SYSTEMIC CRISIS MANAGEMENT AND THE IMPACT ON MONETARY POLICY. THE INVOLVEMENT OF CENTRAL BANKS. AN EMPIRICAL ANALYSIS

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Abstract

In a systemic crisis, many institutions in the financial system may face a lack of liquidity and central banks, as lenders of last resort, have to support them in order to ensure their financial stability. The question is: To what extent the involvement of central banks in systemic crises management, by providing liquidity to credit institutions, affects their ability to accomplish the central goal of monetary policy - price stability?

To answer this question, through this study, we conducted an empirical analysis on the effect which central banks’ involvement in systemic crises management, through liquidity support, has on monetary policy objectives, mainly on price stability. Using a principal components analysis, we built a Monetary policy index and we developed a regression model between this index and the liquidity support provided by central banks in systemic crises.

The conclusion we reached is that the provision of liquidity by the central bank to banking institutions in the system affects its monetary policy objectives only on the short-term. Specifically, providing liquidity support leads to an increase in both monetary aggregates and consumer price index in the first two years of the crisis, after which there is a significant dilution of this impact.

Keywords: systemic crisis; liquidity support; monetary policy; principal components analysis; regression model

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Assigning the central bank with the responsibility for prudential supervision of the financial system, or part of it, is an issue that generated extensive discussion in the literature on the advantages and disadvantages.

Thus, it was highlighted the synergy between central bank’s responsibilities related to prudential supervision and its quality of lender of last resort (Peek, Rosengren and Tootell, 2001, Dardac and Barbu, 2005) and the synergy of information between prudential supervision duties and central bank’s responsibilities related to

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the development and implementation of monetary policy, the argument being that confidential information obtained during the supervision of important institutions in the financial system allows the central bank to make more accurate estimation of macroeconomic indicators relevant to monetary policy.

On the other hand, it was highlighted the conflict of interest between the quality of central bank as lender of last resort – according to which, in order to maintain financial stability, it has to provide liquidity to institutions experiencing difficulties and which can not obtain these resources on the market - and its monetary policy objectives, which may be affected by massive injections of liquidity.

This conflict of interest seems to be even more important in a systemic crisis, when an important part of the financial system institutions may face a lack of liquidity, especially when bank panics or bank runs occur.

In this context, central banks should make decisions having in view, on the one hand, the need to ensure confidence in the financial system, to maintain the necessary level of liquidity on financial markets and individual institutions, to limit moral hazard in providing resources, and, on the other hand, they must take into account the effects that their liquidity support may have on monetary policy objectives.

Regarding the principles according to which loans of last resort are granted, in 1873 Bagehot noted that “in a crisis, the lender of last resort must lend freely at a penalty rate, based on guarantees that are marketable under normal times where there is no panic”.

Also, Fecht and Tyrell (2004) believe that lenders of last resort can follow two distinct policies in providing liquidity to the financial sector in a crisis event. A first option is to provide liquidity in the market by purchasing financial assets, and the second possibility is to assist certain individual financial institutions facing difficulties. Also, the author demonstrates that, although in minor liquidity crises there is no need for loans of last resort, in moderate or severe crises the adoption of one of the two options must take into account the structure of the financial system. Thus, in systems dominated by banks, individual assistance ensures a more efficient allocation of resources, while in market based systems the injection of liquidity into the market is more efficient.

Both possibilities were used to manage the global crisis that began in 2007. Thus, central banks provided financial markets and institutions extended liquidity support by various facilities: secured loans in local or foreign currency, purchases of bonds or other assets (commercial papers, corporate bonds).

Central banks’ reaction to the current crisis was, as is known, prompt, the aim being to restore the normal functioning of various segments of financial markets and, on this basis, investors’ confidence in their viability.

To relax monetary policy and increase the liquidity in the system, central banks of most affected countries have proceeded immediately to the reduction of monetary policy interest rate, its level approaching zero limit in many cases (Bank of England, ECB, Bank of Japan, FED).

The same central banks decided to stop targeting the interest rate and to use other tools capable to increase the money supply in the economy by injecting
liquidity directly, using unconventional strategies for monetary policy purposes. These strategies expand the scope for liquidity management operations, regarding the acceptance of other than the traditional counterparties, in order to provide sufficient liquidity in the banking system.

These unconventional policies represent an additional tool to the management of systemic crisis, which complements the function of central bank of lender of last resort. Basically, they do not operate solely on the money market, which is the standard interface between central banks and the financial sector, but also on other segments of financial markets, aiming to unlock the main transmission channels of monetary policy (interest rate and credit channels).

Regardless of the unconventional characteristics of monetary policy operations implemented, they all involve a substantial change in central bank balance sheet, both in terms of size and structure and risk profile.

As Moessner and Allen (2010, p 8) also show, before the crisis many central banks pursued through monetary policy, low, but positive inflation rates, using as the main instrument official interest rates. But the crisis and associated risks, including deflation, has led to changes in central bank policies and instruments: interest rates were lowered, central banks provided liquidity to financial markets including the through purchases of assets, all leading to an expansionary monetary policy.

On this issue, Mishkin (2010, p. 47) shows that before the current crisis, the analysis of central bank’s functions created a dichotomy between monetary policy (which aims at price stability) and prudential supervision (aiming at financial stability), but he events that occurred after 2007 in the financial systems of many countries demonstrate an intrinsic connection between the two responsibilities of the central bank. Thus, monetary policy can foster credit growth (and the appearance of bubbles), with effects on financial stability, while macro-prudential policies that promote financial stability (through moderating credit growth) may affect monetary policy objectives. The author, however, makes no reference to the relationship between central bank’ quality as lender of last resort, exercised especially in case of a systemic crisis, and monetary policy responsibilities.

In this context, it seems useful to undertake an empirical analysis to reveal whether and to what extent the achievement of monetary policy objectives is affected by central bank’s involvement in the management of systemic crises by providing liquidity to markets and financial institutions.

We included in the analysis a total of 63 systemic crises manifested after 1980 because, according to Bordo (1990), support for financial institutions was the exception rather than a rule before that date. From these crises, 23 occurred after 2007, in the current global crisis.

Using data on these crises, contained in World Economic Outlook and International Financial Statistics databases, we developed a regression model between the liquidity support provided by central banks, as an independent variable, and an index of monetary policy objectives, as a dependent variable.
**The independent variable**

The operations through which the central bank provides liquidity to credit institutions during a systemic crisis and the volume of these operations are not usually public information because they may cause a reputational risk which would result in massive withdrawals of deposits and/or their inability to borrow in the money market.

In this context, in order to measure the degree of central banks’ involvement in managing crises by providing liquidity support, we used an indicator defined as a ratio between the increase in central bank claims on credit institutions in the year in which the crisis was triggered compared with the previous year, on the amount of deposits received by them.

\[
\text{LiquiditySupport} \equiv \frac{CB'\text{'s } _{\text{claims}, t} - CB'\text{'s } _{\text{claims}, t-1}}{\text{Deposits}_{t-1}}
\]

Laeven and Valencia (2008, p.5) used a similar indicator to define “extended liquidity support”.

We believe that this approach in building a liquidity support indicator reflects both the changes in the balance sheets of central banks (the assets growth) and the changes in the funding structure of commercial banks (by reporting the amounts received from the monetary authority to total deposits).

At the same time, we think it is suitable to calculate this indicator for the first year of the crises because liquidity support policies are generally aimed at limiting and halting their extension, and they are used in the initial stages of these events. On this issue Laeven and Valencia (2010) demonstrated that the amounts provided by central banks are withdrawn, on average, within 14 months.

**The dependent variable**

The monetary policy stance is difficult to assess in periods of calm in financial markets, but it becomes even more difficult in times of crisis (when uncertainty increases and the interpretation of financial variables can not be based on the regularities and patterns observed in normal times).

However, in the literature can be found many approaches regarding the variables that may represent good indicators of the monetary policy stance. Thus, there were used certain indices based on the decisions taken by the monetary authorities (Friedman and Schwartz, 1963, Romer and Romer, 1989), the growth rate of monetary aggregates, credit growth, exchange rate, interest rate (Sims, 1992), monetary policy indices constructed using vector autoregressive (Bernanke and Blinder, 1992, Bernanke and Mihov, 1998).

Thus, aiming to define an index of monetary policy, we considered exchange rate and interest rate movements, as the main transmission channels of monetary policy, changes in M1 and M2 monetary aggregates during the period [t-1, t+1] where t is the year of the crisis event, as intermediate targets and the evolution of consumer price index (CPI) as an indicator for assessing the overall achievement of monetary policy objectives.
The preliminary analysis of partial correlation coefficients between these indicators and liquidity support revealed a statistically significant correlation between liquidity support and variables on monetary aggregates and consumer price index, respectively inflation rate. For this reason, we constructed an index of monetary policy based on these variables on the evolution of M1, M2 and CPI.

To get an accurate picture of the developments in monetary aggregates, we used four variables, namely: Percentage increase of M1 in the period \([t-1, t]\), Percentage increase of M1 in the period \([t, t +1]\), Percentage increase in M2 in the period \([t-1, t]\) and Percentage increase of M2 in the period \([t, t +1]\). Regarding inflation, we used two variables, namely: CPI increase during the period \([t-1, t]\) and CPI increase during the period \([t, t +1]\).

We believe that for purposes of this analysis, the method we used in the development of the monetary policy indicator is appropriate, since it will reflect the attainment of the monetary policy objectives, being also consistent with the principles in the literature, which indicate that monetary aggregates can be used as leading indicators of economic activity (the most useful indicator is M1) and the evolution of prices (the appropriate indicator is M2). At the same time, consumer price index is often used to express the inflation targets.

To construct the index we used principal component analysis, a statistical analysis procedure which aims at reducing data dimensionality. This method of data analysis allows the determination of new variables called principal components, which are expressed as linear combinations of original variables. They do not contain redundancy and maintain, at the same time, as much of the information contained in the initial variables.

The mathematical model of principal components analysis can be defined as: given \(X_1, X_2, \ldots, X_n\) - \(n\) original variables that represent characteristics of the phenomena under examination, the determination of principal components is achieved through a transformation of the form \(\Psi : \mathbb{R}^n \rightarrow \mathbb{R}^k\). By this transformation, an element \(x\) of the space \(\mathbb{R}^n\) is converted into an element of \(\mathbb{R}^k\) space.

The transformation \(\Psi\) is linear, by the type \(w = A^*x\), \(A\) being a matrix of real numbers of \(n\times k\) size. The determination of the principal components is equivalent to solving the following optimization problem (Ruxandra, 2009):

\[
\begin{cases}
\text{Max Var}(w) \\
\text{w} = A^*x
\end{cases}
\]

Principal components analysis lead us to the extraction of a single variable that explains 87.556\% of the variance of the six original variables. Thus, by using the first principal component we will only lose a percentage of 12.444\% of the informational content of the original variables.
Total variance of original variables explained by Monetary policy index

Table no. 1

<table>
<thead>
<tr>
<th>Component</th>
<th>Initial Eigenvalues</th>
<th>Extraction Sums of Squared Loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total % of Variance</td>
<td>Cumulative %</td>
</tr>
<tr>
<td>1</td>
<td>5,253</td>
<td>87,556</td>
</tr>
<tr>
<td>2</td>
<td>1,671</td>
<td>98,733</td>
</tr>
<tr>
<td>3</td>
<td>2,657</td>
<td>99,679</td>
</tr>
<tr>
<td>4</td>
<td>1,516</td>
<td>99,939</td>
</tr>
<tr>
<td>5</td>
<td>1,002</td>
<td>99,979</td>
</tr>
<tr>
<td>6</td>
<td>1,001</td>
<td>100,000</td>
</tr>
</tbody>
</table>

Extraction Method: Principal Component Analysis.

The percentage of each of the original variables’ variance explained by the principal component is presented in Table no. 2

The variance of each original variable explained by Monetary policy index

Table no. 2

<table>
<thead>
<tr>
<th>Original variable</th>
<th>Explained variance of each original variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage increase of M1 in the period [t-1, t]</td>
<td>91.2%</td>
</tr>
<tr>
<td>Percentage increase of M1 in the period [t, t+1]</td>
<td>84.2%</td>
</tr>
<tr>
<td>Percentage increase in M2 in the period [t-1, t]</td>
<td>88.4%</td>
</tr>
<tr>
<td>Percentage increase of M2 in the period [t, t+1]</td>
<td>92.9%</td>
</tr>
<tr>
<td>CPI increase during the period [t-1, t]</td>
<td>85.0%</td>
</tr>
<tr>
<td>CPI increase during the period [t, t+1]</td>
<td>83.6%</td>
</tr>
</tbody>
</table>

We will name the resulting principal component Monetary policy index, constructed using the following formula in relation to the original variables included in the analysis:

Monetary policy index = 0.182* Percentage increase of M1 in the period [t-1, t] + 0.175* Percentage increase of M1 in the period [t, t+1] + 0.179* Percentage increase in M2 in the period [t-1, t] + 0.183* Percentage increase of M2 in the period [t, t+1] + 0.176* CPI increase during the period [t-1, t] + 0.174* CPI increase during the period [t, t+1]

Thus, higher values of the index will indicate an expansionary monetary policy and higher inflation rates, while its lower values will indicate a restrictive monetary policy and low rates of inflation.

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Component Score Coefficient Matrix

<table>
<thead>
<tr>
<th>Variable</th>
<th>Component Score Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cresterea procentuală a M1 în perioada ([t;t+1])</td>
<td>0,182</td>
</tr>
<tr>
<td>Cresterea procentuală a M1 în perioada ([t;t+1])</td>
<td>0,175</td>
</tr>
<tr>
<td>Cresterea procentuală a M1 în perioada ([t;t+1])</td>
<td>0,179</td>
</tr>
<tr>
<td>Cresterea procentuală a M2 în perioada ([t;t+1])</td>
<td>0,183</td>
</tr>
<tr>
<td>Creşterea indicelui preţurilor de consum în perioada ([t-1;t])</td>
<td>0,176</td>
</tr>
<tr>
<td>Creşterea indicelui preţurilor de consum în perioada ([t;t+1])</td>
<td>0,174</td>
</tr>
</tbody>
</table>

Extraction Method: Principal Component Analysis.

To determine a potential influence of central bank intervention in crises management through liquidity support on the objectives of monetary policy, we have developed a linear regression model between the Monetary policy index (dependent variable) and Liquidity support (independent variable), with the following form:

\[ \text{Monetary policy index}_i = c + a \times \text{Liquidity support}_i + \epsilon_i \]

The estimation of the parameters of this model led us to the following form:

\[ \text{Monetary policy index}_i = -0.393 + 1.587 \times \text{Liquidity support}_i + \epsilon_i \]

The coefficients are statistically significant for a 99% confidence level and the determination ratio is 59.4%.

The results of the estimation of regression model’s parameters

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Std. Error</td>
<td>Beta</td>
<td></td>
</tr>
<tr>
<td>1 (Constant)</td>
<td>-0.393</td>
<td>0.119</td>
<td>-3.294</td>
<td>.002</td>
</tr>
<tr>
<td>Liquidity support</td>
<td>1.587</td>
<td>0.217</td>
<td>.778</td>
<td>7.326</td>
</tr>
</tbody>
</table>

a. Dependent Variable: Monetary policy index

The conclusion we reached from the analysis is that the central bank’s involvement in crisis management by providing liquidity has a short term influence of its monetary policy through monetary aggregates.

Thus, liquidity support leads both to an increase in monetary aggregates during the first two years of crisis and to an increase in the consumer price index during the same period.

Performing the same analysis for a period of more than three years showed us that this impact is reduced if there are considered long periods of time. Results of regression analysis between Liquidity support and Monetary policy index, over a period of three years, are presented in Table no. 5, revealing they lack a statistical significance.
The results of the estimation of regression model parameters in which Monetary policy index is built over a period of three years

Table no. 5

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Std. Error</td>
<td>Beta</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>(Constant) -1.01</td>
<td>.202</td>
<td>-1.497</td>
<td>.623</td>
</tr>
<tr>
<td></td>
<td>Liquidity support .347</td>
<td>.340</td>
<td>.183</td>
<td>1.020</td>
</tr>
<tr>
<td>a.</td>
<td>Dependent Variable: Monetary policy index - 3 years</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Conclusions

Given the obtained results, we believe that between the objective of ensuring financial stability, pursued through liquidity support provided by the central bank as lender of last resort, and the objective of price stability, pursued through its monetary policy, there is a conflict of interests in case of a event systemic crisis only for short periods of time.

These results are also consistent with the analysis of Laeven and Valencia (2008, p. 26) who show that monetary policy is generally neutral in a banking crisis period, while fiscal policy is expansionary in order to facilitate recovery of the sector real.

At the same time, the conclusions of our empirical analysis confirms the widespread view in the literature that, on the long-term, financial stability and price stability reinforce each other, although in exceptional times there may be a short-term conflict.

On the other hand, these results should be correlated with the effects that central bank involvement in crisis management has on the confidence in the financial system and on interbank interest rate volatility.

Also, the analysis of the consequences of an expansionary monetary policy followed by central banks that engage in crisis management should take into account recent theories on the need to implement countercyclical macroeconomic policies.

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