Analysis of Overnight ROBOR Interbank Interest Rate Recorded in October 2008 Using a Correlational Mathematical Model

Ramona Mariana CALINICA*

Abstract

Information about possible manipulation of the overnight Robor interbank interest rates appeared in the press in late June 2012 when the British bank Barclays was fined for manipulating Libor. Suspicion of manipulation of interest rates has not spared Romania. The purpose of this paper is to provide mathematical support persons or authorities concerned in finding out whether the overnight ROBOR reference rates from October 2008 were the result of an agreement between banks or is a natural reaction to the difficult conditions prevailing at that time, and why not, decision support to establish a intervention policies when deviations of the interbank money market parameters, in relation to a specific goal, above a certain value.

1. Introduction

At the beginning of 2013 in the specialized media information was given on the possible manipulation of interbank interest by certain banks in different countries. Royal Bank of Scotland controlled by the UK state, announced [...] that is expected to pay "significant penalties", and "other sanctions" for having manipulated the Libor interbank interest [12]. Interbank rate manipulation scandal broke in late June 2012 when the British bank Barclays paid 453 million to the U.S. and British authorities for manipulating Libor and in December 2012 it was announced that Swiss bank UBS could pay a fine of 1,63 billion dollars to end the scandal of manipulating Libor interbank rate [18]. The EU Competition Commissioner Joaquin Almunia stated that "EU investigates the reference rates for multiple currencies, including the euro, yen and Swiss franc. We suspect the existence of cartels between certain players in the derivatives market - banks and brokers ". [15] Neither Romania was spared by this " scourge" of handling interbank interests. President of the Competition Council, Bogdan Chiriţoiu said earlier this year that "some banks are suspected of having manipulated money market index, ie the interbank interest rate". [11]

2. How could banks reach an "agreement" on interest rates in the interbank market, and why would they be tempted to do so?

Normally ROBOR and ROBID overnight interests must be at a level slightly higher than the policy rate set by the central bank. [13] However, in 2007, overnight interest rates on interbank markets showed strong oscillations, reaching extreme values, such as 1,72%, interest of ROBOR registered on 20 July 2007, or 54,13%, on 27 April 2007, while the monetary policy rate in 2007 ranged between 7% and 8.75%. Since January 2008, however, ROBOR and ROBID overnight interests have been consistently above the policy rate set by the central bank, reaching the peak values reported on days 17, 20, 21 and 22 of October, ie 46,3%; 56,05%; 53,28%; 57% [9]. Establishing the reference rates of ROBOR and ROBID is in accordance with a set of rules established by the central bank and operational since March 6, 2008 [10]. In short, Article 2.2 of this set of rules specifies who are those who participate in setting the reference rates of ROBID and ROBOR

The organizer will provide the participating status to the credit institution based on the following criteria:

a) interbank money market activity;

b) The limits for deposits in RON granted by credit institutions to other Participants;

c) other credit institutions limits for deposits in RON granted to this credit institution.

At the same time, Article 10.2 of the same set of rules says how great can be the difference allowed between rates of supply and demand:

* Dunarea de Jos University of Galati, Romania. E-mail addresses: ramona.calinica@yahoo.ro (R.M. Calinica).
"10.2. If interest rates are subject to significant increases on interbank market, the differences allowed between supply and demand rates under section 3.4 of these rules, will be:

- twice the amount if the interest rate quoted for deposits exceeds by more than 30% the interest rate per the monetary policy of the National Bank of Romania;
- triple amount if the quoted interest rate exceeds the interest rate on deposits for lending facility;
- unlimited, if the interest rate quoted for deposits exceeds 1,5 times the rate for the credit facility.

Summarizing, from the two articles of the set of rules presented above we find that banks borrowing from each other shall determine ROBID and ROBOR reference rates and the difference allowed between supply and demand rates can be unlimited. Therefore, the answer to the first question in the headline is - Yes, the mechanism for setting the ROBID and ROBOR reference rate enables banks to reach a settlement. To the second question the answer is simple: we talk about banks, and banks are not charity entities, the merchandise they are circulating is money and the aim is profit, and where there is increasing profit, there is temptation as well. It can be added that since 2008 the majority of loans granted by banks has interests expressed in terms of ROBOR or ROBID plus a margin of a few percentage points, in other words a higher ROBID or ROBOR reference rate means a major profit for the bank.

The question might arise: OK, but still banks pay very high interest rates (eg. 57%) to lend to each other; it is worthwhile to make a deal like "Bank 1 borrows from Bank 2, Bank 2 borrows from Bank 3, Bank 3 borrows from Bank 1 " only to increase artificially ROBOR and ROBID? Again the answer is simple: Yes, it is justified to pay a higher interest on interbank borrowing of small amounts, for short periods, knowing that this actually cause increase in interest on loans already granted to individuals and companies, whose value is infinitely greater than the amounts traded in the interbank market. For example in November 2008 only 1.8% of the total banking assets represent claims on credit institutions [7]. But all that has been said so far does not mean that banks have organized a kind of cartel to manipulate key interest rates. Therefore how can we find the answer to the question whether ROBOR overnight interest rates in October 2008 have been manipulated or is a natural reaction to conditions in the interbank money market in that period?

First, let's do a quick revision by drawing an analogy with the football game: we have a "field" (interbank money market), some "players" officially called participants (credit institutions), divided into two teams (some with surplus liquidity, others with deficit liquidity), a referee who sets the rules of the "game" (NBR). Unlike a football game where each team passes the ball to each other, in this game players achieve their goal by passing the ball (money) to the opposing team and the referee from time to time may favor the weaker team (absorb or inject liquidity in the market). As the passes are more (increase the interbank deposits), are recorded the higher "scores" (interest). Naturally "market conditions (liquidity)" leads players to participate in the "game" (fixing) in order to achieve the goal (placing or attracting liquidity). However, how can we tell if the game is "rigged"? One solution would be to try the math!

Although in the game of football mathematical knowledge are not relevant, in our "game" maths might to help. Assuming that the "nature of reality is quantitative" [4], we shall develop a mathematical model which incorporates all relevant information about how to set the reference ROBOR overnight. The literature associates the mathematical model to a system which is defined as a theoretical concept "which describes key issues by representing system knowledge into a usable form, fit for the purpose of the model" [2]. To start with, a good guideline in our approach for creating a mathematical model can be offered by a graphical representation.

Figure 1 provides a synthesized evolution of the most relevant indicators in the interbank money market which are directly related to the operation of fixing: liquidity, interest rate of ROBOR overnight, claims on credit institutions, to which we added just for comparison the NBR's reference interest rate, precisely the things that we talked about earlier. The period considered is June 2004 - November 2008.

The first step in a graphical analysis is studying inertia of processes. The literature states that "all the links and interdependencies that occur between individual factors or groups of factors and phenomena or processes taken wholly or in their structural composition, lead to specific or common evolutionary ways, ways that first appear in the form of stochastic regularities" [6].
Consequently, it will be noted how dynamics of economic indicators analyzed developed in the period June 2004 - October 2008 in order to establish its evolution legitimacy. In particular, if we divide the graph into three zones, June 2004 - Dec. 2005, Dec. 2005-Dec. 2007 and Dec. 2007-Oct. 2008 , we can make the following observations:

**Observation 1 (Zone I)** - When market liquidity increases, interbank lending and ROBOR overnight interest decrease. Natural, right? If banks have excess liquidity, why would they lend? And if money is no longer a commodity so much look after, it is normal that their "price" (interest) decrease.

**Observation II (Zone II)** - When market liquidity declines, banks complete their liquidity deficit by borrowing from the money market and thus increase the volume of interbank transactions, while increasing and interest of ROBOR overnight. This is also natural to happen, if banks lend more, money becomes a commodity much searched for and automatically their "price" is growing.

**Observation III (Zone III)** - When market liquidity has started to grow, naturally interbank loans began to decline. As I said before in Observation 1 - natural, right? If banks have excess liquidity, why would they lend? The paradox is that while interbank lending fell sharply (reaching a historic minimum of 1.8% in November 2008), ROBOR overnight interest exploded, reaching a historic peak of the period, to 57% in October 2008. Simply amazing, isn't it? - Nobody wants to buy the "stuff", but its price explodes from day to day!.

OK, is the probleme solved? No, far from it! There is only one conclusión to draw for now: - between the indicators analyzed in this research there is a strong relationship of determination: excess or déficit of liquidity force banks to borrow or lend by paying or cashing higher or lower interest. The evolution of ROBOR overnight interest in 2008, and especially in October shall be currently called "distortion" of the interbank money market. From the graph we learned important things about the development of the indicators used in determining the ROBOR overnight interest rate mechanism, but no matter how neat as a graph may be and accurate the data used, working in 2D space information is limited. To achieve an efficient mathematical model we shall perform a 3D analysis to enhance the synergy of the indicators when correlated.

The word synergy indicates cooperative, co-action, as defined in the literature as "the combined power of a group of factors when they work together, which is greater than the total power carried by each separate factor" [1]. The basic concepts that provide the foundation necessary for specialized expertise in any field of statistical data analysis are: dependent variables, independent variables, experimental research, correlational research, measurement scale, relationships between variables, the importance of "normal distribution" of the data, the level of statistical significance [3].

The mathematical model derived from our research is of correlational type [16]. For this use is made of the program STATISTICA [17], developed by Stat-Soft company. The question is how do we know which variables are dependent and which independent. Let us return to the relation of determination above: excess or déficit of liquidity force banks to borrow or lend by paying or cashing higher or lower interest. It is clear that liquidity is the independent variable. The variables selected for the mathematical model are shown in Table 1. The data series used in the analysis are recorded monthly average values of the three indicators in the period January 2004 - September 2008. We also introduced in the analysis the period January 2004 - June 2004 as part of the "era" of high interest rates (around 20%), similar to the monthly average interest rate in October 2008 (23.36%). The average value of the ROBOR overnight interest in October 2008 will be used for simulation purpose.
The results of mathematical modeling is a 2nd order polynomial expression (Figure 2):
Liquidity = 3,0371 - 0,0411*x - 0,1809*y + 0,0041*x^2 - 0,0089*x*y + 0,0263*y^2   (1)

Figure 2. Mathematical modeling of the liquidity

3. Results and discussions

The monthly average values of the three indicators in October 2008 were: liquidity 2.45%, ROBOR overnight 23.36%, claims on credit institutions 2.2%. In figure 2, right graph, it is seen that the liquidity zone 2.6% does not cross the interest line 23%. To intersect, interests should be somewhat lower (around 16%) and the claims on credit institutions would have to be much higher (approximately 7%). In other words 23% interest has nothing in common with a liquidity level of 2.45%. If in equation (1) the liquidity value is introduced:
VAR3=2,45%, ROBOR overnight: X= 23,36% and try to solve the equation , we shall found out that solutions Y1 and Y2 of the 2nd order equation are complex numbers , i.e they belong to the real number class.

The question arises again: is the problem solved? Have the interests been manipulated? The answer is: we don’t know! The fact that 23,36% is not a real solution for a correlated mathematical model does not mean it is not a real interest! The literature states that the results of correlational research can only be "interpreted" in terms of causality, based on reasoning, but the correlation data cannot prove causation with certainty [16]. Before one can say that interest rates were manipulated it must be said that the year 2008 was not only the year of crisis coming in Romania, but also the year when the government credit exploded. It is very possible that, due to banks having excess liquidity, they preferred to credit government sector, as the risk associated with this type of asset is zero. In this way, banks could maintain liquidity as government certificates serve as collateral in REPO auctions organized by the central bank which provides liquidity to banks. At the same time, by crediting the government sector they have improved the solvency ratio (precisely due to the low risk).

But what about this solvency? Could it be this way? The answer can only be found trying again with math. All we can do is to take liquidity values recorded in the years before 2008 and with a program (EXCEL for example) to draw the regression line, which is nothing else than the liquidity trend indicator (Figure 3). The values of solvency in 2005-2007 are shown in Table 2.
Table 2. Evolution of the solvency ratio (2005-2007)

<table>
<thead>
<tr>
<th>Solvency ratio (%)</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>21.1</td>
<td>18.1</td>
<td>13.8</td>
</tr>
</tbody>
</table>

Source: NBR [8]

Figure 3 illustrates that the outlook for the end of 2008 was not a good one, and in 2009 it drops below the minimum requirement of 8%. Accordingly, the above scenario assumes credibility. It is possible that only banks having actual liquidity problems have resorted to the interbank money market but have not had where to borrow money from, for the causes listed above. If to the expansion of government credit and solvency problems the distrust generated by the crisis is added, we have a complete picture that could justify the enormous interest amid low trading.

Figure 3. Trend equation of the solvency ratio

\[ y = -3.65x + 24.967 \]

Source: Microsoft Excel, data processing author [14]

Finally we can ask ourselves - What is the use of so much mathematical modeling as if there is still no answer to the question in the title? The answer is given by Peter Sanfey which emphasizes that "the current crisis has shown weaknesses in the economic profession when it comes to predicting the future. [...] This is not an academic frivolity; decision makers need to make judgments about future when deciding the current policy. If this crisis will lead to future forecasts that are less full of inaccuracies than in the recent past, it will be a small but important step forward". [5]

4. Conclusions

Although the mechanism for setting reference rates could allow banks to make a deal, and the temptation to increase profits at the expense of increasing ROBOR interests is a certainty, it is difficult to say that ROBOR interests in October 2008 were manipulated. The present research shows that an average monthly rate of 23.36% as that reported for the month October 2008 represents a distortion of the interbank money market. There is the possibility that ROBOR interest have been manipulated but just as well might be a natural reaction to the conditions that characterized the interbank market at the time: distrust, the explosion of government credit, solvency problems. The mathematical model resulted in the present study can be used to make simulations and to see what can happen if you change certain parameters, with the ultimate goal of identifying a process management method that generated the time series associated with the indicators analyzed, or the establishment of a policy intervention when process deviations relative to a certain goal are above a certain value.

References

[12]. http://economie.hotnews.ro/print?articleId=14164760
[14]. www.mrexel.com
[15]. http://ro.stiri.yahoo.com/ue-extinde-ancheta-privind-manipularea-ratelor-referin%C5%AA%C4%83-%C8%A3-%C4%83-134652444--finance.html
[18]. http://ziare.com/ubs/stiri-ubs/ubs-ar-putea-plati-o-amenda-de-1-63-de-miliarde-de-dolari-pentru-manipularea-libor-1207543