INTEREST RATE PASS-THROUGH IN SERBIA: AN ASYMMETRIC THRESHOLD COINTEGRATION ANALYSIS

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ABSTRACT

The aim of this analysis is to test the long run relationship between the monetary policy rate and different bank lending interest rates in Serbia and to estimate how much of the changes in bank lending rates can be attributed to changes in the key monetary policy rate and the money market interest rate. We look at the period from January 2007 to December 2014.

Estimation results suggest that there is a signifficant long run relationship between bank lending rates and money market rates. However, interest rate pass-through in Serbia appears to be incomplete for both corporate and household lending rates.

In order to test the possibility of asymmetric adjustment of lending rates, we implemented asymmetric TAR and MTAR cointegration models used by Enders and Siklos (2001). Results of analysis suggest nonlinear adjustment of household lending rate, while in the case of corporatate rates it is not detected.

Key words: *Monetary Policy, Monetary Transmission Mechanism, Interest Rate Pass-Through, Asymmetric Threshold Cointegration.*

JEL Classification: *C22, C51, E43, E52*

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INTRODUCTION

The main objective of most central banks is maintaining a low and stable rate of inflation in order to provide good environment for sustainable economic growth. In order to achieve this goal central banks adjust their official short term interest rates. In the first stage of transmission process the official rates affect money market rates, and in the second stage the money market rates influence retail bank interest rate. Finally, the level of deposit and lending rates influeces the real economic activity (consumption and investment).

Since the inflation targeting is the monetary policy strategy in Serbia how fast and to what extent a change in the central bank interest instrument modifies inflation is of the great importance to the monetary authority. Therefore, the monetary authority necessarily has to analyze monetary transmission mechanism through different channels, where estimating the interest rate pass-through effect on economic activity and inflation has become crucial.

Interest rate pass-through could be defined as a speed of adjustment of lending and deposit bank rates to monetary policy interest rate. Higher interest rate pass-through indicate more effective interest rate channel. Complete pass-through means that changes in policy rates are totaly transferred to banking retail rates and monetary policy decisions can be implemented successfully by central banks. Such a pass-through mechanism indicates the effectivness of interest rate channel in establishing price stability and strong banking system.

Most of the empirical studies based their analysis on assumption that each change of key policy rate will be reflected in the changes in money market rates, bank lending rates, and bank deposit rates. Therefore, there is a long-run equilibrium among market rates and monetary policy rates. Although theoretically the pass-through is expected to be close to one, most empirical studies on different countries have found incomplete interest rate pass-through, even in the long run. Possible explanation of this phenomenon is some imperfection of markets, such as the lower degree of competition among banks, presence of asymmetric information, etc.

The aim of this analysis is testing the long-run relationship between the monetary policy rate and different bank lending interest rates in Serbia. Our aim is to estimate how much of the changes in bank lending and deposit rates can be attributed to changes in the key monetary policy rate and money market interest rates. The dataset consist of monthly per annum average interest rates on new business corporate and household loans on monthly basis covering period from January 2007 to December 2014.

The paper is organized as follows. The next section provides rationales for an asymmetric interest rate pass-throug in general. Section 3 describes the data and the methodology. The estimation results are presented in Section 4. Finally, Section 5 concludes.

EXPLANATIONS OF ASYMMETRIC INTEREST RATE PASS-THROUGH

Empirical studies show that a transmission process from the central bank interest rate to the retail bank interest rate is incomplete and may be asymmetric. The change of certain economic indicators may cause an asymmetric adjustment process. First, it is the level of economic growth. In case when high levels of economic growth are observed, it is easier for banks to adjust lending and deposit rates. Subsequently, the demand for loans is higher and banks are more inclined to limit it by greater increases of their lending rates. Moreover, when the output gap is positive and high inflation occurs, the prices are usually adjusted more frequently and more completely in the whole economy, as well as in the banking sector.

On the other hand, higher market rate volatility connected with increased uncertainty lessens the size and the speed of pass-through. In other words, the level of pass-through is influenced by commercial banks' perception whether the change in policy rate is temporary or permanent. In times of higher policy rate or market rate volatility, banks wait to observe whether the changes in these rates are temporary before adjusting retail rates. In cases when the change is considered to be temporary, banks opt not to change interest rates in order to avoid so called menu costs (costs of adjusting interest rates to changes in policy rate). Cross-country studies confirm the abovementioned (see Cottarelli and Kourelis,1994; Mojon,2000; Sander,Kleimer,2004a, 2006).

Complete interest rate pass-through may not prevail in the presence of asymmetric information (adverse selection and moral hazard). Stiglitz and Weiss (1981) argue that increasing lending rate attract borrowers with higher risk preferences since they accept higher rates as their projects have higher expected return. Therefore, although it seems to be profitable, banks might be unwilling to increase lending rates.

The imperfect substitution between bank deposits and other money market and capital market instruments may cause slower interest rate pass-through. The degree of disintermediation and the availability of non-bank financing options affect the pass-through through the increase of elasticity of loan demand and deposit supply to changes in key policy/money market rate. Namely, in developed capital and money markets, companies do rely not only on loans, but also on other, non-bank financing instruments what makes the loan demand more sensitive to changes in interest rates. On the other hand, existence of alternative investment options to deposits affects the elasticity of deposit supply to change in interest rates.

Intensity of competition among banks also influences interest rate elasticity. Low degree of competition among banks and other financial institutions usually results in lower interest rate pass-through (Kot,2004), while higher level of competition among banks appears to cause faster interest rate pass-through (Gropp et al., 2007). According to the structure-conduct-performance hypothesis the level of concentration is inversely related to the degree of competition, because high level of concentration encourages firms to collude. Sørensen and Werner (2006)

show that the level of concentration has negative impact on the speed of interest rate pass-through in the Euro area. Whereas, Corvoisier and Gropp (2001), by investigating the role of concentration in banking sector in Euro zone, find that when an increase in concentration is observed, banks set less competitive rates on loans and demand deposits but not on savings and time deposits. Furthermore, there is a theory in which bank customers can be distinguished as sophisticated and as unsophisticated (Rossen, 1995). The more unsophisticated customers in the market may cause lower and sluggish interest rate pass-through and less pressure for banks to be competitive. Also, the expectation of market participants might play an important role. Becker et al. (2010) point out that some banks may wait adjusting their rates for a sequence of small changes to accumulate or for a large change of money market rates.

Level of capitalization and liquidity position of the bank may influence interest rate pass-through as well. Well-capitalized banks and banks with better liquidity position are less forced to adjust to changes in monetary policy. On the contrary, less liquid and less capitalized banks will adjust their rates faster and in a higher extent, since they rely more on market borrowing and have less ability to neutralize the effects of changes in market rate.

Banks' assets quality can also influence the pass-through. Namely, banks with weak balance sheets may react to expansive monetary policy not by extending new loans at lower rates, but with improving their liquidity position. In other words, already exiting NPLs crowd out new loans (see Saborowski,Weber,2013).

More general factors related to country's institutional and financial structure, such as absence of short-term instruments market, existence of entry barriers and restrictions on international capital flows, public ownership in banking system, etc., also have impact on the speed and size of pass-through.

DATA AND METHODOLOGY

DATA

To examine the interest rate pass-through mechanism in Serbia, we employed average yearly interest rates on new business corporate (C) and household (H) total loans on monthly basis. As a proxy of monetary policy rates we use central banks key policy rates (RR), as well as one/two week maturity money market rate BELIBOR (MMR). Our data set covers the period from January 2007 to December 2014. All data series are taken from National bank of Serbia website.

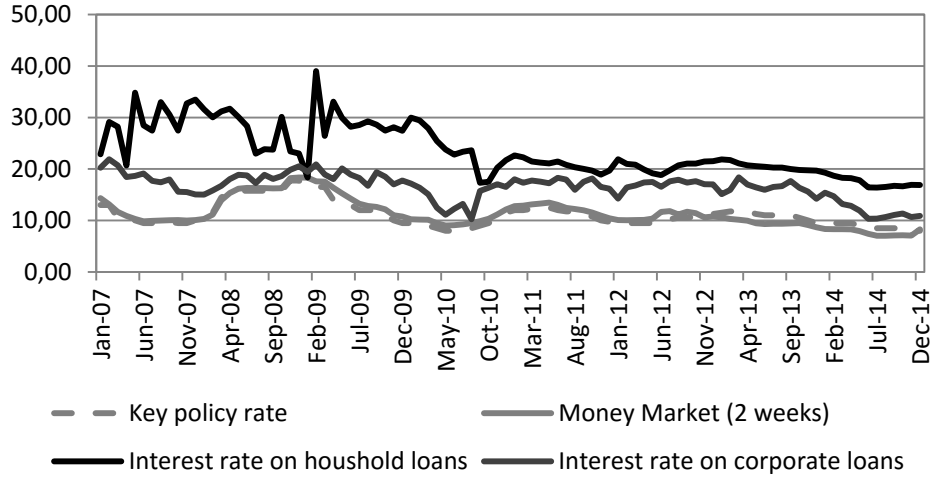

Figure 1: Interest rates in Serbia

Source: National bank of Serbia

Figure 1 shows that the short-term money market rates generally mirrored the key policy rate. Key policy rate movements were followed by moving money market rates and lending rates in the same direction, although relationship between lending rates on household loans and monetary policy actions is less evident. However, for more precisely conclusion, we need to test and estimate long run relationship.

ECONOMETRIC METHODOLOGY

Taking the standard Engle-Granger approach as benchmark, this section describes the TAR and MTAR type of cointegration test of Enders and Siklos (2001) along with the nonlinear ECMs within the context of the interest rate pass-through.The standard two-step Engle-Granger (1987) procedure developed for linear time series models requires OLS estimation of the long-run equilibrium relationship in the form:

$$i_t^l = \alpha + \beta i_t^{mmr} + u_t \quad (1)$$

where *mmr* and i^l_t refer to the money market and lending rates, respectively, and u_t is the stochastic disturbance term measuring the deviation of the lending rate from its equilibrium path. Coefficient α measures the mark-up (or down), β represent the degree of the pass-through in the long-run, with complete pass-through indicated by $\beta = 1$ and incomplete pass-through by $\beta < 1$. The second step of the Engle-Granger approach involves testing for the presence of cointegration, i.e. stationary of the u_t sequence, through the OLS estimation of the equation:

$$\Delta u_t = \rho u_{t-1} + \sum_{i=1}^{p} \lambda_i \Delta u_{t-i} + \nu_t \tag{2}$$

where ρ is the required number of lagged changes of Δut that ensures an iid structure for the disturbance term, νt. Rejecting the null hypothesis of ρ = 0 implies stationarity of ut , namely existence of long-run equilibrium between the money market and lending rates.

The traditional cointegration test overlooks the possibility of asymmetric adjustment. To address this problem Enders and Siklos (2001) propose a specification of asymmetric threshold autoregressive model by extending the Engle-Granger two step procedure with threshold autoregressive (TAR) model, as:

$$\Delta u_t = \rho_1 M_t u_{t-1} + \rho_2 (1 - M_t) u_{t-1} + \sum_{i=1}^{p} \lambda_i \Delta u_{t-i} + \nu_t \tag{3}$$

$$\text{where } M_t = \begin{cases} 1 \ if \ u_{t-1} \geq \tau \\ 0 \ if \ u_{t-1} < \tau \end{cases} \tag{4}$$

M_t is called the Heaviside indicator, ρ_1 and ρ_2 represent the speed of adjustment coefficients in two regimes, τ is the value of threshold.

Stationarity of u_t requires $\rho_1 < 0$ and $\rho_2 < 0$ and $(1+\rho_1)(1+\rho_2) < 1$. If u_{t-1} is above the threshold, the adjustment is measured by $\rho_1 u_{t-1}$, while if u_{t-1} is below the threshold, the adjustment is measured by $\rho_2 u_{t-1}$. For a threshold close to zero, $|\rho_2| > |\rho_1|$ implies sluggish downward adjustment in the lending rate, while for the cases where the τ is significantly different from zero this reflect that interest rate adjust differently to disequilibrium once a certain minimum deviation is exceeded, as stated by Sander and Kleimeirer (see Yildirim, 2012).

Enders and Siklos (2001) also propose momentum threshold autoregressive model (MTAR) which suppose that adjustment depends on changes in the disequilibrium, where the indicator function becomes:

$$M_t = \begin{cases} 1 \ if \ \Delta u_{t-1} \geq \tau \\ 0 \ if \ \Delta u_{t-1} < \tau \end{cases} \tag{5}$$

In both TAR and MTAR models, the null hypothesis of cointegration is testing by non-standard F test, denoted as Φ .

Once the threshold cointegration is established, one can use nonlinear threshold ECM (error correction model) to capture the short run and long run dynamics of money market and lending rates as:

$$\Delta i_t^l = \varphi_{10} + \sum_{i=1}^{p} \varphi_{1i} \Delta i_{t-i}^l + \sum_{i=1}^{p} \delta_{1i} \Delta i_{t-i}^{mmr} + \gamma_{11} M_t u_{t-1} \gamma_{12} (1 - M_t) u_{t-1} + \nu_{1t} \tag{6}$$

Where v_{1t} is the *idd* disturbance term with zero mean and constant variance, $u_{t-1} = \Delta i^{l}_{t} - \alpha - \beta mmr_{t-1}$, γ_{11} and γ_{12} are the error correction terms or speed of adjustment to the long-run equilibrium, M_t is the Heaviside indicator function which has form of (4) and (5) for TAR and MTAR type ECMs, respectively. The parameters φ_i and δ_i indicate short-run dynamics, with rejection of the null of $\delta_i = 0$, suggesting Granger-causality from the money market rate to lending rate. To test for the validity of this assumption Yildirim (2012) re-form the nonlinear ECM in equation (6) by setting money market rate as the dependent variable:

$$\Delta i^{mmr}_{t} = \varphi_{20} + \sum_{i=1}^{p} \varphi_{2i} \Delta i^{mmr}_{t-i} + \sum_{i=1}^{p} \delta_{2i} \Delta i^{l}_{t-i} + \gamma_{21} M_t u_{t-1} \gamma_{22} (1 - M_t) u_{t-1} + v_{2t} \quad (7)$$

In this context, the weak exogeneity assumption is supported when the money market rate does not respond to the disequilibrium error terms, with insignificant γ_{21} and γ_{22} coefficients, but may still be influenced by lagged changes in the lending rate as stated by Engle, Hendry and Richard (see Yildirim, 2012).

ESTIMATION RESULTS

UNIT ROOT TEST

Before starting our analysis, unit root test is done to check stationarity of the series. We use standard test: Augmented Dickey-Fuller (ADF) test (see Dickey and Fuller (1979), Dickey and Fuller (1981), Said and Dickey (1984)), Philips-Perron (PP) test due to Philips-Perron (1988) and Kwiatkowski, Philips, Schmidt and Shin (KPSS) test due to Kwiatkowski et al. (1992) to detect if the variables are non-stationary with stationary first differences. As the null hypothesis: ADF and PP test have unit root, whereas KPSS has stationarity. Critical values for ADF and PP are taken from McKinnon (1996), while for KPSS from Kwiatkowski et al. (1992).

In the ADF test Akaike Information Criterion (AIC) is used to indicate the lag length. Whereas for the PP and KPSS test we use bandwidths are chosen according to Newey-West using Bartlett kernel estimation method. Jönsson (2006) suggested using the Bartlett kernel estimation method while performing the KPSS test for small samples.

According to Table1 and Table 2, existence of unit root cannot be rejected for all series. However, after taking the first differences, the ADF and PP tests shows that series are stationary at 1% significance level so that all series are integrated of order 1, I(1). Results of KPSS test in Table 3 show that the null hypothesis of statinarity is rejected for all series. Since all these tests have low power with short time spans of data we decided to rely on the results indicated by majority of the test (i.e. at least two).

Table 1: ADF unit root test results

ADF Test Statistic			ADF Test Statistic		
Level	Lag	Trend and Intercept	First difference	Lag	Trend and Intercept
C	1	-2.55	C	0	-11.69
H	3	-3.69	H	0	-17.66
RR	1	-2.18	RR	2	-3.53
MMR	1	-2.78	MMR	2	-3.81

Note: The critical values are: -4.05,-3.45, -3.15 at 1%, 5% and 10% statistical significance, respectively

Table 2: Philips-Perron unit root test results

Philips-Perron Test Statistic			Philips-Perron Test Statistic		
Level	Bandwidth	Trend and Intercept	First difference	Bandwidth	Trend and Intercept
C	3	-2.85	C	1	-11.71
H	4	-7.77	H	17	-30.40
RR	5	-2.22	RR	5	-6.83
MMR	5	-2.24	MMR	1	-4.76

Note: The critical values are: -4.05,-3.45, -3.15 at 1%, 5% and 10% statistical significance, respectively.

Table 3: KPSS unit root test results

KPSS LM Test Statistic			KPSS LM Test Statistic		
Level	Bandwidth	Trend and Intercept	First difference	Bandwidth	Trend and Intercept
C	6	0.09	C	2	0.05
H	6	0.07	H	7	0.35
RR	7	0.06	RR	5	0.05
MMR	7	0.08	MMR	5	0.04

Note: The critical values are: 0.21, 0.14, 0.11 at 1%, 5% and 10% statistical significance,respectively.

RESULTS OF THE ENGLE-GRANGER COINTEGRATION TEST

Results of Engle-Granger cointegration test are presented in Table 4. The results of the Engle-Granger cointegration test are reported for each lending rate. The null hypothesis of no cointegration is rejected at the 1 percent significance level for new business corporate loans, while existence of the long run relationship is not supported for new business loans to household. However, not only with respect to structure of monetary mechanism, but also with regard to Chart 1, a strong evidence of cointegration is anticipated for each lending rate. Since the Engle-Granger cointegration test have low power if adjustment to the equilibrium

is asymmetric, we rely on the TAR and MTAR type of cointegration test that account for potential nonlinear nature of the long run relationship between the lending rates and the money market.

Table 4: Results of Engle-Granger cointegration test for lending and money market rates

New business loans to household		New business corporate loons	
B	-0.78***	*β*	0.68***
test statistics of ADF unit root test for residuals	-2.41	*test statistics of ADF unit root test for residuals*	-3.53***

*Source: Author's calculations. Significance levels are denoted as *, **, *** for 10%, 5% and 1%, respectively.*

RESULTS OF THE TAR AND MTAR TYPE COINTEGRATION TEST

In order to examine the interest rate pass-through mechanism in Serbia, we first regress the each banking retail rate on the money market rate separately and then model residual according to TAR specification. The result of cointegration test and symmetric adjustment test are shown in Table 5. Regarding the TAR type cointegration at the 5% significance level, the null hypothesis of no cointegration, $\rho_1 = \rho_2 = 0$ is not rejected for both lending rates, i.e. it is found that cointegration does not exists between the policy rate and loan rates.

Table 5: Results of TAR cointegration test for lending and money market rates

Household loans		Corporate loans	
ρ_1	-0.139	ρ_1	-0.164
ρ_2	-0.658**	ρ_2	-0.247**
P	4	*p*	2
T	-1.125	τ	-1.807
Φ	4.210	Φ	3.421
$\rho_1 = \rho_2$	5.362	$\rho_1 = \rho_2$	0.338

*Note: Only lending rate equations are displayed. A set of critical values for F statistic provided by Enders and Siklos (2001); 5.98 for 5% significance level and 8.24 for 1% significance level. **denotes significance at the 5% level.*

Next, we perform the same analysis using MTAR specification to test possible asymmetric behavior between the expansionary and concretionary divergence of the lending rates series from their long run equilibrium. The test results of cointegration relationship are presents in Table 6. Turning to the MTAR cointegration test, the null of hypothesis of no cointegration, $\rho_1 = \rho_2 = 0$ is rejected at the 1% significance level for loans to households, i.e. there is a long term

relationship between policy rate and the loan rate. F statistic for the symmetric adjustment test indicates that there is an asymmetric adjustment between loans to households and the money market rate.

Table 6: Results of MTAR cointegration test for lending and money market rates

Household loans		Corporate loans	
ρ_1	-0.013	ρ_1	-0.136
ρ_2	-0.607***	ρ_2	-0.447***
P	1	p	2
T	-1.355	τ	-1.198
Φ	15.2402***	Φ	5.119
$\rho_1 = \rho_2$	11.015***	$\rho_1 = \rho_2$	3.505

*Note: only lending rate equations are displayed. A set of critical values for F statistic provided by Enders and Siklos (2001); 6.51 for 5% significance level and 8.78 for 1% significance level. *** denotes statistical significance at the 1% level.*

Next we proceed with estimation of MTAR type nonlinear EC model. Estimation result for loans to households are reported in Table 7. Results suggest that there is long run relationship between the rate on loans to households and the money market rate. Loan rate show slower convergence for positive discrepancies from long-run equilibrium arising from a decrease in the money market rate supporting downward rigidity. Indeed, loan rate adjust to money market rate decreases with the speed of adjustment parameter being - 0.019. Moreover it exhibits the speed of adjustment of -0.571 following money market increases. This indicated the lack of deep financial system as well as domination by commercial banks in financial system of Serbia.

Table 7: Results of estimated threshold error-correction model

Household loans rate	
$\rho 0$	-0.045
$\rho 1$	-0.504***
$\delta 1$	-0.088
$\gamma 1$	-0.019
$\gamma 2$	-0.571

*Note: only lending rate equations are displayed. *** denotes statistical significance at the 1% level.*

CONCLUSION

In this paper we have analysed the long-run relationship between the monetary policy rate and different bank lending interest rates in Serbia and tested how much of the change in bank lending rates can be attributed to changes in the key monetary policy rate and money market interest rate. As Özkan (2003) point out, the monetary transmission mechanism is highly related to efficiency of the

implementation of monetary policy. Thus, analysis of interest rate pass-through of great importance. Kwapil and Scharler (2006) mentioned that the adjustment degree between the monetary policy rate and retail banking interest rates is important factor that determines the relationship between the monetary policy action and the aggregate demand and the inflation.

We analyze asymmetric interest rate pass-through and monetary transmission mechanism in Serbia using Asymmetric TAR and MTAR cointegration models. Results of empirical analysis confirm statistically significant long run relationship between monetary policy rates and lending rates and shows that central bank in inflation targeting in Serbia have control over banking lending rates. The threshold error correction models reveal further downward rigidity of lending rate, implying a reduction in money market rate, following a monetary policy expansion affects the economy differently from a monetary policy contraction, probably due to the shallowness of financial system as well as and domination by commercial banks in financial system in Serbia.

From the perspective of the effectiveness of monetary policy, possible explanations of incompleteness of interest rate pass-through effect are lower level of competition, increase of risk premium, and interest rate volatility during the crisis period, inflation slowdown and keeping key policy rates at low levels, greater reliance on foreign funding, higher level of NPLs, higher level of dollarization, etc.

The findings of incomplete and/or asymmetric interest rate pass-through may create challenging issues if policy makers don't recognized the actual structure of mechanism but rely on the assumption of complete and symmetric interest rate pass-through.

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