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# ANALIZA UTICAJA PROMENE NOMINALNOG DEVIZNOG KURSA NA STOPU INFLACIJE NA PRIMERU ODABRANIH ZEMALJA

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**Rezime**

Stopa inflacije je jedna od osnovnih makroekonomskih varijabli i predstavlja osnovni cilj monetarne politike. Uslovljena je velikim brojem faktora, te je neophodno analizirati uticaj koji njihove promene imaju na stopu inflacije. Cilj ovog istraživanja je analiza pass-through efekta promene nominalnog deviznog kursa na stopu inflacije na primeru odabranih zemalja u razvoju i razvijenih zemalja u periodu od 2014. do 2020. godine, čije su zajedničke karakteristike targetirana stopa inflacije, kao režim monetarne politike i rukovođeno fluktuirajući devizni kurs, kao režim deviznog kursa. Potvrđena je obrnuta proporcionalnost između kretanja nominalnog deviznog kursa i stope inflacije (depresijacija nominalnog deviznog kursa nacionalne valute vodi ka rastu stope inflacije) i veći pass-through efekat u zemljama u razvoju u odnosu na razvijene zemlje.

**Ključne reči:** exchange rate pass-through; devizni kurs; stopa inflacije

**JEL klasifikacija:** E42, E52, E58, C33

# Uvod

Radi sprovođenja adekvatne monetarne politike, neophodno je raspolagati tačnim podacima o makroekonomskim agregatima od značaja, ali i međuzavisnošću između njih, kako bi se precizno odredio uticaj koji promena jednog makroekonomskog agregata ima na druge, a samim tim i na ciljeve monetarne i ekonomske politike. Kao značajne varijable u monetarnoj politici izdvajaju se prevashodno stopa inflacije, ali i devizni kurs, te i njihova međuzavisnost.

Predmet istraživanja rada je pass-through efekat – „prelivanje" promena nominalnog deviznog kursa na stopu inflacije u Srbiji, Mađarskoj i Rumuniji (koje predstavljaju zemlje u razvoju) i Velikoj Britaniji, Kanadi i Novom Zelandu (koje predstavljaju grupu razvijenih zemalja). Posmatrani period nominalnog deviznog kursa i stope inflacije je od 2014. do 2020. godine i prikupljeni podaci su analizirani na kvartalnom nivou.

Cilj istraživanja je empirijski potvrditi obrnutu proporcionalnost kretanja nominalnog deviznog kursa i stope inflacije, tj. potvrditi da depresijacija nominalnog deviznog kursa nacionalne valute vodi ka rastu stope inflacije, kao i veći pass-through efekat u zemljama u razvoju u odnosu na razvijene zemlje.

Metodologija istraživanja obuhvata deskriptivnu statističku analizu podataka, kreiranje panel podataka i utvrđivanje odgovarajućeg panel modela, utvrđivanje dijagrama rasipanja nominalnog deviznog kursa u odnosu na stopu inflacije za svaku posmatranu zemlju, kao i komparativnu analizu radi utvrđivanja sličnosti i razlika između pass-through efekta uticaja promene stope nominalnog deviznog kursa na stopu inflacije u zemljama u razvoju i razvijenim zemljama. Analiza panel podataka je izvršena primenom statističkog softvera STATA, dok je u izradi dijagrama rasipanja korišćen softver Statistica. Statistički značajne razlike se uzimaju kod vrednosti gde je $p < 0,05$.

U prvom delu rada predstavljeni su vladajući stavovi u literaturi, potom su u drugom delu prikazani empirijski podaci o nominalnim deviznim kursevima i stopi inflacije. U trećem delu rada su analizirani dijagram rasipanja nominalnog deviznog kursa u odnosu na stopu inflacije i deskriptivna statistika (za promenljive stopu inflacije i nominalni devizni kurs) i prikazani su rezultati panel analize i odabir odgovarajućeg modela. U poslednjem delu rada izvršeno je poređenje odabranih zemalja regiona (uključujući i Srbiju) i razvijenih zemalja.

# Pregled literature

Procena uticaja šokova na kretanje nominalnih deviznih kurseva stranih valuta i prelivanje inflacije na domaće tržište je efekat koji je u literaturi poznat kao "pass-through" efekat. Od presudnog je značaja za monetarne vlasti, jer uslovljava rast domaćih cena. Može se definisati kao procentualna promena stope inflacije izazvana jednoprocentnom promenom nominalnog deviznog kursa (Ristanović & Tasić, 2018). ERPT (Exchange rate pass-through) može varirati među zemljama sa različitom ekonomskom strukturom, u pogledu stepena otvorenosti, značaja uvoza za tu zemlju itd. (Ortega & Osbat, 2020). Pad ERPT je povezan sa cenovnom stabilnošću, koja je proizvod kredibilne monetarne politike (Allem & Lahiani, 2014). Prema istraživanju MMF-a, sprovedenog na svim članicama u periodu 1960-1990. godine, između zemalja koje koriste različite režime deviznih kurseva postoji različit uticaj koji oni imaju na stopu inflacije. Ukoliko devizne kurseve podelimo u tri grupe: fiksne, rukovođeno fluktuirajuće i slobodno fluktuirajuće, države sa fiksnim deviznim kursevima neretko karakteriše niska stopa inflacije i manje varijacija deviznog kursa (Ghosh i saradnici, 1997).

Analizirajući uticaj promene realnog deviznog kursa na stopu inflacije na primeru azijskih zemlja (ASEAN + Japan, Kina, Južna Koreja) u periodu od 1991. do 2005. godine i poredeći dobijene rezultate sa rezultatima iz Evropske Unije i Severne Amerike, Achsani i saradnici (2010) zaključili su da na tom primeru azijskih zemalja postoji jaka korelacija između deviznog kursa i inflacije i da depresijacija nominalnog (kao i realnog) deviznog kursa utiče na rast inflacije, dok je korelacija između deviznog kursa i inflacije zanemarljiva u EU i Severnoj Americi, ali da je primećen značajan uticaj inflacije na devizni kurs.

U korist smanjenja pass-through efekta nakon uvođenja režima ciljanja stope inflacije kao osnovnog cilja monetarne politike, govori i analiza sprovedena u 27 zemalja u razvoju od kojih 15 ima kao cilj targetiranu inflaciju, a 12 ne, primenom VAR metode. Utvrđeno je da je pass-through efekat smanjen kod sledeća tri cenovana indeksa: CPI (Consumer Price Index), PPI (Producer Price Index), IMP (Import Price Index) (Coulibaly & Kempf, 2010). Tezu da je ERPT efekat niži prilikom fluktuirajućih deviznih kurseva potvrđuju i Kara & Ogunc (2005), na primeru turske lire. Otkako se devizni kurs turske lire slobodno formira na osnovu kretanja ponude i tražnje na tržištu, ERPT efekat je smanjen.

Uticaj promene nominalnog deviznog kursa na inflaciju analiziran je na primeru odabranih afričkih zemalja u periodu od 1978. do 1989. godine – analizirane zemlje su bile: Gambija, Gana, Kenija, Nigerija, Sijera Leone, Somalija, Tanzanija, Uganda, Kongo i Zambija. Primenom bivarijatnog (primena (1) monetarnog agregata i nivoa cena kao varijabili ili (2) deviznog kursa i nivoa cena) i trivarijatnog Grejndžerovog testa (monetarni agregat, nivo cena i devizni kurs kao varijable), potvrđen je veliki uticaj promene deviznog kursa na stopu inflacije u Sijera Leone, Tanzaniji i Kongu, dok je ista korelacija potvrđena primenom bivarijatnog testa u Keniji i trivarijatnog u Gambiji (Canetti & Greene, 1991). Imimole & Enoma (2011) dokazali su primenom ADRL modela na primeru Nigerije da depresijacija nominalnog deviznog kursa nigerijske naire utiče na rast stope inflacije analizirajući podatke u periodu 1986-2008. Korišćenjem mesečnih podataka o stopi inflacije i kursu nigerijske naire u periodu od januara 2006. godine do decembra 2015. godine, primenom GARCH modela (Generalised Auto Conditional Heteroscedastic model) dokazana je negativna veza između volatilnosti deviznog kursa i stope inflacije na kratak rok – rast deviznog kursa za 1% vodi ka padu inflacije za 0,003% (Osabuohien i saradnici, 2018).

## Pregled nominalnih deviznih kurseva i stope inflacije u odabranim zemljama

U zemljama koje su usvojile ciljanje inflacije (Inflation targeting) za režim monetarne politike kao osnovni cilj monetarnih vlasti, zabeleženo je smanjenje pass-through efekta nominalnog deviznog kursa na stopu inflacije (Edwards, 2006), te su upravo i predmet ovog istraživanja zemlje koje spadaju u ovu grupu (targetirana stopa inflacije kao režim monetarne politike + rukovođeno fluktuirajući devizni kurs kao režim deviznog kursa). U istraživanje su uključeni Novi Zeland i Kanada, kao prve države koje su usvojile ciljanje inflacije kao osnovni cilj monetarnih vlasti, nakon kojih su i druge razvijene zemlje i zemlje u razvoju preuzele ovaj režim monetarne politike (Stevanović & Milenković, 2020).

Radi statističke obrade podataka svi nominalni devizni kursevi su izraženi u evrima (kako bi sve nacionalne valute bile izražene u istoj jedinici). Podaci o kvartalnoj vrednosti evra izraženog u srpskim dinarima preuzeti su sa sajta Narodne Banke Srbije, dok su podaci u preostalim valutama preuzeti sa

sajta Evropske Centralne Banke. U Tabeli 1 prikazani su nominalni devizni kursevi za svaku posmatranu nacionalnu valutu, kao i procentualna promena na kvartalnom nivou. Za svaku nacionalnu valutu, nominalne vrednosti deviznih kurseva su prikazane u koloni (1), dok su procentualne promene prikazane u koloni (2).

**Tabela 1.** *Nominalni devizni kursevi odabranih nacionalnih valuta u periodu Q1 2014 – Q4 2020*

| Kvartal | Srpski dinar RSD/EUR | | Mađarska forinta HUF/EUR | | Rumunski lej RON/EUR | | Britanska funta GBP/EUR | | Kanadski dolar CAD/EUR | | Novozelandski dolar NZD/EUR | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (1) | (2) | (1) | (2) | (1) | (2) | (1) | (2) | (1) | (2) |
| Q1 2014 | 0,00864 | / | 0,00325 | / | 0,22222 | / | 1,20482 | / | 0,66225 | / | 0,60976 | / |
| Q2 2014 | 0,00865 | 0,12 | 0,00327 | 0,62 | 0,22573 | 1,58 | 1,23457 | 2,47 | 0,66667 | 0,67 | 0,62893 | 3,14 |
| Q3 2014 | 0,00852 | -1,50 | 0,00320 | -2,14 | 0,22676 | 0,46 | 1,26582 | 2,53 | 0,69444 | 4,17 | 0,63694 | 1,27 |
| Q4 2014 | 0,00831 | -2,46 | 0,00324 | 1,25 | 0,22573 | -0,45 | 1,26582 | 0,00 | 0,70423 | 1,41 | 0,62500 | -1,87 |
| Q1 2015 | 0,00823 | -0,96 | 0,00324 | 0,00 | 0,22472 | -0,45 | 1,35135 | 6,76 | 0,71429 | 1,43 | 0,66667 | 6,67 |
| Q2 2015 | 0,00830 | 0,85 | 0,00327 | 0,93 | 0,22523 | 0,23 | 1,38889 | 2,78 | 0,73529 | 2,94 | 0,66225 | -0,66 |
| Q3 2015 | 0,00832 | 0,24 | 0,00320 | -2,14 | 0,22573 | 0,22 | 1,38889 | 0,00 | 0,68966 | -6,21 | 0,58480 | -11,69 |
| Q4 2015 | 0,00828 | -0,48 | 0,00320 | 0,00 | 0,22422 | -0,67 | 1,38889 | 0,00 | 0,68493 | -0,69 | 0,60976 | 4,27 |
| Q1 2016 | 0,00814 | -1,69 | 0,00320 | 0,00 | 0,22272 | -0,67 | 1,29870 | -6,49 | 0,66225 | -3,31 | 0,60241 | -1,21 |
| Q2 2016 | 0,00813 | -0,12 | 0,00319 | -0,31 | 0,22222 | -0,22 | 1,26582 | -2,53 | 0,68493 | 3,42 | 0,61350 | 1,84 |
| Q3 2016 | 0,00811 | -0,25 | 0,00321 | 0,63 | 0,22371 | 0,67 | 1,17647 | -7,06 | 0,68493 | 0,00 | 0,64935 | 5,84 |
| Q4 2016 | 0,00811 | 0,00 | 0,00323 | 0,62 | 0,22173 | -0,89 | 1,14943 | -2,30 | 0,69444 | 1,39 | 0,65789 | 1,32 |
| Q1 2017 | 0,00807 | -0,49 | 0,00324 | 0,31 | 0,22124 | -0,22 | 1,16279 | 1,16 | 0,70922 | 2,13 | 0,66667 | 1,33 |
| Q2 2017 | 0,00813 | 0,74 | 0,00323 | -0,31 | 0,21978 | -0,66 | 1,16279 | 0,00 | 0,67568 | -4,73 | 0,64103 | -3,85 |
| Q3 2017 | 0,00835 | 2,71 | 0,00326 | 0,93 | 0,21834 | -0,66 | 1,11111 | -4,44 | 0,68027 | 0,68 | 0,62112 | -3,11 |
| Q4 2017 | 0,00840 | 0,60 | 0,00321 | -1,53 | 0,21645 | -0,87 | 1,12360 | 1,12 | 0,66667 | -2,00 | 0,59172 | -4,73 |
| Q1 2018 | 0,00844 | 0,48 | 0,00322 | 0,31 | 0,21459 | -0,86 | 1,13636 | 1,14 | 0,64516 | -3,23 | 0,59172 | 0,00 |
| Q2 2018 | 0,00846 | 0,24 | 0,00315 | -2,17 | 0,21505 | 0,21 | 1,13636 | 0,00 | 0,64935 | 0,65 | 0,59172 | 0,00 |
| Q3 2018 | 0,00846 | 0,00 | 0,00309 | -1,90 | 0,21505 | 0,00 | 1,12360 | -1,12 | 0,65789 | 1,32 | 0,57471 | -2,87 |
| Q4 2018 | 0,00845 | -0,12 | 0,00310 | 0,32 | 0,21459 | -0,21 | 1,12360 | 0,00 | 0,66225 | 0,66 | 0,58824 | 2,35 |
| Q1 2019 | 0,00846 | 0,12 | 0,00315 | 1,61 | 0,21142 | -1,48 | 1,14943 | 2,30 | 0,66225 | 0,00 | 0,59880 | 1,80 |
| Q2 2019 | 0,00848 | 0,24 | 0,00310 | -1,59 | 0,21053 | -0,42 | 1,14943 | 0,00 | 0,66667 | 0,67 | 0,58824 | -1,76 |
| Q3 2019 | 0,00849 | 0,12 | 0,00305 | -1,61 | 0,21142 | 0,42 | 1,11111 | -3,33 | 0,68027 | 2,04 | 0,58480 | -0,58 |
| Q4 2019 | 0,00851 | 0,24 | 0,00301 | -1,31 | 0,20964 | -0,84 | 1,16279 | 4,65 | 0,68493 | 0,69 | 0,58140 | -0,58 |
| Q1 2020 | 0,00851 | 0,00 | 0,00295 | -1,99 | 0,20833 | -0,62 | 1,16279 | 0,00 | 0,67568 | -1,35 | 0,57471 | -1,15 |
| Q2 2020 | 0,00850 | -0,12 | 0,00284 | -3,73 | 0,20661 | -0,83 | 1,12360 | -3,37 | 0,65359 | -3,27 | 0,56180 | -2,25 |
| Q3 2020 | 0,00850 | 0,00 | 0,00283 | -0,35 | 0,20619 | -0,20 | 1,09890 | -2,20 | 0,64103 | -1,92 | 0,56497 | 0,56 |
| Q4 2020 | 0,00850 | 0,00 | 0,00277 | -2,12 | 0,20534 | -0,41 | 1,11111 | 1,11 | 0,64516 | 0,64 | 0,57471 | 1,72 |

*Izvor: www.ecb.europa.eu*

Na osnovu tabelarnog prikaza se zaključuje da su sve posmatrane valute u posmatranom vremenskom intervalu nominalno depresirale u odnosu na evro. U toku posmatranog intervala, bilo je oscilacija u kretanju nominalnih deviznih kurseva - najveće su zabeležene kod kanadskog i novozelandskog dolara. Najveća procentualna depresijacija u odnosu na evro zabeležena je kod mađarske forinte, dok je najmanje oscilacija pretrpeo kurs britanske funte.

Kvartalni podaci o stopi inflacije za sve posmatrane zemlje preuzeti su od strane BIS banke (Bank for International Settlements) i predstavljeni su u Tabeli 2.

**Tabela 2.** *Stopa inflacije u odabranim državama u periodu Q1 2014 – Q4 2020*

| Kvartal | Srbija | Mađarska | Rumunija | Velika Britanija | Kanada | Novi Zeland |
|---|---|---|---|---|---|---|
| Q1 2014 | 2,67 | 0,04 | 1,06 | 1,78 | 1,39 | 1,53 |
| Q2 2014 | 1,79 | -0,17 | 0,93 | 1,76 | 2,22 | 1,62 |
| Q3 2014 | 1,88 | -0,06 | 1,08 | 1,45 | 2,08 | 1,01 |
| Q4 2014 | 2,00 | -0,68 | 1,19 | 0,91 | 1,93 | 0,76 |
| Q1 2015 | 0,89 | -1,04 | 0,55 | 0,10 | 1,07 | 0,25 |
| Q2 2015 | 1,74 | 0,26 | 0,10 | -0,03 | 0,90 | 0,42 |
| Q3 2015 | 1,53 | 0,01 | -1,75 | 0,03 | 1,19 | 0,42 |
| Q4 2015 | 1,40 | 0,49 | -1,21 | 0,10 | 1,33 | 0,08 |
| Q1 2016 | 1,46 | 0,33 | -2,62 | 0,33 | 1,54 | 0,42 |
| Q2 2016 | 0,51 | -0,05 | -2,48 | 0,33 | 1,55 | 0,42 |
| Q3 2016 | 1,00 | 0,06 | -0,50 | 0,70 | 1,23 | 0,42 |
| Q4 2016 | 1,54 | 1,28 | -0,56 | 1,20 | 1,39 | 1,34 |
| Q1 2017 | 3,11 | 2,61 | 0,15 | 2,17 | 1,91 | 2,17 |
| Q2 2017 | 3,69 | 2,06 | 0,71 | 2,76 | 1,32 | 1,74 |
| Q3 2017 | 3,00 | 2,42 | 1,47 | 2,81 | 1,37 | 1,90 |
| Q4 2017 | 2,88 | 2,29 | 3,08 | 3,02 | 1,79 | 1,59 |
| Q1 2018 | 1,60 | 1,97 | 4,65 | 2,71 | 2,06 | 1,10 |
| Q2 2018 | 1,84 | 2,73 | 5,34 | 2,42 | 2,30 | 1,50 |
| Q3 2018 | 2,39 | 3,44 | 4,86 | 2,51 | 2,68 | 1,90 |
| Q4 2018 | 2,07 | 3,22 | 3,64 | 2,26 | 2,04 | 1,89 |
| Q1 2019 | 2,44 | 3,17 | 3,74 | 1,85 | 1,61 | 1,48 |
| Q2 2019 | 2,28 | 3,73 | 4,00 | 2,02 | 2,15 | 1,67 |
| Q3 2019 | 1,35 | 3,06 | 3,84 | 1,85 | 1,94 | 1,46 |
| Q4 2019 | 1,41 | 3,42 | 3,73 | 1,40 | 2,10 | 1,85 |
| Q1 2020 | 1,76 | 4,32 | 3,23 | 1,66 | 1,81 | 2,53 |
| Q2 2020 | 0,96 | 2,49 | 2,53 | 0,68 | 0,02 | 1,45 |
| Q3 2020 | 1,92 | 3,71 | 2,65 | 0,62 | 0,27 | 1,44 |
| Q4 2020 | 1,58 | 2,82 | 2,14 | 0,58 | 0,78 | 1,44 |

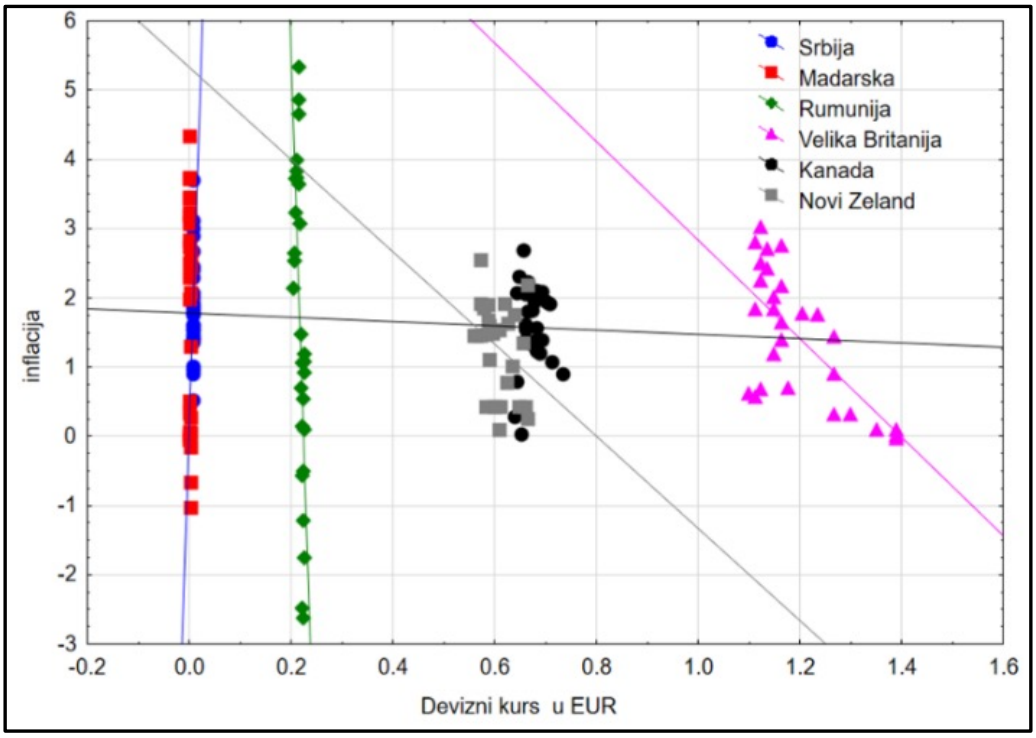
*Izvor: www.bis.org*

Kretanje stope inflacije u posmatranim zemljama beleži oscilacije u toku posmatranog perioda, ali je primetan zajednički trend kretanja kod svih zemalja. Od početka posmatranog perioda do prve polovine 2016. godine stopa inflacije ima pretežno negativan trend kretanja (Rumunija beleži negativnu stopu u trajanju od 6 kvartala), nakon čega dolazi do rasta stope inflacije i ovaj trend kretanja se menja tek od 2020. godine i početka izbijanja pandemije korona virusa, kada dolazi do pada privredne aktivnosti, što vodi ka smanjenju stope inflacije.

# „Pass-through“ efekat nominalnog deviznog kursa na stopu inflacije

Početak empirijske analize podataka upućuje na dijagrame rasipanja nominalnog deviznog kursa u odnosu na stopu inflacije. Za svaku pojedinačnu državu je prikazana jednačina koja objašnjava povezanost nominalnog deviznog kursa i stope inflacije. Nominalni devizni kurs izražen u evrima predstavlja nezavisnu promenljivu, dok je stopa inflacije zavisna promenljiva. Nedostatak dijagrama rasipanja je što se ne uzimaju u obzir različiti vremenski momenti, koji će biti uvaženi prilikom obrade panel podataka.

**Slika 1.** *Dijagrami rasipanja nominalnog deviznog kursa u odnosu na stopu inflacije*




*Izvor: Proračun autora primenom alata Statistica*

| | | | | |
|---|---|---|---|---|
| Srbija: | Y = 0,0270 + 221,4813 * X; | r = 0,0511; | p = 0,79630; | $r^2$ = 0,0026 |
| Mađarska: | Y = 24,4349 – 7239,1438 * X; | r = -0,6330; | p = 0,00030; | $r^2$ = 0,4006 |
| Rumunija: | Y = 50,7426 – 225,6237 * X; | r = -0,6960; | p = 0,00004; | $r^2$ = 0,4844 |
| Velika Britanija: | Y = 9,9516 – 7,1182 * X; | r = -0,6862; | p = 0,00006; | $r^2$ = 0,4709 |
| Kanada: | Y = 1,7752 – 0,3030 * X; | r = -0,0113; | p = 0,95450; | $r^2$ = 0,0001 |
| Novi Zeland: | Y = 5,3318 – 6,6589 * X; | r = -0,3304; | p = 0,08600; | $r^2$ = 0,1092 |

U svim posmatranim zemljama osim u Srbiji postoji obrnuta proporcionalnost između kretanja nominalnog deviznog kursa i stope inflacije, tj. sa rastom nominalnog deviznog kursa stopa inflacije opada. Treba uzeti u obzir činjenicu da su nominalni devizni kursevi svih analiziranih valuta izraženi u evrima, te da rast nominalnog deviznog kursa označava depresijaciju evra, tj. apresijaciju nacionalne valute. Apresijacija nacionalne valute vodi ka padu stope inflacije. U Srbiji je prisutna direktna proporcionalnost, te sa rastom kursa izraženog u evrima (depresijacija evra – apresijacija srpskog dinara), dolazi do rasta stope inflacije. Dobijeni podaci nisu statistički značajno različiti od nule na primeru Srbije, Kanade i Novog Zelanda i upravo ove zemlje imaju najniži koeficijent determinacije.

Radi utvrđivanja uticaja volatilnosti nominalnog deviznog kursa na stopu inflacije u posmatranim zemljama, prikupljeni kvartalni podaci su obrađeni primenom programa STATA. Zemlje su označene brojevima od 1 do 6 (Srbija, Mađarska, Rumunija, Velika Britanija, Kanada i Novi Zeland respektivno) i podaci su balansirani (za svaku posmatranu zemlju se analizira isti broj podataka u vremenskoj seriji). U Tabeli 3 je prikazana osnovna deskriptivna statistika za obe promenljive, ne uzimajući u obzir različite zemlje.

**Tabela 3.** *Osnovna deskriptivna statistika za promenljive stopu inflacije i nominalni devizni kurs*

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Zemlja | 168 | 3,5 | 1,712931 | 1 | 6 |
| Vreme | 168 | 14,5 | 8,101896 | 1 | 28 |
| Stopa inflacije | 168 | 1,582857 | 1,273472 | -2,62 | 5,34 |
| Nominalni devizni kurs u EUR | 168 | ,4519313 | ,4281965 | ,0027735 | 1,388889 |

*Izvor: Proračun autora primenom alata STATA*

Detaljnija deskriptivna statistika je prikazana u Tabeli 4. Ukupan broj analiziranih podataka je 168, a predmet analize je 6 zemalja i 28 vremenskih trenutaka (28 kvartala). Prilikom statističke analize računate su osnovne deskriptivne statistike za obe posmatrane promenljive (nominalni devizni kurs i stopa inflacije): prosek (Mean), standardna devijacija, minimum i maksimum. Izračunate su standardne devijacije za obe varijable posmatrajući samo zemlje i ne uzimajući u obzir vremenski period ("Between"), kao i standardne devijacije za 28 posmatranih vremenskih trenutaka, ne uzimajući u obzir zemlje ("Within").

**Tabela 4.** *Detaljnija deskriptivna statistika za promenljive stopu inflacije i nominalni devizni kurs*

| Variable | | Mean | Std. Dev. | Min | Max | Observations |
|---|---|---|---|---|---|---|
| Stopa inflacije | Overall | 1,582857 | 1,273472 | -2,62 | 5,34 | 168 |
| | Between | | ,2119819 | 1,278571 | 1,881786 | 6 |
| | Within | | 1,258595 | -2,663929 | 5,296071 | 28 |
| Nominalni devizni kurs u EUR | Overall | ,4519313 | ,4281965 | ,0027735 | 1,388889 | 168 |
| | Between | | ,4655582 | ,0031389 | 1,197458 | 6 |
| | Within | | ,0406237 | ,3533743 | ,6433621 | 28 |

*Izvor: Proračun autora primenom alata STATA*

Kada je u pitanju stopa inflacije,"between" standardna devijacija je manja od "within" standardne devijacije, što ukazuje na veću varijaciju stope inflacije tokom vremenskog perioda, nego među zemljama, dok je za promenljivu nominalni devizni kurs veća varijacija među zemljama nego tokom vremenskog perioda. U nastavku istraživanja, predmet analize je povezanost nominalnog deviznog kursa, kao nezavisne promenljive i stope inflacije kao zavisne promenljive analizom panel podataka. Ocena uticaja nezavisne promenljive na zavisnu promenljivu merena je primenom sledećih modela:

1. Model običnih najmanjih kvadrata (Ordinary Last Squares Model - OLS) – prikazan u **Tabeli 5.**

2. Model fiksnih efekata – prikazan u **Tabeli 6.**

3. Model slučajnih efekata – prikazan u **Tabeli 7.**

Prvi model panel podataka je model običnih najmanjih kvadrata. Model posmatra sve vrednosti varijabli, ali ne uzima u obzir različite zemlje.

**Tabela 5.** *Model običnih najmanjih kvadrata*

| Source | SS | df | MS | Number of obs | | 168 |
|---|---|---|---|---|---|---|
| Model | 5,02994455 | 1 | 5,02994455 | F (1,166) | | 3,14 |
| Residual | 265,799284 | 166 | 1,60120051 | Prob > F | | 0,0782 |
| Total | 270,829229 | 167 | 1,62173191 | R-squared | | 0,0186 |
| | | | | Adj R-squared | | 0,0127 |
| | | | | Root MSE | | 1,2654 |
| **Stopa inflacije** | **Koeficijent** | **Standardna greška** | **t** | **P > \|t\|** | **95% Conf. Interval** | |
| Nominalni devizni kurs | -,4053034 | ,2286765 | -1,77 | 0,078 | -,8567926 | ,461858 |
| Konstanta | 1,766026 | ,1421667 | 12,42 | 0,000 | 1,485339 | 2,046714 |

*Izvor: Proračun autora primenom alata STATA*

Dobijeni rezultati upućuju na koeficijent determinacije R2=0,0186 – što ukazuje na slabu objašnjenost varijacija stope inflacije kretanjem nominalnog deviznog kursa – samo 1,86%. Rezultati F testa F (1,166)=3,14; p>0,05 pokazuju da OLS model nije dobar. Rezidualna standardna greška (1,2654) prikazuje koliko u proseku odstupaju stvarne vrednosti stope inflacije od prave regresione linije. Na osnovu prikazanih podataka dobija se model:

**Stopa inflacije = 1,766026 – 0,4053034 * Nominalni devizni kurs**

Model ukazuje na obrnutu proporcionalnost stope inflacije i nominalnog deviznog kursa i da rast nominalnog deviznog kursa za jednu jedinicu, dovodi do smanjenja stope inflacije za 0,4053034 jedinica. Kako OLS model ne uzima u obzir različite zemlje, potrebno je utvrditi i model fiksnih i slučajnih efekata i odabrati najbolji model od navedena tri.

**Tabela 6.** *Model fiksnih efekata*

| | | | | | | |
|---|---|---|---|---|---|---|
| **R-sq** | **Within** | 0,0628 | **Number of Obs** | | 168 | |
| | | | **Number of groups** | | 6 | |
| | **Between** | 0,5526 | **Obs per group:** | **Min** | 28 | |
| | | | | **Avg** | 28 | |
| | **Overall** | 0,0186 | | **Max** | 28 | |
| | | | **F (1,161)** | | 10,79 | |
| **Corr(u_i, Xb)** | | -0,9947 | **Prob > F** | | 0,0013 | |
| **Stopa inflacije** | **Koeficijent** | Standardna greška | t | P > ltl | 95% Conf. | Interval |
| **Nominalni devizni kurs** | -7,76397 | 2,363793 | -3,28 | 0,001 | -12,43201 | -3,095932 |
| **Konstanta** | 5,091638 | 1,072554 | 4,75 | 0,000 | 2,97355 | 7,209726 |
| **Sigma_u** | 3,4599099 | | | | | |
| **Sigma_e** | 1,2409306 | | | | | |
| **Rho** | ,88602458 | | | | | |
| **F (5,161)=2,32** | | **Prob > F = 0,0455** | | | | |

*Izvor: Proračun autora primenom alata STATA*

Dobijeni koeficijent determinacije R2=0,0186 ukazuje na niski procenat objašnjenosti varijacija stope inflacije kretanjem nominalnog deviznog kursa kao nezavisne promenljive. Model koji se dobija glasi:

**Stopa inflacije = 5,091638 – 7,76397 * Nominalni devizni kurs**

Model potvrđuje obrnutu proporcionalnost kretanja stope inflacije i nominalnog deviznog kursa i ukazuje da rast nominalnog deviznog kursa za jednu jedinicu vodi ka smanjenju stope inflacije za 7,76397 jedinica. Vrednost F testa F (1,161)=10,79 i dobijena vrednost p=0,0013, ukazuju da je model fiksnih efekata dobar.

**Tabela 7.** *Model slučajnih efekata*

| | | | | | | |
|---|---|---|---|---|---|---|
| **R-sq** | **Within** | 0,0628 | **Number of Obs** | | 168 | |
| | | | **Number of groups** | | 6 | |
| | **Between** | 0,5526 | **Obs per group: Min** | | 28 | |
| | | | | **Avg** | 28 | |
| | **Overall** | 0,0186 | | **Max** | 28 | |
| | | | **Wald chi2 (1)** | | 3,14 | |
| **Corr(u_i, X)** | | 0 | **Prob > chi2** | | 0,0763 | |
| **Thea** | | 0 | | | | |
| **Stopa inflacije** | **Koeficijent** | **Standardna greška** | **z** | **P > lzl** | **95% Conf. Interval** | |
| **Nominalni devizni kurs** | -,4053034 | ,2286765 | -1,77 | 0,076 | -,8535011 | ,0428943 |
| **Konstanta** | 1,766026 | ,1421667 | 12,42 | 0,000 | 1,487385 | 2,044668 |
| **Sigma_u** | 0 | | | | | |
| **Sigma_e** | 1,2409306 | | | | | |
| **Rho** | 0 | | | | | |

*Izvor: Proračun autora primenom alata STATA*

Model koji se dobija glasi:

**Stopa inflacije = 1,766026 – 0,4053034 * Nominalni devizni kurs**

i pokazuje obrnutu proporcionalnost između stope inflacije i nominalnog deviznog kursa, kao i da rast nominalnog deviznog kursa za jednu jedinicu vodi ka smanjenju inflacije za 0,4053034 jedinice. Dobijeni rezultati Wald testa Wald chi2 (1) = 3,14; p=0,0763>0,05, dovode do zaključka da model slučajnih efekata nije dobar.

Nakon sprovođenja OLS modela, modela fiksnih efekata i modela slučajnih efekata, potrebno je utvrditi koji je model najbolji, što se dobija sprovođenjem F-testa za model fiksnih efekata i Breusch-Pagan LM testa za model slučajnih efekata (prikazan u **Tabeli 8**). Vrednost F testa se očitava iz rezultata dobijenih u program STATA i iznosi F(5,161)=2,32, p = 0,0455 < 0,05 – što ukazuje na odbacivanje H0.

**Tabela 8.** *Breusch-Pagan test*

| **Stopa inflacije** | **Var** | **Sd=sqrt (Var)** |
|---|---|---|
| | 1,621732 | 1,273472 |
| **e** | 1,539909 | 1,240931 |
| **u** | 0 | 0 |
| **Test: Var(u) = 0** | | |
| **Chibar2 (01) = 0,00** | | |
| **Prob > chibar2 = 1,0000** | | |

*Izvor: Proračun autora primenom alata STATA*

Dobijeni rezultati prikazuju odbacivanje H0 kod F-testa, dok to nije slučaj kod Breusch-Paganovog testa, te se zaključuje da je model fiksnih efekata najpogodniji. Konačan model glasi:

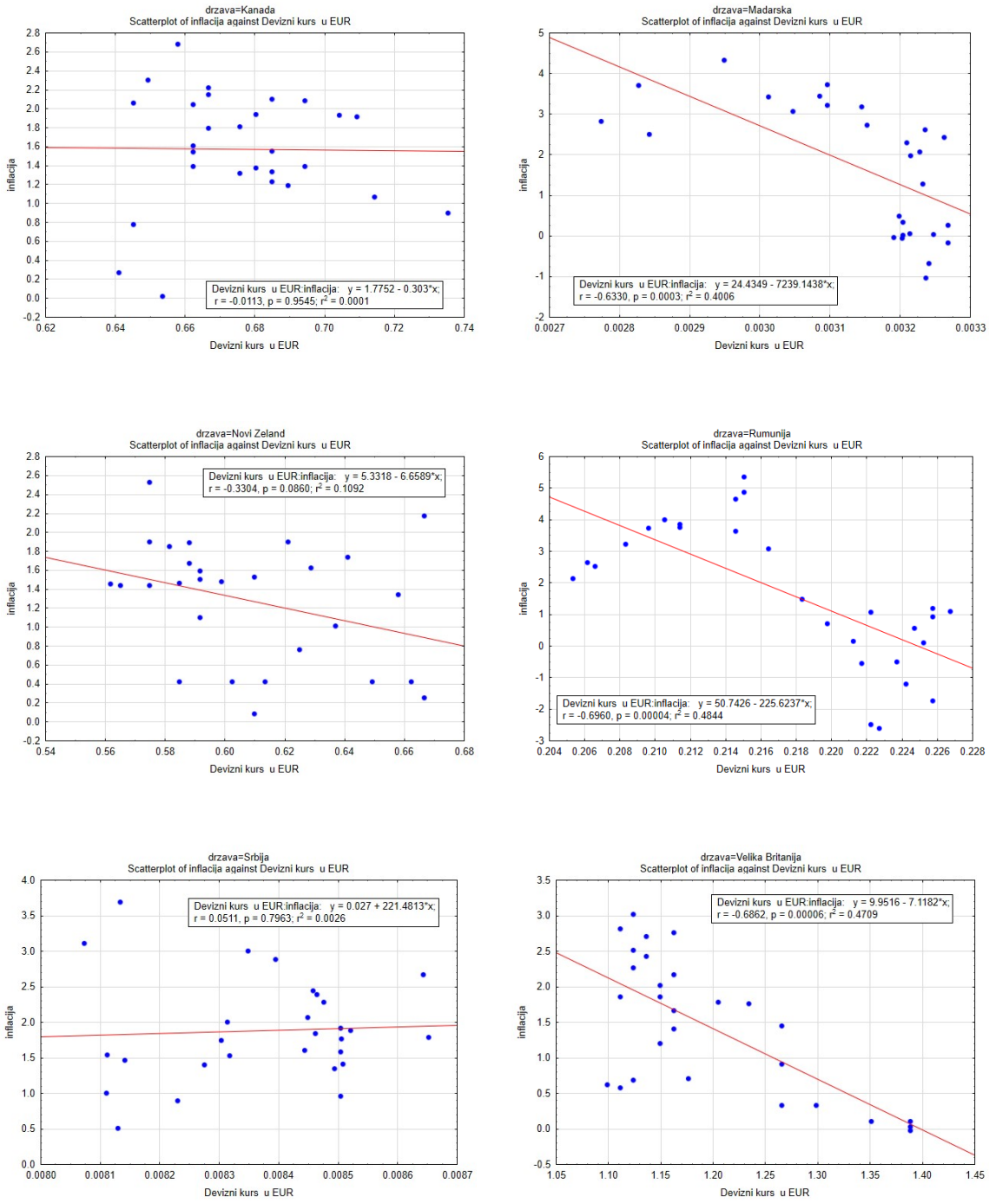
**Stopa inflacije = 5,091638 – 7,76397 * Nominalni devizni kurs**

Dobijeni rezultati istraživanja podudaraju se sa rezultatima istraživanja sprovedenog od strane Honoham & Lane (2004) – koji su utvrdili da je uticaj nominalnog deviznog kursa na kretanje stope inflacije u Evrozoni prisutan i u periodima apresijacije evra (2002-2003) i u periodima depresijacije u odnosu na američki dolar (1999-2001). Istraživanja sprovedena na azijskim državama takođe su u korelaciji sa dobijenim rezultatima: Monfared & Akin (2017) dokazali su na primeru Irana primenom VAR modela i analizom kvartalnih podataka (Q3 1997- Q4 2011) da rast ponude novca i promena realnog deviznog kursa utiču na rast stope inflacije, sa značajnijim uticajem ponude novca na promenu stope inflacije.

## „Pass-through“ efekat: odabrane zemlje u regionu nasuprot odabranim razvijenim zemljama

Kako se u panel analizi posmatraju sve zemlje istovremeno i dobija se jedan model koji objašnjava sve promenljive za sve zemlje, radi detaljnije obrade podataka na nivou pojedinačnih zemalja prikazani su dijagrami rasipanja za sve posmatrane zemlje pojedinačno.

**Slika 2.** *Dijagrami rasipanja nominalnog deviznog kursa u odnosu na inflaciju – pojedinačno prikazane zemlje*




*Izvor: Proračun autora primenom alata Statistica*

Ukoliko se vrši poređenje smera kretanja proporcionalnosti između nominalnog deviznog kursa i stope inflacije, značajnih razlika između zemalja regiona i razvijenih zemalja nema – sa izuzetkom Srbije. Prisutna je obrnuta proporcionalnost - pad stope inflacije nakon nominalne apresijacije nacionalne valute u odnosu na evro.

Kao značajan faktor prilikom poređenja ove dve grupe zemalja javlja se koeficijent uz nezavisnu promenljivu nominalni devizni kurs. U razvijenim zemljama je vrednost ovog koeficijenta na znatno nižem nivou ( -7,1182 ; -0,3030 ; -6,6589 za Veliku Britaniju, Kanadu i Novi Zeland respektivno) u odnosu na koeficijente koji stoje uz nominalni devizni kurs u zemljama u regionu (221,4813; -7239,1438; -225,6237 za Srbiju, Mađarsku i Rumuniju respektivno). Kako ovaj koeficijent ukazuje koliko se menja stopa inflacije nakon promene nominalnog deviznog kursa za jednu jedinicu, može se zaključiti da je u zemljama u regionu ovaj koeficijent mnogo viši, te je i uticaj nominalnog deviznog kursa na stopu inflacije viši. U Kanadi je koeficijent bliži nuli (-0,3030) što znači da je uticaj koji nominalni devizni kurs ima na stopu inflacije veoma mali.

Ukoliko Srbiju, Mađarsku i Rumuniju grupišemo i posmatramo kao zemlje u razvoju, sledeće pravilnosti se uočavaju u toku posmatranog perioda: dinar, forinta i lej su depresirali na kraju posmatranog perioda u odnosu na početak 2014. godine i inflacija je na kraju posmatranog perioda bila viša u Mađarskoj i Rumuniji u odnosu na početak perioda (u Srbiji je inflacija na nižem nivou krajem 2020. godine). Uočava se da je inflaciji potrebno oko godinu dana da počne da raste, nakon što nacionalna valuta nominalno depresira (Srbija: srpski dinar beleži najniže vrednosti od Q3 2015 – Q1 2017, a rast stope inflacije se primećuje u periodu Q3 2016 – Q2 2017; Mađarska: depresijacija forinte u periodu od Q3 2017 – Q4 2018, a rast inflacije Q2 2018 - Q3 2018; Rumunija: lej od Q3 2015 beleži konstantan pad vrednosti, a stopa inflacije raste u periodu Q3 2016 – Q2 2018).

U radu Siljković & Milanović (2015) sprovode analizu ERPT efekta na primeru Srbije, gde je depresijacija nominalnog deviznog kursa primećena od 2003. godine i glavni je uzročnik rasta stope inflacije od 2004. godine. Privatizacija sprovedena nakon 2005. godine vodi ka povećanju priliva stranog kapitala, što je iniciralo apresijaciju dinara, što je potom uticalo na smanjenje stope inflacije. Upravo su značajne oscilacije kursa dinara uticale na postavljanje targetirane stope inflacije kao osnovnog cilja monetarne politike. Podaci dobijeni na osnovu istraživanja Josifidis i saradnici (2009), ukazuju na veliki pass-through efekat deviznog kursa na inflaciju, bez obzira na vrstu deviznog kursa (period 01/2001 – 01/2003 - politika targetiranja deviznog kursa i njegova uloga kao nominalnog sidra; period 01/2003 - 09/2006 – „crawling peg" režim deviznog kursa; period 09/2006 – danas – politika ciljane inflacije kao režim monetarne politike i rukovođeno fluktuirajućeg deviznog kursa kao komplementarnog režima deviznog kursa). Značajan uticaj deviznog kursa na stopu inflacije u Srbiji ne iznenađuje, uzimajući u obzir da smo mala otvorena ekonomija, sa velikom zavisnošću od uvoza i velikim trgovinskim deficitom (Vilaret & Palić, 2006).

Velika Britanija, Kanada i Novi Zeland čine grupu razvijenih zemalja čije sve nacionalne valute beleže nominalnu depresijaciju u odnosu na evro. Oscilacije nominalnih deviznih kurseva su bile niske, ali je zato stopa inflacije značajno oscilirala. Ne uočava se direktna korelacija između kretanja nominalnog deviznog kursa i stope inflacije, jer su vrednosti valuta bile relativno stabilne, što nije slučaj sa stopom inflacije.

Ovim se potvrđuje manji pass-through efekat nominalnog deviznog kursa na stopu inflacije u razvijenim zemljama u odnosu na nerazvijene zemlje, do kakvog se zaključka došlo i istraživanjem podataka prikupljenim iz 29 razvijenih zemalja i 26 zemalja u razvoju u periodu od 1970-2017. godine.

Potvrđena je teza da značajne depresijacije nacionalnih valuta veći uticaj imaju na stopu inflacije u zemljama u razvoju nego u razvijenim zemljama i da je u zemljama sa fleksibilnijim nominalnim deviznim kursevima i ciljanom inflacijom kao osnovnim targetom monetarnih vlasti manji „pass-through" nominalnog deviznog kursa na inflaciju (Ha i saradnici, 2019). Smanjenje pass-through efekta je pozitivan indikator, jer utiče na smanjenje inflatornih pritisaka koji dolaze izvan okvira državnih granica (Edwards, 2006).

## Zaključak

Rezultati istraživanja potvrđuju dosadašnje empirijske rezultate koji govore o obrnutoj proporcionalnosti između nominalnog deviznog kursa i stope inflacije, tj. da depresijacija nacionalne valute vodi ka rastu stope inflacije. Navedena teza je potvrđena u svim analiziranim zemljama osim u Srbiji, gde je prisutna direktna proporcionalnost.

Panel analizom se utvrđuje da je model fiksnih efekata najadekvatniji i dobijeni model (Stopa inflacije = 5,091638 – 7,76397 * Nominalni devizni kurs) govori o padu stope inflacije za 7,76397 jedinica prilikom apresijacije nominalnog deviznog kursa za jednu jedinicu.

Osim Srbije, nema razlika među zemljama regiona i razvijenih zemalja u pogledu obrnute proporcionalnosti nominalnog deviznog kursa i stope inflacije, ali se uočavaju viši koeficijenti uz nezavisnu promenljivu nominalni devizni kurs kod zemalja u regionu, što potvrđuje dosadašnje rezultate o većem pass-through efektu u zemljama u razvoju u odnosu na razvijene zemlje. Pravilnost koja je uočena kod zemalja u razvoju (da nominalna depresijacija nacionalne valute rezultira rastom stope inflacije nakon godinu dana – period od godinu dana je okvirnog karaktera) ne uočava se kod razvijenih zemalja, što takođe potvrđuje manji ERPT efekat u razvijenim zemljama.

Dobijeni rezultati istraživanja predstavljaju dobru osnovu za dalje istraživanje korišćenjem ekonometrijskih modela, koji bi obuhvatili širi vremenski period i veći broj zemalja kod kojih je osnovni cilj monetarnih vlasti targetirana stopa inflacije i gde je prisutan rukovođeno-fluktuirajući devizni kurs. Osim većeg obuhvata zemalja, kako zemalja u razvoju, tako i razvijenih zemalja, značajno bi bilo izvršiti analizu povratnog pass-through efekta koji realni efektivni devizni kurs ima na stopu inflacije

# Literatura

1. Achsani, N., Fauzi, A., Abdullah, P. (2010). The Relationship between Inflation and Real Exchange Rate: Comparative Study between ASEAN+3, the EU and North America. European Journal of Economics, Finance and Administrative Sciences, Issue 18, pp. 69-76.

2. Allem, A., Lahiani, A. (2014). Monetary Policy Credibility and Exchange rate Pass-Through: Some Evidence from Emerging Countries. Economic Modeling, Vol. 43, Issue C, pp. 21-29.

3. Canetti, E., Greene, J. (1991). Monetary Growth and Exchange Rate Depreciation As Causes of Inflation in African Countries: An Empirical Analysis. International Monetary Fund, Working Paper No. 91/67, pp. 1-26.

4. Coulibaly, D., Kempf, H. (2010). Does inflation targeting decrease exchange rate pass-through in emerging countries?. Banque de France, Working Paper 303, pp. 1-25.

5. Edwards, S. (2006). The relationship between exchange rates and inflation targeting revisited. National Bureau of Economic Research, Working Paper 12163, Cambridge, pp. 1-45.

6. Ghosh, A., Gulde, A., Ostry, J., Wolf, H. (1997). Does the Exchange Rate Regime Matter for Inflation and Growth?. International Monetary Fund, Economic Issues No. 2, pp. 1-13.

7. Ha, J., Stocker, M., Yilmazkuday, H. (2019). Inflation and Exchange Rate Pass-Through. Macroeconomics, Trade and Investment Global Practice, World Bank Group, Policy Research Working Paper, No. 8780, pp. 1-40.

8. Honohan, P., Lane, P. (2004). Exchange Rates and Inflation under EMU: An Update. Institute for International Integration Studies, Discussion Paper No. 31, Trinity College Dublin, Dublin, pp. 1-16.

9. Imimole, B., Enoma, A. (2011). Exchange Rate Depreciation and Inflation in Nigeria (1986–2008). Business and Economics Journal, Volume 2011: BEJ-28, pp. 1-12.

10. Josifidis, K., Allegret, J., Beker Pucar, E. (2009). Monetary and Exchange Rate Regimes Changes: The Cases of Poland, Czech Republic, Slovakia and Republic of Serbia. Panoeconomicus, No. 2, pp. 119-226.

11. Kara, H., Ogunc, F. (2005). Exchange rate Pass-Through in Turkey: It is slow, but is it really low?. The Central Bank of Republic of Turkey, Research Department Working Paper No. 5/10, pp. 1-17.

12. Monfred, S., Akin, F. (2017). The Relationship Between Exchage Rates and Inflation: The Case of Iran. European Journal of Sustainable Development, 6 (4), pp. 329-340.

13. Ortega, E., Osbat, C. (2020). Excange rate pass-through in the Euro area and EU countries. Banco de Espana, Documentos Ocasionales No. 2016, pp. 1-80.

14. Osabuohien, E., Obiekwe, E., Urhie, E., Osabohien, R. (2018). Inflation rate, exchange rate volatility and exchange rate pass-through interactions: the Nigerian experience, Journal of Applied Economic Sciences, Volume 13, 2(56), pp. 574-585.

15. Ristanović, M., Tasić, N. (2018). Exchange rate "Pass-through" on prices in Serbia in the post-crisis period. Industrija, Vol. 46, No. 2, pp. 117-129.

16. Siljković, B., Milanović, N. (2015). Retrospektiva i izazovi monetarne strategije ciljane inflacije postkriznog perioda. Ekonomski signali: poslovni magazin, Vol. 10 (2), pp. 1-10.

17. Stevanović, S., Milenković, I., (2020), Comparative analysis of the implementation of the inflation targeting monetary strategy in Canada and New Zealand. Ekonomske teme, 58 (3), pp. 401-414.

18. Vilaret, S., Palić, M. (2006). Pass-through efekat deviznog kursa na inflaciju u Srbiji. Narodna Banka Srbije, Working Papers 2006, pp. 1-19.

19. www.bis.org (Preuzeto sa https://www.bis.org/statistics/cp.htm?m=6%7C382%7C678 31/03/2021 )

20. www.ecb.europa.eu (Preuzeto sa https://www.ecb.europa.eu/stats/policy_and_exchange_rates/euro_reference_exchange_rates/html/index.en.html 31/03/2021)

21. https://nbs.rs (Preuzeto sa https://nbs.rs/sr_RS/indeks/ 31/03/2021)

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# ANALYSIS OF NOMINAL EXCHANGE RATE PASS-THROUGH EFFECT ON INFLATION RATE IN SELECTED COUNTRIES

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**Summary**

Inflation rate is one of the essential macroeconomics variables and it represents the main goal of monetary policy. It is determined by a great number of factors, so it is necessary to analyse the impact their changes have on inflation rate. The purpose of this research is the analysis of the nominal exchange rate pass-through effect on inflation rate in selected emerging and developed countries in the period 2014-2020, which share the same characteristics of inflation targeting, as main monetary policy regime, and managed floating exchange rate, as exchange rate type. Inverse proportion between volatility of nominal exchange rate and inflation rate is proven (depreciation of nominal exchange rate of national currency leads towards the growth of inflation rate), as well as higher pass-through effect in emerging countries compared to developed countries.

**Keywords:** exchange rate pass-through; exchange rate; inflation rate

**JEL classification:** E42, E52, E58, C33

## Introduction

In order to implement adequate monetary policy, it is necessary to have accurate information about important macroeconomics aggregates, but also about the interdependence between them, in order to precisely determine the impact that change of one macroeconomics aggregate has on others, as well as on monetary and economic policy goals. Important variables in monetary policy are, firstly, the inflation rate, as well as exchange rate and their interdependence. The subject of this research is the pass-through effect of nominal exchange rate on inflation rate in Serbia, Hungary and Romania (emerging countries) and Great Britain, Canada and New Zealand (developed countries). Analysed period of nominal exchange rate and inflation rate is 2014-2020 and the acquired data is analysed on a quarterly level.

The aim of this research is to empirically confirm the inverse proportionality of changes of nominal exchange rate and inflation rate – to confirm that the nominal exchange rate depreciation of national currency leads to the inflation rate growth, as well as to prove the higher pass-through effect in emerging countries compared to developed countries.

The methodology of this research contains descriptive statistics of analysed data, creating panel data and establishing the corresponding panel model, determination of scatter plot of nominal exchange rate and inflation rate for each individual country, comparative analysis which enables to determine similarities and differences between pass-through effect of nominal exchange rate changes on inflation rate in emerging and developed countries. The analysis of panel data is performed by statistical software STATA, whereas for the creating of scatter plot software Statistica is used. Statistically significant values are considered when p-value < 0.05.

First part of the paper is a literature review, the second part presents empirical data about nominal exchange rate and inflation rate. The third part of the paper analyses the scatter plot of nominal exchange rate and inflation rate and includes the descriptive statistics (for variables inflation rate and nominal exchange rate), as well as results of panel analysis and selection of corresponding model. The last part of the research features a comparison of selected countries in our region (including Serbia) and developed countries.

## Literature Review

Estimation of impact that economic shocks have on nominal exchange rates of foreign currencies and overflow of inflation on domestic market is known as "pass-through" effect. It is essential for monetary authorities, because it causes a rise in domestic prices. It can be defined as percentage change on inflation rate caused by 1% change of nominal exchange rate (Ristanović & Tasić, 2018). ERPT (Exchange rate pass-through) can vary between countries with different economic structure, regarding the openness of economics, importance of import etc. (Ortega & Osbat, 2020). Decrease of ERPT is connected with price stability, which is a product of credible monetary policy (Allem & Lahiani, 2014). According to IMF research, performed on all members in period 1960-1990, countries that have different regime of exchange rate have a different impact on inflation rate. If regimes of exchange rates are split in 3 groups: fixed, managed floating and floating regimes, countries with fixed exchange rate often have low inflation rate and less exchange rate variations (Ghosh & associates, 1997).

By analysing the effect of real exchange rate change on inflation rate in Asian countries (ASEAN + Japan, China, South Korea) in period 1991-2005 and comparing obtained results with results from European Union and North America, Achsani & associates (2010) came to the conclusion that in analysed Asian countries there is a strong corelation between exchange rate and inflation rate and that the depreciation of nominal (and real) exchange rate has an impact on inflation growth, whereas the corelation between exchange rate and inflation is negligible in EU and North America, but there is a significant impact of inflation rate on exchange rate.

In favour of decreasing pass-through effect after introduction of inflation targeting as main goal of monetary policy, there is an analysis conducted in 27 emerging countries, 15 of which have inflation targeting, and 12 do not, by using the VAR method. It has been determined that pass-through effect has decreased with three following indices: CPI (Consumer Price Index), PPI (Producer Price Index), IMP (Import Price Index) (Coulibaly & Kempf, 2010). Thesis that the ERPT is lower within floating exchange rate regimes was confirmed by Kara & Ogunc (2005), on the example of Turkish lira. Since the exchange rate is floating based on the supply and demand on the market, the ERPT effect has decreased.

The impact of nominal exchange rate change on inflation rate was analysed in selected African countries in period 1978-1989 – the analysed countries were: The Gambia, Ghana, Kenia, Nigeria, Sierra Leone, Somalia, Tanzania, Uganda, Kongo and Zambia. By using the bivariate (involving (1) monetary aggregate and consumer prices as variables or (2) exchange rate variable and consumer prices) and trivariate Granger causality tests (monetary aggregate, consumer prices and exchange rate as variables), high impact of exchange rate change on inflation rate was confirmed in Sierra Leone, Tanzania and Kongo, and same correlation was confirmed by bivariate test in Kenia and by trivariate test in The Gambia (Canetti & Greene, 1991). Imimole & Enoma (2011) have proven (by using the ADRL model in Nigeria) that depreciation of nominal exchange rate of Nigerian naira effects the rise of inflation rate by analysing data from 1986-2008. By using monthly data on the inflation rate and exchange rate of Nigerian naira in period January 2006 - December 2015 and the GARCH model (Generalised Auto Conditional Heteroscedastic model), negative corelation between volatility of exchange rate and inflation rate in short term is proven – increase of exchange rate for 1% leads to decrease of inflation rate for 0.003% (Osabuohien and associates, 2018).

## Overview of Nominal Exchange Rates and Inflation Rates in Selected Countries

Countries that have adopted inflation targeting as a main goal of monetary policy, have recorded a decrease in the pass-through effect of nominal exchange rate on inflation rate (Edwards, 2006), and those countries are the subject of this research (countries that have inflation targeting as a monetary policy regime + managed floating exchange rate as an exchange rate regime). This research includes New Zealand and Canada, as first two countries that have adopted inflation targeting as main goal of monetary authorities, after whom other developed countries and emerging countries have adopted this monetary policy regime (Stevanović & Milenković, 2020).

For statistical processing of the data, all nominal exchange rates are expressed in euros (so all national currencies are expressed in same units). Data about quarterly value of euro expressed in Serbian Dinars was taken from the website of National Bank of Serbia, and data for all other currencies was

taken from the website of the European Central Bank. Table 1 features the nominal exchange rates for each of the national currencies, as well as percentage changes on quarterly basis. For each national currency, the value of nominal exchange rate is presented in column (1), whereas percentage changes are presented in column (2).

**Table 1.** *Nominal Exchange Rates of Selected National Currencies in the Period Q1 2014 – Q4 2020*

| Quarter | Serbian dinar RSD/EUR | | Hungarian forint HUF/EUR | | Romanian leu RON/EUR | | British pound GBP/EUR | | Canadian dollar CAD/EUR | | New Zealand dollar NZD/EUR | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (1) | (2) | (1) | (2) | (1) | (2) | (1) | (2) | (1) | (2) |
| Q1 2014 | 0.00864 | / | 0.00325 | / | 0.22222 | / | 1.20482 | / | 0.66225 | / | 0.60976 | / |
| Q2 2014 | 0.00865 | 0.12 | 0.00327 | 0.62 | 0.22573 | 1.58 | 1.23457 | 2.47 | 0.66667 | 0.67 | 0.62893 | 3.14 |
| Q3 2014 | 0.00852 | -1.50 | 0.00320 | -2.14 | 0.22676 | 0.46 | 1.26582 | 2.53 | 0.69444 | 4.17 | 0.63694 | 1.27 |
| Q4 2014 | 0.00831 | -2.46 | 0.00324 | 1.25 | 0.22573 | -0.45 | 1.26582 | 0.00 | 0.70423 | 1.41 | 0.62500 | -1.87 |
| Q1 2015 | 0.00823 | -0.96 | 0.00324 | 0.00 | 0.22472 | -0.45 | 1.35135 | 6.76 | 0.71429 | 1.43 | 0.66667 | 6.67 |
| Q2 2015 | 0.00830 | 0.85 | 0.00327 | 0.93 | 0.22523 | 0.23 | 1.38889 | 2.78 | 0.73529 | 2.94 | 0.66225 | -0.66 |
| Q3 2015 | 0.00832 | 0.24 | 0.00320 | -2.14 | 0.22573 | 0.22 | 1.38889 | 0.00 | 0.68966 | -6.21 | 0.58480 | -11.69 |
| Q4 2015 | 0.00828 | -0.48 | 0.00320 | 0.00 | 0.22422 | -0.67 | 1.38889 | 0.00 | 0.68493 | -0.69 | 0.60976 | 4.27 |
| Q1 2016 | 0.00814 | -1.69 | 0.00320 | 0.00 | 0.22272 | -0.67 | 1.29870 | -6.49 | 0.66225 | -3.31 | 0.60241 | -1.21 |
| Q2 2016 | 0.00813 | -0.12 | 0.00319 | -0.31 | 0.22222 | -0.22 | 1.26582 | -2.53 | 0.68493 | 3.42 | 0.61350 | 1.84 |
| Q3 2016 | 0.00811 | -0.25 | 0.00321 | 0.63 | 0.22371 | 0.67 | 1.17647 | -7.06 | 0.68493 | 0.00 | 0.64935 | 5.84 |
| Q4 2016 | 0.00811 | 0.00 | 0.00323 | 0.62 | 0.22173 | -0.89 | 1.14943 | -2.30 | 0.69444 | 1.39 | 0.65789 | 1.32 |
| Q1 2017 | 0.00807 | -0.49 | 0.00324 | 0.31 | 0.22124 | -0.22 | 1.16279 | 1.16 | 0.70922 | 2.13 | 0.66667 | 1.33 |
| Q2 2017 | 0.00813 | 0.74 | 0.00323 | -0.31 | 0.21978 | -0.66 | 1.16279 | 0.00 | 0.67568 | -4.73 | 0.64103 | -3.85 |
| Q3 2017 | 0.00835 | 2.71 | 0.00326 | 0.93 | 0.21834 | -0.66 | 1.11111 | -4.44 | 0.68027 | 0.68 | 0.62112 | -3.11 |
| Q4 2017 | 0.00840 | 0.60 | 0.00321 | -1.53 | 0.21645 | -0.87 | 1.12360 | 1.12 | 0.66667 | -2.00 | 0.59172 | -4.73 |
| Q1 2018 | 0.00844 | 0.48 | 0.00322 | 0.31 | 0.21459 | -0.86 | 1.13636 | 1.14 | 0.64516 | -3.23 | 0.59172 | 0.00 |
| Q2 2018 | 0.00846 | 0.24 | 0.00315 | -2.17 | 0.21505 | 0.21 | 1.13636 | 0.00 | 0.64935 | 0.65 | 0.59172 | 0.00 |
| Q3 2018 | 0.00846 | 0.00 | 0.00309 | -1.90 | 0.21505 | 0.00 | 1.12360 | -1.12 | 0.65789 | 1.32 | 0.57471 | -2.87 |
| Q4 2018 | 0.00845 | -0.12 | 0.00310 | 0.32 | 0.21459 | -0.21 | 1.12360 | 0.00 | 0.66225 | 0.66 | 0.58824 | 2.35 |
| Q1 2019 | 0.00846 | 0.12 | 0.00315 | 1.61 | 0.21142 | -1.48 | 1.14943 | 2.30 | 0.66225 | 0.00 | 0.59880 | 1.80 |
| Q2 2019 | 0.00848 | 0.24 | 0.00310 | -1.59 | 0.21053 | -0.42 | 1.14943 | 0.00 | 0.66667 | 0.67 | 0.58824 | -1.76 |
| Q3 2019 | 0.00849 | 0.12 | 0.00305 | -1.61 | 0.21142 | 0.42 | 1.11111 | -3.33 | 0.68027 | 2.04 | 0.58480 | -0.58 |
| Q4 2019 | 0.00851 | 0.24 | 0.00301 | -1.31 | 0.20964 | -0.84 | 1.16279 | 4.65 | 0.68493 | 0.69 | 0.58140 | -0.58 |
| Q1 2020 | 0.00851 | 0.00 | 0.00295 | -1.99 | 0.20833 | -0.62 | 1.16279 | 0.00 | 0.67568 | -1.35 | 0.57471 | -1.15 |
| Q2 2020 | 0.00850 | -0.12 | 0.00284 | -3.73 | 0.20661 | -0.83 | 1.12360 | -3.37 | 0.65359 | -3.27 | 0.56180 | -2.25 |
| Q3 2020 | 0.00850 | 0.00 | 0.00283 | -0.35 | 0.20619 | -0.20 | 1.09890 | -2.20 | 0.64103 | -1.92 | 0.56497 | 0.56 |
| Q4 2020 | 0.00850 | 0.00 | 0.00277 | -2.12 | 0.20534 | -0.41 | 1.11111 | 1.11 | 0.64516 | 0.64 | 0.57471 | 1.72 |

*Source: www.ecb.europa.eu*

Based on Table 1 we can conclude that all selected national currencies have recorded nominal depreciation towards the euro in the analysed period. During the analysed period, there were oscillations in nominal exchange rates – highest oscillations are noted with Canadian and New Zealand dollar. Highest percentage depreciation towards the euro is marked with Hungarian forint, whereas lowest oscillations are noticed with British pound.

Quarterly data about the inflation rate for analysed countries are taken from BIS bank (Bank for International Settlements) and they are presented in Table 2.

**Table 2.** *Inflation Rate in Selected Countries in the Period Q1 2014 – Q4 2020*

| Quarter | Serbia | Hungary | Romania | Great Britain | Canada | New Zealand |
|---|---|---|---|---|---|---|
| Q1 2014 | 2.67 | 0.04 | 1.06 | 1.78 | 1.39 | 1.53 |
| Q2 2014 | 1.79 | -0.17 | 0.93 | 1.76 | 2.22 | 1.62 |
| Q3 2014 | 1.88 | -0.06 | 1.08 | 1.45 | 2.08 | 1.01 |
| Q4 2014 | 2.00 | -0.68 | 1.19 | 0.91 | 1.93 | 0.76 |
| Q1 2015 | 0.89 | -1.04 | 0.55 | 0.10 | 1.07 | 0.25 |
| Q2 2015 | 1.74 | 0.26 | 0.10 | -0.03 | 0.90 | 0.42 |
| Q3 2015 | 1.53 | 0.01 | -1.75 | 0.03 | 1.19 | 0.42 |
| Q4 2015 | 1.40 | 0.49 | -1.21 | 0.10 | 1.33 | 0.08 |
| Q1 2016 | 1.46 | 0.33 | -2.62 | 0.33 | 1.54 | 0.42 |
| Q2 2016 | 0.51 | -0.05 | -2.48 | 0.33 | 1.55 | 0.42 |
| Q3 2016 | 1.00 | 0.06 | -0.50 | 0.70 | 1.23 | 0.42 |
| Q4 2016 | 1.54 | 1.28 | -0.56 | 1.20 | 1.39 | 1.34 |
| Q1 2017 | 3.11 | 2.61 | 0.15 | 2.17 | 1.91 | 2.17 |
| Q2 2017 | 3.69 | 2.06 | 0.71 | 2.76 | 1.32 | 1.74 |
| Q3 2017 | 3.00 | 2.42 | 1.47 | 2.81 | 1.37 | 1.90 |
| Q4 2017 | 2.88 | 2.29 | 3.08 | 3.02 | 1.79 | 1.59 |
| Q1 2018 | 1.60 | 1.97 | 4.65 | 2.71 | 2.06 | 1.10 |
| Q2 2018 | 1.84 | 2.73 | 5.34 | 2.42 | 2.30 | 1.50 |
| Q3 2018 | 2.39 | 3.44 | 4.86 | 2.51 | 2.68 | 1.90 |
| Q4 2018 | 2.07 | 3.22 | 3.64 | 2.26 | 2.04 | 1.89 |
| Q1 2019 | 2.44 | 3.17 | 3.74 | 1.85 | 1.61 | 1.48 |
| Q2 2019 | 2.28 | 3.73 | 4.00 | 2.02 | 2.15 | 1.67 |
| Q3 2019 | 1.35 | 3.06 | 3.84 | 1.85 | 1.94 | 1.46 |
| Q4 2019 | 1.41 | 3.42 | 3.73 | 1.40 | 2.10 | 1.85 |
| Q1 2020 | 1.76 | 4.32 | 3.23 | 1.66 | 1.81 | 2.53 |
| Q2 2020 | 0.96 | 2.49 | 2.53 | 0.68 | 0.02 | 1.45 |
| Q3 2020 | 1.92 | 3.71 | 2.65 | 0.62 | 0.27 | 1.44 |
| Q4 2020 | 1.58 | 2.82 | 2.14 | 0.58 | 0.78 | 1.44 |

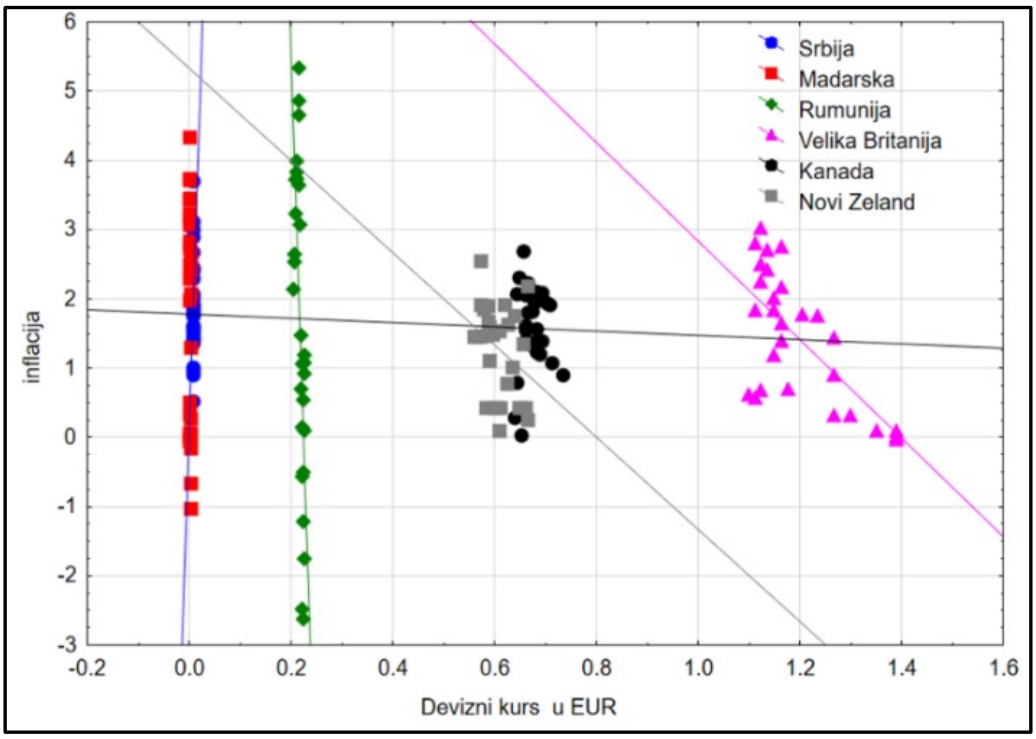
*Source: www.bis.org*

Inflation rate movements in analysed countries have noted oscillations during the observed period, but a common trend of movement was recorded in all countries. From the beginning of the observed period until the first half of 2016, inflation rate has mostly negative trend (Romania had deflation for 6 quarters), after which inflation rate started to rise and this trend changed in 2020, when the corona virus pandemic started, which affected the decline in economic activity, which led to a inflation rate decrease.

## "Pass-Through" Effect of the Nominal Exchange Rate on the Inflation Rate

The beginning of empirical analysis is presented by scatter plot of nominal exchange rate and inflation rate. For each individual country there is an equation that represents correlation between nominal exchange rate and inflation rate. Nominal exchange rate in euros is an independent variable, whereas the inflation rate is a dependent variable. What scatter plot is missing are different time periods, which will be included in the panel analysis.

**Picture 1.** *Scatter Plot of the Nominal Exchange Rate and the Inflation Rate*




*Source: Authors' calculation by using the statistical software Statistica*

| | | | | |
|---|---|---|---|---|
| Serbia: | Y = 0.0270 + 221.4813 * X; | r = 0.0511; | p = 0.79630; | $r^2$ = 0.0026 |
| Hungary: | Y = 24.4349 – 7239.1438 * X; | r = -0.6330; | p = 0.00030; | $r^2$ = 0.4006 |
| Romania: | Y = 50.7426 – 225.6237 * X; | r = -0.6960; | p = 0.00004; | $r^2$ = 0.4844 |
| Great Britain: | Y = 9.9516 – 7.1182 * X; | r = -0.6862; | p = 0.00006; | $r^2$ = 0.4709 |
| Canada: | Y = 1.7752 – 0.3030 * X; | r = -0.0113; | p = 0.95450; | $r^2$ = 0.0001 |
| New Zealand: | Y = 5.3318 – 6.6589 * X; | r = -0.3304; | p = 0.08600; | $r^2$ = 0.1092 |

In all analysed countries except in Serbia, there is an inverse proportion between the movement of nominal exchange rate and inflation rate – when nominal exchange rate increases, inflation rate decreases. What should be taken into account is that all nominal exchange rates are nominated in euros, so when nominal exchange rates increase, this means the depreciation of the euro and the appreciation of the national currency. Appreciation of national currency leads to inflation rate decrease. In Serbia, there is direct proportionality, so when the exchange rate in euros increases (depreciation of the euro = appreciation of Serbian dinar), there will be a rise in inflation rate. Obtained results are not statistically significant for Serbia, Canada and New Zealand, and these countries have lowest coefficients of determination.

In order to establish the effect that volatility of nominal exchange rate has on inflation rate in selected countries, obtained quarterly data is processed in statistical software STATA. Countries are marked with numbers 1 to 6 (Serbia, Hungary, Romania, Great Britain, Canada and New Zealand respectively) and data is balanced (all countries have the same number of analysed data in the time series).

In Table 3 presents the basic descriptive statistics for both variables, not taking into account different countries.

**Table 3.** *Basic Descriptive Statistics for Inflation Rate and Nominal Exchange Rate Variables*

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Country | 168 | 3.5 | 1.712931 | 1 | 6 |
| Period | 168 | 14.5 | 8.101896 | 1 | 28 |
| Inflation rate | 168 | 1.582857 | 1.273472 | -2.62 | 5.34 |
| Nominal exchange rate (EUR) | 168 | .4519313 | .4281965 | .0027735 | 1.388889 |

*Source: Authors´ calculation by using statistical software STATA*

Detailed descriptive statistics is presented in Table 4. Total number of analysed data is 168, and the analysis subjects are 6 countries and 28 time periods (28 quarters). During the statistical analysis, basic descriptive statistics were performed for both variables (nominal exchange rate and inflation rate): Mean, Standard Deviation, minimum and maximum. Standard deviations are calculated for both variables taking into account only countries and now the different period ("Between"), as well as standard deviations for 28 different time periods, and not taking into account the country ("Within").

**Table 4.** *Detailed Descriptive Statistics for Inflation Rate and Nominal Exchange Rate Variables*

| Variable | | Mean | Std. Dev. | Min | Max | Observations |
|---|---|---|---|---|---|---|
| Inflation rate | Overall | 1.582857 | 1.273472 | -2.62 | 5.34 | 168 |
| | Between | | .2119819 | 1.278571 | 1.881786 | 6 |
| | Within | | 1.258595 | -2.663929 | 5.296071 | 28 |
| Nominal exchange rate (EUR) | Overall | .4519313 | .4281965 | .0027735 | 1.388889 | 168 |
| | Between | | .4655582 | .0031389 | 1.197458 | 6 |
| | Within | | .0406237 | .3533743 | .6433621 | 28 |

*Source: Authors´ calculation by using statistical software STATA*

When it comes to inflation rate, "between" standard deviation is lower than "within" standard deviation, which means that inflation rate has higher variations during the time period than between countries, whereas for variable nominal exchange rate variations are higher between countries than during the time period.

The following part of the research consists of analysis of corellation between nominal exchange rate, as independent variable, and inflation rate, as dependant variable, by using the panel data. To determine the impact independent variable has on the dependant variable, following models will be presented:

1. Ordinary Last Squares Model – OLS – presented in Table 5.

2.Fixed effects model –presented in Table 6.

3.Random effects model – presented in Table 7.

First model of panel data is the Ordinary Last Square Model. It analyses all values of variables, but it does not take into account different countries.

**Table 5.** *Ordinary Last Squares Model*

| Source | SS | df | MS | Number of obs | | 168 |
|---|---|---|---|---|---|---|
| Model | 5.02994455 | 1 | 5.02994455 | F (1.166) | | 3.14 |
| Residual | 265.799284 | 166 | 1.60120051 | Prob> F | | 0.0782 |
| Total | 270.829229 | 167 | 1.62173191 | R-squared | | 0.0186 |
| | | | | Adj R-squared | | 0.0127 |
| | | | | Root MSE | | 1.2654 |
| Inflation rate | Coefficient | Standard deviation | t | P >ltl | 95% Conf. Interval | |
| Nominal exchange rate (EUR) | -.4053034 | .2286765 | -1.77 | 0.078 | -.8567926 | .461858 |
| Constant | 1.766026 | .1421667 | 12.42 | 0.000 | 1.485339 | 2.046714 |

*Source: Authors' calculation by using statistical software STATA*

Obtained results show that the coefficient of determination is R2=0.0186 – which means that differences of inflation rate are poorly explained by nominal exchange rate changes – only 1.86%. Results of F-test F (1.166) = 3.14; p>0.05 are showing that the OLS model is not adequate. The root-mean-square deviation (1.2654) shows the average deviation of real values of inflation rate from linear regression line. Obtained results created the following model:

**Inflation rate = 1.766026 – 0.4053034 * Nominal exchange rate**

This model indicates an inverse proportionality between inflation rate and nominal exchange rate, and that the increase of nominal exchange rate for one unit leads to the decrease of inflation rate for 0.4053034 units. Since the OLS model is not taking into account different countries, it is necessary to determine the fixed effects and random effects models and to choose the corresponding one.

**Table 6.** *Fixed Effects Model*

| Source | SS | df | MS | Number of obs | | 168 |
|---|---|---|---|---|---|---|
| Model | 5.02994455 | 1 | 5.02994455 | F (1.166) | | 3.14 |
| Residual | 265.799284 | 166 | 1.60120051 | Prob> F | | 0.0782 |
| Total | 270.829229 | 167 | 1.62173191 | R-squared | | 0.0186 |
| | | | | Adj R-squared | | 0.0127 |
| | | | | Root MSE | | 1.2654 |
| **Inflation rate** | **Coefficient** | **Standard deviation** | **t** | **P >ltl** | **95% Conf. Interval** | |
| Nominal exchange rate (EUR) | -.4053034 | .2286765 | -1.77 | 0.078 | -.8567926 | .461858 |
| Constant | 1.766026 | .1421667 | 12.42 | 0.000 | 1.485339 | 2.046714 |

*Source: Authors' calculation by using statistical software STATA*

Coefficient of determination R2=0.0186 signifies the low percentage of inflation rate variations caused by nominal exchange rate change as independent variable. Following model is defined:

**Inflation rate = 5.091638 – 7.76397 * Nominal exchange rate**

This model confirms the inverse proportionality of inflation rate and nominal exchange rate changes, and it shows that the increase of nominal exchange rate by 1 unit leads to inflation rate decrease by 7.76397 units. Results of the F-test F (1.161)=10.79 and p=0,0013, confirm that the fixed effects model is corresponding.

**Table 7.** *Random Effects Model*

| R-sq Within | 0.0628 | Number of Obs | 168 |
|---|---|---|---|
| | | Number of groups | 6 |
| Between | 0.5526 | Obs per group: Min | 28 |
| | | Avg | 28 |
| Overall | 0.0186 | Max | 28 |
| | | Wald chi2 (1) | 3.14 |
| Corr(u_i. X) | 0 | Prob> chi2 | 0.0763 |
| Thea | 0 | | |

| Inflation rate | Coefficient | Standard deviation | z | P >lzl | 95% Conf. Interval | |
|---|---|---|---|---|---|---|
| Nominal exchange rate | -.4053034 | .2286765 | -1.77 | 0.076 | -.8535011 | .0428943 |
| Constant | 1.766026 | .1421667 | 12.42 | 0.000 | 1.487385 | 2.044668 |
| Sigma_u | 0 | | | | | |
| Sigma_e | 1.2409306 | | | | | |
| Rho | 0 | | | | | |

*Source: Authors' calculation by using statistical software STATA*

Obtained results create the following model:

**Inflation rate = 1.766026 – 0.4053034 * Nominal exchange rate**

And it confirms the inverse proportionality between inflation rate and nominal exchange rate, as well as that the increase in nominal exchange rate by one unit leads to a decrease of inflation rate by 0.4053034 units. Results of Wald test Wald chi2 (1) = 3.14; p=0.0763>0.05, lead to the conclusion that the random effects model is not corresponding.

The following step after performing the OLS model, fixed and random effects model is to determine the corresponding model, which can be done by conducting the F-test for fixed effects model and the Breusch-Pagan LM test for random effects model (presented in Table 8). The results of the F-test can be found in the report from STATA and they are F(5.161)=2.32, p = 0.0455 < 0.05 – which points to the rejection of Hypothesis H0.

**Table 8.** *Breusch-Pagan Test*

| Inflation rate | Var | Sd=sqrt (Var) |
|---|---|---|
| | 1.621732 | 1.273472 |
| e | 1.539909 | 1.240931 |
| u | 0 | 0 |
| Test: Var(u) = 0 | | |
| Chibar2 (01) = 0.00 | | |
| Prob>chibar2 = 1.0000 | | |

*Source: Authors' calculation by using statistical software STATA*

Obtained results point to rejection of H0 within the F-test, while this is not the case with the Breusch-Pagan test, so the conclusion is that the fixed effects model is the most corresponding model. The final model is:

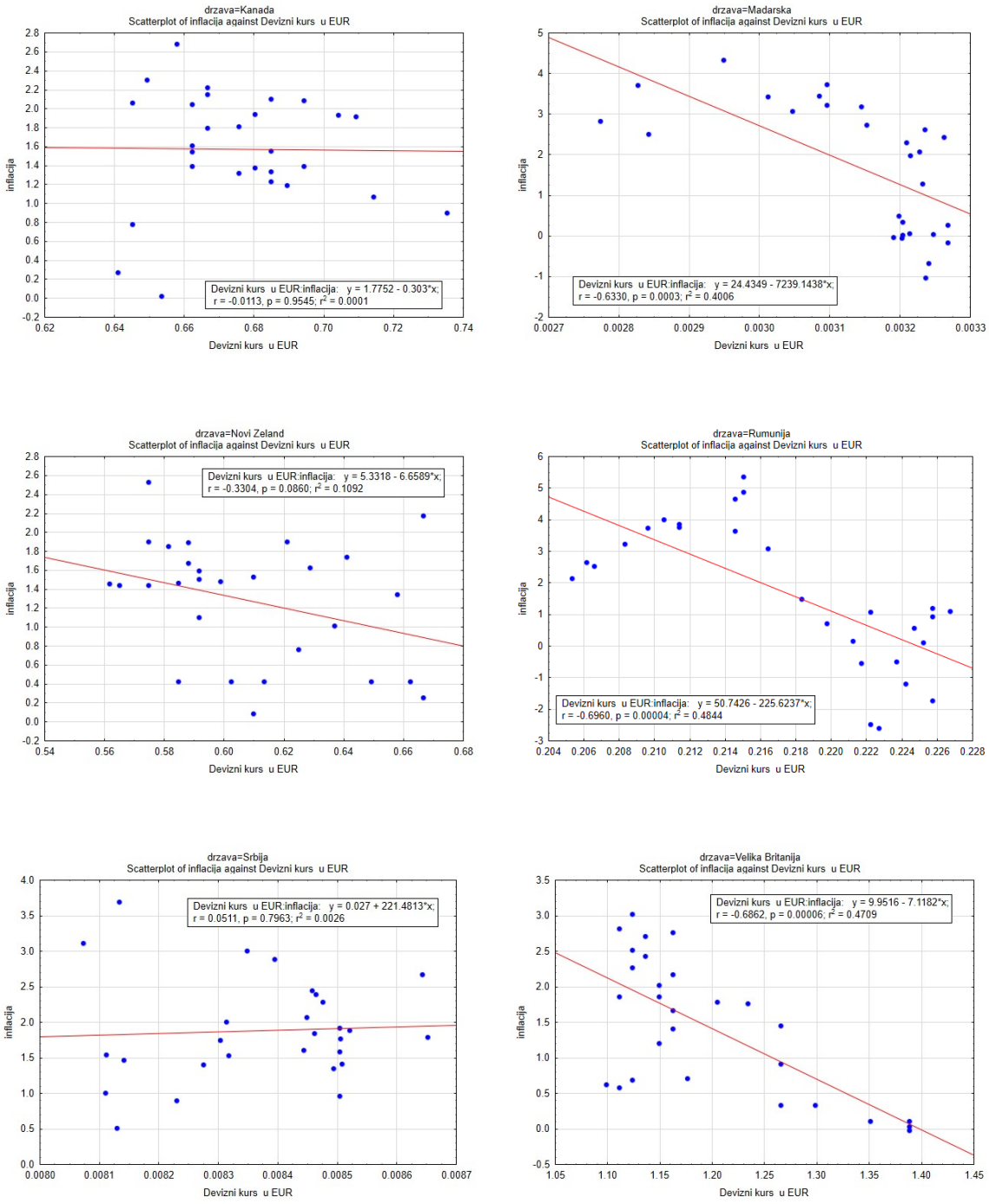
**Inflation rate = 5.091638 – 7.76397 * Nominal exchange rate**

These results are in correlation with results of Honoham & Lane (2004) research – which have determined that the nominal exchange rate impact on inflation rate in the Eurozone is present in periods of euro appreciation (2002-2003) and euro depreciation towards the American dollar (1999-2001). Research based on Asian countries also prove the results of this research: Monfared & Akin (2017) have proven on the example of Iran by using the VAR model and analysing quarterly data (Q3 1997- Q4 2011) that the growth of money supply and exchange rate change have impact on inflation rate growth, with more significant impact of money supply on inflation rate change.

## "Pass-Through" Effect: Selected Countries in the Region Versus Selected Developed Countries

Since panel analysis is taking into account all selected countries at the same time, one model is obtained for all variables for all countries, in order to have more detailed data processing for each country, scatter plot is created for each country individually.

**Picture 2.** *Scatter Plot of Nominal Exchange Rate and Inflation Rate – Presented by Each Country*




*Source: Authors' calculation by using statistical software Statistica*

If we make a comparison of direction of proportionality between nominal exchange rate and inflation rate, there are no significant differences between countries from our region and developed countries – with the exception of Serbia. Inverse proportionality is observed – decrease of inflation rate follows the appreciation of national currency regarding the euro.

As factor of importance when comparing these two groups of countries, the coefficient next to the independent variable nominal exchange rate occurs. In developed countries the value of this coefficient is on a lower level ( -7.1182 ; -0.3030 ; -6.6589 for Great Britain, Canada and New Zealand respectively) compared to coefficients next to the nominal exchange rate in countries in our region (221.4813; -7239.1438; -225.6237 for Serbia, Hungary and Romania respectively).

Since this coefficient signifies how much the inflation rate is changing after the nominal exchange rate changes by one unit, we can conclude that in countries in our region this coefficient is higher, so the pass-through effect of nominal exchange rate on inflation rate is higher. In Canada this coefficient is close to zero (-0.3030) which means that the effect of nominal exchange rate on inflation rate is weak.

If we group Serbia, Hungary and Romania and observe them as emerging countries, the following regularity can be noticed during the analysed period: dinar, forint and leu depreciated at the end of the analysed period compared to the beginning of 2014 and inflation rate was higher at the end of the analysed period compared to the beginning of analysed period in Hungary and Romania (in Serbia the inflation rate was lower at the end of 2020). It takes around one year for the inflation rate to start with the increase, after the national currency nominally depreciates (Serbia: Serbian dinar had lowest values in the period Q3 2015 – Q1 2017, and inflation rate can be noted in the period Q3 2016 – Q2 2017; Hungary: depreciation of Hungarian forint in the period Q3 2017 – Q4 2018, and inflation rate increased in the period Q2 2018 – Q3 2018; Romania: as of Q3 2015 leu is depreciating, and inflation rate was increasing in the period Q3 2016 – Q2 2018).

Siljković & Milanović (2015) have performed the ERPT effect analysis in Serbia, where there is depreciation of nominal exchange rate from 2003, which has led to the inflation rate increase as from 2004. Conducted privatisations after 2005 led to the increase of foreign capital inflow, which initiated appreciation of dinar, which led to the decrease of inflation rate. These significant oscillations in dinar exchange rate are exactly what influenced the setting of inflation targeting as main goal of monetary policy. Results from Josifidis and associates research (2009), point to high pass-through effect of exchange rate on inflation, regardless of the type of exchange rate regime (in the period 01/2001 – 01/2003 – monetary policy of exchange rate targeting and its role as nominal anchor; period 01/2003 – 09/2006 – "crawling peg" exchange rate regime; 09/2006 – until today – policy of inflation targeting as monetary policy regime and managed floating exchange rate as exchange rate regime). High impact of exchange rate on inflation rate in Serbia is not surprising, considering the fact that this is a small open country, with a high level of import dependence and high trade deficit (Vilaret & Palić, 2006).

Great Britain, Canada and New Zealand make the group of developed countries which national currencies noted nominal depreciation towards the euro. Oscillations of nominal exchange rates were low, but inflation rates oscillations were significant. Direct corelation between nominal exchange rate movement and inflation rate cannot be noticed, because values of currencies were relatively stable, which is not the case with the inflation rate.

This confirms a lower pass-through effect of nominal exchange rate on inflation rate in developed

countries compared to emerging countries, which was the conclusion obtained in research of 29 developed countries and 26 emerging countries in the period 1970-2017. The thesis that the significant depreciations of national currencies have higher impact on inflation rate in emerging countries then in developed countries is confirmed, and that countries with more flexible nominal exchange rate and inflation targeting as main goal of monetary policies have lower pass-through effect of nominal exchange rate on inflation rate (Ha & associates, 2019). Decreasing the pass-through effect is a positive indicator, because it leads to the lowering of inflation pressures that arise from outside of country's boarders (Edwards, 2006).

## Conclusion

Results of this research confirm so far the empirical results about inverse proportion between nominal exchange rate and inflation rate, meaning that the depreciation of national currency leads to an increase in the inflation rate. This thesis is confirmed in all analysed countries except in Serbia, where direct proportionality is present.

Panel analysis determines that the fixed effects model is the most corresponding model, and it signifies (Inflation rate = 5.091638 – 7.76397 * Nominal exchange rate) a decrease of inflation rate by 7.76397 units for of the nominal exchange rate appreciation by one unit.

Aside from Serbia, there are no differences between countries from our region and developed countries concerning inverse proportionality between nominal exchange rate and inflation rate, but higher coefficients next to the independent variable nominal exchange rate in countries in our region can be noticed, which confirms so far the results about the higher pass-through effect in emerging countries compared to developed countries. The regularity that has been observed with emerging countries (nominal exchange rate depreciation of national currency results with inflation rate growth after one year – period of one year roughly determined) is not present within developed countries, which confirms a lower ERPT effect in developed countries, as well.

Results obtained from this research are an adequate basis for further research by using econometric models, which would include longer time periods and a larger number of countries that share the same main goal of monetary policy – inflation targeting and managed floating exchange rate. Besides including a higher number of countries, emerging as well as developed, it would be significant to conduct the analysis of the pass-through effect that the real exchange rate has on the inflation rate.

# References

1. Achsani, N., Fauzi, A., Abdullah, P. (2010). The Relationship between Inflation and Real Exchange Rate: Comparative Study between ASEAN+3, the EU and North America. European Journal of Economics, Finance and Administrative Sciences, Issue 18, pp. 69-76.

2. Allem, A., Lahiani, A. (2014). Monetary Policy Credibility and Exchange rate Pass-Through: Some Evidence from Emerging Countries. Economic Modeling, Vol. 43, Issue C, pp. 21-29.

3. Canetti, E., Greene, J. (1991). Monetary Growth and Exchange Rate Depreciation As Causes of Inflation in African Countries: An Empirical Analysis. International Monetary Fund, Working Paper No. 91/67, pp. 1-26.

4. Coulibaly, D., Kempf, H. (2010). Does inflation targeting decrease exchange rate pass-through in emerging countries?. Banque de France, Working Paper 303, pp. 1-25.

5. Edwards, S. (2006). The relationship between exchange rates and inflation targeting revisited. National Bureau of Economic Research, Working Paper 12163, Cambridge, pp. 1-45.

6. Ghosh, A., Gulde, A., Ostry, J., Wolf, H. (1997). Does the Exchange Rate Regime Matter for Inflation and Growth?. International Monetary Fund, Economic Issues No. 2, pp. 1-13.

7. Ha, J., Stocker, M., Yilmazkuday, H. (2019). Inflation and Exchange Rate Pass-Through. Macroeconomics, Trade and Investment Global Practice, World Bank Group, Policy Research Working Paper, No. 8780, pp. 1-40.

8. Honohan, P., Lane, P. (2004). Exchange Rates and Inflation under EMU: An Update. Institute for International Integration Studies, Discussion Paper No. 31, Trinity College Dublin, Dublin, pp. 1-16.

9. Imimole, B., Enoma, A. (2011). Exchange Rate Depreciation and Inflation in Nigeria (1986–2008). Business and Economics Journal, Volume 2011: BEJ-28, pp. 1-12.

10. Josifidis, K., Allegret, J., Beker Pucar, E. (2009). Monetary and Exchange Rate Regimes Changes: The Cases of Poland, Czech Republic, Slovakia and Republic of Serbia. Panoeconomicus, No. 2, pp. 119-226.

11. Kara, H., Ogunc, F. (2005). Exchange rate Pass-Through in Turkey: It is slow, but is it really low?. The Central Bank of Republic of Turkey, Research Department Working Paper No. 5/10, pp. 1-17.

12. Monfred, S., Akin, F. (2017). The Relationship Between Exchage Rates and Inflation: The Case of Iran. European Journal of Sustainable Development, 6 (4), pp. 329-340.

13. Ortega, E., Osbat, C. (2020). Excange rate pass-through in the Euro area and EU countries. Banco de Espana, Documentos Ocasionales No. 2016, pp. 1-80.

14. Osabuohien, E., Obiekwe, E., Urhie, E., Osabohien, R. (2018). Inflation rate, exchange rate volatility and exchange rate pass-through interactions: the Nigerian experience, Journal of Applied Economic Sciences, Volume 13, 2(56), pp. 574-585.

15. Ristanović, M., Tasić, N. (2018). Exchange rate "Pass-through" on prices in Serbia in the post-crisis period. Industrija, Vol. 46, No. 2, pp. 117-129.

16. Siljković, B., Milanović, N. (2015). Retrospektiva i izazovi monetarne strategije ciljane inflacije postkriznog perioda. Ekonomski signali: poslovni magazin, Vol. 10 (2), pp. 1-10.

17. Stevanović, S., Milenković, I., (2020), Comparative analysis of the implementation of the inflation targeting monetary strategy in Canada and New Zealand. Ekonomske teme, 58 (3), pp. 401-414.

18. Vilaret, S., Palić, M. (2006). Pass-through efekat deviznog kursa na inflaciju u Srbiji. Narodna Banka Srbije, Working Papers 2006, pp. 1-19.

19. www.bis.org (Preuzeto sa https://www.bis.org/statistics/cp.htm?m=6%7C382%7C678 31/03/2021 )

20. www.ecb.europa.eu (Preuzeto sa https://www.ecb.europa.eu/stats/policy_and_exchange_rates/euro_reference_exchange_rates/html/index.en.html 31/03/2021)

21. https://nbs.rs (Preuzeto sa https://nbs.rs/sr_RS/indeks/ 31/03/2021)