INTEREST RATE PASS-THROUGH IN SERBIA: EVIDENCE FROM INDIVIDUAL BANK DATA

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Interest rate pass-through in Serbia: evidence from individual bank data

Mirjana Miletić, Aleksandar Tomin, Andjelka Djordjević

Abstract: The paper considers interest rate pass-through in Serbia, based on evidence from individual bank data. Analysis was conducted for the period from September 2010 to May 2021 using panel cointegration tests and estimates obtained by the fully modified ordinary least square method (FMOLS), dynamic ordinary least square method (DOLS), pooled mean group method (PMG) and mean group method (MG).

Estimation results suggest that there is a significant long-run relationship between bank lending rates in national currency and rates in the domestic money market. Interest rate pass-through from money market to rates on dinar loans is complete for both corporate and household loans, whereas the reaction is stronger and faster in case of corporates, as they have more alternative sources of finance than households. Estimates obtained by the FMOLS, DOLS, PMG and MG methods are quite similar, indicating the robustness of the results. The pass-through estimation is also performed for the shorter period – September 2010 to end-2014, with results suggesting the interest rate channel gained more strength over time, thanks to the increasing interbank competition, higher economic growth, and more favorable macroeconomic prospects of the economy. Statistically significant impact of the risk premium measured by EMBI on dinar corporate loans is also confirmed. Given the fact that around two thirds of loans are FX-indexed, we have estimated the influence of 3M and 6M EURIBOR to rates on euro-indexed corporate and household loans. Long-run relationship and statistically significant impact of country risk premium on euro-indexed interest rates is also confirmed, along with the high pass-through of EURIBOR.

In addition, we tested whether interest rate pass-through is affected by some individual bank characteristics such as size, strength of deposit base, liquidity, quality of credit portfolio, capital position and the share of dinar loans in total loans.

Key words: interest rate pass-through, panel, monetary transmission mechanism.
JEL Code: C32, C33, E43.

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Non-Technical Summary

In developed market economies the interest rate channel is the most important transmission mechanism channel. Therefore, it is important for every central bank to assess its efficiency – the speed at which bank lending and deposit rates adjust to changes of the monetary policy rate. Generally, monetary transmission process encompasses two phases. In the first phase, change in the reference rate is transmitted to the money market rates and is largely dependent on yield curve stability. In the second phase, money market rates carry forward to lending and deposit interest rates as they represent opportunity cost or the cost-of-funds. In theory, in the long run the change in the policy rate should completely transmit to a change in lending interest rates. However, different factors such as asymmetric information, imperfect substitution, level of competition among banks, macroeconomic conditions etc. can hamper its full transmission.

Many empirical studies on interest rate pass-through are available and they differ in scope, geographical dimension, estimation method, time dimension, selection of exogenous variable, etc. However, all of them tackle the same two questions – the degree and the speed of the pass-through – and the results vary across countries and bank products. This heterogeneity could be explained by different factors – degree of competition among banks, banking system ownership, monetary policy regime, development of money market and financial system, openness of the economy, legal and cultural differences etc.

Comparable and consistent time series of bank lending rates on new business loans for Serbia start from September 2010. That was the main reason why we opted for panel method in examining the pass-through of money market interest rates to various bank interest rates. Though interest rate pass-through in Serbia had been already touched, this is the first time it has been examined from individual bank level. This was an additional stimulus for us as this kind of analysis is quite scarce in the available empirical literature. So far it was conducted for some individual euro area and non-euro area countries (Germany, Italy, Belgium, Poland, and Turkey). Generally, they found almost complete long-run pass-through, but incomplete and heterogeneous size and speed of adjustment in the short run. Our findings are similar, suggesting that there is a significant long-run relationship between bank lending rates in national currency and money market rates.

We also investigated the transmission process of this segment of credit market by examining the relationship between EURIBOR and interest rates on new euro-indexed business loans. The results are similar to those for dinar loans. High long-term coefficients and almost complete pass-through are found for both corporate and household loans, with significant impact of the risk premium, measured by EMBI. Looking by the type of loans, the pass-through is stronger for corporate loans as current assets and investment loans have higher coefficients than housing loans.

The size and speed of the pass-through are also determined by individual bank characteristics (size, strength of deposit base, quality of credit portfolio, capital position, liquidity and share of dinar loans in total loans), which we examined in the second phase of our analysis, by grouping banks into two clusters. The results suggest that the long-term adjustment is complete for corporate and household lending rates, with mixed results between clusters in terms of the speed of adjustment. In the case of household sector, adjustment is faster for banks with smaller balance sheet assets, while well-capitalized banks, banks with higher non-performing loans and a higher share of deposits in total liabilities tend to adjust more slowly. As for corporates, the adjustment is faster for less capitalized, more liquid banks, banks with a higher deposit base and lower non-performing loan ratios.

Contents

1 Introduction

Inflation targeting is the main monetary policy strategy in large number of countries. As central banks of those countries tend to achieve the inflation target by changing the interest rate applied in their main monetary policy operations, the analysis of the monetary transmission mechanism through different channels becomes crucial for monetary authorities, while estimating the interest rate pass-through effect on the real economy has an important role.

Interest rate pass-through could be defined as the degree to which changes of central bank key policy or market rates transmit onto retail bank rates (lending and deposit bank rates). A higher interest rate pass-through indicates a more effective interest rate channel, where complete pass-through means that changes in policy rates are fully transferred to retail bankrates. Besides, the size of the interest rate pass-through is an indicator of the degree of competition among commercial banks in the credit market. Thus, the interest rate pass-through is important not only for monetary policy, but also for financial stability.

Many empirical studies based their analysis on the assumption that a long-run equilibrium among market and monetary policy rates exists. The underlying assumption of this relation is that banks set their interest rates in relation to the marginal cost of funding, which is approximated by the money market rate. In the next step, the relationship between lending interest rates and money market interest rates is been estimated. However, a lot of empirical studies conducted on different countries' data have found incomplete interest rate pass-through with the imperfection of markets, lower degree of competition among banks, presence of asymmetric information, etc. as a possible explanation of this phenomenon.

Our paper contributes to the literature of the bank lending channel and interest rate pass-through by being the first to analyse the interest rate pass-through in Serbia based on a micro dataset.

The basis of this analysis is testing the long-run relationship between monetary policy rate and different bank lending interest rates in Serbia and estimating how much of the changes in bank lending rates can be attributed to changes in the key monetary policy rate and money market interest rates. Having in mind a substantial share of euro-indexed loans in total loans, we have also examined the pass-through effect of EURIBOR to interest rates on euro-indexed loans. The dataset consists of per annum average interest rates on new business corporate and household national currency and euro-indexed loans for a sample of 19 banks operating in the Serbian market on monthly basis, covering the period from September 2010 to May 2021. Empirical testing is done using panel estimation techniques.

In order to empirically investigate whether interest rate pass-through is affected by individual banks characteristics, two bank clusters were set up. Based on the distribution of each indicator such as size, liquidity, strength of deposit base, quality of credit portfolio and capital position, for both clusters long-run and short-run pass-through rates are estimated and compared.

The rest of the paper is structured as follows. In Section 2 we discuss theoretical background and summarize different explanations for the possible sluggish and incomplete

interest rate pass-through. In Section 3 we provide an overview of the literature and empirical findings relating to interest rate pass-through in Central and Eastern European countries (CEECs), as well as industrial countries. Section 4 provides a description of econometric methodology that was used in empirical analysis, followed by a description of the data sample in Section 5. Empirical findings of the pass-through effect for the whole sample of banks, as well as for the effect of bank characteristics on interest rate pricing are presented in Section 6, while Section 7 summarizes the main conclusions.

2 Theoretical background of interest rate pass-through

Crucial for testing the effectiveness of monetary policy is monitoring how changes in the key monetary policy rate are transmitted onto money market rates at the longer maturity, in the first stage, and how much bank deposit and lending rates are affected by the changes in money market rates, in the second.

The first stage of transmission from the monetary policy rate to money market rates depends on the yield curve stability. The connection between short-term and long-term (market) nominal interest rates is provided by the term structure of interest rates. The slope and dynamics of the yield curve is usually determined by three main theories: expectations (long-term interest rates are obtained as the average of current and expected short-term interest rates), liquidity preference (investors require liquidity premium for holding less liquid assets) and segmentation (interest rates for different segments can be determined individually, according to specific demand and supply factors). If the term structure remains unchanged over time, changes in the policy rate will result in the proportionate shift in the yield curve. If, for some reason, the shape of the yield curve changes, the size of the pass-through can also change.

The second stage concerns how the change in money market rates is reflected in bank lending and deposit rate changes. In line with the *cost-of-funds approach* [see de Bondt (2002, 2005)] banks set their retail rates according to their marginal costs, which are approximated by money market rates. The corresponding market rate is assumed to represent opportunity cost or the cost-of-funds against which the bank sets its retail rate with an addition of a mark-up aimed to compensate bank for the interest rate risk and credit risk. Additionally, the selection of market rates of similar maturity also reflects the degree of competition between traditional banking products (loans and deposits) and non-bank products (capital market-based products). The abovementioned links between these rates can be described through following interconnections. In funding their short-term loans, banks often rely on money market instruments, which makes bank loan rates linked to money market rates. On the other hand, as investment in bonds stands as an alternative to their lending activity, the yields on long-term government securities can be viewed as opportunity costs for banks. Similar link exists between market and deposit rates since households and non-financial sector can hold their assets not only in deposits but also in government securities. Additionally, deposits can be viewed as a source of banks' funding alternative to money market instruments.

A similar approach, known as *monetary policy approach,* comes from Sander and Kleimeier (2004a) who say that if the assumption of a stable yield curve is fulfilled (monetary

policy rate affects simultaneously short- and long-term rates), the relationship between monetary policy rate and retail (lending and deposit) rates can be observed directly.

Coming back to the cost-of-funds approach, the relationship between market rates and bank lending and deposit rates can be illustrated using a marginal cost pricing model, where the interest rate set by the bank $i^{l/d}$ equals the marginal cost of funding approximated by a market interest rate i^{m} and a constant mark-up α [see de Bondt (2002)]:

$$i^{l/d} = \alpha + \beta i^{m}$$

The degree of pass-through in the previous equation is represented by the coefficient β, where elasticity lower than one results in an incomplete pass-through from money market rates on lending/deposit rates ($\beta < 1$).

Many factors may influence the strength and speed of the interest rate pass-through [see Egert and MacDonald (2006), Horváth, Krekó and Naszódi (2004)]. Complete interest rate pass-through may not prevail in the presence of **asymmetric information** (adverse selection and moral hazard). Stiglitz and Weiss (1981) explain how the existence of asymmetric information between lenders and borrowers may cause an upward stickiness of lending rates. Any increase in lending rates may result in adverse selection or moral hazard, or both. In adverse selection more risky projects are favored to safer, which in such a set of circumstances are regarded as not profitable. Moral hazard arises when borrowers choose to invest in riskier projects due to high rates of return, or when even safer projects fail to pay credit back, knowing that potential costs will be borne, partially or completely, by others (most often by the government budget). In order to avoid these situations, banks may opt to adjust lending rates disproportionally to the rise in market rate, setting them at lower levels, below the equilibrium rate. However, asymmetric information can also result in amplified pass-through ($\beta > 1$) in the case when banks charge disproportionally higher interest rates in an attempt to compensate for higher risks resulting from adverse selection and moral hazard [see de Bondt (2005)].

The **structure of financial system** and the availability of non-bank financing options may also affect the pass-through. In developed capital and money markets, companies have more options for alternative non-bank sources of finance, which makes the loan demand more sensitive to changes in interest rates. Thus, the **imperfect substitution** between bank deposits and other money market and capital market instruments may cause incomplete interest rate pass-through.

Level of banks competition may also influence interest rate pass-through. Usually, a higher degree of banks competition results in a higher interest rate pass-through [see Kot, (2004)]. This effect might differ depending on the direction of change in the key policy rate. For example, Mojon (2000) concludes that sharper competition among banks contributes to a faster and more symmetric adjustment of bank rates, while Weth (2002) showed that if competition is weak, hikes of the key policy rate result in quicker changes of lending than deposit rates, while opposite holds true in a situation of reducing the key policy rate.

Capital and **liquidity position** of the bank could influence interest rate elasticity too. Less liquid and less capitalized banks will adjust their rates faster and to a larger extent than well-capitalized and banks with a better liquidity position, since they have less ability to offset the effects of changes in market rate.

Macroeconomic conditions also have impact on the interest rate pass-through [see Egert et al. (2007) and Egert and MacDonald (2009)]. For example, interest rate pass-through is usually more rapid in the period of higher economic growth, due to the fact that more favorable economic conditions for enterprises and households enable banks to pass more easily the changes in the interest rate onto their lending and deposit rates. Higher market rate volatility is usually connected with increased uncertainty that may lessen the size and the speed of the pass-through. Rotenberg and Saloner (1987) explain price rigidity by formulating the *menu costs theory*, according to which banks will change their lending rates only when the benefits from doing so are greater than the costs of changing the rates. Hence, if the monetary policy rate change is perceived as small and temporary, and the costs associated with changing retail rates are higher than the benefits, banks may opt to delay the retail rate changes.

Quality of credit portfolio can also influence the interest rate pass-through. Banks with a higher share of NPLs would benefit from an expansive monetary policy to strengthen their liquidity and their financial health rather than increase their credit portfolio by cutting their interest rates [Saborowski and Weber, 2013]. Therefore, higher NPL ratios are expected to reduce the pass-through.

3 An overview of the empirical literature

In the past two decades numerous studies examining the interest rate pass-through have been conducted. Despite the diversity of approaches, the majority of the studies conclude that the degree and speed of pass-through differ considerably across countries, as well as across banking products, especially in the short run. The evidence of whether there is full pass-through in the long run is more scattered and so far, no clear consensus has emerged [Sorensen and Werner (2006)].

Some of the first research papers on interest rate pass-through in advanced economies [Cottarelli and Kourelis (1994), Borio and Fritz (1995)] found mostly complete pass-through in the long run and incomplete adjustment in the short run. Research, based on aggregate level data for EU countries such as in Mojon (2000), Donnay and Degruse (2001), Toolsema et al. (2001), Sander and Kleimeier (2004a), de Bondt (2005), etc. in general find incomplete and sluggish pass-through, with differences in coefficients among countries. The main findings of these analyses are: the rates on loans tend to react faster with more complete pass-through than rates on deposits and that the reaction is more complete and faster for short term loans then for those of longer maturities. The heterogeneity in pass-through is explained by a different degree of competition among banks, banking system ownership, monetary policy regime, development of money market and financial system, openness of the economy, etc.

A number of interest rate pass-through analyses have been performed for CEE countries [Horvath et al. (2004), Wrobel and Pawlowska (2002), Crespo-Cuaresma et al. (2004, 2007), Sander and Kleimeier (2004b), Tieman (2004), Petrevski and Bogoev (2012), Saborowski and Weber (2013), etc.]. In most of them, results indicate that the pass-through in CEE economies is faster than in the euro area and higher for loans than for deposits. Among loans, usually lending rates for households react less with slower adjustment than those for corporate loans. Heterogeneity among CEE countries is present and can be explained by different

macroeconomic factors and financial structure. Crespo-Cuaresma et al. (2007) found evidence on declining pass-through in five CEE countries (Czech Republic, Hungary, Poland, Slovakia and Slovenia) in the period from mid 1990s up to mid-2000s, which can be attributed to inflation slowdown, declining competition among banks and greater reliance on foreign funding. Petrevski and Bogoev (2012) analysed the pass-through from money market rates to lending rates in three SEE economies with rigid exchange rate regimes – Macedonia, Bulgaria and Croatia. They found evidence of complete pass-through in the long run only for Macedonia, and incomplete for Bulgaria and Croatia, while in the short run the adjustment is incomplete and sluggish. Saborowski and Weber (2013) named the high liquidity, NPL ratios and loan dollarization as factors that weaken the pass-through in the group of Eastern European economies.

The panel method is less represented in the research on interest rate pass-through so far. In their panel, based on aggregate data, Sorensen and Werner (2006) reported a high degree of heterogeneity of the pass-through of market interest rates to bank interest rates in the euro area. Different long-run multipliers and speed of adjustment coefficients among countries can be primarily attributed to the different degree of competition in the banking sector across countries. Panel analyses on bank level data, as used in this paper, are quite scarce. Studies concerning some individual eurozone countries comprise those by Weth (2002), Gambacorta (2008) and De Graeve et al. (2004, 2007), finding almost complete pass-through in the long run for Germany and Italy, and heterogeneous results for Belgium. All of them found incomplete and heterogeneous size and speed of adjustment in lending rates in the short run. As for the non-euro area countries, research based on bank level data has been done by Chmielewski (2003), Horvath et al. (2004), Aydin (2007), Stanislawska (2014). In Turkey [see Aydin (2007)], the pass-through is higher for household loans then for corporate loans. Among household loans, the rates on cash and automobile loans move proportionally with the policy rate, while housing loans in the period of rapid credit growth display excessive sensitivity to the policy rate changes. For Poland [see Stanislawska (2014)] the results suggest complete pass-through effect for corporate deposits and some categories of household deposits. Also, completeness is found for consumer credit rates. As far as the influence of individual bank characteristics on the pass-through effect is concerned, results point out that they affect long-run multipliers only to a limited degree.

Several studies also examine the issue of an interest rate pass-through process depending on the direction of key policy rate change. The response of bank rates to changes in the key policy rate or money market rates seems to depend in some cases on whether market interest rates are rising or falling [Aydin (2007), Yildirim (2013), Mojon (2000)] or whether bank interest rates are below or above equilibrium levels [Hofmann (2000), Kleimeier and Sander (2000)].

4 Econometric methodology

Prior to testing long-run relationship between monetary policy rate and different kinds of lending rates, different panel unit root tests had been applied [(Levin, Lin and Chu (2002), Im, Peseran and Shin (2003), Maddala and Wu (1999), Choi (2001)].

After panel unit root test to determine whether time series of interest rates are nonstationary, we checked long-run relationship using Peter Pedroni (1997) panel cointegration tests. Although we presented all seven Pedroni tests, the decision relating to cointegration was made based on group *ADF*, panel *ADF*, and panel ρ statistics, that is, if at least one of those statistics confirms it. Specifically, we had in mind the results of Pedroni (2004) that showed that for values of T larger than 100, all seven statistics that were proposed do fairly well and are quite stable, while for smaller samples (T is lower than 20), group *ADF* statistics is the most powerful, followed by panel *ADF* and panel ρ statistics. We chose to use the non-weighted instead of the weighted panel Pedroni statistics due to their better performance in small samples. We also implemented Westerlund (2006) panel cointegration tests, which take into account cross-sectional dependence. Two of those tests are designed to test the alternative hypothesis that the panel is cointegrated as a whole (panel tests), while the other two (group mean tests) are designed to test the alternative hypothesis that at least one unit is cointegrated. Those test statistics are all normally distributed.

The long-run relationship between relevant macroeconomic variables was estimated by fully modified OLS (FMOLS), dynamic OLS (DOLS), pooled mean group (PMG), and mean group (MG) estimator techniques.

FMOLS estimation allows for serial correlation in the residuals and for endogeneity of regressors in the cointegrating regression, and results in an asymptotically efficient estimation of the cointegrating vector. The pooled FMOLS coefficients can be computed in two different ways: within a dimension and between dimensions. Here, we will present only the between-dimension group FMOLS estimator of the mean panel cointegration parameter from the equation:

$$y_{it} = \alpha_{1i} + \beta x_{it} + \mu_{it}$$

$$x_{it} = \alpha_{2i} + x_{it-1} + \epsilon_{it}$$

where is $\xi_{it} = (\mu_{it}, \epsilon_{it,})$ vector error process with the asymptotic covariance matrix Ω_i, where is Ω_{11} scalar long run variance of the residual μ_{it}, Ω_{22} is $m \times m$ long run covariance among the ϵ_{it}, and Ω_{21} is $m \times 1$ vector of long run covariance between μ_{it} and each of ϵ_{it}.

Cointegration parameter is given as:

$$\beta^*_{GFM} = \frac{1}{n}\sum_{i=1}^{n}\left(\sum_{t=1}^{T}\left(x_{it} - \bar{x}_i\right)^2\right)^{-1}\left(\sum_{t=1}^{T}\left(x_{it} - \bar{x}_i\right)y^*_{it} - T\hat{\gamma}_i\right),$$

$$y^*_{it} = y_{it} - \frac{\hat{L}_{21i}}{\hat{L}_{22i}}\Delta x_{it},$$

$$\hat{\gamma}_i = \hat{\Gamma}_{21i} + \hat{\Omega}^0{}_{21i} - \frac{\hat{L}_{21i}}{\hat{L}_{22i}}\left(\hat{\Gamma}_{22i} + \hat{\Omega}^0{}_{21i}\right)$$

where x_{it} is the m-dimensional vector of explanation variables, and $\hat{L}_i$ is the lower triangular decomposition of a consistent estimator of the asymptotic covariance matrix $\Omega_i = \Omega_i^0 + \Gamma_i - \Gamma_i'$, with $\hat{L}_i$ normalized such that $\hat{L}_{22i} = \hat{\Omega}_{22i}^{-1/2}$, Γ_i is the weighted sum of autocovariances and the serial correlation adjustment parameter $\hat{\gamma}_i$. The FMOLS estimator is distributed normally [see Pedroni 1997, p. 103].

The expression following the summation over *i* is identical to the conventional time series FMOLS estimator, and the between-dimension estimator can be constructed simply as the average FMOLS estimator for each panel member. Likewise, the associated t statistics for the between-dimension estimator can be constructed as:

$$\bar{t}_{\beta^* GFM} = \frac{1}{\sqrt{n}} \sum_{i=1}^{n} \hat{L}_{11i}^{-2} \left(\sum_{t=1}^{T} \left(x_{it} - \bar{x}_i \right)^2 \right)^{-1/2} \left(\sum_{t=1}^{T} \left(x_{it} - \bar{x}_i \right) y_{it}^* - T \hat{\gamma}_i \right) \rightarrow N(0,1)$$

In order to obtain an unbiased estimator of the long-run parameters, DOLS estimator uses parametric adjustment to the errors by including the past and the future values of the differenced regressors. The DOLS estimator is obtained from the following equation:

$$y_{it} = \alpha_i + x_{it}' \beta_i + \sum_{j=-q}^{q} c_{ij} \Delta x_{it+j} + \upsilon^*_{it}$$

where c_{ij} is the coefficient of a lead or lag of the first differenced explanatory variables. The estimated coefficient of DOLS is given by:

$$\hat{\beta}_{GDOLS} = \frac{1}{n} \sum_{i=1}^{n} \left(\sum_{t=1}^{T} \left(z_{it} z_{it}' \right) \right)^{-1} \left(\sum_{t=1}^{T} z_{it} \hat{y}^*_{it} \right),$$

where $z_{it} = \left[x_{it} - \bar{x}_i, \Delta x_{i,t-q}, ..., \Delta x_{i,t+q} \right]$ is $2(q+1) \times 1$ vector of regressors and $\hat{y}^*_{it} = y_{it} - \bar{y}_i$.

The Pooled Mean Group (PMG) estimator, introduced by Pesaran, Shin and Smith (1997), involves pooling and averaging and allows the intercepts, short-run coefficients and error variances to differ freely across groups, but the long-run coefficients are constructed to be the same. They propose estimating the following autoregressive distributed lag (ARDL) model of order p and q:

$$\Delta y_{it} = \mu_i + \varphi_i (y_{i,t-1} - \Theta x_{it}) + \sum_{j=1}^{p-1} \lambda_{ij} \Delta y_{i,t-j} + \sum_{j=0}^{q-1} \delta_{ij} \Delta x_{i,t-j} + \epsilon_{ij}$$

The dependent variable in the first differences is regressed on the lagged values of the dependent and independent variables in the levels and first differences. The long-run coefficients, Θ, are defined to be the same across groups. Testing statistical significance of the error correction term from the pooled mean group estimator can be used as a test of cointegration. A negative and statistically significant error correction term, φ, confirms

presence of long-run relationship between y_{it} and x_{it}. The equation is estimated using the maximum likelihood procedure.

In this setup, Θ shows the degree of pass-through in the long run, while δ_{i0} stands for short-term pass-through (effect on bank lending interest rates within a month). Error correction term displays how fast banks respond to monetary policy decisions on policy rate, where average adjustment period in terms of months is calculated as $(1-\delta_{i0})/\varphi$.

The kind of estimation where panel coefficients were obtained by averaging individual cross-sectional coefficients is called Mean Group (MG) estimation. The MG allows that all of the parameters can differ across units. Pesaran, Shin and Smith (1997) suggest using Hausman test (1978) to test long-run homogeneity. Rejection of the test would suggest that panel is too heterogeneous for imposing long-run homogeneity, in which case PMG method is inadequate.

5 Data description and definition of variables

For dinar loans, the dataset consists of per annum average interest rates on new business corporate (*C_NB*) and household (*H_NB*) loans on a monthly basis covering the period from September 2010 to May 2021. As a proxy of monetary policy rate we have used the central bank key policy rate (IR), as well as interbank money market rates with one-week maturity (BELIBOR1W) and with three-month maturity (BELIBOR3M). The main monetary policy instrument is the key policy rate applied in the National Bank of Serbia (NBS) main open market operations – notably the 1-week reverse repo transactions[1] – to temporarily change the liquidity conditions of the banking system. As of December 2012, main open market operations of withdrawing liquidity have been conducted at variable interest rate auctions, with the key policy rate indicating the maximum rate that could be accepted.

In the period observed on average approximately 37% of new business loans to the private sector were in dinars. Out of that, with 25% of new business loans in dinars on average, the dinarization is less pronounced in the corporate sector, while this share for households is much higher (66%). Bearing in mind the level of euroization of loans we have tested the effects of the three- and six-month EURIBOR to interest rates on euro-indexed loans, too. Since the reserve requirement is used as a supportive monetary policy instrument that influences the price of banks' sources of finance and has been amended on several occasions in the period under review[2], we have used EURIBOR series adjusted by effective foreign currency reserve requirement rate (RR), calculated as *EURIBOR/(1-RR*).

[1] 2-week repo transactions until July 2012.

[2] By decreasing foreign currency reserve requirement ratio and by increasing its portion allocated in dinars. As of February 2016, ratios for foreign currency liabilities stood at 20% and 13%, for maturities up to and over two years, with 38% and 30% of foreign currency reserve requirement allocated in dinars. Dinar reserve requirement rates stood at 5% and 0%, depending on maturity.

The interest rate data came from statistics collected by the NBS. During the period observed the number of banks in the Serbian market declined from 33 to 24. For testing the pass-through effect on lending rates for households we have included 19 banks (accounting on average for 98.2% of the total banking sector assets) and for corporates we have included 17 banks (accounting on average for 92.2% of the total banking sector assets), as they have reported interest rate data for the whole period. The number of banks included in the analysis for testing the reaction of different loan categories of household and corporate lending rates is lower and it is dependent upon whether the banks granted a certain type of loan during the whole period observed.

Chart 1 shows the movement of the NBS repo rate and interbank money market rates, Chart 2 displays weighted average rates by type of dinar loans, and Chart 3 and Chart 4 the movement of money market and dinar lending rates for the corporate and household sector, respectively.

Chart 1. **Monetary policy and interbank market rates**
(in %)

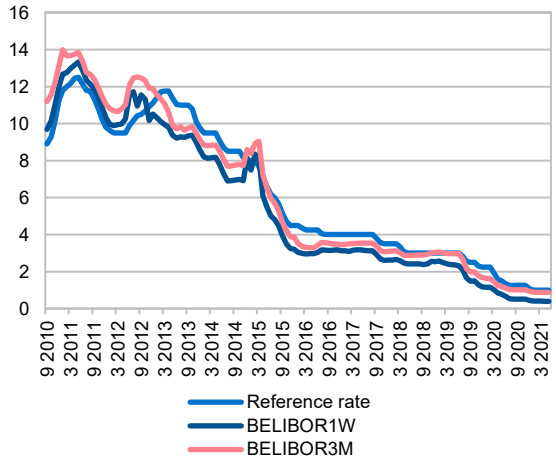


Chart 2. **Weighted average dinar lending rates to households and corporates by purpose**
(in %)

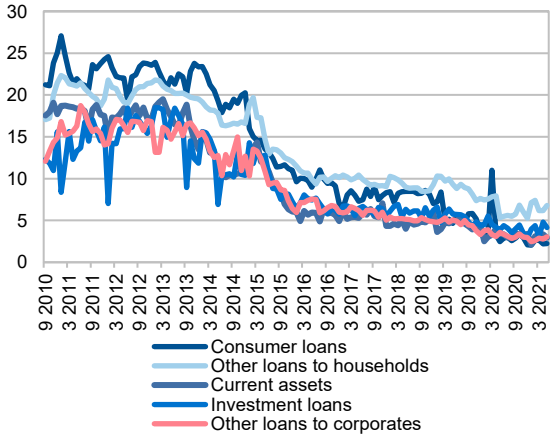


Chart 3. **Interest rates for corporate dinar loans and BELIBOR3M**
(in %)

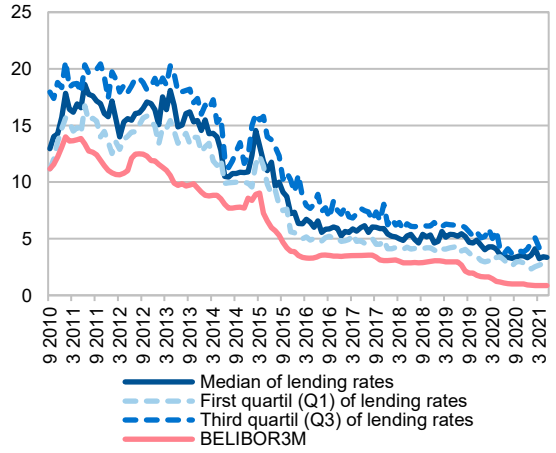
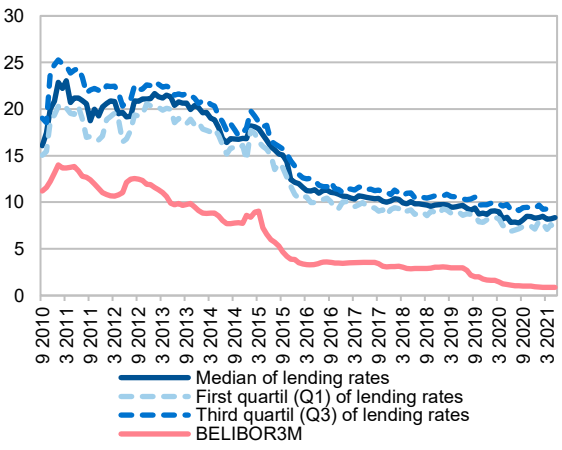


Chart 4. **Interest rates for household dinar loans and BELIBOR3M**
(in %)



Source: NBS.

Chart 1 confirms that short-term money market rates generally mirrored the key policy rate movements. The relationship between lending rates on household and corporate loans and interbank money market rates is evident (Chart 3 and Chart 4), too. However, for a more precise conclusion, we need to test and estimate the long-run relationship.

Although this period is characterized by phases of monetary policy tightening and relaxing, the period of relaxation is prevailing. The latest cycle of monetary policy relaxation started in May 2013 and since then a significant fall in corporate and household lending rates has been recorded, with the exception of early 2015, when temporary dinar liquidity shortage in the banking sector caused higher volatility of interbank money market rates, and consequently lending rates. However, the fall in interest rates has accelerated since March 2015 along with the speed-up in monetary policy relaxation.

In order to address the problem of heterogeneity of the pass-through effect across banks, we take into account several bank characteristics: **size, quality of credit portfolio, structure of financing, capital position and liquidity**. Each feature is considered separately. According to the median value of each indicator, banks are divided into two groups. We used total assets as a size indicator and the share of NPLs in total loans as a portfolio quality indicator. Structure of financing was measured by the share of non-financial sector deposits in total liabilities, capital position by capital adequacy ratio (CAR) and liquidity as the share of liquid[3] in total assets.

6 Empirical results

6.1 Testing the relationship for dinar interest rates

We started the empirical analysis by testing for the presence of a unit root in a series of interest rates on dinar loans. According to the results of panel unit root tests, non-stationarity could not be strongly rejected at 5% significance level in almost all cases, which led us to the conclusion that variables are non-stationary in levels (see Table 1 in Appendix).

The cointegration relationship between interest rates on new business corporate dinar loans and money market interest rates BELIBOR1W and BELIBOR3M is confirmed by all Pedroni tests for the model with individual intercepts. Long-run relationship is also confirmed for interest rates on new household dinar loans and money market interest rates by all Pedroni tests. To control cross-sectional dependence, we employ Westerlund panel cointegration test. Overall, the results strongly reject the null hypothesis of no cointegration (see Table 2 and Table 3 in Appendix).[4]

In order to estimate the long-run relationship between dinar lending and money market rates, we employed FMOLS and DOLS methods. The results obtained for the whole sample

[3] Liquid assets comprise claims on NBS, claims under repo transactions and investment in government securities.

[4] The unit root and panel cointegration tests were performed for EURIBOR and interest rates on euro-indexed loans too, but, for practical reasons, only the results of those carried out on dinar loans are presented.

suggest that there is a significant long-run relationship (Table 1) and that the pass-through effect is complete for both total corporate and household loans. In both cases, the pass-through effect is more pronounced for new business corporate than for household loans, which is in line with the findings of Horvath et al. (2004), Crespo-Cuaresma et al.(2007) and Sander and Kleimeier (2004b) and opposite to those of Aydin (2007).

Table 1 **Estimates of the long-run pass-through of market rates to bank lending rates**

	FMOLS		DOLS	
	Corporate loans	**Household loans**	**Corporate loans**	**Household loans**
BELIBOR1W	1.29***	1.19***	1.29***	1.19***
BELIBOR3M	1.24***	1.15***	1.24***	1.15***

Note: Grouped *FMOLS* and grouped *DOLS* with automatic lags selection based on *SIC*. * refers to statistical significance at 10%, ** refers to statistical significance at 5%, and *** refers to statistical significance at 1%.

In order to test the change in the interest rate channel strength, we have estimated coefficients in two periods, 2010–2014 and 2010–2021. The coefficients obtained proved the strengthening of the interest rate channel over time (Table 2), as for the whole period of analysis (2010–2021) the results suggest complete interest rate pass-through, thanks to the increasing interbank competition in the loan market, higher economic growth and reduced internal and external imbalances and therefore, significantly reduced macroeconomic uncertainty.

Table 2 **Estimates of the long run pass-through of market rates to bank lending rates - DOLS method**

	2010-2014		2010-2021	
	Corporate loans	**Household loans**	**Corporate loans**	**Household loans**
BELIBOR1W	0.91***	0.68***	1.29***	1.19***
Number of observations	867	965	2.166	2.421
BELIBOR3M	0.88***	0.68***	1.24***	1.15***
Number of observations	867	965	2.166	2.421

Note: Grouped *DOLS* with automatic lags selection based on *SIC*. * refers to statistical significance at 10%, ** refers to statistical significance at 5%, and *** refers to statistical significance at 1%.

Further, we tried to examine the impact of the country risk premium, measured by EMBI, on the interest rate pass-through. The results confirmed a relationship with statistically significant coefficients hovering around 0.5 (Table 3), indicating that lower risk premium in addition to monetary policy relaxation of the NBS also affect the fall of dinar lending interest rates for corporate sector. The inclusion of EMBI has brought the interest rate pass-through coefficient closer to 1. For the household sector, a statistically significant relationship between lending rates and EMBI was not found.

Table 3 **Estimates of the long run pass-through of market rates to bank lending rates**

	FMOLS	DOLS
	Corporate loans	**Corporate loans**
BELIBOR1W	1.12***	1.13***
EMBI	0.52***	0.48***
BELIBOR3M	1.07***	1.08***
EMBI	0.54***	0.50***

Note: Grouped *FMOLS* and grouped *DOLS* with automatic lags selection based on *SIC*. * refers to statistical significance at 10%, ** refers to statistical significance at 5%, and *** refers to statistical significance at 1%.

The long-run relationship is confirmed by PMG and MG methods (Table 4), too, also indicating complete pass-through effect for corporate and household loans. Hausman test indicates insignificant difference between the results obtained by MG and PMG methods for corporates, while in the case of households, using MG method is preferable. Overall, results obtained by PMG and MG methods show that the long-run interest rate pass-through effect for corporate loans ranges from 1.18 to 1.30, while the result obtained for household loans ranges between 1.19 and 1.23, depending on the money market rate used.

Table 4. **PMG and MG estimates of the pass-through of market rates to bank lending rates**

	PMG				MG			
	Corporate loans		Household loans		Corporate loans		Household loans	
	estimate	p value	estimate	p value	estimate	p value	estimate	p value
	BELIBOR1W, monthly average				BELIBOR1W, monthly average			
Q_i	1.235	0.000	1.344	0.000	1.296	0.000	1.225	0.000
f_i	-0.505	0.000	-0.210	0.000	-0.574	0.000	-0.254	0.000
d_{i0}	-0.377	0.019	-0.071	0.592	-0.504	0.000	-0.123	0.369
d_{i1}			0.234	0.030			0.185	0.040
λ_{i1}			0.019	0.636			0.037	0.351
m_i	1.430	0.000	1.370	0.000	1.463	0.000	1.829	0.000
Average adjustment period	2.7		5.1		2.6		4.4	
Hausman	1.210	0.271	3.460	0.060				
	BELIBOR3M, monthly average				BELIBOR3M, monthly average			
Q_i	1.184	0.000	1.302	0.000	1.247	0.000	1.192	0.000
f_i	-0.519	0.000	-0.221	0.000	-0.593	0.000	-0.270	0.000
d_{i0}	-0.424	0.000	0.053	0.701	-0.583	0.000	-0.011	0.942
d_{i1}			0.222	0.126			0.158	0.256
λ_{i1}			-0.002	0.954			0.017	0.636
m_i	1.220	0.000	1.337	0.000	1.200	0.000	1.791	0.000
Average adjustment period	2.7		4.3		2.7		3.7	
Hausman	1.390	0.238	3.200	0.070				
Number of observations	2,176		2,432		2,176		2,432	

Table 4 also presents estimates of the short-term adjustment of dinar lending rates. In line with expectations, the speed of adjustment term is negative and statistically significant in all cases. About 50–60% of the money market change after one month is transmitted to corporate lending rates and about 21–27% is transmitted to household lending rates. This result is not surprising as corporates have more finance alternatives relative to households. The average period of adjustment in the interest rate channel for household loans (4–5 months) is longer than in the case of corporate loans (2–3 months). This can be linked to the fact that companies have more alternative sources of finance than households. However, immediate reaction is negative, although statistically insignificant in the case of household loans.

Analysis was conducted for different types of dinar loans too – in the case of corporate sector analysis covers interest rate on current assets loans and for households it covers interest rates for cash loans (Table 5). Estimation results indicate that dinar corporate loans for current assets display excessive sensitivity to interbank money market rates, while cash loans are slightly less sensitive than other types of household loans in dinars. One of the possible reasons could be that cash loans are largely refinanced and that banks compete among themselves not only by lowering interest rates, but also by extending loan maturity.

Table 5. **DOLS estimates of the pass-through of market rates to different types of bank lending rates**

	Corporate current asset loans (15 banks)	Household cash loans (19 banks)
BELIBOR1W	1.31***	1.12***
BELIBOR3M	1.26***	1.09***

Note: Grouped *DOLS* with automatic lags selection based on *SIC*. * refers to statistical significance at 10%, ** refers to statistical significance at 5%, and *** refers to statistical significance at 1%.

6.2 Testing the relationship for euro-indexed interest rates

We have also estimated the long-term pass-through from EURIBOR to euro-indexed loans, both for total and for certain types of loans - current asset and investment loans for corporates, and housing loans for households (Tables 6 and 7). As in the analysis of dinar loans, we employed the FMOLS and DOLS methods. The obtained results suggest pass-through that is almost complete both in the case of corporates and households, while a somewhat stronger relationship was found with EURIBOR3M than with EURIBOR6M.

Table 6 **Estimates of the long run pass-through between euro-indexed bank lending rates, money market rates and risk premium**

	FMOLS		DOLS	
	Corporate loans	Household loans	Corporate loans	Household loans
EURIBOR3M	0.89***	0.99***	0.94***	1.02***
EMBI	0.94***	0.82***	0.91***	0.81***
EURIBOR6M	0.90***	0.88***	0.86***	0.91***
EMBI	0.99***	0.81***	0.88***	0.79***

Note: Grouped *FMOLS* and grouped *DOLS* with automatic lags selection based on *SIC*. * refers to statistical significance at 10%, ** refers to statistical significance at 5%, and *** refers to statistical significance at 1%.

The country risk premium, measured by EMBI, declined and has been hovering around its historic lows at the end of 2019, thanks to the improvement in macroeconomic fundamentals. The NBS supported this by delivering low and stable inflation, preserving financial stability, and contributing to the improved investment climate. The drop in risk premium allowed for the decline in interest rates, as we found a strong and significant influence of the country risk premium on the euro-indexed lending rates, on both corporate and household loans. This relationship proves to be stronger in the case of corporate loans, with statistically significant coefficients around 0.9, as corporates are more exposed to general macroeconomic conditions, while for household loans they move around 0.8.

Looking by the type of loans, we found stronger connection for current asset loans (with coefficients between 0.96 and 1.05) compared to investment loans (between 0.74 and 0.9). The impact of risk premium is also significant but more pronounced for current asset loans, as those loans have a more dispersed use and are granted to a broader range of different clients and therefore might be perceived as riskier by banks. The obtained lower coefficients for housing loans (0.6–0.7) can be partially explained by the presence of subsidized lending programs in the part of the period observed. Although significant, the impact of the risk premium on this type of loans is also lower (0.5), which is understandable as the vast majority of these loans, besides being adequately collateralized, is also insured with the National Mortgage Insurance Corporation.

Table 7 **Estimates of the long run pass-through between euro-indexed bank lending rates, money market rates and risk premium**

	FMOLS			DOLS		
	Corporate Current Assets (16 banks)	Corporate investment loans (13 banks)	Housing loans (15 banks)	Corporate Current Assets (16 banks)	Corporate investment loans (13 banks)	Housing loans (15 banks)
EURIBOR3M	1.05***	0.83***	0.61***	1.04***	0.90***	0.66***
EMBI	1.05***	0.84***	0.56***	1.04***	0.81***	0.54***
EURIBOR6M	0.96***	0.74***	0.54***	0.97***	0.80***	0.59***
EMBI	1.02***	0.83***	0.55***	1.00***	0.79***	0.53***

Note: Grouped FMOLS and grouped DOLS with automatic lags selection based on *SIC*. * refers to statistical significance at 10%, ** refers to statistical significance at 5%, and *** refers to statistical significance at 1%.

6.3 Testing impact of different individual bank characteristics on interest rate pass-through

To test whether interest rate pass-through is affected by individual bank characteristics, a separate equation was estimated for each bank characteristic (size, strength of deposit base, quality of credit portfolio, capital position, liquidity, dinarization criterion). Banks with the indicator value above the median (except for the share of NPLs, where it is opposite) are categorized in Cluster I, while banks with a lower-than-median indicator value belong to Cluster II (Table 8). The tests are performed only for dinar loans. The results are presented in Appendix, and they suggest that individual bank characteristics influence more long-term adjustment of household lending rates in national currency.

Table 8 **Average values of indicators by clusters during the observed period**

Bank characterstics	Median
Size criterion - total assets (bln RSD)	131.7
Portfolio quality - share of NPLs to total loans, gross principle*	1.7% - corporates 3.0% - households
Deposit base - share of deposits in total liabilities	48.8%
Capital position - Capital adequacy ratio	22.0%
Liquidity - share of liquid assets** to total assests	23.5%
Dinarization criterion - share of dinar in total loans	41.8% - households 17.4% - corporates

* Average values of indicator in the last 12 months, cluster I refers to values below the median

** Claims on NBS, claims under repo transactions and investment in government securities

As for the size criterion (Table 5 in Appendix), bigger banks adjust their interest rate on corporate loans somewhat faster than smaller banks, but the difference is not significant. Bigger banks have easier access to cheaper sources of funding (as this group mainly comprises subsidiaries of foreign banks) and they usually serve better quality corporate clients that have a broader range of possible sources of finance. The opposite holds true in the case of household loans – smaller banks adjust faster. A possible explanation could be that the smaller value of a single credit lot allows for stronger competition in the household segment.

As for the quality of the credit portfolio, the reaction of lending rates on corporate loans to money market rates BELIBOR1W is almost the same for both clusters (Table 6 in Appendix), while to BELIBOR3M it is stronger for banks with lower NPL ratios, which is in line with intuition. In the case of households, the reaction is stronger for the banks with lower NPL ratios too, while differences among the coefficients between clusters are higher than in the case of corporates.

Differences between the clusters are also found in the case of sources of bank financing. Banks with a higher share of deposits from non-financial sector recorded a slower adjustment to market interest rates in the case of household loans, which is in line with expectations. A statistically significant difference was also found for corporate loans, but contrary to expectations, the lower long-run coefficient was recorded for banks with a lower share of deposits (Table 6 in Appendix). One of the reasons could be that this cluster is predominantly made of foreign banks' subsidiaries that have access to cheaper funds from abroad, either within the group or through participation in international credit lines.

The results indicate almost the same long-term reaction of interest rates on corporate loans for both clusters of banks based on capital adequacy ratios (Table 8 in Appendix), while in the

case of household loans, banks with lower capital adequacy ratios tend to adjust more. Slower adjustment of big and well-capitalized banks is in line with the credit channel view, as those banks have more capacity to avoid transferring the higher cost of the sources of funding onto clients in the case of monetary tightening. However, this classification into clusters is tentative, as all banks in Serbia are well-capitalized, with individual ratios far above the minimum capital adequacy requirement.

As for the liquidity criterion, the theoretical prediction that less liquid banks adjust faster to interest rate changes is not confirmed, given that more liquid banks follow money market interest rates faster than less liquid ones (Table 8 in Appendix). That could partly be explained by the prevalence of monetary policy easing and the reduction in money market interest rates during the sample period, which more liquid banks used to increase their market position. Also, it should be borne in mind that this cluster classification, as in the case of capitalization criterion, is only tentative, since all banks in Serbia are liquid.

The results indicate stronger long-term reaction of banks with a higher share of dinar loans in total loans (Table 9 in Appendix) for both corporate and household loans, which is in line with expectations, while in the case of corporates, the difference between clusters is not significant.

7 Concluding remarks

The aim of this paper was to test the long-run relationship between monetary policy rate and money market rates and different bank lending dinar interest rates in Serbia and to test the strength of the interest rate channel. Analysis was conducted for the period from September 2010 to May 2021 by the panel data methods. The novelty of the paper lies in presenting evidence of interest rate pass-through for the Serbian economy, based on the average pass-through across individual banks.

The results of empirical analysis can be summarized as follows:

1. **The confirmed statistically significant long-run relationship between monetary policy rates/money market rates and dinar lending rates shows that the interest rate pass-through effect is complete**.

2. **The interest rate channel gained more strength over time**, as confirmed by the higher long-run relationship coefficient in the whole period compared to the period 2010–2014.

- Some of the possible explanations for the strengthening of the interest rate pass-through are a higher level of competition, decline in the risk premium and interest rate volatility in recent years, rising reliance on domestic sources of funding, speed-up in economic recovery and strengthening of macroeconomic fundamentals, etc.
- Interest rate pass-through for dinar loans appears to be complete for both corporate and household lending rates, with long-run coefficients exceeding 1.
- The long run pass-through estimates using different methods (FMOLS, DOLS, and MG) are very close to each other, indicating robustness of the results. Also, results of PMG and MG methods pointed to a homogenous reaction for the corporate sector.

- Average period of adjustment in the interest rate channel for household loans is longer than in the case of corporate loans and could be linked to the fact that companies have more alternative sources of finance than households.

3. A statistically significant relationship between lending rates for corporates, money market rates and risk premium, measured by EMBI, indicates **that lower risk premium, in addition to monetary policy relaxation of the NBS, also affects dinar lending interest rates for the corporate sector**. The inclusion of EMBI has brought the interest rate pass-through coefficient closer to 1. An assessment done for different types of dinar loans indicates that **corporate loans for current assets display excessive sensitivity to interbank money market rates, while consumer loans are slightly less sensitive than other types of household loans**.

4. **Individual bank characteristics affect the interest rate pass-through.**

- In the case of the household sector, banks with a higher capital adequacy ratio, higher NPL share, higher share of deposits in total liabilities and higher share of dinar loans in total loans tend to adjust more slowly to changes in the reference rate, though with a complete pass-through. Contrary to expectations, the pass-through is higher for banks with smaller than for banks with bigger balance sheet assets.
- As for corporates, the adjustment is faster for banks with lower NPL ratios, which is in line with intuition. Contrary to expectations, adjustment is faster for banks with a higher share of liquid assets in total assets and a higher deposit base, but, as in the case of households, the pass-through is complete for both bank groups. As for other criteria, the differences across banks in respect of the adjustment of dinar corporate loans interest rates are minimal.

5. The assessed pass-through between EURIBOR and new business euro-indexed loans suggest complete pass-through in the case of household loans by both FMOLS and DOLS methods, while for corporate loans it is close to complete. The strong connection between lending rates and the risk premium is also found. Looking by the type of loans, the pass-through effect of EURIBOR is stronger for current asset loans than for investment loans. The pass-through effect is lower for housing loans compared to total euro-indexed household loans.

Appendix

Table 1 **Panel unit root test results**

	Corporate loans	Household loans	Current assets loans	Cash loans
Levin, Lin & Chu t*	-0.769 (0.211)	0.271 (0.607)	0.110 (0.544)	0.219 (0.587)
Im, Pesaran and Shin W	2.400 (0.991)	2.13(0.983)	2.418 (0.992)	2.232 (0.987)
ADF - Fisher X^2 - stat	11.815 (0.99)	23.931 (0.963)	10.215 (0.99)	17.351 (0.998)
ADF - Choi Z - stat	2.674 (0.996)	2.211 (0.986)	2.679 (0.996)	2.331 (0.990)

Note: P values are given in parentheses. Model with individual effects was used.
The number of lags included in the model is chosen according to the Schwarz information criterion.

Table 2 **Results of Pedroni panel cointegration test**

	[C_NB, BELIBOR1W]	[H_NB, BELIBOR1W]	[C_NB, BELIBOR3M]	[H_NB, BELIBOR3M]
Panel v	9.310***	12.391***	6.730***	7.731***
Panel rho	-56.400***	-25.948***	-56.470***	-25.831***
Panel PP	-24.121***	-14.538***	-24.262***	-14.777***
Panel ADF	-15.130***	-11.227***	-15.063***	-11.349***
Group rho	-50.491***	-18.202***	-50.470***	-17.704***
Group PP	-27.350***	-12.283***	-27.634***	-12.525***
Group ADF	-18.051***	-11.513***	-17.958***	-11.609***

Note: Model with individual intercepts. In all tables, * refers to statistical significance at 10%, ** refers to statistical significance at 5%, and *** refers to statistical significance at 1%. The number of lags included in the model is chosen according to the Schwarz information criterion.

Table 3 **Results of Westerlund panel cointegration tests**

	[C_NB, BELIBOR1W]	[H_NB, BELIBOR1W]	[C_NB, BELIBOR3M]	[H_NB, BELIBOR3M]
Gt	-5.444 (0.000)	-4.432 (0.000)	-5.486 (0.000)	-4.554 (0.000)
Ga	-51.119 (0.000)	-33.104 (0.000)	-52.643 (0.000)	-34.886 (0.000)
Pt	-21.556 (0.000)	-19.414 (0.000)	-21.606 (0.000)	-19.862 (0.000)
Pa	-46.026 (0.000)	-31.729 (0.000)	-47.202 (0.000)	-32.288 (0.000)

Note: Values in parentheses are bootstrapped p-values, robust in the presence of common factors in the time series.

Table 4 **MG estimates of the pass-through of market rates to bank lending rates according to size criterion**

	Corporate				Households			
	Cluster I		Cluster II		Cluster I		Cluster II	
	estimate	p value	estimate	p value	estimate	p value	estimate	p value
	BELIBOR1W, monthly average				BELIBOR1W, monthly average			
Q_i	1.301	0.000	1.288	0.000	1.199	0.000	1.254	0.000
f_i	-0.609	0.000	-0.535	0.000	-0.242	0.000	-0.269	0.000
d_{i0}	-0.573	0.002	-0.424	0.034	-0.098	0.639	-0.150	0.414
d_{i1}					0.279	0.064	0.081	0.553
λ_{i1}					0.076	0.050	-0.005	0.944
m_i	1.347	0.000	1.593	0.000	1.870	0.000	1.782	0.000
Average adjustment period	2.6		2.7		4.5		4.3	
Number of observations	1,152		1,024		1,270		1,143	
	BELIBOR3M, monthly average				BELIBOR3M, monthly average			
Q_i	1.252	0.000	1.242	0.000	1.170	0.000	1.217	0.000
f_i	-0.626	0.000	-0.555	0.000	-0.258	0.000	-0.281	0.000
d_{i0}	-0.533	0.005	-0.640	0.000	0.039	0.859	-0.066	0.737
d_{i1}					0.293	0.106	0.008	0.969
λ_{i1}					0.046	0.227	-0.014	0.836
m_i	1.067	0.000	1.351	0.000	1.856	0.000	1.718	0.000
Average adjustment period	2.4		3.0		3.7		3.8	
Number of observations	1,152		1,024		1,270		1,143	

Note: Cluster I refers to banks with bigger total assets, cluster II to banks with total assets less than 131.7 billion of dinars.

Table 5 **MG estimates of the pass-through of market rates to bank lending rates according to quality of portfolio criterion**

	Corporate				Households			
	Cluster I		Cluster II		Cluster I		Cluster II	
	estimate	p value	estimate	p value	estimate	p value	estimate	p value
	BELIBOR1W, monthly average				BELIBOR1W, monthly average			
Q_i	1.329	0.000	1.247	0.000	1.268	0.000	1.178	0.000
f_i	-0.565	0.000	-0.588	0.000	-0.259	0.000	-0.250	0.000
d_{i0}	-0.383	0.032	-0.678	0.001	-0.198	0.058	-0.039	0.886
d_{i1}					0.166	0.202	0.207	0.218
λ_{i1}					0.072	0.256	-0.001	0.976
m_i	1.514	0.000	1.390	0.000	1.758	0.000	1.906	0.000
Average adjustment period	2.4		2.9		4.6		4.2	
Number of observations	1,280		896		1,270		1,143	
	BELIBOR3M, monthly average				BELIBOR3M, monthly average			
Q_i	1.280	0.000	1.200	0.000	1.233	0.000	1.147	0.000
f_i	-0.577	0.000	-0.615	0.000	-0.274	0.000	-0.263	0.000
d_{i0}	-0.475	0.001	-0.737	0.000	-0.061	0.647	0.045	0.872
d_{i1}					0.091	0.641	0.233	0.263
λ_{i1}					0.058	0.335	-0.027	0.516
m_i	1.237	0.000	1.148	0.000	1.713	0.000	1.877	0.000
Average adjustment period	2.6		2.8		3.9		3.6	
Number of observations	1,280		896		1,270		1,143	

Note: Cluster I refers to banks with the share of NPLs for corporates less than 1.7% and for households less than 3%, cluster II to banks with the share of NPLs for corporates over 1.7% and for households over 3%.

Table 6 **MG estimates of the pass-through of market rates to bank lending rates according to deposit base criterion**

	Corporate				Households			
	Cluster I		Cluster II		Cluster I		Cluster II	
	estimate	p value	estimate	p value	estimate	p value	estimate	p value
	BELIBOR1W, monthly average				BELIBOR1W, monthly average			
Q_i	1.361	0.000	1.237	0.000	1.184	0.000	1.271	0.000
f_i	-0.550	0.000	-0.596	0.000	-0.225	0.000	-0.303	0.000
d_{i0}	-0.311	0.159	-0.676	0.000	0.157	0.363	-0.434	0.010
d_{i1}					0.067	0.448	0.317	0.093
λ_{i1}					0.040	0.438	0.035	0.598
m_i	1.249	0.000	1.653	0.000	1.764	0.000	1.901	0.000
Average adjustment period	2.4		2.8		3.7		4.7	
Number of observations	1,024		1,152		1,270		1,143	
	BELIBOR3M, monthly average				BELIBOR3M, monthly average			
Q_i	1.312	0.000	1.189	0.000	1.156	0.000	1.233	0.000
f_i	-0.568	0.000	-0.615	0.000	-0.225	0.000	-0.318	0.000
d_{i0}	-0.460	0.023	-0.693	0.000	0.288	0.097	-0.343	0.073
d_{i1}					0.031	0.768	0.300	0.269
λ_{i1}					0.020	0.697	0.016	0.792
m_i	0.978	0.003	1.340	0.000	1.748	0.000	1.838	0.000
Average adjustment period	2.6		2.8		3.2		4.2	
Number of observations	1,024		1,152		1,270		1,143	

Note: Cluster I refers to banks with the share of deposits in total liabilities over 48.8%, cluster II to banks with the share of deposits in total liabilities less than 48.8%.

Table 7 **MG estimates of the pass-through of market rates to bank lending rates according to capital position criterion**

	Corporate				Households			
	Cluster I		Cluster II		Cluster I		Cluster II	
	estimate	p value	estimate	p value	estimate	p value	estimate	p value
	BELIBOR1W, monthly average				BELIBOR1W, monthly average			
Q_i	1.293	0.000	1.296	0.000	1.147	0.000	1.311	0.000
f_i	-0.560	0.000	-0.581	0.000	-0.249	0.000	-0.261	0.000
d_{i0}	-0.617	0.005	-0.478	0.003	0.089	0.696	-0.358	0.001
d_{i1}					0.044	0.796	0.343	0.000
λ_{i1}					-0.023	0.709	0.145	0.016
m_i	1.827	0.000	1.253	0.000	2.003	0.000	1.634	0.000
Average adjustment period	2.9		2.5		3.7		5.2	
Number of observations	1,024		1,152		1,270		1,143	
	BELIBOR3M, monthly average				BELIBOR3M, monthly average			
Q_i	1.245	0.000	1.257	0.000	1.121	0.000	1.272	0.000
f_i	-0.567	0.000	-0.606	0.000	-0.264	0.000	-0.274	0.000
d_{i0}	-0.663	0.010	-0.553	0.000	0.185	0.542	-0.228	0.055
d_{i1}					-0.039	0.866	0.378	0.070
λ_{i1}					-0.036	0.531	0.077	0.001
m_i	1.570	0.000	0.984	0.000	1.983	0.000	1.577	0.000
Average adjustment period	2.9		2.6		3.1		4.5	
Number of observations	1,024		1,152		1,270		1,143	

Note: Cluster I refers to banks with capital adequacy ratio over 22%, cluster II to banks with CAR less than 22%.

Table 8 M**G estimates of the pass-through of market rates to bank lending rates according to liquidity criterion**

	Corporate				Households			
	Cluster I		Cluster II		Cluster I		Cluster II	
	estimate	p value	estimate	p value	estimate	p value	estimate	p value
	BELIBOR1W, monthly average				BELIBOR1W, monthly average			
Q_i	1.351	0.000	1.232	0.000	1.236	0.000	1.213	0.000
f_i	-0.579	0.000	-0.569	0.000	-0.234	0.000	-0.278	0.000
d_{i0}	-0.401	0.061	-0.620	0.000	-0.136	0.521	-0.108	0.549
d_{i1}					0.295	0.049	0.063	0.636
λ_{i1}					0.109	0.011	-0.042	0.505
m_i	1.267	0.000	1.683	0.000	1.780	0.000	1.882	0.000
Average adjustment period	2.4		2.8		4.9		4.0	
Number of observations	1,152		1,024		1,270		1,143	
	BELIBOR3M, monthly average				BELIBOR3M, monthly average			
Q_i	1.300	0.000	1.187	0.000	1.207	0.000	1.176	0.000
f_i	-0.581	0.000	-0.606	0.000	-0.249	0.000	-0.291	0.000
d_{i0}	-0.392	0.017	-0.798	0.000	-0.010	0.966	-0.012	0.952
d_{i1}					0.326	0.069	-0.028	0.892
λ_{i1}					0.076	0.085	-0.047	0.416
m_i	0.963	0.002	1.467	0.000	1.763	0.000	1.821	0.000
Average adjustment period	2.4		3.0		4.1		3.5	
Number of observations	1,152		1,024		1,270		1,143	

Note: Cluster I refers to banks with the share of liquid assets over 23.5%, Cluster II refers to banks with the share of liquid assets less than 23.5%.

Table 9 **MG estimates of the pass-through of market rates to bank lending rates according to dinarization criterion**

	Corporate				Households			
	Cluster I		Cluster II		Cluster I		Cluster II	
	estimate	p value	estimate	p value	estimate	p value	estimate	p value
	BELIBOR1W, monthly average				BELIBOR1W, monthly average			
Q_i	1.300	0.000	1.290	0.000	1.316	0.000	1.124	0.000
f_i	-0.557	0.000	-0.594	0.000	-0.264	0.000	-0.245	0.000
d_{i0}	-0.415	0.022	-0.605	0.003	-0.028	0.870	-0.228	0.302
d_{i1}					0.162	0.053	0.211	0.294
λ_{i1}					0.057	0.152	0.016	0.833
m_i	1.568	0.000	1.345	0.000	1.888	0.000	1.762	0.000
Average adjustment period	2.5		2.7		3.9		5.0	
Number of observations	1,152		1,024		1,270		1,143	
	BELIBOR3M, monthly average				BELIBOR3M, monthly average			
Q_i	1.252	0.000	1.242	0.000	1.278	0.000	1.097	0.000
f_i	-0.580	0.000	-0.607	0.000	-0.286	0.000	-0.250	0.000
d_{i0}	-0.455	0.009	-0.728	0.000	0.107	0.510	-0.142	0.574
d_{i1}					0.104	0.353	0.219	0.426
λ_{i1}					0.034	0.373	-0.002	0.998
m_i	1.325	0.000	1.060	0.001	1.888	0.000	1.682	0.000
Average adjustment period	2.5		2.8		3.1		4.6	
Number of observations	1,152		1,024		1,270		1,143	

Note: Cluster I refers to banks with the share of dinar loans to households over 41.8% and to banks with the share of dinar loans to corporate sector over 17.4%.

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