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## INVESTIGATION OF ENGEL-WEST EXPLANATION OF MEESE-ROGOFF PUZZLE ON SERBIA-EUROZONE CASE: *LAG AUGMENTED VAR* APPROACH

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**ABSTRACT:** The study is dedicated to research of Engel-West explanation of Meese-Rogoff puzzle on Serbia-Eurozone case (2004:q4 – 2015:q2). The analysis was conducted by applying lag augmented VAR procedure (*LA-VAR*), which enables quite reliable testing of Granger causality when (some or all) time series are non-stationary without mandatory prior testing of cointegration and differencing thereof. The following Engel et al. [2005] investigation was carried out on bivariate and multivariate VAR models, taking into account five macroeconomic fundamentals (money supply differential, inflation rate differential, interest rate differential, real GDP differential and interaction of money supply differential and real GDP differential). The obtained results demonstrate quite unconvincing indications about empirical validity of present-value exchange rate models, and do not confirm findings of Engel et al. [2005].

**KEY WORDS:** exchange rate, macroeconomic fundamentals, random walk, Granger causality, Meese-Rogoff puzzle

The international economics literature has had Meese-Rogoff puzzle for quite a long time now – as a part of widely formulated *exchange-rate disconnect puzzle* [Obstfeld et al. 2001: 380], which is composed of impossibility to find reliable empirical evidence for the existence of relation between exchange rate and its (macroeconomic) fundamentals implied by theoretical models. Namely, numerous empirical papers have not succeeded in offering sufficiently solid and convincing proofs about the impact of basic macroeconomic variables, such as money supplies, GDP, inflation rate differential and interest

rate differential to exchange rate. Although such impact, according to numerous theoretical models, should have empirical basis, econometric tests have demonstrated that dynamics of exchange rate is quite commonly well approximated by random walk, which makes the use of mentioned macroeconomic fundamentals quite senseless in terms of its forecasting.

Meese et al. [1983a] were the first to indicate this puzzle by testing the accuracy of forecasting of various structural models (Frenkel-Bilson, Dornbusch-Frankel and Hooper-Morton models) and time series exchange rate models (univariate time series models and unrestricted vector auto-regression) out-of-sample. The testing was based on dollar/pound, dollar/mark, dollar/yen and trade-weighted dollar exchange rates. The results obtained demonstrated that random walk model is not at all of lower capability for forecasting compared to the aforementioned structural and time series exchange rate models. In addition, Meese et al. [1983b] have rejected the option that poor performances of the aforementioned structural models can be attributed to inconsistent or inefficient estimation of parameters.

Engel et al. [2005] are of the opinion that despite certain studies developed after the Meese-Rogoff puzzle, which claimed that evidence about out-of-sample exchange rate predictability for various versions of fundamentals-based models had been found, the robustness of empirical results was not confirmed in any way. Inability to obtain consistent and robust results which would empirically corroborate out-of-sample exchange rate predictability inspired Engel et al. [2005] to offer one completely new approach to validation of present-value exchange rates models. Namely, they demonstrated that the exchange rate was arbitrarily well approximated as a random walk if at least one fundamental is I(1) process and if discount factor is close to one. In other words, the exchange rate will follow a process arbitrarily close to a random walk if the following two conditions are fulfilled: (a) at least one explanatory variable (observable or unobservable fundamental) is a non-stationary, and (b) the value of discount factor is close to one.

If the mentioned assumptions are fulfilled, the exchange rate will follow near random walk behaviour, which means that it is virtually unpredictable. This implies the conclusion that weak relation between the exchange rate and fundamentals, known as Meese-Rogoff puzzle, is a consequence of present-value exchange rate models, not the evidence against them. The key question posed by Engel et al. [2005] is how it is possible at all to check validity of the exchange rate theoretical models, provided all the stated is true. Instead of testing the ability of model to relatively precisely predict the future exchange rate dynamics, it is more purposeful to check whether current exchange rate values can be useful for prediction of future fundamentals' values. This approach is fully grounded since the exchange rate is according to present-value exchange rate models determined as a sum of present expected values of observable and unobservable fundamentals. If the model approximate real DGP well, and if expectations credibly reflect future values of fundamentals, current exchange rate values should be useful in prediction of these fundamentals. In other words, if previous conditions are fulfilled, there should be Granger causality from the

exchange rate to macroeconomic fundamentals. Such result is in favour of attitude about the empirical validity of present-value exchange rate models, but it cannot and must not be whatsoever construed as its sound proof. Using the data from G7 member states (1974–2001), treating the USA as a host country, proofs were discovered for Granger causality from the exchange rate to fundamentals. Although it is neither strong, nor convincing, it is far more expressed than the causality in the opposite direction.

Engel et al. [2005] also make strict demarcation line between two basic findings of theirs. The fact is that current exchange rate can be useful predictor for future macroeconomic fundamentals if, according to present-value exchange rate models, the expected values of fundamentals significantly determine the current exchange rate, does not mean that approximate random walk in exchange rates must be dominantly attributed to near unity discount factor. For random walk exchange rates behaviour at least one more explanation can be offered which is fully consistent with present-value exchange rate models, and this is that exchange rate movements are predominantly determined by unobserved fundamentals that follow a random walk.

In this study we tended to check Engel et al. [2005] finding about the presence of Granger causality from exchange rate to macroeconomic fundamentals on Serbia-Eurozone case. In other words, we tested a hypothesis that data for Serbia and Eurozone generate quite convincing indication about the empirical validity of present-value exchange rate models.

The paper consists of five parts. In the first part we exposed the essence of Meese-Rogoff puzzle and Engel-West's explanation of it. The second part contains an overview of literature pertaining to predictability of exchange rate dynamics. The third part includes the essence of theoretical framework on which the Engel-West's explanation of the Meese-Rogoff puzzle is based. The fourth part contains the most important information about data used in testing, as well as results of Granger causality tests. Finally, the fifth part consists of the most significant conclusions of the analysis.

## LITERATURE REVIEW

Numerous authors have tested the predictability of exchange rate dynamics. Cheung et al. [2005] tested the forecasting performance of different exchange rate structural models (interest rate parity, productivity based models and a composite specification), formulated during the 1990<sup>s</sup>, comparing them with two reference models – purchasing power parity model and the sticky-price monetary model. The models were estimated in the form of first differences and error correction specifications, and model performances were evaluated by mean squared error, direction of change metrics, and the “consistency” test of Cheung et al. [1998]. Testing on time horizon of 1, 4 and 20 quarters did not succeed in revealing any model/specification combination which could be characterised as a very successful one. Some models, however, demonstrate good performances in terms of one evaluation measure/exchange rate/time horizon, which is not applicable in other cases.

On the other hand, Mark [1995] has shown that evidence can be found for the presence of economically significant predictable components in long-term variations of exchange rate. Namely, the evidence was obtained based on regression model estimated between long-term changes in exchange rate and current deviation of exchange rate from linear combination of relative money supply and relative real income. Predictability in short term was compromised by the fact that short-term dynamics of exchange rate is determined by noise. Yet, the impact of noise has been averaged out over time, revealing systematic changes in exchange rate determined by economic fundamentals. Kilian [1999] has partially questioned these analyses by presenting own results of the long-horizon exchange rate predictability analysis. Based on them, it can be claimed that there is a kind of predictability of exchange rate, but not that it is better in the case of longer forecast horizons.

Mark et al. [2001] managed to identify cointegration relation between the exchange rate and monetary fundamentals on quarterly panel data for 19 countries (from 1973:q1 to 1997:q1). In addition, monetary fundamentals are characterised by significant predictability of future dynamics of exchange rates, which does not necessarily pertain to the rate vis-à-vis the US dollar only. Yet, this study as well generates a big puzzle which is reflected in the fact that monetary fundamentals have significantly higher predictability potential than the fundamentals covered by PPP.

Bacchetta et al. [2010] were checking whether the cause of Meese-Rogoff puzzle is instability of the relation between nominal exchange rates and macroeconomic fundamentals. Although time-varying parameters imply small probability that relation between the exchange rate and macroeconomic fundamentals, assessed based on a sample, can be successfully used for prediction of exchange rate dynamics in the future, the authors stress one specific effect with the opposite direction action. Namely, there is the fact that time-varying parameters tend to increase the explanatory power of fundamentals. These two influences almost cancel each other so that the net effect of time-varying parameters on out-of-sample forecasting performance of exchange rate models is almost neutral. The final conclusion is that poor out-of-sample fit can be explained by poor rather than instable relation between the exchange rate and macroeconomic fundamentals.

In rich literature dedicated to this matter, there are papers that quite independently suggest out-of-sample exchange rate predictability. Molodtsova et al. [2009] managed to offer evidence about short-term predictability for 11 out of 12 currencies vis-à-vis the US dollar, taking into account the model that incorporates Taylor rule fundamentals. The evidence of out-of-sample exchange rate predictability resulting from Taylor rule models, are far stronger than the evidence obtained by testing of conventional interest rates, purchasing power parity and monetary models.

Yet, Rogoff et al. [2008] greatly shadowed these findings. Investigating the ability of structural theoretical models to predict the exchange rate dynamics in short run, they also concluded that it is quite modest. According to them, key reasons for overstressing the relatively feeble positive results that go in

favour of structural theoretical models are contained in excessive reliance on asymptotic test statistics (Clark-West and Clark-McCracken test statistics), wrong interpretation thereof, as well as on insufficient checking of robustness of results over different forecast windows.

### THEORETICAL FRAMEWORK

Engel et al. [2005: 486] have demonstrated through analytical simulations that findings on unpredictability of exchange rate dynamics are, under certain circumstances, an implication of theoretical asset-pricing present-value models, not an argument that question the validity of these models (“We show analytically that in the class of present-value models we consider, asset prices will follow a process arbitrarily close to a random walk if (1) at least one forcing variable (observable fundamental or unobservable shock) has a unit autoregressive root and (2) the discount factor is near unity.”). Engel et al. [2005: 491–492] have demonstrated in what way the theoretical models of exchange rate can be presented in a form of asset-pricing present-value model, starting from the fact that numerous theoretical structural models mathematically formalise relation between the exchange rate and linear combination of their expected value and different fundamentals. With regard to the afore mentioned, many theoretical models of exchange rate, such as monetary models and Taylor rule model, completely fit in asset-pricing present-value model framework. Monetary model of exchange rate [Engel et al. 2005: 493] can be presented as:

$$s_t = \frac{1}{1+\alpha} \left[ m_t - m_t^* - \gamma(y_t - y_t^*) + q_t - (v_m - v_m^*) - \rho_t \right] + \frac{\alpha}{1+\alpha} E_t s_{t+1}, \quad (1)$$

where  $s_t$ ,  $m_t$ ,  $y_t$ ,  $q_t$ ,  $v_m$ ,  $\rho_t$  respectively stand for log of the exchange rates, log of the money supply, log of output, log of real exchange rate, shock to money demand and risk premium (deviation from uncovered interest rate parity). In addition, denotation “\*” shows that variable refers to foreign country. At the same time Taylor rule model [Engel et al. 2005: 495] can be formulated as:

$$s_t = \beta_0(i_t - i_t^*) + \beta_0(p_t - p_t^*) - \beta_1(y_t^g - y_t^{*g}) - \beta_2(\pi_t - \pi_t^*) - v_t + v_t^* - (1 - \beta_0)\rho_t + (1 - \beta_0)E_t s_{t+1}. \quad (2)$$

Denotations in equation (2) have the following meaning:  $i_t$  – interest rate,  $p_t$  – log of price level,  $y_t^g$  – log of output gap,  $\pi_t$  – log of inflation rate,  $v_t$  – Taylor rule shock and  $\rho_t$  – risk premium. Everything that applies to general asset-pricing present-value model also applies to monetary and Taylor rule exchange rate models. Both conditions needed to enable that the exchange rate follow near random walk behaviour (that at least one fundament is I(1) process or nearly so and that discount factor is close to one) are completely realistic. Namely, Engel et al. [2005: 496–497] provide for overview of literature which

corroborates these assumptions. In addition, the results of unit root tests (theirs and ours) dominantly indicate non-stationarity of observed fundamentals.

Therefore, based on the above stated, it can be concluded that if standard exchange rate models are plausibly calibrated exchange rate should be arbitrarily well approximated as a random walk, so that Meese-Rogoff puzzle is implication of the models, not a proof against them. Yet, simple observation that the exchange rate follows the random walk is not complete and full confirmation of appropriateness of theoretical exchange rate models. Should present-value exchange rate models imply that exchange rate behaves as a random walk, how would it be possible to check empirical validity of the model at all? Taking into account that the exchange rate is determined as a sum of present expected values of observable and unobservable fundamentals, it is logical to expect that present-value exchange rate models imply Granger causality from exchange rates to fundamentals. According to Engel et al. [2005], these models suggest Granger-causality from the exchange rate towards the fundamentals. Detection of Granger-causality accordingly is a result consistent to present-value exchange rate models; however, as concluded by Engel et al. [2005: 512], it is not a strong direct support to these models. Key question in our study is whether there is evidence for Granger-causality from the exchange rate towards the fundamentals. The following chapter of the paper contains results of Granger causality testing on the Serbia-Eurozone case.

#### DATA AND GRANGER CAUSALITY TESTS RESULTS

During the research, quarterly data was used for the period 2004:q4 – 2015:q2 (see table 1). The exchange rate time series ( $s$ ) presented a natural logarithm of end-of-quarter nominal bilateral exchange rate between RSD and euro and was taken from the official website of the National Bank of Serbia. Money supply differential ( $m-m^*$ ) was calculated as the difference between the logarithm of end-of-quarter seasonally adjusted M1 money supply for Serbia and Eurozone. Both series of money supply were taken from website of the reference central banks (National bank of Serbia and European Central Bank). Inflation rate differential ( $p-p^*$ ) is a difference between the logarithm of consumer price index for Serbia and Eurozone with 2006 taken as base period. The series are respectively taken from websites of the Statistical Office of the Republic of Serbia and Eurostat. Interest rate differential ( $i-i^*$ ) was obtained as difference of end-of-quarter interest rate at interbank money market (3m Belibor and 3m Euribor). The series were taken from: [Banke online: Belibor; Euribor-rates.eu: Euribor]. Interest rate differential is the only time series obtained as difference between the original data rather than logarithms, which is in accordance with theoretical model. Real GDP differential ( $y-y^*$ ) is a difference between the logarithm of real seasonally adjusted GDP for Serbia and Eurozone. The series were respectively taken from websites of the Statistical Office of the Republic of Serbia and Eurostat. Finally, interaction of money supply differential and real GDP differential ( $m-m^*-(y-y^*)$ ) was obtained as difference between the money supply differential and real GDP differential.

Table 1. Variables Used in the Empirical Research

Variable	Label	Description
Bilateral exchange rate	s	End-of-quarter
Money supply differential	(m-m*)	Seasonally adjusted money supply (end-of-quarter)
Inflation rate differential	(p-p*)	Consumer price index
Interest rate differential	(i-i*)	3m Belibor and Euribor rate (end-of-quarter)
Interaction of money supply differential and real GDP differential	(m-m*)-(y-y*)	Seasonally adjusted variables (money supply and real GDP)
Real GDP differential	(y-y*)	Seasonally adjusted real GDP

Source: Authors calculation

Unit root testing (see table 2) indicated several very important facts: (a) all first differentials of relevant time series are stationary at 5% significance level, except for first difference of inflation rate differential  $\Delta(p-p^*)$  when it comes to DF-GLS unit root test; (b) inflation rate differential  $(p-p^*)$  and real GDP differential  $(y-y^*)$  are non-stationary series according to all used unit root tests; (c) exchange rate ( $s$ ), money supply differential  $(m-m^*)$  and interaction of money supply differential and real GDP differential  $(m-m^*)-(y-y^*)$  are almost surely non-stationary series taking into account that only KPSS test indicates their stationarity; (d) interest rate differential  $(i-i^*)$  is most probably a stationary series, taking into account that only PP test indicates its non-stationarity. Therefore, the general conclusion of unit root testing is that all series are almost surely I(1) processes, except for the interest rate differential, which is stationary one.

Preliminary testing of cointegration applying Engle-Granger and Johansen's test does not generate robust findings about their presence.<sup>1</sup> Regardless of such findings, unit root tests results open the space for application of lag augmented VAR procedure (*LA-VAR*) [Toda et al. 1995], which enables quite reliable testing of Granger causality when (some or all) time series are non-stationary. By extending VAR( $p$ ) model, i.e. by formulating VAR( $p+k$ ) model, where  $p$  and  $k$  are optimal order of VAR model and greatest order of time series integration, respectively, enables that Wald test statistics is asymptotically chi-square distributed with  $p$  degrees of freedom under the null. Such methodological framework provides possibilities for testing of Granger causality without obligatory prior testing of cointegration and time series differencing.

<sup>1</sup> Results are available from the authors upon request.

Table 2. Unit Root Tests Results

Variable/test	dc	k	ADF	DF-GLS	PP	KPSS
s	c+trend	2	-1.978 (-3.53)	-1.86 (-3.19)	-2.12 (-3.52)	0.10 (0.15)
$\Delta s$	c+trend	1	-5.70 (-3.53)	-5.68 (-3.19)	-4.95 (-3.52)	0.08 (0.15)
(m-m*)	c	1	-1.99 (-2.94)	-1.55 (-1.95)	-2.00 (-2.93)	0.09 (0.46)
$\Delta(m-m^*)$	c	0	-4.37 (-2.94)	-4.00 (-1.95)	-4.36 (-2.94)	0.14 (0.46)
(p-p*)	c+trend	1	-0.26 (-3.52)	-0.45 (-3.19)	-1.34 (-3.52)	0.22 (0.15)
$\Delta(p-p^*)$	c+trend	1	-3.62 (-3.53)	-3.10 (-3.19)	-4.84 (-3.52)	0.06 (0.15)
(i-i*)	c+trend	3	-4.43 (-3.53)	-4.56 (-3.19)	-2.64 (-3.52)	0.06 (0.15)
(m-m*)-(y-y*)	c+trend	4	-2.44 (-3.53)	-2.01 (-3.19)	-2.10 (3.52)	0.10 (0.15)
$\Delta(m-m^*)-\Delta(y-y^*)$	c	0	-5.97 (-2.94)	-3.87 (-1.95)	-5.97 (-2.94)	0.16 (0.46)
(y-y*)	c	3	-0.38 (-2.94)	-0.12 (-1.95)	-0.54 (-2.93)	0.72 (0.46)
$\Delta(y-y^*)$	c	2	-3.28 (-2.94)	-2.54 (-1.95)	-5.07 (-2.94)	0.10 (0.46)

Note: dc represents deterministic components in ADF, DF-GLS, PP and KPSS tests, k the number of lags which aim to eliminate autocorrelation in residuals in ADF. Deterministic components in test regression equations have been determined based on Stock-Watson test. Critical values at 5% significance level are shown in the parentheses. The testing was conducted using software package EViews 5.1.

Source: Authors calculation



Table 3. Bivariate Granger Causality Tests Results

$H_0$	$(m-m^*)^1$	$(p-p^*)^2$	$(i-i^*)^3$	$(m-m^*)-(y-y^*)^4$	$(y-y^*)^5$
Fundament fails to cause exchange rate	—	—	—	**	—
Exchange rate fails to cause fundament	—	**	—	—	***

Note: 1) testing was conducted based on VAR model of third order ( $p=3$ , LM-Stat(10)=7.069(0.132), JB=4.882(0.2997); 2) testing was conducted based on VAR model of the second order ( $p=2$ , LM-Stat(10)=1.494(0.828), JB=3.622(0.4595); 3) testing was conducted based on VAR model of the fourth order ( $p=4$ , LM-Stat(10)=3.411(0.492), JB=2.462(0.651); 4) testing was conducted based on VAR model of the second order ( $p=2$ , LM-Stat(10)=7.591(0.108), JB=0.593(0.964); 5) testing was conducted based on VAR model of the second order ( $p=2$ , LM-Stat(10)=2.361(0.6696), JB=2.989(0.5597); \*\*\* and \*\* represents rejection of null hypothesis at 1% and 5% significance levels. More detailed test results are available at request. The testing was conducted using software package EViews 5.1.

Source: Authors calculation

Bivariate Granger causality testing (see table 3) demonstrates that indications about empirical validity of present-value exchange rate models are quite weak. Namely, in only two out of five cases (inflation rate differential and real GDP differential) Granger causality was discovered as from the exchange rate to the fundament. In addition, Granger causality in opposite direction, from the fundament to the exchange rate, was discovered only in one single case (interaction of money supply differential and real GDP differential).

Furthermore, in accordance with Engel et al. [2005], we have grouped all variables into four groups (group 1:  $(s, (p-p^*), (i-i^*), (y-y^*))$ ; group 2:  $(s, (m-m^*), (y-y^*))$ ; group 3:  $(s, (p-p^*), (y-y^*))$ ; and group 4:  $(s, (m-m^*), (p-p^*), (y-y^*))$ ) so as to carry out multivariate Granger causality tests. The obtained results (see table 4) demonstrate the presence of causality of exchange rate towards fundaments in only three out of ten cases, while causality is present in the opposite direction only in one case.

While weak causality from the fundament to the exchange rate is expected and suitable for Meese-Rogoff puzzle, causality in the opposite direction should, according to findings of Engel et al. [2005], be more significantly present and should indicate empirical validity of present-value exchange rate models. Yet, this research indicates quite the opposite conclusion. Causality from the exchange rate to the fundaments is only slightly more represented than causality in the opposite direction, which is insufficient to empirical validity of present-value exchange rate models. In other words, the exposed results do not confirm the findings obtained by Engel et al. [2005].

Table 4. Multivariate Granger Causality Tests Results

H <sub>0</sub> : Fundament fails to cause exchange rate				
	Group 1	Group 2	Group 3	Group 4
(m-m*)		—		—
(p-p*)	—		—	*
(i-i*)	—			
(m-m*)-(y-y*)				
(y-y*)	—	—	—	—
All	—	—	—	—
H <sub>0</sub> : Exchange rate fails to cause fundament				
(m-m*)		—		—
(p-p*)	—		—	—
(i-i*)	**			
(m-m*)-(y-y*)				
(y-y*)	**	—	—	***

Note: group 1) testing was conducted based on VAR model of fourth order ( $p=4$ , LM-Stat(10)= 22.600(0.125), JB= 4.144(0.844); group 2) testing was conducted based on VAR model of the eighth order ( $p=8$ , LM-Stat(10)= 10.027(0.348), JB= 9.281(0.158); group 3) testing was conducted based on VAR model of the seventh order ( $p=7$ , LM-Stat(10)= 8.830(0.453), JB= 4.420(0.620); group 4) testing was conducted based on VAR model of the second order ( $p=2$ , LM-Stat(10)= 18.000(0.324), JB= 5.213(0.735); \*\*\*, \*\* and \* represents rejection of null hypothesis at 1%, 5% and 10% significance levels. More detailed test results are available at request. The testing was conducted using software package EViews 5.1.

Source: Authors calculation

## CONCLUSION

There is no doubt that the obtained results instruct the rejection of baseline hypothesis that data for Serbia and Eurozone generate quite convincing indication about the empirical validity of present-value exchange rate models. Namely, testing of non-stationarity of quarterly time series (2004:q4 – 2015:q2) for Serbia and Eurozone generated the results which clear the room for the application of lag augmented VAR procedure, based on simple increase of order of time lags in VAR model for the greatest order of time series integration. This procedure enables that Wald test statistics is asymptotically chi-square distributed with  $p$  degrees of freedom under the null, which allows testing of Granger causality at time series level (without prior cointegration testing), even when series are of different integration levels. Following Engel

et al. [2005], intending to implement relatively unstructured investigation of connection between the exchange rate and macroeconomic fundamentals, testing was based on bivariate and multivariate VAR models. The obtained results demonstrate quite inconvincible indications about empirical validity of present-value exchange rate models. Namely, Granger causality from the exchange rate to the fundement was discovered only in five out of a total of fifteen cases. Causality in opposite direction was located only in two cases which is expected taking into account the Meese-Rogoff puzzle. Such findings are significantly opposite to results obtained by Engel et al. [2005] for G7 countries, treating the USA as a host economy.

The obtained results doubtlessly confirm the existence of the Meese-Rogoff puzzle in Serbia-Eurozone case, which is in accordance with most empirical researches implemented on the samples of other countries. The key finding of this paper is that there is no convincing robust findings that present-value exchange rate models are valid in the observed case. Regardless of whether we accept the Engel-West explanation of Meese-Rogoff puzzle as accurate, predictability of exchange rate dynamics is very weak. Engel-West explanation tells us that this should be accepted as a consequence of the present-value exchange rate models, not as a proof that would question their validity. Taking into account no robust evidence for Granger causality from the exchange rate to the fundaments have been found, the results of this analysis challenge the Engel-West explanation, which could indicate irrelevance of present-value exchange rate models. Yet, when drawing such conclusions, one should be very careful, bearing in mind that the research was conducted only for the Serbia-Eurozone case. The check of robustness of obtained results should be carried out on an extended sample of countries, which is not subject of this analysis. Although results of this research do not have direct applicability and use value for policy makers, they warn that Engel-West explanation of Meese-Rogoff puzzle cannot be *a priori* accepted as relevant one, at least not in Serbia-Eurozone case.

The significance of this study is contained in the fact that this is the only empirical research known to the authors related to Engel-West explanation of Meese-Rogoff puzzle on Serbia-Eurozone case. Yet, it should be stated that there is a lack that commonly and reasonably appears when it comes to researches conducted for Serbia. There is no doubt that these are quite short time series which, regardless of the application of *LA-VAR* procedure, actuate the small-sample bias problem. Elimination of this lack by employing the residual-based bootstrap method in order to derive bootstrap distribution [Ko et al. 2015] could be a guideline for future researches.

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ИСПИТИВАЊЕ ЕНГЛ-ВЕСТОВОГ ОБЈАШЊЕЊА МЕСЕ-РОГОФОВЕ  
НЕДОУМИЦЕ НА СЛУЧАЈУ СРБИЈА–ЕВРОЗОНА:  
*LAG AUGMENTED VAR* ПРИСТУП

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**РЕЗИМЕ:** У литератури из области међународне економије прилично дуго фигурише „Meese-Rogoff puzzle” – као део шире формулисане „exchange-rate disconnect puzzle”, која се састоји у немогућности изналажења поузданих емпиријских доказа о постојању релације између девизног курса и његових (макроекономских) фундамената која проистиче из теоријских модела. Наиме, бројни емпиријски радови нису успели да понуде довољно чврсте и убедљиве доказе о утицају основних макроекономских варијабли попут понуде новца, БДП-а, инфлационог диференцијала и диференцијала каматних стопа на девизни курс. Иако би, сходно бројним теоријским моделима, овакав утицај требало да има емпиријско утемељење, економетријска тестирања показују да је динамика девизног курса веома често добро апроксимирана случајним ходом, што употребу поменутих макроекономских фундамената у циљу његовог предвиђања чини прилично бесмисленом. Немогућност добијања конзистентних и робусних резултата који би емпиријски поткрепили предвидивост девизног курса инспирисала је Енгла и др. [2005] да понуде један потпуно нови приступ валидацији модела девизног курса заснованих на садашњим вредностима. Наиме, они су показали да је девизни курс добро апроксимиран случајним ходом уколико је барем један фундамент  $I(1)$  процес и ако је вредност дисконтног фактора блиска јединици. Другим речима, девизни курс прати процес близак случајном ходу уколико су задовољена следећа два услова: (а) да је најмање једна експланаторна варијабла нестационарна и (б) да је вредност дисконтног фактора приближно једнака јединици. Уколико су поменуте претпоставке задовољене динамика девизног курса се може апроксимирати случајним ходом, што значи да је готово непредвидива. Ово имплицира закључак да је слаба веза између девизног курса и фундамената, позната као „Meese-Rogoff puzzle”, последица теоријских модела заснованих на садашњим вредностима, а не доказ против њих. Уместо да се тестира способност модела да релативно прецизно предвиде динамику девизног курса, целесходније је проверити да ли текуће вредности девизног курса могу бити корисне за предвиђање будућих вредности фундамената. Овакав приступ је потпуно основан имајући у виду да је девизни курс сходно моделима девизног курса заснованим на садашњим вредностима детерминисан као сума садашњих очекиваних вредности фундамената. Другим речима, требало би да постоји Грејнцорова узрочност од девизног курса према макроекономским фундаментима. У овој студији смо настојали да проверимо Енглоу и др. [2005] налаз о присуству Грејнцорове узрочности

од девизног курса према макроекономским фундаментима на примеру Србије и Еврозоне. Резултати до којих се дошло показују прилично неубедљиве индиције о емпиријској валидности модела девизног курса заснованих на садашњим вредностима. Наиме, само у пет од укупно петнаест случајева откривена је Грејнцорова узрочност од девизног курса ка фундаменту. Узрочност у обрнутом смеру лоцирана је једино у два случаја.

КЉУЧНЕ РЕЧИ: девизни курс, макроекономски фундаменти, случајни ход, Грејнцорова узрочност, Месе-Рогофова недоумица