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THE MONETARY POLICY INTEREST RATE CHANNEL IN TIMES OF FINANCIAL TURBULENCE: CASE STUDY ON ROMANIA

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Key words: interest rate pass-through, interbank market interest rates, error correction model, Romania, financial crisis

Abstract: *This study aims to conduct a qualitative and quantitative analysis, focusing on the case of Romania, on the interest rate pass-through process and to discuss the results in light of the recent financial market tensions. More precisely, the study focuses on how the changes in the policy rate are transmitted to interbank market rates. The symmetric ECM is employed which incorporates both short-term and long-term information and additionally we use an ARDL model. The empirical results suggest that the NBR uses its policy instruments efficiently (the reserve requirements ratio and especially the policy interest rate) in conducting its monetary policy. This analysis offers some interesting policy insights and provides valuable information in assessing the effects of the recent financial crisis on the interbank rate developments. The result of this study could be used by monetary authorities to increase the efficiency of the monetary policy.*

1. INTRODUCTION

After a rigorous survey of the economic literature one can notice that economists do not agree on how the monetary policy conducted by a central bank affects the economy; their views diverge in terms of the specific channels through which monetary policy works. Nevertheless, an understanding of the transmission process is essential to the appropriate design and implementation of such a monetary policy. Monetary policy compresses the rules and various actions and instruments employed by a monetary authority in order to achieve its objective(s). The path of consequences a change in the economy's stock of money triggers in terms of real magnitudes is known as the *transmission mechanism*.

The *interest rate channel* is a very important monetary transmission channel through which central bankers can affect key macroeconomic variables. It is often regarded by some as the traditional mechanism or the "main channel of monetary policy transmission". Taylor [1] subscribed to this affirmation but was strongly disputed by Bernanke and Gertler [2].

According to the interest rate channel an expansionary policy leads to a reduction in longer-term real interest rates, which in turn affects business investment, investment in residential housing, and consumer expenditure on durable goods. The corresponding shift in aggregate demand is eventually reflected in aggregate output and prices.

The importance of the interest rate channel as part of the *monetary policy transmission mechanism* (MPTM hereafter) is even greater in the Romanian economy given the fact that its financial system is bank-based. In the period until 2000, the interest rate channel was almost inactive; therefore the MPTM had a low efficiency. The possibilities of the National Bank of Romania (NBR) to influence the real economy have been reduced, due mainly to the banking system that was dominated by a few banks, which did not depend on resources drawn from the central bank, the budget deficits that were financed by the banking sector and the volume of bank loans that presented low levels. After 2000, in the context of the reforms undertaken in the Romanian economy, the restrictive monetary policy pursued by the central bank had positive results. The disinflation process and increasing competition among banks led credit institutions to reduce active and passive interest rates for operations in lei, as well as the margin between them. Also, the year 2000 marks the beginning of the recovery process of financial intermediation and the connections between financial variables and the real economy [3].

This study aims to conduct a qualitative and quantitative analysis, focusing on the case of Romania, on the interest rate pass-through (IRPT hereafter) process and to discuss this issue in light of the recent financial market tensions. The results reveal how rapidly and extensively changes in the policy rate are passed on the interbank interest rates and some potential mutations in the monetary transmission channel. To the best of our knowledge it is the first attempt to make an assessment of the IRPT within the first stage (monetary policy rate – interbank interest rates) in the context of the financial crisis.

This analysis offers some interesting policy insights and provides valuable information in assessing the effects of the recent financial crisis on the interbank rate developments. The result of this study could be used by monetary authorities to increase the efficiency of the monetary policy.

The study proceeds as follows: in section two we attempt to critically examine the literature regarding theoretical and empirical studies of the IRPT; in section three we present the data and the econometric methodology. The findings are presented in section four and in the final section we bring together final remarks, some possible policy implications and some future directions for our research.

2. SURVEY OF THE LITERATURE ON INTEREST RATE PASS-THROUGH

Research undertaken in *the black-box of the interest rate pass-through mechanism* [4] abounds but the results and conclusions differ and are sometimes contradictory, depending on the panel of countries, markets or periods analysed. The methodological approach, the length of the research, the selection of exogenous money market rates and the presence of structural changes have also a big influence on the results [5]. Therefore, one can distinguish many braches of the economic literature on the subject of IRPT.

Some of the studies, on individual countries as well as comparative analyses, focus on the factors explaining the

sluggishness or rigidity (stickiness) in the IRPT. Hence, some of them are: costs related to asymmetric information or the agency cost theory [6], switching costs [7], search costs [8], fixed adjustments costs or the menu costs theory [9], [10], risk-sharing costs [11], [12], and costs generated by high volatility and uncertainty [13]. Furthermore, the efficiency of the IRPT is linked to the degree of competition among banks [14] but more precisely on the level of concentration in the interbank market [15], [16]. Hannan and Berger [13] point out the fact that deposit rates adjust significantly more sluggishly in concentrated markets. Van Leuvensteijn *et al.* [16] find that, in the case of the Euro area, stronger competition lowers interest spreads between bank and market rates for most loan products; in addition, they highlight the fact that retail interest rates react more strongly to changes in interbank interest rates if the markets are more competitive.

There are also studies that investigate the characteristic features of the IRPT mechanism in a country or a panel of countries. Thus, some focus on the *asymmetries* in the pass-through [14], i.e. various interest rates (retail or interbank rates) react differently to upward or downward shifts in the policy controlled interest rates (there is a non-linear relationship between the retail interest rates and asymmetric information or business cycles). Karagiannis *et al.* [17] found in the case of the Eurozone that banks tend to pass to depositors only the decrease of the original money market change and to borrowers more of its increases while for the US the situation is exactly the opposite. Others [9], point out the *heterogeneity* of IRPT not only across countries but also between different product categories within the same banking branch.

Other studies focus on different economic events that influence the process of pass-through, events such as the introduction of the euro [18], [19]. Very few studies analyse the impact of the global financial crisis that erupted in 2007 and intensified in the second half of the year 2008. Such a study [20] reveals the fact that the transmission of the impulses from the monetary policy rates to the interest rates on the market has been interrupted, and we may see that the results of this process were different in the Euro area and in the USA: the "policy rate – short-term interest rates" channel has been affected to a smaller extent in the Euro area, whereas the "policy rate – long-term interest rates" channel has been severely affected in both regions. Other studies [21] draw attention on the low efficiency of the transmission channels of the interest rate (in the Eurozone) from the interbank market to the retail market. Another study conducted by ECB [22] shows that, during the financial crisis, the interest rates on the retail market responded relatively satisfactorily to the volatility of the EURIBOR rate and of other long-term interest rates. Karagiannis *et al.* [17] stressed that in the case of the Eurozone the money market rate works more efficiently as a "policy vehicle variable" while for the case of US, the central bank rate is transmitted more efficiently to retail rates. A general idea on the research is that although the pass-through mechanism from interbank rates to retail rates has worked relatively well during the financial turmoil, the pass-through from policy rates to interbank rates has been greatly affected mainly due to the disruptions in the money and funding markets. This was reflected, among others, in elevated and volatile risk premia [23] and in lower confidence among banks [4].

Regarding the economic literature on the case of Romania, one important study is the one conducted by Antohi *et al.* [24], in which the authors empirically analyse the transmission of monetary policy impulses on the financial variables of the Romanian economy by considering both segments of the transmission process. Another significant study is the one undertaken by Tieman [25], which focuses on the transmission channel of the interest rates for the countries belonging to Central and Eastern Europe and uses monthly data from the 1995:01 – 2004:02 period. Tieman managed to refute the hypothesis according to which the *pass-through* of the interest rates from the monetary policy to the interest rates plays a minor role in Romania in comparison with the role played in other transition economies. The investigation performed at NBR [26] with regard to the transmission of the variations of the interbank interest rates to the interest rates of the non-banking customers' credits and deposits over the 2003:05 – 2009:12 period confirmed the slow-pace adjustment of the *pass-through* in the case of the Romanian economy. This behaviour is explained, among other things, by the characteristics of the credit/deposit contracts.

As for the empirical research studies on the pass-through transmission there is a tendency to use single equation models by focusing primarily on the responses of the retail rates to changes in the wholesale rates. The Error Correction Model, the Threshold Autoregressive Model and the LSE-Hendry GETS methodology are some of the tools employed by economists in quantifying the IRPT.

Some authors consider the interbank money market rates [17] to be policy controlled variables because central banks can influence them through the short-term interest rate and thus deny them a thorough investigation. We think that this statement is overrated. Of course interbank interest rates respond within a short time horizon to the shifts in the central bank policy rate but sometimes the pass-through may be incomplete and even asymmetrical (due to factors such as bank market power or adjustment costs) while in other cases the responses exceed expectations; the adjustment of interbank interest rates to changes in policy rates although sometimes it is taken for granted, is nevertheless a important element of the interest rate transmission mechanism. Thus, the efficiency of the transmission mechanism depends heavily on the efficiency of the monetary interbank market as a link between the monetary policy interest rates and retail interest rates. While studying the case of Romania, the present paper provides a thorough analysis of the IRPT from policy rates to the interbank rates highlighting in the meantime the impact of the global economic and financial crisis that erupted in August 2007.

3. THE INTEREST RATE PASS-THROUGH: THEORETICAL CONSIDERATIONS

The fundamental relation between *monetary policy rates*, the interest rates on the *interbank market* and the interest rates on the *retail market* is schematically presented in Figure 1. The IRPT can be broken down into two stages. The first stage analyses the impact of the modifications occurred at the level of the interest rates on the interbank market (IB_{ir}) for the entire spectrum of maturities (short term and long term), following the variations of the monetary policy interest rate (MP_{ir}), whereas the second stage focuses on the transmission channel of the impulses from the interbank monetary market to the interest rates charged by the credit institutions (R_{ir}) from their customers (D_{ir} for deposit interest rates and L_{ir} for credit interest rates).

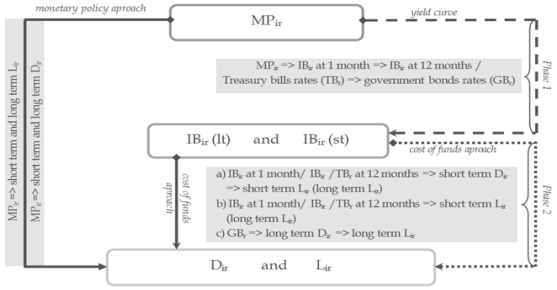

Fig. 1. The interest rate transmission mechanism
Source: [27], [28] author's own calculation

The literature in the field distinguishes between three important research directions (they can be deduced from Figure 1). On the one hand, there are studies which focus exclusively on the IB_{ir} –– R_{ir} relation (for example [26]). This approach is based on the *cost of funds approach* [29]. Other authors (Tieman [25] among others) focus on the direct impact of MP_{ir} on D_{ir} and L_{ir}, approach that Sander and Kleimer [15] name the *monetary policy approach*. The third research direction analyses the two distinct stages of the interest rate *pass-through* discussed in the previous paragraph [30]. Thus, the stability of the yield curve is of utmost importance for the analysis of the first stage of this research direction (MP_{ir} – IB_{ir}), whereas the second stage (IB_{ir} – D_{ir}/L_{ir}) can be studied by using the approach based on the *cost of funds approach*.

The main idea of the interest rate *pass-through* consists in: adjustments in the monetary policy interest rates generate modifications of the (interbank) market rates, starting with maturities of less than 12 months and moving through the yield curve towards the rates with longer maturities. Although it is said that the pass-through from policy interest rates to market interest rates is in the majority of the cases proportionate, any twist in the yield curve (regardless of its slope, negative or positive) could change the size of the pass-through. Subsequently, the modifications which occur on the interbank market are transferred to the credit and deposit interest rates of commercial banks which during the final stage of monetary transmission, influence, in their turn, the level of savings, investments and consumptions and, thus, the level of overall demand and prices.

4. DATA USED AND RESEARCH METHODOLOGY

4.1 Data

The research study is based on data series at monthly frequency over the period 2003:05 – 2011:09 obtained from monthly reports of the NBR. The data is presented in Table 1.

Regarding the exogenous interest rates, the study uses data provided by the central bank official (policy) rate highlighting thus the monetary policy stance. Because we wish to analyse the impact of the monetary policy instruments on the interbank money market we also use the reserve requirements ratio denominated in lei. As the study will show, this instrument was not so efficient in the period before October 2008 but its impact is incontestable afterwards. We could also use a proxy of the policy rate, the T-bills (yields on Romanian treasury bills with discount) but the study focuses largely on monetary policy issues.

As for the interbank market interest rates, the study uses the Romanian Interbank Bid Rate (ROBID) and Offer Rate (ROBOR) and the average interest rate on transactions.

Table 1. Data series used in the analysis of the IRPT

Symbol	Description
MP_{ir}	monetary policy interest rate
RR_l	reserve requirements ratio denominated in lei
IB_{air}	average interest rate on transactions (interbank deposits)
ROBOR_1W	Romanian Interbank Offer Rate at 1 week over spot - a.r.
ROBOR_xM	Romanian Interbank Offer Rate with maturity of 1, 3, 6, 9, 12 months - a.r.
ROBID_1W	Romanian Interbank Bid Rate at 1 week over spot - a.r.
ROBID_xM	Romanian Interbank Bid Rate with maturity of 1, 3, 6, 9, 12 months - a.r.

Note: measured in percentage points; a.r. = average rates

The analysis was performed on the following samples:

- *Sample no. 1* (data from May 2003 to October 2011); this is the full sample containing 101 observations.
- *Sample no. 2* consists of data from May 2003 to September 2008; the data from this sample are prior to the effects of the international financial crisis felt in the Romanian economy, following Lehman Brothers' bankruptcy.
- *Sample no. 3*; the period under consideration is October 2008 – October 2011, summing 36 observations.

4.2 Methodology

An important strand of the empirical literature on the IRPT focuses on the dynamic multiplier method [31]. This methodology involves estimating a simple dynamic model in which the endogenous interest rate is regressed using its own lagged values and the one of the exogenous interest rates. Nevertheless, this approach has one important disadvantage: there is a loss of long-run information on the level of the variables analysed. This is why we employ a symmetric Error-Correction Model (ECM) that incorporates both short-term and long-term information. Additionaly we will use an Autoregressive Distributed Lag model (ARDL).

The connection between policy rates and interbank market rates can be illustrated using the following formula:

$$\boldsymbol{IB_{ir}} = \alpha + \beta * \boldsymbol{MP_{ir}} + \varepsilon \qquad (1)$$

where, IB_{ir} stands for the interbank interest rate, MP_{ir} is the monetary policy interest rate, **β** is the long-run pass-through coefficient, and **α** is a constant mark-up (the intercept).

If the pass-through β in the relationship (1) equals 1, then we have a complete or perfect pass-through of the policy rates to interbank rates but this rarely happens, given the presence of imperfect competition and asymmetric information. If the value of β is lower than one (β < 1), this is the case of incomplete pass-through when banks do not respond to monetary impulses on a one-to-one basis. If, on the other hand, the elasticity of β is greater than one (β > 1), then we are dealing with a situation of *overshooting* where there is perfect competition on the interbank money market.

We employ the ECM provided that the interest rate series (both explanatory and dependent) are non-stationary I(1) and cointegrated. The ECM (as the one used by us and specified in formula (2)) has been applied extensively in the literature but the exact model depends on the authors' approach [19] [22], [25], [15].

$$\begin{aligned}\Delta IB_{ir_t} &= c + \omega_1 * \Delta IB_{ir_{t-1}} + \omega_2 * \Delta IB_{ir_{t-2}} + \boldsymbol{\mu_0} * \Delta MP_{ir_t} + \\ &+ \mu_1 * \Delta MP_{ir_{t-1}} + \mu_2 * \Delta MP_{ir_{t-2}} + \boldsymbol{\gamma_1} * ECM_{t-1} + \varepsilon\end{aligned} \qquad (2)$$

where,

$$ECM_t = IB_{ir_t} - \alpha - \beta * MP_{ir_t} \qquad (3)$$

where, **β** is the long-run multiplier, μ_0 measures the immediate or the short-term pass-through, γ_1 measures the speed of adjustment of the short-run dynamics to the long-run equilibrium relationship (this is a proxy of the effectiveness of the interest rate channel of monetary policy and it shows how much of the gap created by a change in the policy interest rate is closed in one month).

If the interest rate series are I(1) processes but are not cointegrated, we used the Autoregressive Distributed Lag model (ARDL) specified in equation 3. We follow the procedure specified in Cottarelli and Kourelis [9].

$$\Delta IB_{ir_t} = c + \omega_1 * \Delta IB_{ir_{t-1}} + \omega_2 * \Delta IB_{ir_{t-2}} + \mu_0 * \Delta MP_{ir_t} + \\ + \mu_1 * \Delta MP_{ir_{t-1}} + \mu_2 * \Delta MP_{ir_{t-2}} + \varepsilon \quad (4)$$

and,

$$\beta = (\mu_0 + \mu_1 + \mu_2)/(1-(\omega_1 + \omega_2)) \quad (5)$$

where, **β** is the long-run pass-through coefficient (computed value), and μ_0 is the immediate or the short-term pass-through.

In general, interest rates are stationary processes or I(0) because they do not normally exhibit a long-term trend. Nevertheless, in transition economies (and Romania is not an exception), interest rates present a declining trend as the transition takes hold and the problem of inflation is reined in [31]. To determine the unit root properties of the variables under investigation we apply two types of tests: the Augmented Dickey-Fuller (ADF) test [32] [33] and the Phillips-Perron (PP) test [34]. If the results for the unit root tests will show that the time series in levels are I(1) and at first differences are stationary then we will consider that the interest rates are I(1) and further tests can be performed. To determine if there is a long-run equilibrium relationship among non-stationary time variables, i.e. the series are cointegrated or not, we use the methodology developed by Johansen [36] (the Johansen test).

To see how much of the current value of one variable can be explained by past values of another variable within the MPTM, we used Granger Causality tests. The results will show if there are Granger-type causality relations between the NBR's monetary policy instruments and IB_{ir}, thus testing the hypothesis that there is a functional and efficient interest rate channel. We will also be able to test if certain variables are endogenous or exogenous.

We will also estimate the degree of correlation between MP_{ir} and IB_{ir}. Empirical analysis uses simple correlations in the raw series (level) for different lags. The results will show if there are weak or strong correlations and how fast interest rates react to changes in different exogenous variables. Also, the correlation coefficients will help us to determine the most appropriate interest rates to continue our empirical analysis.

5. EMPIRICAL RESULTS AND IMPLICATIONS

The IRPT from policy rates to interbank market rates constitutes the first step of the interest rate channel. In this particular section, we present the estimated values of the pass-through in Romania and discuss them in light of the global financial crisis. More precisely, we study how the financial distress in the money markets interfered in the transmission mechanism from autumn 2008 till the autumn of 2011. We begin by presenting and discussing the results for the unit root tests that are outlined in Table 2. We used the ADF test (with intercept) and the PP test (with intercept) and the number of lags was chosen using the AIC and the SC.

Table 2. The integration order for selected interest rate series

Variables	Sample 1	Sample 2	Sample 3
MP_{ir} and RR_l	I(1)*	I(1)*	I(1)*
ROBID (1W, 1M, 3M)	I(1)*	I(1)*	I(1)*
ROBID (6M, 9M, 12M)	I(1)*	I(1)*	I(1)**
ROBOR (1W, 1M, 3M)	I(1)*	I(1)*	I(1)*
ROBOR (6M, 9M, 12M)	I(1)*	I(1)**	I(1)*
IB_{air} and T-bills	I(1)*	I(1)*	I(1)*

*, **, *** denote significance on 1, 5 and 10 percent level, respectively.

According to the results in Table 2, the data series are non-stationary processes. We can say thus with a 95% confidence level that the data for the three samples, according to ADF and PP test results, are I(1) processes. In conclusion, the non-stationarity of all the series allows us to continue our analysis by conducting Granger tests, correlation analysis and cointegration tests to identify the presence of a long-run equilibrium.

After performing the Granger Causality tests we arrived at the following conclusions:

- at the level of sample 1 (data from 2003:05 to 2011:10) the policy rate exercised the most significant influence on the other analysed interest rates; there is a considerable Granger-type causality relation between the monetary policy interest rate and interbank interest rates with maturities of 1 week to 3 months.
- at the level of sample 2 (data from 2003:05 to 2008:09), we may notice a relation of causality, only for the short-term (up to one month), between MP_{ir} and ROBOR rates (maturities of 3 to 12 months); we may also notice a Granger causality relation for the medium term (2-3 months) between MP_{ir} and ROBID rates (for the entire maturity spectrum); as concerns the level of reserve requirements, we cannot reject the null hypothesis of no Granger causality.
- at the level of sample 3 (the data from 2008:10 to 2011:09), we may identify a stable and significant relation of Granger causality between MP_{ir} and ROBOR rates (all maturities); we may also notice the fact that the ROBID rates are no longer so sensitive to the variations of the policy interest rates.
- the influence of the modifications operated by NBR starting with the month of October 2008 (following the decrease of excess liquidity in the banking sector and the reaching by the banks of a state of liquidity shortage) in the level of reserve requirements for the liabilities denominated in lei of the credit institutions can be analysed from the perspective of their influence on the interest rates. Thus, we may notice the fact that the reduction of the reserve requirements ratio from 20% to 18% (in November 2008) and, later on, to 15%, which is also the current rate, had a considerable impact on the interest rates at which Romanian banks borrow money from one another in the national currency.

In conclusion, the test results confirm the NBR capacity to influence, by means of its instruments (primarily through the open-market operations and the reserve requirements mechanism), the great majority of interest rates on the interbank monetary market.

Regarding the Cross Correlation analysis between the monetary policy instruments (MP_{ir} and RR_l) and the interbank rates, the results are presented in Table 3.

Table 3. Correlation analysis results between monetary policy instruments and the interbank rates (raw data)

Interbank rates	Sample 1		Sample 2		Sample 3	
	MP_{ir}	RR_l	MP_{ir}	RR_l	MP_{ir}	RR_l
ROBID_1W	0.90	0.34	0.92	0.30	0.95	0.82
ROBID_1M	0.89	0.35	0.93	0.32	0.96	0.83
ROBID_3M	0.89	0.34	0.93	0.33	0.97	0.86
ROBID_6M	0.87	0.34	0.92	0.34	0.97	0.88
ROBID_9M	0.85	0.35	0.91	0.35	0.97	0.89
ROBID_12M	0.83	0.35	0.90	0.35	0.97	0.89
ROBOR_1W	0.91	0.37	0.95	0.30	0.91	0.85
ROBOR_1M	0.92	0.36	0.97	0.32	0.92	0.87
ROBOR_3M	0.93	0.33	0.98	0.32	0.92	0.90
ROBOR_6M	0.92	0.32	0.98	0.33	0.92	0.91
ROBOR_9M	0.92	0.33	0.98	0.33	0.91	0.91
ROBOR_12M	0.91	0.33	0.97	0.34	0.92	0.92
IB_{air}	0.91	0.37	0.94	0.30	0.90	0.84

Legend: IB_{air} = average interest rate on transactions

The connections between MP_{ir} and the ROBID and ROBOR rates are powerful and immediate. The ROBID rate which has the most significant correlation coefficient (of 0.89) is the one with one week maturity. Regarding the ROBOR rate that is the most sensitive to the oscillations of the monetary policy interest rate is the one with 3 months maturity (with a correlation coefficient of 0.93).

With regard to the ratio of reserve requirements, the connection between this monetary policy instrument and the interest rates on the interbank market is weaker (compared to the MP_{ir}): the correlation coefficients vary between 0.23 and 0.34 and the lags for which the most powerful correlations have been identified vary between 1 and 8 months. This suggests that the analysed interest rates react at different velocities at impulses from the monetary policy.

From the data processed in sample 3, we noticed a stronger connection between the MP_{ir} and ROBID rates in comparison with that between MP_{ir} and ROBOR rates. The most powerful connection is that between MP_{ir} and ROBID at 9 months. Both interbank rates react almost immediately to the variations of the policy interest rate. Thus they manage to show the high capacity of the central bank to influence market rates. The relatively weaker correlation between the policy rate and the average interest rate of interbank operations could be due to the smaller maturity of the latter.

The capacity of the central bank to influence the interbank market is also confirmed by the results of the analyses of the correlation coefficients for the series from the first difference which were no longer included in this paper because of space-related constraints. Taking into consideration the results of the Granger tests and the correlation coefficients obtained for the raw series (level) (Table 3), the rest of our analysis will use the monetary policy interest rate as the main monetary policy instrument. At the same time, because of the already mentioned constraints, we will restrict our analysis to the ROBID and ROBOR rates with 3 and 6 months maturities as reference rates of the interbank monetary market.

After employing the Johansen methodology, we obtained the results shown in Table 4. According to the computed data there is a long-run relationship between the monetary policy interest rate and the ROBOR rates in all the samples. Regarding the ROBID rates, there are cointegration relations but only in the third sample. Regarding the last period analysed, we are reserved with regard to the obtained results, as these may be distorted by the much reduced temporal dimension of the used dataset.

Table 4. The cointegration test results using the Johansen procedure

MP_{ir} and IB_{ir}	Test	Sample 1		Sample 2		Sample 3	
		VT	Ct?	VT	Ct?	VT	Ct?
ROBID_3M	Tr	10.41	NO	11.21	NO	17.32**	YES
	Me	9.45	NO	10.21	NO	15.71**	YES
ROBID_6M	Tr	8.92	NO	9.27	NO	20.58*	YES
	Me	8.00	NO	8.35	NO	19.27*	YES
ROBOR_3M	Tr	17.26**	YES	24.51*	YES	31.38**	YES
	Me	15.90**	YES	23.23*	YES	29.42**	YES
ROBOR_6M	Tr	16.96**	YES	26.25*	YES	33.30**	YES
	Me	15.55**	YES	24.94*	YES	31.34**	YES

Legend: Tr. and Me. = Trace test and Max-Eigenvalue test; VT = the value of the test used in assessing whether a cointegration relation exists or not; Ct? = "Is there cointegration or not?".
*, **, *** denote significance on 1, 5 and 10 percent level, respectively

According to the computed data, there is a long-run relationship between the monetary policy interest rate and the ROBOR rates in all the samples. Regarding the ROBID rates, there are cointegration relations but only in the third sample.

Before computing and interpreting the values of the IRPT, we must pay special attention to the specificity of the data belonging to the two analysed periods (the period before and after October 2008, when the effects of the international financial crisis were felt in the Romanian economy). Thus, before the effects of the international financial crisis had become more visible: 1) the Romanian economy registered a period of sustained growth, accompanied by a continuous process of disinflation and nominal appreciation of our national currency (with effects on the risk premium); 2) there was a gradual intensification of the competitive process in the banking sector, and the credit institutions used their resources for augmenting their market share; 3) following the loosening of monetary control, there was excess liquidity. After October 2008, following economic and financial shocks, we witnessed: 1) the deterioration of the macroeconomic conditions; 2) the powerful increase of competitiveness in the banking sector, focusing on the efficient management of the quality of the credit portfolio and the structure of the balance sheets; 3) the modification of the net position of the banking system, supported by the increasing level of mistrust among credit institutions (the amplification of the risk perceived by banks was one of the main effects).

A dysfunctional interbank market is characterized not only by its *elevated and volatile risk premia* [23] but also by the widening of the interest rate spreads.

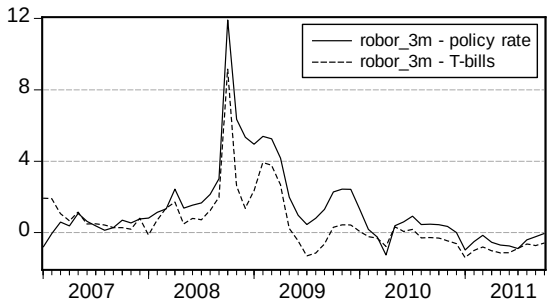

Fig. 2. Interest rate spreads (percentage points)

An important spread is the one between the ROBOR rate at 3 months and the policy interest rate (see Figure 2). The ability of NBR to steer the ROBOR rate at 3 months was gravely hampered after October 2008 given the fact that the

spread between those two rates jumped from a ±2 percentage points interval to almost 12 percentage points. In the period preceding the global financial crisis but after 2000 the policy interest rate and the interbank market rates moved closely together with a larger deviation (a spread of -3.30%) around 2005 regarding the process of account liberalization. Nevertheless, as the financial turbulences were felt in the Romanian economy these various interest rates started to move different. An important reason is that not all the cuts in the policy interest rates were passed to the interbank market rates. The effects were felt in the IRPT to retail interest rates. Another important spread is the one between the ROBOR rate at 3 months and the yields on Romanian treasury bills. This could be viewed as a Romanian proxy of the so-called TED spread (the spread between unsecured interbank lending and Treasury bill rates [37]). This spread provides a quantitative picture for the extra return that a bank expects when lending to another bank rather than to the government. In Figure 2 one can see the disturbance in the functioning of the interbank market starting with the beginning of 2008. After reaching its pick in October 2008, the Romanian TED spread returned to calm waters after October 2009. A more comprehensive analysis (that was not realized given the lack of data) would imply decomposing the spread into two components: a spread between the ROBOR rates and the credit default swap rates (*a basis spread* that could prove a measure of credit and liquidity risk) and another spread between the latter and the Treasury bill rates.

After employing the models specified in equations (2) and (4) we obtained the results specified in Table 5.

Table 5. The estimated IRPT from policy rates to interbank market rates

	Sample 1			**Sample 2**			**Sample 3**		
Coeff.	St PT	Lt PT	Adj.	St PT	Lt PT	Adj.	St PT	Lt PT	Adj.
IR	μ_0	β	γ_1	μ_0	β	γ_1	μ_0	β	γ_1
ROBID 3M	0.44* *0.14*	1.09 -	-	0.43* *0.15*	1.08 -	-	1.72* *0.54*	1.92* *0.09*	0.63* *0.14*
ROBID 6M	0.46* *0.12*	1.04 -	-	0.45* *0.13*	1.02 -	-	1.77* *0.41*	1.80* *0.07*	0.60* *0.14*
ROBOR 3M	0.69* *0.22*	0.96* *0.12*	0.20* *0.06*	0.44* *0.11*	0.89* *0.10*	0.13* 0.06	4.23* *1.33*	2.39* *0.11*	1.32* *0.23*
ROBOR 6M	0.70* *0.22*	0.87* *0.12*	0.19* *0.06*	0.41* *0.10*	0.71* *0.15*	0.07** *0.04*	4.48* *1.25*	2.24* *0.09*	1.43* *0.24*

Legend: *St* and *Lt PT* denote short-term and long-term pass-through; *Adj*. stands for the speed of adjustment and has negative values (the coefficient is expected to be negative because it indicates adaptation to the long-run equilibrium); numbers in *italic* are the Standard errors.
*, **, *** denote significance on 1, 5 and 10 percent level, respectively.

Regarding the results in Table 5, before October 2008, companies were more interested in setting up deposits than in obtaining loans (as a result of excess liquidity), observation resulted by analyzing the values of the parameter β, associated with the ROBID, respectively EURIBOR rates; after this period we may notice a thorough change in the behavior of the banking sector (the transmission surplus which affected both interest types might have been caused by the firm management by NBR of the liquidity on the monetary market, as well as by the increasing mistrust among credit institutions). The results reveal an *overshooting* of over 180% for ROBID rates and of over 220% for ROBOR rates in response to the variations of the monetary policy interest rates (we may notice the concern of the banks in relation to obtaining financial resources, as external liabilities were no longer an option). The *cash* hunt and the panic specific to data in sample 3 also led to the increase of the values of the μ_0 indicator, practically annihilating any modification at the level of the monetary policy interest rate. Before October 2008, interbank rates would receive, during the first month, approximately 43% of the modification of the monetary policy interest rate. After the manifestation of the effects of the crisis in the Romanian economy, the short-term *pass-through* became very sensitive, registering excessively big values (the ROBID rates would receive during the first month over 175% of the variations of the monetary policy interest rate, whereas values of over 430% were registered for the ROBOR rates). As a result of the very big values registered at the level of parameters β and μ_0, the values of parameter γ_1 are also high for the data in sample 3, thus suggesting a high adjustment rate of the short-term dynamics, moving towards long-term equilibrium.

The transmission of a temporary shock of the monetary policy interest rate on the interbank market interest rates is illustrated in figure 3. In order to obtain the values, we used an unrestricted VAR with data series in the first difference and the obtained response employed cumulated values. We may notice that the adjustments at the level of the monetary policy interest rate are gradually transmitted to the interbank monetary market with an immediate response of about 25% for ROBID rates and of 30% for ROBOR rates.

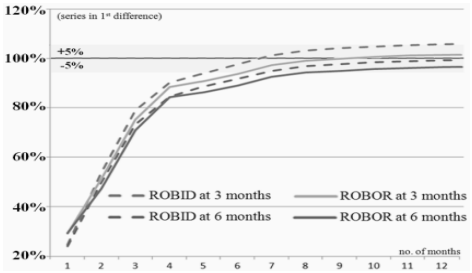

Fig. 3. The impulse-response function of monetary policy interest rate to interbank rates

A simple analysis of each of the two maturities reveals the fact that, although short-term reactions are more marked in the case of ROBOR rates, the ROBID rates undergo an ampler adjustment on the long term. We may thus conclude that the results obtained by using an unrestricted VAR validate the remarks made when using the ECM.

6. CONCLUSION

Following the intensification of the international financial crisis in autumn 2008, not only was the functioning of the financial system seriously hindered but also the monetary policy transmission mechanism was heavily damaged for many central banks. At least this was the case of the ECB and the Fed. The purpose of this study was to analyse, on the Romanian case, the interest rate pass-through process before and after October 2008 (when the effects of the recent financial market tensions were mostly felt on the Romanian economy). To know and to understand the specific features of the interest rate transmission mechanism (one of Romania's most important monetary policy transmission channel) is of great importance for the National Bank of Romania and for the achievement of its monetary policy objectives. An important aspect worth mentioning is the fact that the study is focused on a specific niche: the pass-through from the NBR's policy interest rate to the interbank market

rates (viewed as important links between the monetary policy rate and the retail interest rates).

According to the empirical results highlighted in this paper, the reaction of the interbank interest rates to the shifts in the monetary policy interest rate was *slow* or *sluggish* over the period 2003:05 – 2008:09. The contemporaneous responses of the ROBOR and ROBID rates are almost equal but on the long run, only the ROBID rates have a complete pass-through. However, the ROBOR rates are not "so far behind". The empirical results so far are in line with other studies that deal with the IRPT in Romania [26] or other countries in Central and Eastern Europe [25].

The results on the IRPT (1st stage) in Romania in the period following October 2008 seem to be quite *violent* (we are reserved as these results may be distorted by the much reduced temporal dimension of the used dataset in the sample). On the short-run, the immediate responses of the interbank rates are very high, and they may mirror the lack of liquidity on the interbank market and from mother banks, constraints on the access to long-term funding and the increase in risk perception and a sharp decrease in confidence among banks. Although on the long-term the pass-through is complete (with $\beta > 1$), the coefficients are still too high (reflecting an overreaction from the banks to any behavior in the monetary policy interest rate). Among the factors which affected the *pass-through* of the interest rates, it is worth mentioning: the change of the net position of BNR in relation to the banking system, the deterioration of the expectations of the banking institutions concerning the evolution of the monetary policy interest rate, the deterioration of macroeconomic indicators (including inflation), etc. After this episode of financial turbulence in the Romanian economy, the credit institutions have reassessed their risk perception becoming thus more cautious (*credit rationing*).

Other important results regard the reserve requirements ratio which, in the case of the National Bank of Romania, proved to be a very efficient instrument of monetary policy in helping guide the short-term interest rates (according to the Cross Correlation and Granger Causality tests).

An understanding of the IRPT is crucial to policymakers especially in the context created by the recent financial crisis. The current analysis of the IRPT could be a valuable input to the National Bank of Romania in assessing the effects of the changes that occurred in the interbank market. Also, given the fact that many bank loan and deposit rates (in the national currency) are linked to the Romanian interbank rate, such a study could be of valuable importance in evaluating the extent to which policy rates are passed to retail rates.

In future studies we intent to test the existence of symmetric or asymmetric behaviour in the transmission of interest rate impulses and to incorporate in the model expected, as well as unexpected, monetary policy impulses.

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