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DOMESTIC FINANCE AND INSTITUTIONS

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The Interest Rate Pass-through from Policy Rates to Interbank Interest Rates in the Romanian Financial System

Abstract

This study aims to conduct a qualitative and quantitative analysis, focusing on the case of Romania, namely on the interest rate pass-through process and to discuss the results in light of the recent financial market tensions. Technically, the study focuses on the speed and magnitude of the pass-through from variations in the monetary policy interest rate to wholesale interest rates. For this reason the symmetric error correction model is employed, which incorporates both short-term and long-term information. Additionally, we use a standard-VAR model. We also look at the asymmetries in the pass-through. This analysis offers some interesting policy insights as well as valuable information in assessing the effects of the recent financial crisis on the interbank rate developments. The results show that the reactions of the Romanian interbank interest rates to the variations created by the National Bank of Romania in the monetary policy interest rate were sluggish over the periods May 2003 to September 2008 but 'violent' in the period following October 2008. The empirical results obtained in this study might be useful for the increase in the efficiency of monetary policy implementation, providing useful information to whoever is eager to look inside the *black box* of the Romanian monetary policy transmission mechanism.

Keywords: Interest Rate Pass-Through, Policy Interest Rate, Interbank Money Market Interest Rates, Error Correction Model, VAR Model, Cointegration Vector Analysis
JEL Codes: E43, E50, E52, E58, G20, G21

I. Introduction

Financial intermediation is of great importance not only to economic growth but also to the proper functioning of our society. Although researchers and policy makers use different terms such as financial development, financial markets, financial system or finance (and many others), they emphasise the same issue, which is that of *financial intermediation by banks*. Because banks take on such a significant role in the process of financial intermediation, they are considered to be important players in the financial system, especially in the euro area (where banks are the primary source of financing for the real economy). But these financial intermediaries (i.e. banks) do not play by their own rules. The main figure in this pyramidal structure is the central bank.

Although monetary authorities develop and implement the monetary policy decisions in order to affect the economic cycle, banks also play a significant role in the process of monetary policy implementation, thus being 'important conveyers of monetary policy impulses' (Sander and Kleimeier, 2004: 462). These conveyers that Sander and Kleimeier refer to are the monetary policy channels.

The process of the transmission of monetary policy decisions in the real economy is achieved in different ways which will eventually be seen in the final results, in the amplitude and meaning of the decisions made and, at the same time, in the timing and persistence of the ensuing effects. For many central bankers the *interest rate channel* is just a part of the monetary policy transmission mechanism through which the monetary authority affects, for a certain time period, the evolution of the macroeconomic indicators specific to the real economy. Nevertheless, the interest rate is a very important policy instrument used by the National Bank of Romania (NBR) in conducting its monetary operations given the fact that Romania's financial system is bank-based. This is also the case for the euro area financial system given the importance of banks in the euro land economy.

In Romania before the 2000s, the interest rate channel was almost inactive; therefore the monetary policy transmission mechanism (hereafter, MPTM) had a low efficiency. The possibilities of the NBR

to influence the real economy have been reduced, mainly due to the banking system that was dominated by a few credit institutions, 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 the increasing competition among banks led credit institutions to reduce active and passive interest rates for the operations in the national currency, as well as the margin between them. Also, the year 2000 represented the beginning of the recovery process of the financial intermediation and the connections between financial variables and the real economy.

In this context, this study aims to conduct a qualitative and quantitative analysis, focusing on the case of Romania, on the interest rate pass-through (hereafter IRPT) 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 this is the first attempt is to make an assessment of the IRPT within the first stage (monetary policy rate – interbank interest rates) in the context of the financial crisis. The author does not consider Romania's economy as being a closed one (especially if we consider that foreign capital is dominant in the Romanian banking sector covering almost 90 per cent of the total banking assets) and in his econometric models he does not take into consideration other factors that could influence/alter the interest rate pass-through on the Romanian interbank market.

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 the monetary authorities to increase the efficiency of the monetary policy.

The study proceeds as follows: *Section two* introduces the Romanian financial system. *Section three* presents some theoretical considerations on the interest rate channel. In

section four we examine the theoretical and empirical literature regarding the interest rate pass-through. *Section five* introduces the data and the econometric methodology of the paper. The findings are presented in *section six* and in *section seven* we bring together the final remarks, possible policy implications and some future directions for our research.

II. Overview of the Romanian Financial System

When analysing the MPTM, researchers (Cecchetti, 1999; Antohi, Udrea and Braun, 2003 among others) found that the *structure of the financial system* is of utmost importance for both its segments. In a financial system, the impulse of a decision made by the monetary authorities at the moment t turns into a response of one/several financial variables at a moment $t+m$, in a certain direction and at a certain scale, with a specific duration and persistence. For the member countries of the Monetary Union, the source of the asymmetries in the financial structure of economies is given firstly by discrepancies at legislative level and, secondly, by the particularities of the financial markets (Cecchetti, 1999). As for Romania, the variations which occurred at the level of the financial system starting in 2000 had a favourable impact on the MPTM, in the sense of its increased efficiency.

A clear understanding of the structural specificity of the Romanian financial systems is of great importance for the central bank when developing and implementing the monetary policy. Since the policy interest rates have increased in reputation as the main monetary policy instrument in many economies, Romania also has aligned itself to this international trend in central banking. In this sense, the NBR pays special attention to the interest rates as instruments of monetary policy.

As mentioned earlier, the Romanian financial system is a bank-based one, for banks own over 80 per cent of the total assets of the financial institutions (respectively over 90 per cent of the financial sector, together with non-banking financial institutions at the end of 2010). Thus, bank loans represent the foundation of the Romanian financial system, a situation that is similar to that of the European Union (Zingales and Rajan, 2003) or of other economies from Central and Eastern Europe. Table 1 sketches a profile of the

Romanian financial system, revealing the dominant position of banks and the strong dynamics of private retirement plans towards the end of the period. At the same time, we may notice that, although banks dominate the financial system, the process of the convergence of the domestic financial markets towards the European ones creates the perfect environment for the development of insurance and capital market investments.

Table 1 Profile of the Romanian Financial System, 2000-2010

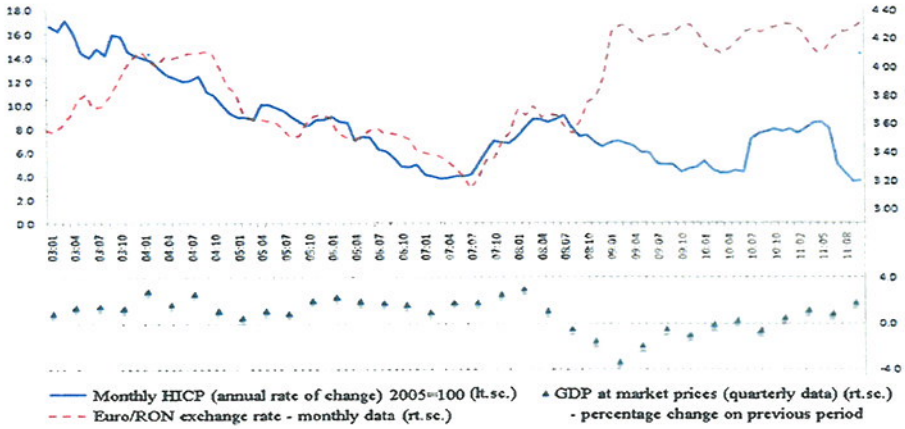
Financial institutions	Net assets as a share of GDP (%)									
	2000	2002	2003	2004	2005	2006	2007	2008	2009	2010
Credit institutions [1)]	28.73	31.46	31.27	36.94	45.08	50.91	60.44	61.09	66.30	66.55
Insurance companies [2)]	1.17	1.51	1.78	1.90	2.20	2.50	3.00	3.00	3.34	3.27
Open-end investment funds [3)]	0.05	0.09	0.09	0.21	0.17	0.30	0.30	0.20	0.67	1.07
Private pension funds	0	0	0	0	0	0	0	0.17	0.47	0.84
Financial investment companies	1.44	1.45	1.45	1.29	1.76	2.30	2.80	1.20	1.49	n.a.
Non-bank financial institutions	n.a.	1.89	2.21	3.62	4.50	4.70	7.20	8.40	7.53	7.00
Total – Financial system (FS)	31.39	36.4	36.8	43.96	53.71	60.71	73.74	74.06	79.8	78.73
BVB [4)]	1.36	6.02	6.17	13.80	19.40	21.28	20.66	8.88	16.08	19.94
RASDAQ [4)]	2.57	4.02	4.01	3.23	2.84	3.11	5.87	2.35	2.48	2.11
Total – other financial institutions	3.93	10.04	10.18	17.04	22.24	24.39	26.53	11.23	18.56	22.05
Total – FS and stock market capitali-sation	35.32	46.44	46.98	61,0	75.95	85.1	100.3	85.29	98.36	100.8

Source: NBR annual and monthly reports, (www.http://bnro.ro), Report on Insurance Market and for the Activity (www.csa-isc.ro/), Monthly reports of the Asociatia Administratorilor de Fonduri (www.kmarket.ro/), Activity reports of the CNVM, (www.cnvmr.ro/), author's calculations.

Note: [1)] in the calculation, the total of net assets of credit institutions, including CREDITCOOP, has been considered; [2)] the total value of the net assets according to the centralised balance-sheets; [3)] the total value of the net assets according to the centralised balance-sheets from the annual reports; [4)] stock market capitalisation

In the current context, before the effects of the international financial crisis became more visible, the Romanian economy registered: 1) a period of sustained economic growth, accompanied by a continuous process of disinflation and nominal appreciation of the national currency (see Figure 4) with effects on the *risk premium*; 2) a gradual intensification of the competitive process in the banking sector, the credit institutions using their resources to augment their market share (see Figure 5 for an overview of the degree of concentration in the Romanian banking system); 3) following the loosening of monetary control, there was excess of liquidity.

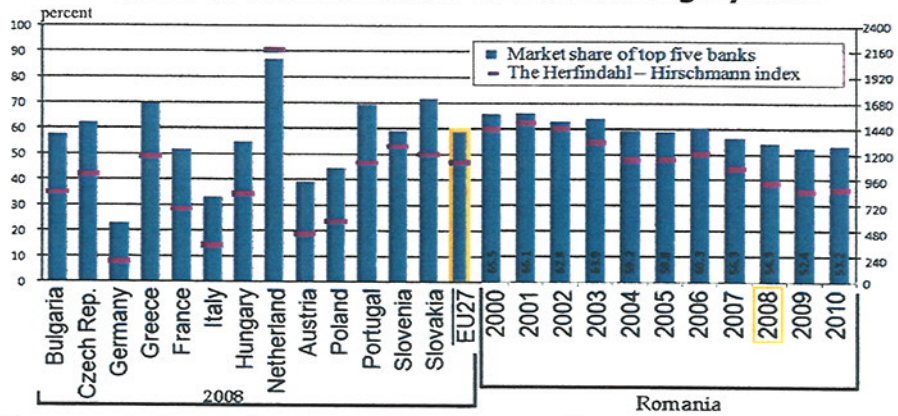
Figure 1 – Indices of Economic Health



Source: Author's illustration using Eurostat data

The degree of concentration in the banking system registered decreasing values starting in 1991, but it started to increase again towards the end of 1997. Its value varied over the 2000-2010 period, but the trend was a decreasing one, from about 66 per cent in 2000 to 53 per cent in 2010. It is worth mentioning that, when compared to 2008, the level was below the average values registered in the European Union. The situation is also confirmed by the evolution of the Herfindahl – Hirschmann index, which started to decline in 2006, reaching a value of 857 points at the end of 2009, thus indicating the existence of a competitive banking sector, as far as assets were concerned.

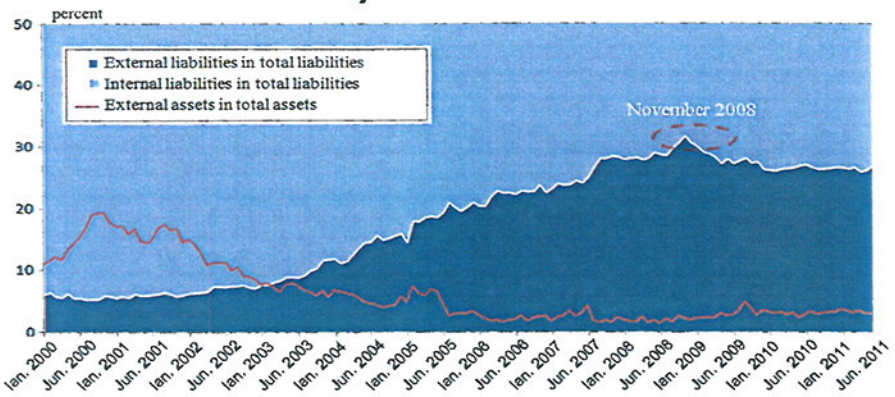
Figure 2 – International Comparisons with regard to the Degree of Concentration in the Banking System



Source: Author's illustration using Eurostat and NBR data

Following the economic and financial shocks in the Romanian economy, we witnessed: 1) a deterioration of the macroeconomic indicators (including inflation); 2) a powerful increase of competitiveness in the banking sector with a shift of focus on the effective management of the quality of the credit portfolio and the balance sheets structure (see Figure 3 for the dynamics of the share of external debts in the total debts of financial monetary institutions); 3) the variations 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).

Figure 3 – Dynamics of the Share of External Debts in the Total Debts of Monetary Financial Institutions in Romania



Within these coordinates NBR implements its monetary policy decisions. All the factors mentioned above must be taken into consideration when analysing the effectiveness of the IRPT in Romania. The accurate knowledge of the factors that influence banks' behaviour and of the responses of the market to the actions of the central bank would have positive implications for the efficiency of the monetary policy implementation process.

III. The Interest Rate Channel - Theoretical Considerations

The *interest rate channel* is a very important monetary transmission channel used by central bankers to affect key macroeconomic variables in order to reduce inflationary pressures or to stimulate economic growth. It is often regarded by some as the 'main channel of monetary policy transmission' (Taylor, 1995), a statement strongly disputed by Bernanke and Gertler (1995). Other channels of the monetary policy transmission mechanism that economists often refer to are: other asset effect channel, the exchange rate channel, the credit channel and the expectations channel.

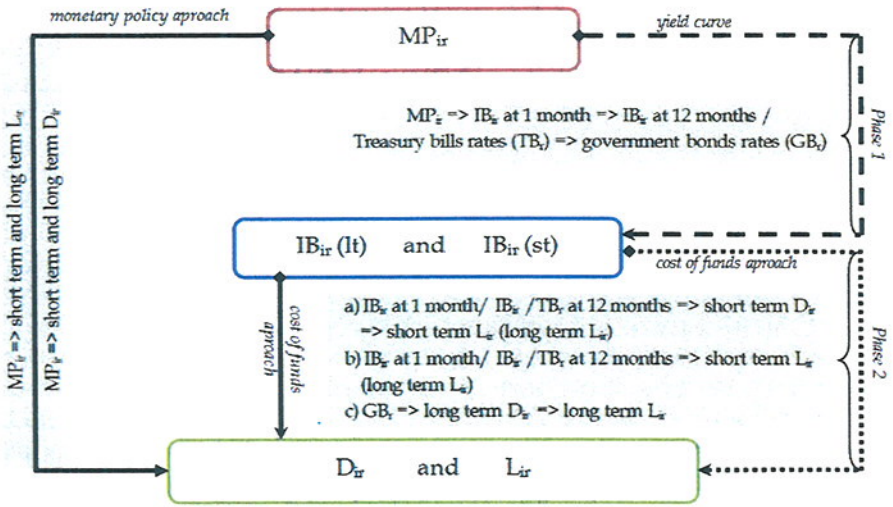
Keynesians consider the interest rate channel to be the traditional monetary policy transmission channel. Thus, variations in the interest rate are of great importance in the well-known IS/LM model. The following concise presentation is meant to explain the effects of monetary expansion with the help of the

above mentioned transmission channel (Mishkin, 1996: 4): M ↑ => ir ↓ => I ↑ => Y ↑

According to the model, an expansionary monetary policy ($M \uparrow$) leads to a decline in interest rates ($i_r \downarrow$) which lowers the cost of capital for firms and consumers and increases investment ($I \uparrow$) and consumption. This increase in investment will lead in time to an overall increase in output ($Y \uparrow$). Further investigations showed that in the case of the households segment, the interest rate channel also affects the expenditure on durable goods and housing. Mishkin (1996) also highlights the fact that when adjusting the interest rate channel, more attention should be given to *real* interest rates rather than to *nominal* ones. As for the term structure, we should focus on long-term interest rates rather than on the short-term interest rates since 'it is the real long term interest rate that is viewed as having the major impact on spending'. Regarding the other channels we will not go into details for this is not the purpose of the current study. A detailed discussion of the most important transmission channels can be found in Mishkin (1995) and Bean, Larsen and Nikolov (2002).

Variations in the *monetary policy rates* are normally reflected in the changes of the interest rates on the *interbank money market* and in the interest rates on the *retail money market,* both in the short-run and in the long-run. These shifts 'in cascade' in the interest rates are known as the *interest rate pass-through* (IRPT hereafter) as presented in Figure 4.

Figure 4 – The Interest Rate Transmission Mechanism



Source: Égert, Crespo and Reininger (2007) and Égert and MacDonald (2006) author's design

As one can see in Figure 4, the IRPT can be divided into two stages. The first stage analyses the impact of the variations occurred in the level of 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}). Regarding the second stage, it focuses on the transmission channel of the impulses from the interbank monetary market to the interest rates used by credit institutions (R_{ir}) in their commercial relation with the customers (D_{ir} for deposit interest rates and L_{ir} for credit interest rates).

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 (e.g., Radu, 2010). This branch of study is based on the *cost of funds approach* (de Bondt, 2002). Other authors (among others Tieman, 2004) focus on the direct impact of MP_{ir} on D_{ir} and L_{ir}, an approach that Sander and Kleimer (2004) 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 (Berstein and Fuentes, 2003). 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 analysed by using the approach based on the *cost of funds approach*.

To conclude, the main idea of IRPT consists as follows: adjustments in the monetary policy interest rates generate variations of the (interbank and retail) money market rates, starting with shorter maturities (less than 12 months) and moving *via* the expectations channel towards interest rates with longer maturities. The effects obtained after the fine-tuning of the interest rate channel are of a specific *size* and *speed*. Regarding the magnitude of the adjustment, although researchers found that the pass-through from policy interest rates to market interest rates is, generally, proportionate (one-to-one pass-through), any twist in the yield curve (regardless of its slope, negative or positive) could change its size (i.e., pass-through). Subsequently, the variations which occur on the interbank market are transferred to the credit and deposit interest rates of commercial banks, which influence the level of savings, investments and consumptions and, finally, the level of overall demand and prices during the final stage of monetary transmission. As for the delay/lags felt on the final targets with a change in a monetary policy variable such as the interest rate, it depends on many factors: specificity of the financial systems, phase of the economic cycle, monetary policy regime, the degree of development of the money market, etc. Therefore, in order to achieve specific monetary policy objectives in the future the central bank must properly assess the timing and the sizing of the adjustment process of the interest rate channel.

Some authors consider the interbank money market rates to be policy controlled variables (Karagiannis, Panagopoulos and Vlamis, 2010), while others use them as proxys for the monetary policy rates, assuming thus that once a central bank policy rate is changed, interbank interest rate will soon follow it (i.e., an instantaneously and complete pass-through). These assumptions are made because central banks can influence the interbank market rates through short-term interest rates and thus deny them a thorough investigation. We think that, due to

current events, 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; although sometimes the adjustment of interbank interest rates caused by changes in policy rates is taken for granted, it is nevertheless an important element of the interest rate transmission mechanism and we consider that it needs a thorough analysis. Thus, the efficiency of the transmission mechanism depends heavily on the efficiency of the monetary interbank market as a link between monetary policy interest rates and retail interest rates. While studying the Romanian example, the present paper provides an elaborate analysis of the IRPT from policy interest rates to wholesale interest rates highlighting in the meantime the impact of the global economic and financial crisis that erupted in August 2007.

As mentioned above, the development of the interbank money market is of great importance for the proper functioning of the interest rate channel. Two main reasons can be mentioned here: 1) the interbank interest rates provide a very important price signal for many other interest rates in an economy (especially in the Romanian economy which is a bank-based one); 2) the interbank interest rates represent an important element of banks' funding cost, which alters the retail interest rates offered to companies and households. At the end of this chain of causal relationships there are decisions regarding savings and investment and the real economic activity.
Finally, monetary authorities must take into consideration the specific phase of the business cycle in order to design the appropriate monetary policy.

IV. Survey of Theoretical and Empirical Literature on Interest Rate Pass-Through

Studies undertaken in the 'black-box of the interest rate pass-through mechanism' (Cocris and Apostoaie, 2011; Apostoaie, 2012) abound, but the results and conclusions differ and are sometimes contradictory, depending on the panel of countries, markets or periods analysed. The methodological approach, the

scope and length of the research, the data sources, the selection of exogenous money market rates and the presence of structural changes also have a big influence on the results (Kleimeier and Sander, 2006). Therefore, one can distinguish many braches of the economic literature on the subject of IRPT.

In terms of the aggregation level of data employed, some studies use aggregate interest rate series for individual countries (Mojon, 2000; Bredin, Fitzpatrick and O'Reilly, 2001; Heinemann and Schüler, 2001; Toolsema, Sturm and de Haan, 2002) or for the euro area as a whole (Donnay and Degryse, 2001; de Bondt, 2002 and 2005; de Bondt, Mojon and Valla, 2005), while other studies use micro bank data in individual countries (for the case of Italy see Cottarelli and Kourelis, 1994 or Gambacorta, 2004; for UK see Heffernan, 1997; for US see Berlin and Mester, 1999; for Germany see Weth, 2002).

Regarding the exogenous interest rates, money market rates are often used to estimate the pass-through to retail interest rates. More recent studies in this field use money market interest rates of comparable maturity with the bank interest rates in order to better highlight the marginal cost-of-funds approach (Sørensen and Werner, 2006).

Some studies on individual countries as well as comparative analyses, focus on the sluggishness or rigidity (stickiness) in the IRPT. The pass-through from wholesale interest rates (policy and interbank rates) to retail rates is found to be sluggish when it is incomplete, i.e. when a variation in the wholesale rate leads to a less than one-for-one change in the interbank or retail rate. In Cottarelli and Kourelis (1994) we found that there are two distinct meanings of the term 'interest rate stickiness'. One of them refers to relative inelasticity of the bank rates with respect to variations in the demand for bank loans and deposits. The second meaning has been used to indicate that 'in the presence of a change of money market rates, bank rates change by a smaller amount in the short-run; thus short-run stickiness, and also possible in the long-run, hence long-run stickiness,' (Cottarelli and Kourelis, 1994). In our paper we refer to the latter meaning. Factors that explain the stickiness of the IRPT are well analysed: costs related to asymmetric information or the agency cost theory (Stiglitz and Weiss, 1981), switching

costs (Klemperer, 1987; Lowe and Rohling, 1992), search costs (Calem and Mester, 1995), fixed adjustments costs or the menu costs theory (Cottarelli and Kourelis, 1994; Hofmann and Mizen, 2004), risk-sharing costs (Berger and Udell, 1992; Fried and Howitt, 1980) and costs generated by high volatility and uncertainty (Borio and Fritz, 1995).

The extent to which the IRPT is more or less effective is also linked to the degree of competition among banks (Hannan and Berger, 1991), more precisely to the level of concentration in the interbank market (Sander and Kleimeier, 2004; van Leuvensteijn *et al.*, 2008). In their theory of oligopolistic behaviour for loan rate stickiness, Hannan and Berger (1991) point out the fact that interest rates adjust significantly more sluggishly in concentrated markets. Van Leuvensteijn *et al.* (2008) found that, in 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 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, 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). Hannan and Berger (1991) found that deposit rates react significantly more sluggishly to upward variation rather than downward changes. Karagiannis, Panagopoulos and Vlamis (2010) found that banks from the Eurozone tend to pass to depositors only the decrease of the original money market change and to borrowers more of its increases while in the US the situation is exactly the opposite. Another important well studied feature is the *heterogeneity* of IRPT. Cottarelli and Kourelis (1994) point out that there is heterogeneity not only across countries but also between different product categories within the same banking branch. Among the factors that explain the heterogeneity of the pass-through Sørensen and Werner (2006) mention: structural differences in the financial systems, rigidity and size of bank costs, banking system ownership, monetary policy regime, the extent of money market

development, the openness of the economy, the degree of the development of the financial system as well as the legal and regulatory system.

Other studies focus on different economic events that influence the process of pass-through, such as the introduction of the euro (Toolsema, Sturm and de Haan, 2001; de Bondt, 2005). In this respect, a special focus is aimed at analysing the impact of the common monetary policy regime on the process of interest rate adjustments by the national banking sector of different euro area countries. It was thought that a single currency could act as a boost in the pass-through mechanism making it more complete and homogeneous. Nevertheless, the studies of Sander and Kleimeier (2004) showed that there is a lack of integration and important cultural and legal differences within the Eurozone which continue to preclude full integration and lead to a heterogeneous monetary policy transmission process.

Very few papers analyse the impact of the global financial crisis that erupted in 2007 on the money and funding market. Because these markets have become more intertwined in the past 20 years, disruptions in the financial flows can have adverse macroeconomic consequences (Cihák, Harjes and Stavrev, 2009). A study conducted by the IMF staff (IMF, 2008) reveals the fact that, in the context of the recent financial market tensions, the transmission of 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 US: 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 (Cihák, Harjes and Stavrev, 2009) draw attention to 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 (2009) shows that, during the financial crisis, interest rates on the retail market responded relatively satisfactorily to the volatility of the EURIBOR rate and to other long-term interest rates. Karagiannis, Panagopoulos and Vlamis (2010) emphasised that in the Eurozone the money market rate works more effectively as a 'policy vehicle variable' while for the case of US, the central bank rate is transmitted more effectively

to retail rates. A general idea of 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* (Minegishi and Cournède, 2010) and in lower confidence among banks (Cocris and Apostoaie, 2011).

Regarding the economic literature in the case of Romania, one important study is that of Antohi, Udrea and Braun (2003), 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 (Tieman, 2004) focuses on the transmission channel of the interest rates for the countries from Central and Eastern Europe and uses monthly data from January 1995-February 2004. Tieman (2004) 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 to the role played in other transition economies. The investigation performed at NBR (Radu, 2010) regarding the transmission of the variations of the interbank interest rates to the interest rates of the non-banking customers' credits and deposits over the May 2003-December 2009 period confirmed the slow-pace adjustment of the *pass-through* in the Romanian economy. This behaviour is explained, among other things, by the characteristics of the credit/deposit contracts.

Regarding the empirical researches 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 IRPT.

Frey and Manera (2007) review the existing empirical literature on price asymmetries presenting a detailed and updated survey of the existing empirical contributions on price asymmetries in the transmission mechanism that links input prices to output prices.

Table 2 – Econometric Models of Asymmetric Price Transmission

Acronym	Detailed model
ARDLpp	Autoregressive Distributed Lag Model based on period-to-period price variations
ARDLcu	Autoregressive Distributed Lag Model based on cumulative price variations
ECMeg	Error Correction Model estimated with Engle and Granger's method
ECMsw	Error Correction Model estimated with Stock and Watson's method
ECMth	Error Correction Model with threshold cointegration
PAM	Partial Adjustment Model
RSM	Regime Switching Model
DRS	Deterministic Regime Switching Model
SRS	Stochastic Regime Switching Model
VECM	Vector Error Correction Model
VAR	Vector Autoregressive Model
VARcu	Vector Autoregressive Model based on cumulative price variations
VRS	Vector Regime Switching Model
VRSeg	Vector Regime Switching Model estimated with Engle and Granger's method

Source: Frey and Manera (2007)

As one can see in Table 2, particular attention is given to autoregressive distributed lags, partial adjustments, error correction models, regime switching and vector autoregressive models.

V. Data used and Research Methodology
Data used in the Study

As we have mentioned in the first part of the paper, our objective is to study the pass-through process from policy interest rates to wholesale interest rates (comprising interbank interest rates and treasury bill interest rates) in Romania and to assess its speed and magnitude during the period 2003-2012. Therefore we want to test if there is a complete pass-through or not, at what speed and with what delay the interbank interest rates react to changes in policy interest rates, and if there is a symmetric or asymmetric adjustment in the pass-through process. According to some studies, wholesale rates are expected to move together, in the long-run, with NBR's policy interest rate.

For this reason several interest rate data series extracted from the NBR monthly reports were used. These data series are at monthly frequency and cover the May 2003-January 2012 period (see Table 3).

Table 3 – Data Series used in the Analysis of the Interest Rate Pass-Through

Simbol	Description
MP_{ir}	monetary policy interest rate
IB_{air}	average interest rate on transactions (interbank deposits)
T-bills	yields on treasury bills with discount; for the period 2004:09 – 2005:09, 2007:12 and 2008:03 we used yields of government bonds with interest and for the period 2005:10-2006:12 we used proxy data
ROBOR_xM	Romanian Interbank Offer Rate with maturity of 3 and 6 months - a.r.
ROBID_yM	Romanian Interbank Bid Rate with 3 and 6 months maturity - a.r.

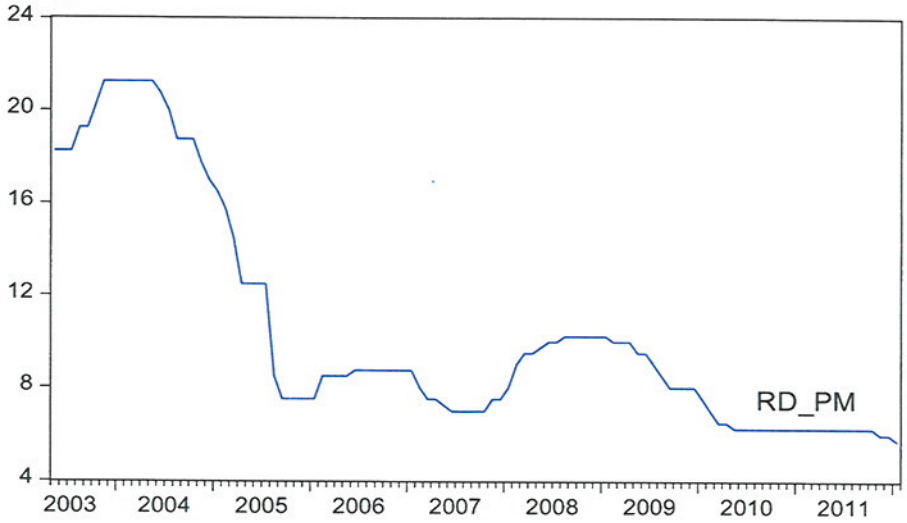
Note: measured in percentage points; a.r. = average rates

With respect to the exogenous interest rates, the study uses data provided by the central bank official (policy) interest rate and thus highlights the monetary policy stance. According to NBR,

> *the monetary policy interest rate is the interest rate on NBR's main open-market operations. Currently, these are repo operations with a maturity of one week, executed in the form of tenders, at a fixed interest rate* (NBR, 2012).

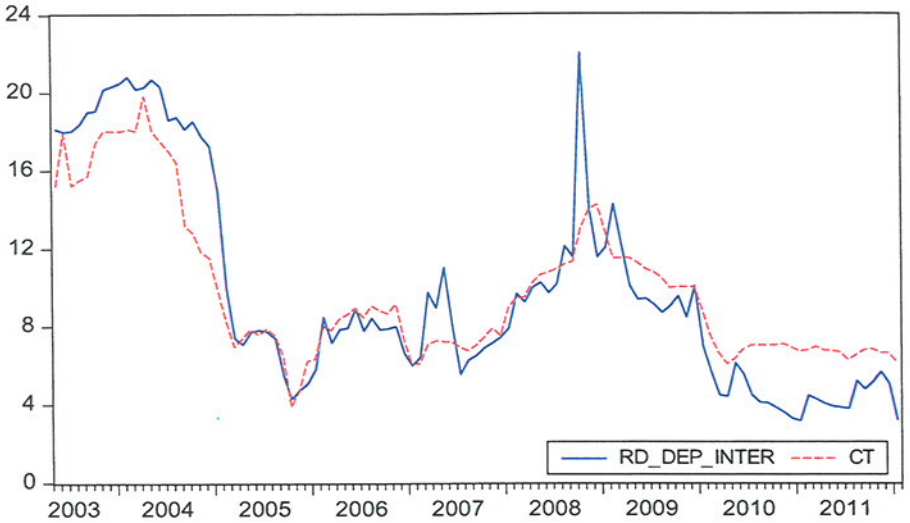
The behaviour of the monetary policy interest rate for the period taken into consideration is presented in Figure 5.

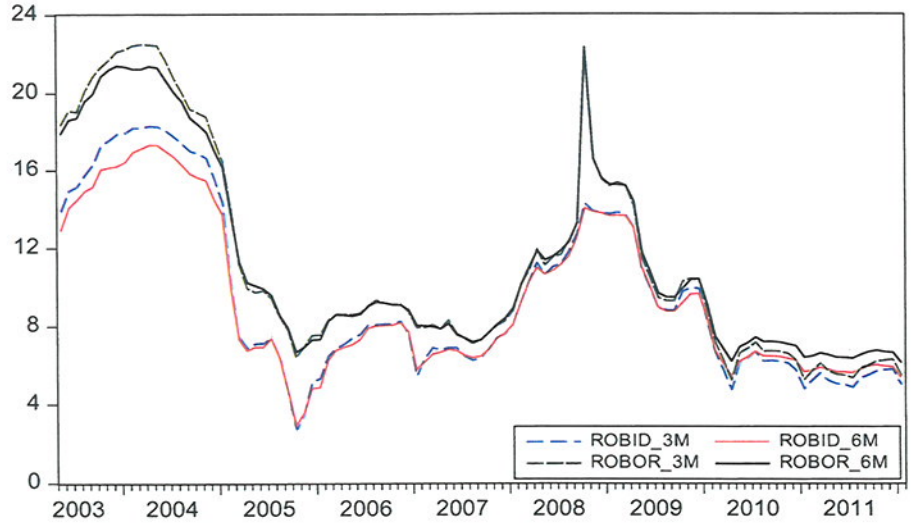
Figure 5 – The Dynamics of the Monetary Policy Interest Rate



As for the wholesale market interest rates, the study uses the Romanian Interbank Bid Rate (ROBID) and Offer Rate (ROBOR), both at different maturities (at three and six months), the average interest rate on transactions and the yields on Romanian treasury bills (with discount). The dynamics of these variables is presented in Figure 6.

Figure 6 – The Dynamics of the Wholesale Interest Rates





The analysis was performed on the following samples:
1. *Sample no. 1* or *S1* (data from May, 2003 to January, 2012); this is the full sample containing 105 observations.

2. *Sample no. 2* or *S2* 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.
3. *Sample no. 3* or *S3*; the period used is October, 2008 – January, 2012, totalling40 observations.

Research Methodology and Models

An important strand of the empirical literature on IRPT focuses on the *dynamic multiplier method* (Maskay and Pandit, 2009). 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. For this reason, we will employ a *symmetric Error-Correction Model* (ECM) that incorporates both short-term and long-term information. Thus, we will minimise the loss of information.

To summarise, for the study of the IRPT in Romania we will use the following statistical and econometrical methods and tests:

1. *Descriptive statistics*: we will use this statistical method to study the nature of each interest rate data series. Among others, we will obtain information regarding mean, standard deviation, minimum and maximum for each series and for the three samples (see Annex 1).

2. *Correlation analysis*: by employing this specific analysis we want to extract information from data about which interest rates series are correlated. 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.

3. *Unit root tests:* almost all interest rate series are suspected to be nonstationary (at least in emerging economies). In order to avoid obtaining spurious regressions when using these data in econometric analysis, we will determine the unit root properties. Unit root tests are carried out for every series under

investigation to determine if they are stationary in level (I(0)) or in first difference (I(1)). Thus, we will apply two types of tests: the Augmented Dickey-Fuller (ADF) test (Kleimeier and Sander, 2006; van Leuvensteijn *et al.*, 2008) and the Phillips-Perron (PP) test (Borio and Fritz, 1995).

4. *Granger Causality tests:* in order to see how much of the current value of one variable can be explained by past values of other variables within the MPTM, we will use Granger Causality tests. The results will show if there are Granger-type causality relations between the NBR's monetary policy instruments and wholesale interest rates, thus testing the hypothesis that there is a functional and effective interest rate channel. We will also be able to test if certain variables are endogenous or exogenous.

5. *Cointegration tests:* 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 (1995), i.e. the Johansen test.

6. *Error correction analysis*: if the interest rate series will prove to be cointegrated, then error correction modelling (ECM) will be used to capture the short-run dynamics along the long-term equilibrium of the interest rates.

7. *Testing for asymmetry*: we also study the possible asymmetries that could appear in the adjustment process of the interest rates. In this respect we will test the asymmetries relative to the equilibrium point (also studied by Scholnick (1999) and Sander and Kleimeier (2002)).

The connection between policy interest rates and wholesale interest rates can be illustrated using the following equation (1).

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

where, IB_{ir} stands for the interbank interest rate (or any other wholesale rate),

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

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 wholesale 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 deal 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 studies but the exact model depends on the authors' approach (G. de Bondt, 2005; Tieman, 2004; Sander and Kleimeier, 2004).

$$\Delta IB_{ir_t} = \alpha' + \omega_1 * \Delta IB_{ir_{t-1}} + \omega_2 * \Delta IB_{ir_{t-2}} + \ldots + \omega_k * \Delta IB_{ir_{t-k}} + \mu_0 * \Delta MP_{ir_t} + \mu_1 * \Delta MP_{ir_{t-1}} + \mu_2 * \Delta MP_{ir_{t-2}} + \ldots + \mu_p * \Delta MP_{ir_{t-p}} + \gamma * ECM_{t-1} + \varepsilon \qquad \textbf{(2)}$$

and $ECM_t = IB_{ir_t} - \alpha - \beta * MP_{ir_t}$

where, **β** is the long-run multiplier,

μ_0 measures the immediate or the short-term pass-through,

γ measures the speed of adjustment of the short-run dynamics to the long-run equilibrium relationship (it shows how much of the gap created by a change in the policy interest rate is closed in one month),

k and **p** indicate the optimal lag length; to select the lag length we used the following information criteria: LR, FPE, AIC, SC and HQ (priority was given to the Akaike criterion) progressively eliminating insignificant results.

If the interest rate series are I(1) processes but are not cointegrated we will use a standard VAR model specified in equation (3).

$$\Delta IB_{ir_t} = \alpha + \omega_1 * \Delta IB_{ir_{t-1}} + \omega_2 * \Delta IB_{ir_{t-2}} + \ldots + \omega_k * \Delta IB_{ir_{t-k}} + \mu_0 * \Delta MP_{ir_t} + \mu_1 * \Delta MP_{ir_{t-1}} + \mu_2 * \Delta MP_{ir_{t-2}} + \ldots + \mu_p * \Delta MP_{ir_{t-p}} + \varepsilon \quad (3)$$

and $\beta = (\mu_0 + \mu_1 + \mu_2 + \ldots + \mu_p)/(1 - (\omega_1 + \omega_2 + \ldots + \omega_k))$

where, **β** is the long-run pass-through coefficient (value computed),

μ_0 measures the immediate or the short-term pass-through.

However, although this standard VAR specification avoids spurious regression problems it leads nevertheless to a loss of information on the long-run relationship.

Generally, 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 (Maskay and Pandit, 2009).

If or when we encounter interest rate series that are I(0) processes, we will use the model specified in equation (4).

$$IB_{ir_t} = \alpha + \omega_1 * IB_{ir_{t-1}} + \omega_2 * IB_{ir_{t-2}} + \ldots + \omega_k * IB_{ir_{t-k}} + \mu_0 * MP_{ir_t} + \mu_1 * MP_{ir_{t-1}} + \mu_2 * MP_{ir_{t-2}} + \ldots + \mu_p * MP_{ir_{t-p}} + \varepsilon \quad (4)$$

and $\beta = (\mu_0 + \mu_1 + \mu_2 + \ldots + \mu_p)/(1 - (\omega_1 + \omega_2 + \ldots + \omega_k))$

The lag length with which the wholesale interest rates (IB_{ir}) fully adjust to the long-run equilibrium (β) is given by the expression (Égert and MacDonald, 2006):

$$(1 - \mu_0) / |\gamma| \quad (5)$$

Regarding the possible asymmetries in the pass-through process we will use the asymmetric short-run dynamic model to investigate if the interbank interest rates adjust in an asymmetric manner to their divergence from the long-run

equilibrium relationship with respect to the policy interest rate (procedure also used in Scholnick (1996), Sander and Kleimeier (2000) and Ozdemir (2009)). For this reason, we substitute the ECT (γ) terms in the error correction model with ECT^+ (γ^+) and ECT^- (γ^-), as follows:

$$\begin{cases} Y_t^+ = Y_t, & \text{if } Y_t > Y_t^* \\ Y_t^+ = 0, & \text{otherwise} \end{cases} \quad \text{and} \quad \begin{cases} Y_t^- = Y_t, & \text{if } Y_t < Y_t^* \\ Y_t^- = 0, & \text{otherwise} \end{cases}$$

Subsequently, the short run dynamic model takes the following form:

$$\Delta IB_{ir_t} = \alpha + \omega_1 * \Delta IB_{ir_{t-1}} + \omega_2 * \Delta IB_{ir_{t-2}} + \ldots + \omega_k * \Delta IB_{ir_{t-k}} + \mu_0 * \Delta MP_{ir_t} + \mu_1 * \Delta MP_{ir_{t-1}} + \mu_2 * \Delta MP_{ir_{t-2}} + \ldots + \mu_p * \Delta MP_{ir_{t-p}} + \gamma^+ * ECM^+_{t-1} + \gamma^- * ECM^-_{t-1} + \varepsilon \quad (6)$$

Thus, the asymmetric mean adjustment lag of the interbank interest rate above the equilibrium, it is $[(1 - \mu_0) / |\gamma^+|]$ while below the equilibrium is $[(1 - \mu_0) / |\gamma^-|]$. The asymmetric mean adjustment lag measures the time span during which interbank interest rates stick above and/or below the equilibrium. If the estimates for the γ^+ and γ^- are statistically significant and $|\gamma^+| > |\gamma^-|$, then the interbank interest rates adjust downward faster than upward in terms of variations in the policy interest rate. Nevertheless, if $|\gamma^+| < |\gamma^-|$, then the interbank interest rates adjust upward faster than downward.

VI. Empirical Results

The results for the unit root tests are outlined in Table 4 and 5. We used the ADF tests (with and without intercept) and the robustness of the results was confirmed by the PP test (with and without intercept). The number of lags was chosen using the AIC and the SC information criteria.

Table 4 – The Integration Order for Selected Interest Rate Series using ADF tests

Variables	Series in levels			Series in first difference		
	S1	S2	S3	S1	S2	S3
MP_{ir}	-1.35	-1.14	-1.36	-2.86*	-5.40***	-4.26***
ROBID_3M	-1.88	-1.61	-1.45	-5.82***	-4.28***	-4.14***
ROBID_6M	-2.01	-1.60	-1.63	-5.57***	-4.27***	-3.68***
ROBOR_3M	-1.34	-1.51	-1.53	-10.3***	-3.70***	-7.52***
ROBOR_6M	-1.41	-1.59	-1.60	-10.6***	-3.36*	-7.71***
IB_{air}	-1.84	-1.34	-1.95	-11.7***	-6.40***	-8.59***
T-bills	-2.15	-1.28	-0.87	-9.34***	-7.90***	-4.42***

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

Table 5 – The Integration Order for Selected Interest Rate Series using PP Tests

Variables	Series in levels			Series in first difference		
	S1	S2	S3	S1	S2	S3
MP_{ir}	-1.36	-1.10	-1.41	-7.29***	-5.39***	-4.25***
ROBID_3M	-1.39	-1.23	-1.21	-5.73***	-4.26***	-3.88***
ROBID_6M	-1.44	-1.21	-1.15	-5.50***	-4.26***	-3.37**
ROBOR_3M	-1.39	-1.21	-1.21	-10.3***	-3.70***	-8.34***
ROBOR_6M	-1.43	-1.21	-1.26	-10.6***	-3.29*	-8.57***
IB_{air}	-1.74	-1.39	-1.61	-11.8***	-6.39***	-19.1***
T-bills	-1.60	-1.32	-0.89	-9.39***	-7.89***	-2.87*

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

According to the results in Tables 4 and 5, the data series are non-stationary processes. We can thus say, with a 90 per cent 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.

Because we deal with non-stationary data series we will follow the Toda and Yamamoto (1995) procedure to test for Granger causality. There are, of course, other approaches that can be used when testing for Granger causality in I(p) data series (e.g., Lütkepohl, 2007) but we will employ the T-Y procedure. Thus, the basic steps that we followed were:

1. We established that the maximum order of integration for all the interest rate series is 1.
2. We set up VAR models in the levels of the data (between the policy interest rate and all the wholesale rates) and determined

the appropriate maximum lag length for the variables in each VAR.
3. We made sure that the VAR were well-specified, i.e. ensuring that there is no serial correlation in the residuals.
4. We then took the preferred VAR models and added in an additional lag of each of the variables into each of the equations.
5. We then tested for Granger non-causality. A very important aspect worth mentioning is that we did not include the coefficients for the 'extra' lag when we performed the Wald tests; the extra lag was used just to fix up the asymptotics.

Table 6 – VAR Granger Causality/Block Exogeneity Wald Tests

MP_{ir}	Sample 1		Sample 2		Sample 3	
Dependent variables:	Chi-sq	df	Chi-sq	df	Chi-sq	df
ROBID_3M	12.85*	7	11.11**	3	2.77	2
ROBID_6M	11.92	7	9.34**	3	1.79	2
ROBOR_3M	12.07**	5	2.09	2	7.41***	1
ROBOR_6M	11.84**	5	7.72	6	8.65***	1
IB_{air}	13.40**	5	8.14**	2	3.91**	1
T-bills	35.32***	7	16.97**	5	11.28***	2

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

Table 6 summarises the results for the Granger Causality tests. According to the null hypothesis, NBR's policy interest rate (MP_{ir} or RD_PM) does not *Granger-cause* a wholesale interest rate (ROBID, ROBOR, IB_{air} or T-bills). It is clear from the table above that there is a number of cases in which the null hypothesis is rejected, therefore the monetary policy interest rates *Granger causes* the interbank interest rates as well as the average yields of the T-Bills.

In conclusion, the test results confirm NBR's capacity to influence, by means of its policy interest rate (primarily through the open-market operations), the great majority of interest rates on the interbank monetary market.

Regarding the Cross Correlation analysis between the monetary policy interest rate and the wholesale interest rates, the results are presented in Table 7.

Table 7 – Correlation Analysis Results between Monetary Policy Interest Rate and the Wholesale Rates (Series in Level)

MP_{ir} and wholesale interest rates	Sample 1		Sample 2		Sample 3	
	Cor.	Lag*	Cor.	Lag*	Cor.	Lag*
ROBID_3M	0.8948	0	0.9320	1	**0.9693**	0
ROBID_6M	0.8748	0	0.9223	1	**0.9739**	0
ROBOR_3M	**0.9343**	0	**0.9771**	0	0.9291	0
ROBOR_6M	**0.9276**	0	**0.9777**	0	0.9239	0
IB_{air}	0.9119	0	0.9438	1	0.8951	0
T-bills	0.8781	0	0.9238	2	0.9763	0

Legend: IB_{air} = average interest rate of transactions (interbank deposits); T-bills = treasury bills yields with discount; Cor = Correlation; * no. months

The connections between MP_{ir} and the ROBID and ROBOR rates are powerful and immediate. The ROBID rate that has the most significant correlation coefficient (0.89) is the one with a three-month maturity. Nevertheless, in sample 1 the policy interest rate has bigger correlation indices with the ROBOR rates, and among those two analysed, the most sensitive to the fluctuations of the monetary policy interest rate is the one with three-month maturity (with a correlation coefficient of 0.93). The estimations are mirrored in sample 2.

From the data processed in sample 3, we noticed a stronger connection between the MP_{ir} and ROBID rates in comparison to

that between MP_{ir} and ROBOR rates. The most powerful connection is that between MP_{ir} and 6-months ROBID. Both interbank rates almost immediately react to the variations of the policy interest rate (no lags). Thus, they reveal 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 in the first difference that were not included in this paper because of space-related constraints.

Taking into consideration the results of the Granger tests and the correlation coefficients, we will restrict our analysis to the ROBID and ROBOR interest rates as reference rates of the interbank monetary market.

After employing the Johansen methodology, we noticed that there is a long-run relationship between the monetary policy interest rate and all the interbank interest rates (an exception is the six-month ROBOR rate in the second sample). Concerning the last period analysed, we are reserved with respect to the obtained results, as these may be distorted by the much reduced temporal dimension of the used dataset.

After employing the methodology previously specified we obtained the results presented in Table 8.

Table 8 – The Estimated Interest Rate Pass-Through from Policy Rates to Interbank Market rates

Coefficients	Sample 1			Sample 2			Sample 3		
The IB interest rates	Immediate *pass-through*	Long term *pass-through*	Speed of adjust-ment	Immediate *pass-through*	Long term *pass-through*	Speed of adjust-ment	Immediate *pass-through*	Long term *pass-through*	Speed of adjust-ment
	μ_0	β	γ	μ_0	β	γ	μ_0	β	γ
ROBID_3M	0.47*	0.77***	-	0.47***	0.76**	-0.15***	1.69***	1.91***	-0.64***
	(0.130)	(0.118)	0.11*** (0.037)	(0.139)	(0.107)	(0.060)	(0.503)	(0.079)	(0.139)
ROBID_6M	0.47*	0.67***	-	0.47***	0.64***	-0.12**	1.73***	1.80***	-0.60***
	(0.110)	(0.123)	0.09*** (0.031)	(0.123)	(0.123)	(0.053)	(0.381)	(0.062)	(0.129)
ROBOR_3M	0.71***	1.03***	-	0.46***	1.02***	-0.16*	3.95***	2.38***	-1.26***
	(0.221)	(0.108)	0.20*** (0.069)	(0.119)	(0.049)	(0.085)	(1.259)	(0.101)	(0.225)
ROBOR_6M	0.71***	0.94***	-	0.39***	0.927	-	4.52***	2.29***	-1.12***
	(0.214)	(0.113)	0.19*** (0.068)	(0.097)	-		(1.237)	(0.108)	(0.202)

Legend: *, **, *** denote significance on 10%, 5% and 1% level, respectively; standard deviations are in (·)

In almost all the samples where cointegration relationships were found, the coefficients for the error correction terms and for the short-run and long-run adjustments are statistically significant and have the right signs.

Referring to sample 1 and 2, for all the interbank rates μ_0 is lower than 1, which indicates that the immediate pass-throughs from the policy interest rate to interbank interest rates are incomplete. If in the first sample the contemporaneous pass-throughs for the ROBID rates are sensibly lower in comparison with the ones for the ROBOR rates, in the second sample the discrepancies are minor. Moreover, the small values of γ reveal a sluggish adjustment of interbank interest rates towards equilibrium (short-run stickiness – but for the retail bank rates – has also been found for other European countries (Sander and Kleimeier, 2002) or in the euro area (Bondt, 2005)). These values range from nine per cent for six-month ROBID to 20 per cent for three-month ROBOR (both in the first sample). Regarding the mean adjustment lags of the interbank interest rates analysed in sample 1, it requires about five to six months for the ROBID rates and approximately two months for the ROBOR rates to get to their long-run equilibrium. In sample 2, it requires about four to five months for all the interbank rates to get to their long-run equilibrium.

Before October 2008 companies were more interested in setting up deposits than in obtaining loans (as a result of excess liquidity), observation confirmed also by the estimates of the β parameter, associated with the ROBID, respectively ROBOR rates (in sample 1 and 2); after this period (sample 3) we may notice a thorough change in the behaviour 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 of the data in sample 3 reveal an *overshooting* of over 180 per cent for ROBID rates and of over 220 per cent for ROBOR rates in response to the variations of the monetary policy interest rates (we may notice the banks' concern with regards 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. 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 between 169 per cent and 173 per cent of the variations of the monetary policy interest rate, whereas values of over 390 per cent 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 are also high for the data in sample 3, suggesting a high adjustment rate of the short-term dynamics, moving towards long-term equilibrium. The symmetric short-run pass-throughs of the ROBID rates deviations from the long-run equilibriums are corrected by about 60 to 64 per cent in the current period while for the ROBOR rates the corrections range from 112 to 126 per cent.

In order to verify the robustness of the results we employed a (unrestricted) VAR model for the data series in first difference. The transmission of a temporary shock of the monetary policy interest rate to the interbank market interest rates is illustrated in Figure 7. The resulted responses reflect the cumulated values. We may notice that the variations in the monetary policy interest rate are gradually transmitted to the interbank monetary market with an immediate response of about 23 per cent for ROBID rates and of 30 per cent for ROBOR rates (see Table 9). On the long-run, almost all the estimates reveal the fact that we could be dealing with a complete pass-through.

Figure 7 – The Impulse-Response Function of Monetary Policy Interest Rate to Interbank Interest Rates

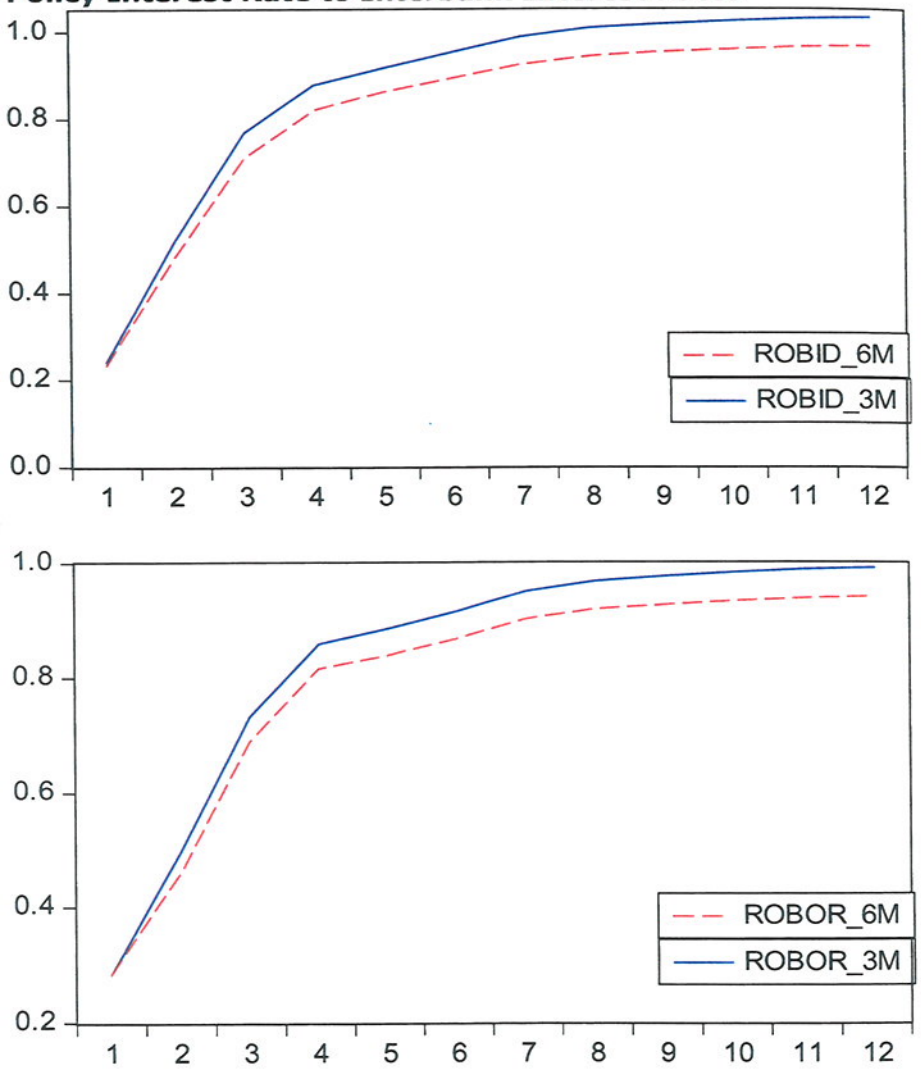


Table 9 – The Estimated Interest Rate Pass-through from Policy Rates to Interbank Market Rates

Period	Short-run	Months					Long-run
IB_{ir}	effect	2	3	4	6	9	effect
DROBID_3M	0.239	0.521	0.767	0.877	0.951	1.016	1.037
DROBID_6M	0.233	0.484	0.710	0.819	0.892	0.951	0.971
DROBOR_3M	0.283	0.496	0.732	0.858	0.915	0.976	0.996
DROBOR_6M	0.284	0.458	0.689	0.815	0.866	0.925	0.945

(percentage points)

A simple analysis of the two maturities of each of the interbank interest rate reveals the fact that, although short-term reactions are more visible in the case of ROBOR rates, the ROBID rates undergo a more extensive adjustment on the long term. We may thus conclude that the results obtained by using a standard VAR validate the remarks made when using the error correction model.

We will now finish our analysis by studying the possible asymmetries in the adjustment process of the interest rate pass-through mechanism. The results of the estimates are presented in Table 10.

Table 10 – The estimated Interest Rate Pass-through from Policy Rates to Interbank Market Rates

Interbank interest rates	Symmetric	Asymmetry		Test[1]: $\gamma^+ = \gamma^-$	
	γ	γ^+	γ^-	χ^2	p-Value
ROBID_3M	-0.11***	0.001	-.28***	7.786	[0.005]***
	(0.037)	(0.054)	(0.068)		
ROBID_6M	-0.09***	-0.001	-.23***	6.638	[0.010]**
	(0.031)	(0.047)	(0.061)		
ROBOR_3M	-0.20***	-.25***	-0.059	0.972	[0.324]
	(0.069)	(0.084)	(0.161)		
ROBOR_6M	-0.19***	-.24***	-0.014	1.188	[0.275]
	(0.068)	(0.083)	(0.176)		

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

The results of the asymmetry testing (using the Wald statistic) indicate that, for the ROBOR rates we can reject the hypothesis that $\gamma^+ = \gamma^-$, which suggests that there are no asymmetries in the way the three and six month Romanian Interbank Offer Rates adjust to the variations of the policy interest rate. Nevertheless, for the ROBID rates, we found significant estimates for the asymmetries in the adjustment process. If we were to reflect on the estimated coefficients, we can say that the asymmetries found for the Romanian Interbank Bid Rates indicate a faster adjustment when these specific rates are low relative to their long-run equilibrium rather than when they are high and when the policy rate is decreasing rather than when it is increasing (if we were to replace mean γ with 0). In other words, the downwards adjustment is faster than the upwards one. The situation for the ROBOR rates is exactly the opposite.

Regarding the mean adjustment lags of the interbank interest rates, it requires about two months for the ROBID rates to get to their long-run equilibrium when they adjust downwards, and also approximately two months for the ROBOR rates when the adjustment is upwards.

VII. Conclusions

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 for many central banks was heavily damaged. This was at least the case of the ECB and the Fed. The purpose of this study was to analyse, taking the Romanian example, the interest rate pass-through process before and after October, 2008 (when the effects of the recent financial market tensions were mostly felt in 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 (NBR) 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 interest rate and retail interest rates).

According to the empirical results highlighted in this paper, the reactions of the interbank interest rates to the shifts in the monetary policy interest rate were *slow* or *sluggish* over the May 2003-September 2008 period indicating a rigid adjustment process. The contemporaneous responses of the ROBOR and ROBID rates are almost equal, but in the long run, only the ROBOR rates have a complete pass-through. However, the ROBID rates are not 'so far behind'. The empirical results so far are in line with other studies that deal with the IRPT in Romania (Radu, 2010) or other countries in Central and Eastern Europe (Tieman, 2004).

The results on the IRPT (for the 1st stage) in Romania in the period following October, 2008 seem to be quite *abnormal* (we are reserved as these results may be distorted by the very 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 in the long-run, the pass-through is complete

(with $\beta > 1$), the coefficients are still too high (reflecting the banks' overreaction to any behaviour 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 BNR's net position 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 and thus became more cautious (*credit rationing*).

An understanding of the IRPT is crucial to policymakers, especially in the context created by the recent financial crisis. We hope that our analysis will contribute to a better understanding which to that adds to the wider evidence that already exists for other European countries. The special focus on the interbank market is due to the fact that many bank loan and deposit rates (in the national currency) are linked to the Romanian interbank rate (especially the 3-months ROBOR interest rate). Therefore, such a study could be of valuable importance in evaluating the extent to which policy rates are passed to retail rates and therefore a valuable input to NBR.

In his future studies, the author intends to incorporate in the econometric model the expected, as well as unexpected, monetary policy impulses. Likewise, he intends to consider the external factors that alter the interest rate pass-through. Another important aspect on which he would like to perform in-depth analyses and incorporate in the paper (especially in the econometric models) refers to the historical dimension of the interest rate pass-through. Thus, in accordance with the feedback received from the discussants and speakers from the *3rd EABH* Workshop for Young Scholars 'Public Policies & the Direction of Financial Flows', the author intends to focus more on the history and construction of the NBR's monetary policy, the foreign influences in determining a specific stance of monetary policy, the specific way of functioning of the Romanian interbank market, the factors affecting the interest rate pass-through etc. Also, considering the feedback received at the event, the author will take into consideration other countries from Central and Easter Europe in order to perform country comparative analysis.

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Annexes

Annexe 1 – Descriptive Statistics on Monthly Data Series for 2003:05-2012:01

	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
RD_PM	10.52	8.75	21.25	5.75	4.92	1.17	2.88
ROBID_3M	9.57	7.63	18.31	2.72	4.40	0.74	2.20
ROBID_6M	9.37	7.72	17.32	2.92	3.95	0.69	2.09
ROBOR_3M	11.26	9.16	22.50	5.24	5.39	0.93	2.47
ROBOR_6M	11.28	9.16	22.33	6.15	5.00	0.94	2.43
RD_DEP_INTER	9.79	7.98	22.03	3.16	5.39	0.88	2.50
CT	9.78	8.42	19.80	3.86	3.80	1.05	3.02

Annexe 2 – Descriptive Statistics on Monthly Data Series for 2003:05-2008:09

	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
RD_PM	12.42	9.50	21.25	7.00	5.31	0.59	1.66
ROBID_3M	10.57	8.11	18.31	2.72	4.74	0.46	1.71
ROBID_6M	10.15	8.05	17.32	2.92	4.29	0.40	1.71
ROBOR_3M	12.77	9.84	22.50	6.41	5.59	0.67	1.77
ROBOR_6M	12.57	10.09	21.42	6.68	5.24	0.63	1.73
RD_DEP_INTER	11.46	8.93	20.82	4.27	5.47	0.60	1.71
CT	10.54	8.92	19.80	3.86	4.26	0.76	2.22

Annexe 3 – Descriptive Statistics on Monthly Data Series for 2003:05-2012:01

	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
RD_PM	7.43	6.25	10.25	5.75	1.59	0.78	1.96
ROBID_3M	7.94	6.22	14.27	4.74	3.20	0.89	2.33
ROBID_6M	8.11	6.44	14.02	5.40	2.97	1.00	2.50
ROBOR_3M	8.80	6.72	22.15	5.24	4.03	1.45	4.50
ROBOR_6M	9.20	7.19	22.33	6.15	3.80	1.60	5.05
RD_DEP_INTER	7.06	5.35	22.03	3.16	4.01	1.59	5.99
CT	8.54	7.00	14.23	6.02	2.48	0.84	2.34

Notes

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