realističnija i analitički pouzdanija ocena stečajnog rizika u posmatranim privrednim društvima. Ovakav pristup može predstavljati korisnu osnovu za blagovremeno prepoznavanje finansijskih poteškoća i donošenje odgovarajućih upravljačkih i poslovnih odluka u cilju očuvanja održivosti poslovanja.

Zahvalnica

Sredstva za realizaciju istraživanja obezbeđena su od strane Ministarstva nauke, tehnološkog razvoja i inovacija prema ugovorima: 451-03-34/2026-03/200117 i 451-03-33/2026-03/200117 od 05.02.2026. godine.

Sukob interesa

Autori izjavljaju da ne postoji sukob interesa.

6 Literatura

1. Agencija za privredne registre (APR), (2026). Finansijski izveštaji analiziranih preduzeća, dostupno na <https://fin.apr.gov.rs/JavnaPretraga> (pristupljeno 09.04.2026).
2. Agencija za privredne registre (APR), (2023). Podaci o broju poljoprivrednih preduzeća na području AP Vojvodine dobijeni na upit.
3. Altman, E. I. (1983). Corporate financial distress a complete guide to predicting, avoiding, and dealing with bankruptcy. *Wiley Interscience, John Wiley and Sons*, ISBN: 0-471-08707-6.
4. Altman, E. I. (1968). Financial ratios, discriminant analysis and the prediction of corporate bankruptcy. *The Journal of Finance*, 23(4), 589-609, ISSN: 0022-1082, <https://doi.org/10.1111/j.1540-6261.1968.tb00843.x>.
5. Altman, E. I., Hartzell, J., & Peck, M. (1995). A scoring system for emerging market corporate bonds. *Salomon Brothers High Yield Research*.
6. Begović, S. V., Bonić, L., & Jovin, S. (2020). A comparison of the bankruptcy prediction models on a sample of Serbian companies. *Theme*, 503-518, ISSN: 0353-7919, <https://doi.org/10.22190/TEME180619036V>.
7. Bešlić Obradović, D., Jakšić, D., Bešlić Rupiće, I., & Andrić, M. (2018). Insolvency prediction model of the company: the case of the Republic of

- Serbia. *Economic research*, 31(1), 139-157. ISSN: 1331-677X, <https://doi.org/10.1080/1331677X.2017.1421990>.
8. Boratynska, K., & Grzegorzewska, E. (2018). Bankruptcy prediction in the agribusiness sector: Lessons from quantitative and qualitative approaches. *Journal of Business Research*, 89, 175–181, ISSN: 0148-2963, <https://doi.org/10.1016/j.jbusres.2018.01.028>.
 9. Céu, M.S., & Medeiros Gaspar, R. (2022). Vegetative cycle and bankruptcy predictors of agricultural firms. *Agricultural Economics*, 68(12), 445-454, ISSN: 0139-570X, <https://doi.org/10.17221/206/2022-AGRICECON>.
 10. Jakovčević, K., & Andrašić, J. (2012). Diagnosis of operating business of agricultural-industrial companies in the Republic of Serbia. *African Journal of Business Management*, 6(38), 10253, ISSN: 1993-8233.
 11. Jakšić, D., Mijić, K., Zekić, S., Poljašević, J. (2015). Comparative profitability analysis of milk production companies to milk processing companies in Serbia. *Custos e @gronegocio on line*, 11(3), 206-226, ISSN: 1808-2882.
 12. Jocić, B., Milić, D., Zekić, V., Novaković, D., Novaković, T., & Ilić, Z. (2024). Analysis of the possibility of bankruptcy in medium-sized agribusiness companies in AP Vojvodina. *Economics of Agriculture*, 71(2), 469-484, ISSN: 0352-3462, <https://doi.org/10.59267/ekoPolj2402469J>.
 13. Klepac, V., & Hampel, D. (2017). Predicting financial distress of agriculture companies in EU. *Agricultural Economics*, 63(8), 347-355, <https://doi.org/10.17221/374/2015-AGRICECON>
 14. Kušter, D. (2023). Efficiency of working capital & assets management in the function of SMEs bankruptcy prediction. *Management: Journal of Sustainable Business and Management Solutions in Emerging Economies*, 28(3), 57-69, ISSN: 1820-0222, <https://doi.org/10.7595/management.fon.2023.0007>.
 15. Milić, D., Jocić, B., Novaković, D., Zekić, V. & Novaković, T. (2025). Analiza bankrotstva mikro preduzeća iz industrije ulja i masti u Republici Srbiji. *Agroekonomika/Agrieconomica*, 54(107), 59-68, ISSN: 0350-5928.
 16. Milić, D., Jocić, B., Novaković, D., Zekić, V., Novaković, T., Radišić, M., & Radišić, M. (2025). Evaluating the effectiveness of the models for assessing the initiation of bankruptcy proceedings. *Economic of Agriculture*, 72(3), 1073–1087, ISSN: 0352-3462, <https://doi.org/10.59267/ekoPolj25031073M>.
 17. Milić, D., Tekić, D., Novaković, T., Zekić, V., Popov, M., & Mihajlov, Z. (2022). Credit rating of agricultural and food companies in Vojvodina.

Contemporary Agriculture, 71(1-2), 51-56, ISSN: 0350-1205, <https://doi.org/10.2478/contagri-2022-0008>.

18. Mizdraković, V., & Bokić, M. (2016). Reassessment of corporate bankruptcy prediction models efficiency: evidence from Serbia. *TEME: Časopis za Društvene Nauke*, 40(4), ISSN: 0353-7919.
19. Muminović, S., Pavlović, V., & Cvijanović, J. M. (2011). Predictive ability of various bankruptcy prediction Z-score models for Serbian publicly listed companies. *Industrija*, 39(3), 1-12, ISSN: 0350-0373.
20. Republički zavod za statistiku, 2023a Popis poljoprivrede: broj gazdinstva i površina pod različitim usevima i kategorijama, dostupno na: <https://data.stat.gov.rs/Home/Result/1300021101?languageCode=sr-Cyrl&displayMode=table> (pristupljeno 10.05.2026).
21. Republički zavod za statistiku, 2023b Popis poljoprivrede: korišćeno poljoprivredno zemljište gazdinstva po kategorijama, dostupno na: https://popispoljoprivrede.stat.gov.rs/media/31119/tabela-21_cir.xlsx (pristupljeno 05.05.2026).
22. Zakon o računovodstvu („Službeni glasnik RS“, br. 73/2019 i 44/2021).
23. Qu, Y., Quan, P., Lei, M., & Shi, Y. (2019). Review of bankruptcy prediction using machine learning and deep learning techniques. *Procedia Computer Science*, 162, 895–899, ISSN: 1877-0509, <https://doi.org/10.1016/j.procs.2019.12.065>

BANKRUPTCY RISK IN SMALL AGRICULTURAL ENTERPRISES IN THE AUTONOMOUS PROVINCE OF VOJVODINA: CASE STUDY

Milić Dragan¹, Jocić Bogdan², Novaković Dragana³, Novaković Tihomir⁴

Abstract

In the context of pronounced market instability, fluctuations in input prices, climate-related disturbances, and general economic uncertainty, the assessment of bankruptcy risk has become particularly important, especially in the agricultural sector. The subject of this research are small agricultural enterprises located in the Autonomous Province of Vojvodina, Republic of Serbia, engaged in the growing of cereals (except rice), leguminous crops, and oilseeds during the period from 2021 to 2025. The aim of the research is to evaluate the bankruptcy risk of the observed companies by applying Altman's Z" score, as well as the models developed in the studies of Dragana Bešlić et al. and Denis Kušter. The data required for the implementation of these models were obtained from publicly available financial statements published by the Serbian Business Registers Agency. The research results indicate that the observed companies do not demonstrate the same level of financial stability, as certain companies showed signs of increased bankruptcy risk, while others maintained a more stable business position throughout the analyzed period.

Keywords: bankruptcy, agriculture, insolvency, Altman EMS score

¹ Milić Dragan, PhD, Full Professor, University of Novi Sad, Faculty of Agriculture, Trg Dositeja Obradovića 8, 21000 Novi Sad, Republic of Serbia, e-mail: dragan.milic@polj.edu.rs, ORCID ID: <https://orcid.org/0000-0003-0377-1540>.

² Jocić Bogdan, Msc, Corresponding author, Research Assistant, University of Novi Sad, Faculty of Agriculture, Trg Dositeja Obradovića 8, 21000 Novi Sad, Republic of Serbia, e-mail: bogdan.jocic@polj.edu.rs, ORCID ID: <https://orcid.org/0000-0002-1745-3255>.

³ Novaković Dragana, PhD, Assistant Professor, University of Novi Sad, Faculty of Agriculture, Trg Dositeja Obradovića 8, 21000 Novi Sad, Republic of Serbia, e-mail: dragana.tekic@polj.uns.ac.rs, ORCID ID: <https://orcid.org/0000-0002-1924-6196>.

⁴ Novaković Tihomir, PhD, Assistant Professor, University of Novi Sad, Faculty of Agriculture, Trg Dositeja Obradovića 8, 21000 Novi Sad, Republic of Serbia, e-mail: tihomir.novakovic@polj.uns.ac.rs, ORCID ID: <https://orcid.org/0000-0002-8405-3403>.

1

Introduction

In a dynamic business environment, maintaining the financial stability of companies represents one of the key issues in economic analysis, particularly under conditions of pronounced market uncertainty, rising input costs, changes in interest rates, and disruptions in supply chains. Milić et al. (2025) emphasize that the timely adoption of business decisions aimed at preventing business disruption must be based on a thorough analysis of the relevant influencing factors. This issue is of particular importance in the agricultural sector, given that the operations of agricultural enterprises, in addition to being exposed to the usual market and financial risks, are also strongly influenced by climatic factors, biological production cycles, and yield fluctuations. As a result, their financial position is additionally exposed to heightened sensitivity and fluctuations (Céu et al., 2022). The timely identification of financial difficulties and the assessment of the probability of bankruptcy are of considerable importance, as they are relevant not only to business owners and management, but also to creditors, investors, the state, and other relevant participants in the broader economic context (Qu et al., 2019). Bankruptcy risk assessment models, which are based on accounting and financial indicators, play an important role in identifying early signs of deteriorating business performance, thereby enabling the timely implementation of appropriate corrective measures. Altman's model, based on the use of discriminant analysis (Altman, 1968), is most commonly regarded in the literature as the starting point for the development of bankruptcy prediction models. Subsequent research has been directed toward improving classification accuracy through the application of more advanced statistical techniques. Although the field of bankruptcy prediction has progressed methodologically, numerous studies indicate that there is no universal model that demonstrates equal effectiveness across all sectors, countries, and institutional governance. The accuracy of the assessment depends on the sample structure, company size, industry, the quality of financial reporting, and the specific features of the national economies, which is why empirical studies emphasize the need for sector-specific and regional validation of the applied models (Mizdraković & Bokić, 2016; Begović et al., 2020; Milić et al., 2025). This is particularly important in agriculture, where standard models, developed primarily on samples of industrial enterprises, may not fully capture the specific characteristics of agribusiness companies (Boratynska et al., 2018; Klepáč & Hampel, 2017). Agricultural production has traditionally held an important place in the economic structure of the Republic of Serbia, owing to favorable agroecological conditions as well as the historical and developmental determinants that have shaped it (Jakšić et al., 2015). According to data from the Statistical Office of the Republic of Serbia, around 38% of the total agricultural land used in the country is located in the Autonomous Province of Vojvodina (SORS, 2023b). Cereals account for approximately 67% of the sowing structure in the Republic of Serbia (SORS, 2023a). Within Sector A – Agriculture in the Autonomous Province of Vojvodina, micro and small enterprises

were the predominant type of business entity in 2023, accounting for approximately 95% of the total (SBRA, 2023).

Based on the above, the subject of this study comprises small agricultural enterprises in the Autonomous Province of Vojvodina registered for the cultivation of cereals (excluding rice), legumes, and oilseeds. The aim of the research is to conduct an empirical analysis of bankruptcy risk based on publicly available financial statements and through the application of several models. The research seeks to contribute to the literature on sector-specific bankruptcy risk assessment while also providing practically relevant insights into the degree of financial vulnerability of small agricultural enterprises in one of the most important agricultural region of the Republic of Serbia.

1.1. Literature Review

For the purpose of providing a theoretical and empirical foundation for the research, the relevant literature on bankruptcy risk assessment in the Republic of Serbia can be systematized according to several criteria: the applied assessment model, the percentage of classification accuracy, the frequency of Type I and Type II errors, the forecasting time horizon, as well as the most commonly identified factors contributing to increased bankruptcy risk. Such an approach (presented in Table 1) enables a clearer understanding of the advantages and limitations of individual models, while also facilitating the identification of the most reliable methodological solutions for the analysis of bankruptcy risk in the Serbian business environment.

Based on the presented studies, it can be observed that the domestic literature most commonly applies Altman's models, particularly Z' and Z'' , while more recent studies increasingly employ alternative approaches such as the Zmijewski model, the Kraliček Quick Test, the Springate model, and the Beneish M-score. Research reporting quantitative indicators of model performance suggests that the Zmijewski model achieves the highest overall accuracy, especially over a shorter forecasting horizon. Begović et al. (2020) report that this model achieved an accuracy of 91.19% in assessing bankruptcy risk one year prior to bankruptcy, while its accuracy two years prior to bankruptcy amounted to 88.05%. On the other hand, Altman's Z'' model has also proven to be relatively reliable, with the additional advantage that it does not require capital market data, which makes it applicable to enterprises whose equity is not publicly traded. A particularly important criterion for assessing model reliability concerns the frequency of Type I and Type II errors. A Type I error refers to the incorrect classification of bankrupt enterprises as financially stable, whereas a Type II error denotes the incorrect classification of active enterprises as risky.

Table 1. Summary of previous research on bankruptcy risk assessment in the Republic of Serbia

Authors	Models	Accuracy / Errors	Main conclusion
<i>Muminović et al. (2011)</i>	Altman Z, Z', Z"	Z": accuracy 68.2–77.3%; Type II error 4.55–9.09%	The Z" model is the most reliable for Serbian enterprises because it does not require stock market data.
<i>Mizdraković and Bokić (2016)</i>	M score, Altman Z', Z"	M score: accuracy 74.3%; Type I error 34.29%, Type II error 17.4%	The M score is more suitable for domestic conditions, while Altman's models should be combined with other analyses.
<i>Begović et al. (2020)</i>	Altman Z", Zmijewski	Zmijewski: 91.19% one year and 88.05% two years prior to bankruptcy; Altman Z": 84.9% - 85.53%	The Zmijewski model achieves the highest accuracy, particularly over a shorter forecasting horizon.
<i>Srebro et al. (2021)</i>	Altman Z, Z', Z", Beneish M score	M score indicates manipulation in 20% - 44% of enterprises	The Z and Z" models indicate higher bankruptcy risk, whereas Z' provides a more favorable classification.
<i>Milić et al. (2022)</i>	Altman Z', Kraliček Quick test	General accuracy rates were not reported	Micro and small enterprises exhibit higher risk, most commonly due to weaker liquidity and low profitability.
<i>Jocić et al. (2024)</i>	Altman Z', Springate, Kraliček Quick test	General accuracy rates were not reported	Agricultural enterprises are riskier than food industry enterprises, primarily due to weaker liquidity and profitability indicators.

Source: Authors' presentation.

In practical terms, a Type I error is of particular importance for creditors, investors, and other business decision-makers, as it may lead to an underestimation of actual bankruptcy risk. Conversely, a high frequency of Type II errors may result in the unjustified labeling of financially stable enterprises as risky, which may adversely affect their credit potential and business reputation. In this regard, the findings of previous studies indicate that models with lower values of both types of errors have greater practical utility in bankruptcy risk assessment. In addition to comparing models according to classification accuracy, previous studies also

point to the recurrence of certain financial factors that increase enterprises' exposure to bankruptcy risk. The most significant factors most frequently identified include low profitability, liquidity problems, extended liabilities settlement periods, unfavorable credit performance, and possible manipulation in financial reporting. In agricultural and food enterprises, differences according to firm size are also particularly pronounced, with micro and small enterprises being more frequently exposed to moderate and high bankruptcy risk than medium-sized enterprises. Furthermore, some studies indicate that food enterprises exhibit a higher level of financial stability than agricultural enterprises, primarily due to more favorable liquidity and profitability indicators. Overall, previous research demonstrates that there is no single model that can be regarded as absolutely superior under all circumstances. Model reliability depends on the structure of the sample, the sector to which the enterprises belong, the availability of financial data, firm size, and the forecasting horizon. Therefore, more recent studies recommend combining multiple models, along with additional analysis of key financial indicators and sector-specific characteristics. Such an approach is particularly important in the analysis of agricultural and food enterprises, where bankruptcy risk depends not only on general financial performance, but also on the specific features of the production cycle, market fluctuations, and the structure of business operations.

2 Methods and materials

The research is focused on the analysis of bankruptcy risk in small agricultural enterprises engaged in the cultivation of cereals (except rice), leguminous crops, and oilseeds in the territory of the Autonomous Province of Vojvodina in the Republic of Serbia. The small enterprises included in the study were classified into this category in accordance with the criteria prescribed by the Accounting Law of the Republic of Serbia (Article 6). According to the official classification of economic activities, the observed activity is registered under code 0111.

The study employed a case study approach based on a sample of five small agricultural enterprises, which were designated in the analysis as Enterprise A, Enterprise B, Enterprise C, Enterprise D, and Enterprise E. The names of the enterprises were not disclosed in the paper, given that the analysis concerns the sensitive issue of bankruptcy risk assessment, although the data used were publicly available. The enterprises were selected on the basis of several criteria: belonging to the same line of business, location within the Autonomous Province of Vojvodina, classification as small legal entities, and the availability of complete financial statements for the observed period.

The financial data required for the application of the models, covering the period from 2021 to 2025, were obtained from publicly available financial statements published on the website of the Serbian Business Registers Agency

(SBRA, 2026). Given the size and structure of the sample, the research findings cannot be generalized to all small agricultural enterprises in the Autonomous Province of Vojvodina; rather, they should be interpreted as indicative findings based on a case study. The obtained results provide insight into the financial stability and bankruptcy risk of the analyzed enterprises, as well as into the identification of certain patterns that may be useful for future research based on a larger and more representative sample.

For the purpose of analyzing the probability of initiating bankruptcy proceedings, the following models were applied:

One of the earliest models for assessing bankruptcy risk was developed by *Edward I. Altman* in 1968. By applying discriminant analysis to the financial performance data of 66 manufacturing companies whose shares were publicly traded, Altman formulated the Z score model. Out of 22 financial ratios analyzed, Altman included five in the final version of the model (Altman, 1968). Since the model did not allow for the assessment of bankruptcy risk in companies whose capital was not publicly traded, Altman later revised it. The new Z' score model was intended for evaluating bankruptcy risk in manufacturing companies that were not listed on the stock exchange (Altman, 1983). However, this version did not demonstrate satisfactory performance in assessing the bankruptcy risk of service-sector enterprises, which led Altman and his collaborators to develop additional models. Among these was a model designed for companies operating in emerging markets, which is applied in this research. The modified Altman Z'' score model is defined by the following formula:

$$Z'' = 3.25 + 6.56X_1 + 3.26X_2 + 6.72X_3 + 1.05X_4$$

The variables included in the discriminant function were calculated as follows:

Z'' = Z'' score;

X_1 = (current assets - current liabilities) / total assets;

X_2 = retained earnings / total assets;

X_3 = earnings before interest and taxes / total assets and

X_4 = book value of equity / total liabilities.

According to the revised cutoff values of the Z'' score model, values above 5.85 indicate financial stability, the interval from 4.50 to 5.85 denotes the gray zone (moderate bankruptcy risk), and values below 4.50 point to high bankruptcy risk.

Bešlić et al. (2018) developed a model for assessing bankruptcy risk in companies in the Republic of Serbia by applying logistic regression. The empirical analysis included 126 small, medium-sized, and large manufacturing enterprises that were either active or undergoing bankruptcy proceedings in the 2010 and 2011

business years. During the model development phase, 24 financial indicators were analyzed. The model is expressed by the following formula:

$$Bis = -5.167 + 3.938X_1 + 2.768X_2 + 0.927X_3 + 3.777X_4 - 5.664X_5$$

The indicators in the logistic regression function were calculated as follows:

Bis = Bis score;

X_1 = (current assets - current liabilities) / total assets;

X_2 = book value of equity / total assets;

X_3 = sales revenue / (current assets - current liabilities);

X_4 = total revenues / total expenses and

X_5 = net cash flow from operating activities / total assets.

The LR model correctly classified, on average, 88.37% of the enterprises in the training sample and 82.5% of those in the validation sample.

The application of stepwise logistic regression (LR) in a model for assessing bankruptcy risk was presented in the study by *Kušter* (2023). The sample consisted of 100 small and medium-sized enterprises from the Republic of Serbia, including 50 active firms and 50 bankrupt firms, with additional matching by size, industry, and level of business activity. The observed companies were either active or undergoing bankruptcy proceedings during the period from 2018 to 2021. The D model takes the following form:

$$D = -0.406 + 8.176X_1 + 16.443X_2$$

The indicators in the logistic regression function were calculated as follows:

D – D score;

X_1 = net income / total assets and

X_2 = cash and cash equivalents / current assets.

The model initially achieved an overall accuracy of 79%, correctly classifying 78% of bankrupt firms and 80% of active enterprises. At the same time, the Type I error rate amounted to 20%, while the Type II error rate was 22%.

The level of bankruptcy risk according to the tested LR models, specifically formulated for the economy of the Republic of Serbia, is determined by applying the following logistic regression equation:

$$P_i (\text{bankruptcy}) = \frac{1}{1 + e^{-(Bis \text{ and } D)}}$$

Where are:

Bis and D – scores obtained by models;

e – natural logarithm (2,718281828459) and

P_i – probability of bankruptcy.

A calculated P_i value less than 0.5 classifies the enterprise as distressed, i.e. as having a high risk of bankruptcy. If the conditional probability represented by the calculated P_i value is equal to or greater than 0.5, the enterprise is considered financially stable, with no bankruptcy risk.

3 Results and discussion

The assessment of bankruptcy risk represents an important aspect of analyzing the financial stability of enterprises operating in the cultivation of cereals (excluding rice), legumes, and oilseeds. The specific features of agricultural production, including pronounced exposure to climatic conditions, yield fluctuations, and changes in market prices, further emphasize the need to apply reliable models for evaluating financial distress. Based on the collected financial data of the analyzed enterprises, the study demonstrates the Altman's Z" score results (Table 2).

Table 2. Assessment of bankruptcy risk using Altman's Z" score

Company	Values of Z" score				
	2021	2022	2023	2024	2025
A	7.39*	8.67*	10.54*	8.41*	6.12*
B	3.27***	1.97***	1.97***	2.90***	2.81***
C	7.79*	7.52*	7.07*	6.58*	6.85*
D	8.85*	8.93*	7.38*	6.73*	6.98*
E	3.34***	5.02**	5.56**	5.69**	6.37*

Legend: *** - highly distressed bankruptcy zone; ** - moderate bankruptcy risk zone; * - without bankruptcy risk

Source: Author's calculation

The results of the analysis using Altman's EMS score indicate a pronounced differentiation in the financial position of the observed enterprises during the period from 2021 to 2025. Enterprises A, C, and D were classified throughout the entire period within the stable business zone, indicating no bankruptcy risk. The model values calculated for enterprise B pointed to a pronounced bankruptcy risk over the analyzed period. In contrast, enterprise E recorded an improvement in financial stability, moving from a high-risk zone to a zone of moderate risk of initiating bankruptcy proceedings.

The assessment of bankruptcy risk in agricultural enterprises specialized in the cultivation of cereals (excluding rice), legumes, and oilseeds, performed using the BIS model, is presented in Table 3.

Table 3. Assessment of bankruptcy risk using the BIS score

<i>Company</i>	<i>Values of Bis score</i>				
	<i>2021</i>	<i>2022</i>	<i>2023</i>	<i>2024</i>	<i>2025</i>
<i>A</i>	0.99	0.99	0.99	0.99	0.99
<i>B</i>	0.99	0.01*	0.01*	0.01*	0.01*
<i>C</i>	0.99	0.99	0.99	0.99	0.99
<i>D</i>	0.99	0.99	0.99	0.99	0.99
<i>E</i>	0.01*	0.99	0.99	0.99	0.99

*Legend: * - highly distressed bankruptcy zone*

Source: Author's calculation.

The evaluation of bankruptcy risk using the BIS score showed that enterprises A, C, and D were classified within the stable business zone throughout the observed period from 2021 to 2025, since no year with pronounced bankruptcy risk was identified for them. In contrast, enterprise B exhibited a deterioration in its financial position, as after a stable year in 2021, a highly distressed bankruptcy zone was continuously present from 2022 to 2025. On the other hand, enterprise E displayed the opposite trend, because pronounced bankruptcy risk was present only in 2021, while financial stability was recorded in the remaining years. These findings point to the heterogeneity of the financial positions of the observed enterprises, highlighting both companies with stable operations and no bankruptcy risk, as well as those showing marked changes in financial stability.

The application of the D model in the evaluation of bankruptcy risk in agricultural enterprises is presented in Table 4.

Table 4. Assessment of bankruptcy risk using the D score

<i>Company</i>	<i>Values of D score</i>				
	<i>2021</i>	<i>2022</i>	<i>2023</i>	<i>2024</i>	<i>2025</i>
<i>A</i>	0.45*	0.43*	0.40*	0.23*	0.43*
<i>B</i>	0.19*	0.13*	0.27*	0.42*	0.41*
<i>C</i>	0.76	0.64	0.05*	0.49*	0.66
<i>D</i>	0.89	0.83	0.42*	0.42*	0.43*
<i>E</i>	0.86	0.59	0.94	0.60	0.63

*Legend: * - highly distressed bankruptcy zone*

Source: Author's elaboration.

Enterprises A and B were classified within the high bankruptcy risk zone throughout the period from 2021 to 2025. The indicator values ranged from 0.23

to 0.45, suggesting the persistent presence of bankruptcy risk during all observed years. Company C was classified as financially stable in 2021 and 2022, whereas a deterioration in its financial position, that is, a temporary destabilization of operations, was recorded in 2023 and 2024. However, in 2025, this enterprise once again exhibited business performance without indications of potential bankruptcy proceedings. Enterprise D was assessed as stable during the first two years of observation, while in the remaining years the model results pointed to a worsening financial position and a shift toward riskier business zones. Company E maintained financial stability throughout the entire analyzed period, without any indications of the initiation of bankruptcy proceedings.

A comparative analysis of all five enterprises indicates that Enterprise B can be assessed as the company with the highest bankruptcy risk, given that its unfavorable classification was confirmed by all three models, with the risk being both persistent and pronounced throughout most of the observed years. In contrast, Enterprise E demonstrates a trend of improving financial stability, although the intensity of this improvement varies depending on the model applied. Companies C and D occupy an intermediate position: according to the Altman EMS and BIS models, they appear financially stable, whereas the K model reveals certain periods of deterioration, which may point to latent weaknesses not sufficiently captured by the other models. The greatest methodological ambiguity relates to Enterprise A, which is classified as stable according to two models, yet as persistently high-risk according to the K model. Therefore, for this enterprise, the assessment of bankruptcy risk can be considered highly dependent on the choice of model, further confirming the importance of applying multiple indicators in the evaluation of financial stability. The presented findings broadly align with earlier research results, particularly those of Jakovčević et al. (2012), Vlaović Begović et al. (2014), Srebro et al. (2021), Milić et al. (2022), and Jocić et al. (2024), which likewise emphasize the importance of applying bankruptcy risk assessment models and confirm the existence of a certain risk of bankruptcy initiation in agricultural enterprises. The similarities and differences in the results obtained by the applied models may be explained by their methodological foundations. Each model employs a different combination of financial indicators and assigns a different weight to their contribution in assessing bankruptcy risk. This means that some models may be more sensitive to liquidity problems, others to the level of indebtedness, and still others to profitability and operational efficiency. For this reason, it is not unexpected that partially different assessments may be obtained for the same enterprise. In this study, the convergence of findings for certain companies may be interpreted as confirmation of a more clearly pronounced financial pattern, whereas differing bankruptcy risk assessments for other companies indicate a more complex structure of their financial position. In this way, differences among the models should not be viewed as a weakness of the research; on the contrary, they contribute to a more

comprehensive understanding of the multidimensional nature of bankruptcy risk. The findings also have broader significance, as they confirm that the assessment of bankruptcy risk in agricultural enterprises requires caution in the interpretation of results. In the agricultural sector, financial indicators often reflect the effects of factors that are not directly contained in balance sheet positions, such as yield fluctuations, production seasonality, dependence on weather conditions, and price instability in the market. This implies that even when financial models provide a useful picture of vulnerability, they do not fully capture all the determinants shaping the likelihood of bankruptcy. This is precisely where the importance of the present research lies: it demonstrates that quantitative models have substantial practical value, but that their interpretation must always be linked to sector-specific characteristics and the particularities of the business environment. The findings of this study are largely consistent with previous research emphasizing the usefulness of such models for the early identification of financial difficulties in agricultural enterprises. However, the significance of this consistency with earlier studies does not lie solely in confirming the applicability of the models, but also in suggesting the existence of relatively stable patterns of financial vulnerability under similar institutional and sectoral conditions. In other words, similar results may stem from the fact that agricultural enterprises face comparable constraints related to market uncertainty, financing conditions, and exposure to external shocks. Therefore, the findings obtained do not merely represent a descriptive confirmation of previous research, but also contribute to a better understanding of why bankruptcy risk manifests itself in a specific manner within this sector.

4 Conclusion

The results of the empirical analysis indicated pronounced heterogeneity in the level of bankruptcy risk among the analyzed enterprises operating in the sector of cereals (excluding rice), legumes, and oilseeds during the period from 2021 to 2025. The strength of this empirical analysis lies in the simultaneous application of several bankruptcy risk assessment models, which enabled a comparative evaluation of the financial vulnerability of the observed enterprises. An additional value of the research stems from the fact that the analysis was conducted on companies from the agricultural sector, which is specific due to its pronounced exposure to market, production, and climatic risks. In this way, the obtained results are of particular importance for understanding the financial stability of enterprises under sector-specific business conditions. At the same time, certain research limitations should be taken into account when interpreting the results. First, the analysis included a relatively small number of companies, which limits the possibility of broader generalization of the findings. In addition, the applied models were based exclusively on financial indicators and therefore did not include qualitative determinants of business performance, such as management

quality, market position, institutional environment, climatic influences, and other sector-specific factors that may significantly affect the probability of bankruptcy. Future research should therefore be directed toward expanding the sample to include a larger number of agricultural enterprises, as well as a longer observation period. It would also be useful to incorporate additional bankruptcy risk assessment models and to apply contemporary statistical methods. A particularly valuable contribution to future research could come from the inclusion of qualitative and sector-specific indicators, which would allow for a more comprehensive understanding of the causes of financial instability and improve the reliability of bankruptcy risk assessment in agriculture. Considering the findings in their entirety, the research confirms substantial variation in bankruptcy risk and financial stability among the analyzed companies. The obtained results justify the simultaneous application of multiple models, since only their combination can provide a more realistic and analytically reliable assessment of bankruptcy risk in the observed enterprises. Such an approach may serve as a useful basis for the timely identification of financial difficulties and for making appropriate managerial and business decisions aimed at preserving business sustainability.

Acknowledgments

The research was funded by the Ministry of Science, Technological Development and Innovation under Contracts No. 451-03-34/2026-03/200117 and 451-03-33/2026-03/200117, dated 5 February 2026.

Conflict of interests

The authors declare no conflict of interest.

5 References

1. Altman, E. I. (1983). *Corporate financial distress a complete guide to predicting, avoiding, and dealing with bankruptcy*. Wiley Interscience, John Wiley and Sons. ISBN: 0-471-08707-6.
2. Altman, E. I. (1968). Financial ratios, discriminant analysis and the prediction of corporate bankruptcy. *The Journal of Finance*, 23(4), 589-609. ISSN: 0022-1082. <https://doi.org/10.1111/j.1540-6261.1968.tb00843.x>.
3. Altman, E. I., Hartzell, J., & Peck, M. (1995). A scoring system for emerging market corporate bonds. Salomon Brothers High Yield Research.
4. Begović, S. V., Bonić, L., & Jovin, S. (2020). A comparison of the bankruptcy prediction models on a sample of Serbian companies. *Theme*, 503-518. ISSN: 0353-7919. <https://doi.org/10.22190/TEME180619036V>.
5. Bešlić Obradović, D., Jakšić, D., Bešlić Rupiće, I., & Andrić, M. (2018). Insolvency prediction model of the company: the case of the Republic of Serbia. *Economic*

- research, 31(1), 139-157. ISSN: 1331-677X.
<https://doi.org/10.1080/1331677X.2017.1421990>.
6. Boratynska, K., & Grzegorzewska, E. (2018). Bankruptcy prediction in the agribusiness sector: Lessons from quantitative and qualitative approaches. *Journal of Business Research*, 89, 175–181. ISSN: 0148-2963.
<https://doi.org/10.1016/j.jbusres.2018.01.028>
 7. Céu, M.S., & Medeiros Gaspar, R. (2022). Vegetative cycle and bankruptcy predictors of agricultural firms. *Agricultural Economics*, 68(12), 445-454. ISSN: 0139-570X.
<https://doi.org/10.17221/206/2022-AGRICECON>
 8. Jakovčević, K., & Andrašić, J. (2012). Diagnosis of operating business of agricultural-industrial companies in the Republic of Serbia. *African Journal of Business Management*, 6(38), 10253. ISSN: 1993-8233.
 9. Jakšić, D., Mijić, K., Zekić, S., Poljašević, J. (2015). Comparative profitability analysis of milk production companies to milk processing companies in Serbia. *Custos e @gronegocio on line*, 11(3), 206-226. ISSN: 1808-2882.
 10. Jocić, B., Milić, D., Zekić, V., Novaković, D., Novaković, T., & Ilić, Z. (2024). Analysis of the possibility of bankruptcy in medium-sized agribusiness companies in AP Vojvodina. *Economics of Agriculture*, 71(2), 469-484. ISSN: 0352-3462.
<https://doi.org/10.59267/ekoPolj2402469J>.
 11. Klepac, V., & Hampel, D. (2017). Predicting financial distress of agriculture companies in EU. *Agricultural Economics*, 63(8), 347-355. <https://doi.org/10.17221/374/2015-AGRICECON>
 12. Kušter, D. (2023b). Efficiency of working capital & assets management in the function of SMEs bankruptcy prediction. *Management: Journal of Sustainable Business and Management Solutions in Emerging Economies*, 28(3), 57-69. ISSN: 1820-0222.
<https://doi.org/10.7595/management.fon.2023.0007>.
 13. Law on Accounting (Official Gazette of the Republic of Serbia, Nos. 73/2019 and 44/2021).
 14. Milić, D., Jocić, B., Novaković, D., Zekić, V. & Novaković, T. (2025). Bankruptcy Risk Analysis of Micro Enterprises in Serbia's Oil and Fat Industry. *Agrieconomica*, 54(107), 59-68. ISSN: 0350-5928.
 15. Milić, D., Jocić, B., Novaković, D., Zekić, V., Novaković, T., Radišić, M., & Radišić, M. (2025). Evaluating the effectiveness of the models for assessing the initiation of bankruptcy proceedings. *Economic of Agriculture*, 72(3), 1073–1087. ISSN: 0352-3462. <https://doi.org/10.59267/ekoPolj25031073M>
 16. Milić, D., Tekić, D., Novaković, T., Zekić, V., Popov, M., & Mihajlov, Z. (2022). Credit rating of agricultural and food companies in Vojvodina. *Contemporary Agriculture*, 71(1-2), 51-56. ISSN: 0350-1205. <https://doi.org/10.2478/contagri-2022-0008>.
 17. Mizdraković, V., & Bokić, M. (2016). Reassessment of corporate bankruptcy prediction models efficiency: evidence from Serbia. *TEME: Časopis za Društvene Nauke*, 40(4). ISSN: 0353-7919.

18. Muminović, S., Pavlović, V., & Cvijanović, J. M. (2011). Predictive ability of various bankruptcy prediction Z-score models for Serbian publicly listed companies. *Industry*, 39(3), 1-12. ISSN: 0350-0373.
19. Serbian Business Registers Agency (SBRA) (2023). Data on the number of agricultural enterprises in the territory of AP Vojvodina obtained upon request.
20. Serbian Business Registers Agency (SBRA) (2026). Financial statements of the analyzed enterprises. Available at: <https://fin.apr.gov.rs/JavnaPretraga> (accessed 09.04.2026).
21. Statistical Office of the Republic of Serbia (SORS), 2023a Census of Agriculture: number of holdings and area under different crops and categories. Available at: <https://data.stat.gov.rs/Home/Result/1300021101?languageCode=sr-Cyrl&displayMode=table> (accessed 09.04.2026).
22. Statistical Office of the Republic of Serbia (SORS), 2023b Popis poljoprivrede: korišćeno poljoprivredno zemljište gazdinstva po kategorijama. https://popispoljoprivrede.stat.gov.rs/media/31119/tabela-21_cir.xlsx (accessed 09.04.2026).
23. Qu, Y., Quan, P., Lei, M., & Shi, Y. (2019). Review of bankruptcy prediction using machine learning and deep learning techniques. *Procedia Computer Science*, 162, 895–899. ISSN: 1877-0509. <https://doi.org/10.1016/j.procs.2019.12.065>