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Monetary Conditions and GDP Evolution in Romania

Dan Constantin Olteanu

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MONETARY CONDITIONS AND GDP EVOLUTION IN ROMANIA

DAN CONSTANTIN OLTEANU

Abstract: We deal with the evolutions of monetary conditions in Romania before and during the economic crisis, and the extent to which GDP shocks are related to these conditions. The results confirmed the essential role of interest rate, credit and exchange rate in this respect, which underlines the importance of the monetary policy measures for stimulating the domestic/external demand. The exchange rate has an important weight, which shows the contribution of the currency depreciation to the pre-crisis increase of the domestic product. During the crisis (2008-2010), the reduction of GDP growth is more ample than the reduction of monetary conditions, revealing an important role of the real channel in transmitting shocks from abroad. The currency depreciation failed to stimulate the domestic product because of the low external demand, of similar devaluations of competitors’ currencies, but also because of the increasing proportion of imports in the exported products. Under these conditions, the reduction in capital account had a substantially recessionistic effect. Since the end of 2010, the GDP oscillations have been restored around the monetary conditions, which have recovered the capacity to anticipate the macroeconomic evolution.

Key-words: monetary conditions index, GDP growth, Macro-financial linkages

JEL Classification: E44, E52, E32

1. Introduction

The mechanisms by which financial conditions influence the real economy are a widely debated issue in literature. And this, because in the last decades the financialisation of economies has intensified and the equilibrium of the financial market has played an increasing role in macroeconomic performance. Moreover, the monetary policy transmission channels have become more complex and evolved in time, due to many financial innovations associated with the deregulation of financial markets. In this context, the start and the transmission of the global crisis through the financial channel have had unpredictable effects difficult to counteract, confirming the essential role of financial conditions in macroeconomic stability.

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Eastern European countries – highly dependent on foreign funding – have strongly felt the liquidity crisis in foreign financial markets. Although the banking system was not exposed to “toxic” assets in the USA, the increasing cost and diminishing funding amplified the existing bank balance sheet deterioration (high proportion of external assets, high leverage, high lending rate – non-performing assets). This combination of factors caused major problems to the banking systems of some countries, and government support was required. In Romania, the measures to temper lending taken by the NBR\textsuperscript{3} before the crisis prevented such problems but it was not possible to avoid the financial instability contagion from abroad through external borrowing, exchange rate and asset price channels. Of course, there was a substantial transmission of recession through the real channel (export decline).

Considering the importance of the evolution of financial variables for the real economy stability, attempts have been made since the early 1990s to synthesize the national financial conditions as a composite index, cumulating the oscillations of the most representative financial indicators. First, it was the monetary condition index (MCI) set by the National Bank of Canada, which synthesized the modifications (shocks) of variables corresponding to the most important monetary policy transmission channels – interest rate and exchange rate – in relation to their trend. Gradually, the evolution of financial markets led to increasing importance of some transmission channels independent of the monetary policy. Therefore, other financial variables corresponding to various transmission channels were added, both of neoclassic type (interest rate measures and spreads; asset prices) and of non-neoclassic type (credit indicators). This resulted in financial condition indexes (FCI). Hatzius \textit{et al.} (2010, pp. 9-10) provided a synthesis of the characteristics of the main MCIs used by financial institutions in developed countries (Deutsche Bank, Bloomberg, OCDE, etc.).

The MCI was initially used as an intermediate target of the central bank, placed somewhere between the monetary policy instruments and the final target (usually, inflation or aggregated demand). Because of its unsatisfactory outcome, the utilisation of the MCI gradually diminished, but it began to be used as an evaluation indicator of the monetary policy (restrictive or relaxed one). Precisely this assessment, in the case of Romania, is the topic of this paper. We are interested in how this index

\textsuperscript{3} National Bank of Romania.
evolved during the financial crisis and, especially, in the way the MCI evolution was correlated with GDP decline from the previous trend. This correlation can be considered a measure of how the growth rate was affected by monetary conditions.

2. The methodological framework

An MCI include any financial variable whose shock (deviation from the trend) significantly influences the state of the economy – revealed, as a rule, by various indicators of the real economy (domestic product, industrial production, etc.). The emergence of the theories regarding the monetary transmission mechanisms was followed by the occurrence of a multitude of variables with possible impact on the real economy. But the test results show that the most significant variables are those related to the interest rate, money supply, credit, exchange rate, and asset prices. The variables included in the MCI are weighted depending upon the importance of the related shocks for explaining the variation in the domestic product or the industrial production. The question of estimating such weights is vital for setting an MCI, as the weights determine the index performance.

In principle, there are four approaches to measuring the weights of variables $X_j$, components of an index of type $MCI = \sum c_j X_j$:

a) Determining the weights by means of an investment–saving (IS) equation, when the variation in a result indicator of the real economy (GDP or industrial production) is explained by previous values both of itself and of the financial variables, as follows:

$$\Delta Y_t = a_0 + \sum_{i=1}^n B_i \Delta Y_{t-i} + \sum_{j=1}^m \sum_{p=1}^r c_j X_{p,t-i} + \epsilon_t$$

where: $\Delta Y$ shows real economy changes, $X_j = (X_1 \ldots X_m)$ are the financial variables that we want to include in the MCI; $n$ is the number of lags included in equation; $m$ is the number of financial variables; $\epsilon$ is the error term. The coefficient of a financial variable in the future MCI results from the sum of the coefficients of this variable for all lags included in the IS equation.

b) Deducing the weights of MCI variables by means of an autoregressive vector (VAR) model of the following form:

$$Z_{t} = A_{t} + \sum_{i=1}^m B_{i} \epsilon_{t-i} + \epsilon_{t}$$
where: $Z$ is a vector $m \times 1$ of all variables (including $\Delta Y_t$), $A_i$ is a vector $m \times 1$ of the intercepts, $B_i$ is matrix $m \times m$ of the slope parameters. The weight of a variable in the MCI is determined by the average cumulated response of $Y_t$ to a shock of the errors of that variables, revealed by the impulse-response function (IRF) of the VAR model.

Unlike the previous variant, the IRF measures the impact of each variable on all the other variables. In a classic VAR model, built according to Christopher Sims (the author of VAR), all variables are considered to be endogenous, so that a shock to a financial variable implies both the direct effect and the indirect one through the other variables on the response variable.

c) Using complex structural models that should take into account the interactions among the main macroeconomic variables. This variant is suitable for the accurate quantification of the influence of financial variables, but it is a difficult attempt since it requires complex data on financial institutions, consumer behaviour and investments of households, as well as of companies, and others. But according to Gauthier et al. (2004, p. 6), some financial variables, such as asset price, play a limited role in macroeconomic models built by leading financial institutions. And this, because of the lack of consensus in literature regarding the mechanisms by which these indicators influence the aggregated demand and inflation.

d) Calculating the weights of MCI variables in relation to the capacity of various indicators and their combinations to predict the evolution of the domestic product and inflation. Stock and Watson (2002), English, Tsatsaronis and Zoli (2005) and others made such attempts and acquired important results, using a 1-2 year forecasting horizon.

Below, we use the VAR method to determine the weights of the MCI components.

### 3. An index of monetary conditions for Romania

In Annexes 1 and 2 we included a set of financial variables used for selection, with stationarity tests. The indicators include several measures of interest rate, money supply, private credit, bank deposits, and exchange rate indicators. The growth rate is computed in relation to the previous quarter, after the seasonal adjustment of data (as necessary) by the Census X12 method. We did not provide logarithms to the data series because this procedure means losing information, which is undesirable for building a VAR model (Cozmâncă, 2000, p. 30).
The modest size of data sample does not allow for using a large number of variables and lags, since the degree of freedom diminishes and cause big standard errors and very big confidence intervals of the coefficients. We opted for maximum 3 financial variables for building the MCI. To select the variables to be included, we computed in Annex 3 – for each factor $X_j$ – the individual impact on domestic product growth rate, using the relation below. Because we use quarterly data, we select a lag $n=4$.

$$\Delta Y_t = a_0 + \sum_{i=1}^{4} b_i \Delta Y_{t-i} + \sum_{j=1}^{3} c_j \Delta X_{j,t-4} + \epsilon_t.$$  \hspace{.5cm} (3)

Considering the regression results shown in Annex 3 and Granger causality tests (Annex 4), the importance of the variables from an economic theory perspective, and the economic relevance of parameters in several forms of VAR models, we selected three financial variables:
- three-month inter-bank real interest rate ($\%$), denoted by $R_{\text{IR}3}$;
- growth of real private credit over the previous quarter ($\%$) denoted by $\Delta R_{\text{PCR}}$;
- growth of nominal exchange rate over the previous quarter ($\%$), denoted by $\Delta NEX$;

to which we add the GDP real growth rate over the previous quarter, denoted by $\Delta GDP$.

In general, for setting an MCI, real variables are preferred, especially for long-term analyses, because it is assumed that economic agents take into account, for example, the real interest rate, not the nominal one, when they make decisions on consumption or investments. Therefore, although there are opinions favouring the influence of the “money illusion” on the above decisions, we opted for deflating the three variables by the consumer price index (CPI). To calculate the real variables, we used, in general, the CPI in relation to the previous quarter, except for several measures of the real interest rate, where we used the annual growth rate of prices, according to the following formula:

$$\Delta \text{GDP}_{\text{annual}} (\%) = \left[ \left( \frac{\text{CPI}_t}{\text{CPI}_{t-1}} \right)^{\frac{1}{4}} - 1 \right] \cdot 100$$ \hspace{.5cm} (4)

where: $\text{CPI}_t$ is the index of quarterly consumer prices on a 2005=100 fixed basis.

*Real* increases in the indicator $X$ were calculated by the following formula:

$$\Delta R_{\text{X}_t} (\%) = \left[ \frac{1 + (\Delta X_t / 100)}{1 + (\Delta \text{CPI}_t / 100)} - 1 \right] \cdot 100. \hspace{.5cm} (5)$$
Where  \( \Delta_{CP_t} = ((CP_t/CP_{t-1})-1)\times 100 \), except for the real interest rate, when we used  \( \Delta_{CP_t \text{ annual}} \).

The figures included in Annex 5 show the evolution of the three financial indicators selected, besides the evolution of the GDP growth rate, between 1998-2012. The charts show very high oscillations of the variables, especially the GDP, before 2000 as well as after 2007, when the global crisis began. Therefore, for calculating the weight of financial variables in the GDP, we used a sample corresponding to a period as monotonous as possible regarding the indicator evolution. The selected interval was Q3.1999 – Q2.2008.

For the above-mentioned interval we built an unrestricted VAR model, using a four-period (quarterly data) lag, besides the impulse-response function (IRF) of the domestic product for a shock of each financial variable. We selected this lag – although too long if related to the sample size – considering both the lag length tests (FPE, AIC and HQ indicate this lag) and the “wrong” parameter signs (contrary to economic theory) in the IRF of VAR with 2 and 3 lags. Moreover, the IRF results for VAR4 are better – as regard the correlation of the MCI with  \( \Delta_{GDP} \) - than those produced by VAR2 and VAR3.

The IRF receives the impact of any X variable on the other ones of the VAR model, by changing by one unit the regression error of the equation corresponding to that variable. Therefore, according to Swiston (2008, p. 7), the coefficient of each financial variable revealed by the IRF is adequate for being used later in the MCI, because it is the response of the dependent variable (in our case, GDP) on a certain period \( t+k \), to a shock of that financial factor, at time \( t \).

The big issue when calculating the IRF is the error correlation between equations, and that is why the Cholesky procedure decomposes the residuals  \( u_t \) in equation (2) into two parts: one caused by exogenous factors, and the other one caused by the other variables of the system. This process implies a complex set of algebraic transformations and ordering of the variables; the more correlated the residual variables are, the stronger the influence of ordering on results is – IRF coefficients (Brooks, 2008, p. 301). As a rule, variables are ordered by the length of the delay in responding to the variation in the other variables; it is considered that the last variable in that row reacts immediately to an impulse from the other ones. That is why we ussualy find the following order: GDP, inflation, interest rate, credit, and the alternative consisting in reversing the last two elements, as shown by Jääskela (2007, p. 13). The exchange rate is the last, after the interest rate, which implies a
delayed answer of the monetary policy to an exchange rate shock (Bjørnland, 2008, p. 201). Of course, the order is determined by the specific characteristics of the analysed economy.

The charts in Figure 1 show the response of GDP growth rate to a shock of one standard deviation of the three financial variables, spanning eight quarters.

Figure 1: The response of GDP growth rate to a shock of one standard deviation of monetary variables, using the Cholesky decomposition (± 2 standard errors)

Source: Own calculations, based on data from IMF – International Statistics and Eurostat, using EViews.
For using the Cholesky decomposition of errors, we first ordered the variables as follows: GDP growth rate, three-month inter-bank real interest rate, real private crediting rate, nominal exchange rate variation; further other variables may be tested.

The charts show a negative reaction of GDP to an impulse of the interest rate, delayed for 3 quarters. Then, we see a positive initial response for Q2 and Q3 in the case of the real credit, and then the response oscillates. The response to an impulse of the exchange rate (devaluation) is also positive, but for a short period, and then it oscillates because of increasing domestic prices. We could say that the three responses are consistent with economic theory for a credible period of four quarters; the oscillations are caused by a relatively large number of lags (4).

By computing the averages of the IRF coefficients for three, four or five periods, and using three variable ordering variants, we obtained nine MCI, denoted by MCI1 - MCI9 (Annex 6). For ordering the variables we always kept the GDP as the first variable, because of the delay in response as against the other variables.

Testing the MCI performance is based on three criteria: the correspondence of the coefficient signs with economic theory; graphical examination of the MCI capacity to predict the evolution of the result indicator (industrial production, GDP, etc.) and especially to anticipate the inflexion points of the trend; the size of the correlation / determination coefficient between the MCI and the result indicator. The financial variable coefficients for the nine MCIs are presented in Annex 6, besides the regression results with $\Delta_GDP$. The performances of the nine indexes are close, but the weights of the variables show considerable differences among the MCI variants, revealing substantial error correlation. According to the results, we selected MCI5(t-1) to be the most performing for predicting $\Delta_GDP(t)$ variation. Figure 2 (right scale) describes the evolution of the actual variation of GDP, compared with the GDP predicted by the MCI5 variation. The left scale shows the regression error.

The graph shows a relatively good capacity of the index to anticipate the GDP evolution up to 2007 (the period for which it was built). But what concerns us is the MCI evolution during the 2008-2011 financial crisis. The index anticipates the decrasing trend of the GDP growth rate between 2008-2009, but we also see a significant difference: the actual GDP trend is below the MCI predicted trend. This could mean
a poor performance of the index or that it might be caused by a decisive role of the exchange rate (which increased significantly over that period) in MCI5 variation. But, in our opinion, the main reason is the influence of external factors, which affected the GDP, the first one being the export component (external demand) diminution. The second cause, which produced a negative shock to the GDP at the end of 2008, is a contraction of domestic absorption because of decreasing foreign capital inflows. The currency depreciation could not stimulate the domestic product growth because of the low external demand, the simultaneous devaluation of the competitor’s currencies, as well as the increasing proportion of imports in exported products. In these circumstances, the capital account diminution had a substantial recessionistic effect. The simultaneous action of the two causes – export and foreign capital – does not allow for a distinction between their contributions. Starting with the end of 2010, the correlation of the two indicator trends occurred again.

Figure 2: Actual $\Delta GDP(t)$, and $\Delta GDP(t)$ estimated by MCI5(t-1), 2000 - 2011

![Graph showing actual and estimated GDP changes](source)

Source: Own calculations, based on IMF and Eurostat data, using EViews.
The coefficients of the MCI component variables and the GDP response to shocks show the capacity of the financial conditions to predict the macroeconomic evolution. Thus, it confirms the essential role of interest rate, credit and exchange rate in this respect, which reveals the importance of monetary policy measures for stimulating domestic/external demand and preserving economic stability. The best performing MCI is that with a decisive contribution of the exchange rate (Annex 6), which confirms the contribution of depreciation to the GDP growth.

4. Conclusions

The monetary condition index computed in this chapter aimed to synthesize the actions of three monetary variables (interest rate, credit and exchange rate) on the GDP variation. Very often, such attempts fail, for several reasons. The first one is the multitude of financial variables affecting the output, having more and more indirect influence because of the increasing complexity of the financial market. An index incorporating only three variables cannot cover all financial shocks that deviate the GDP from the trend. The second reason is that the influence intensity of various financial indicators changes over time, and this dynamics cannot be revealed by an MCI. An ideal way is to adjust it periodically, and calibrated for as short periods of time as possible. The problem is that analyses based on a large number of variables in a short period of time are affected by inaccurate estimates. The third reason is that the financial variable shocks influence the domestic product at different speeds. Averaging one variable effects for a certain number of periods (quarters, etc.) in the IRF produce quite a distorted picture of the impact of that indicator. Finally, qualitative variables such as unrealistic positive expectations of future incomes (which cause overconsumption and speculative bubbles) or risk aversion (which significantly diminishes during “boom” periods) will never be quantified in mathematical formulas.

For EE countries, an important target of further research on the interaction of the financial economy and the real one is the inclusion of some variables able to capture external shocks. Also, comparative analyses of the financial variable influence by country could allow us to clearly define the role of external shocks as well as to identify the best monetary policy practice.
Annex 1

Variables used during the selection process

<table>
<thead>
<tr>
<th>Factor</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Delta GDP$</td>
<td>Real GDP growth rate (%)</td>
</tr>
<tr>
<td>$\Delta IR3$</td>
<td>Three-month interbank interest rate, differentiated (% per year)</td>
</tr>
<tr>
<td>$\Delta IR6$</td>
<td>Six-month interbank interest rate, differentiated (% per year)</td>
</tr>
<tr>
<td>$\Delta IR12$</td>
<td>Twelve-month interbank interest rate, differentiated (% per year)</td>
</tr>
<tr>
<td>$R_{IR3}$</td>
<td>Real three-month interbank interest rate (% per year)</td>
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<tr>
<td>$R_{IR6}$</td>
<td>Real six-month interbank interest rate (% per year)</td>
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<tr>
<td>$R_{IR12}$</td>
<td>Real twelve-month interbank interest rate (% per year)</td>
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<tr>
<td>$\Delta LR$</td>
<td>Lending interest rate, differentiated (% per year)</td>
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<tr>
<td>$\Delta DR$</td>
<td>Deposit interest rate, differentiated (% per year)</td>
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<td>$R_{LR}$</td>
<td>Real lending interest rate (% per year)</td>
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<tr>
<td>$R_{DR}$</td>
<td>Real deposit interest rate (% per year)</td>
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<tr>
<td>$\Delta M1$</td>
<td>M1 growth rate (%)</td>
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<tr>
<td>$\Delta M2$</td>
<td>M2 growth rate (%)</td>
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<tr>
<td>$\Delta R_{M1}$</td>
<td>M1 real growth rate (%)</td>
</tr>
<tr>
<td>$\Delta R_{M2}$</td>
<td>M2 real growth rate (%)</td>
</tr>
<tr>
<td>$\Delta PCR$</td>
<td>Domestic bank debt growth rate for the private sector (%)</td>
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<tr>
<td>$\Delta R_{PCR}$</td>
<td>Real domestic bank debt growth rate for the private sector (%)</td>
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<tr>
<td>$\Delta TD$</td>
<td>Total deposit growth rate (%)</td>
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<tr>
<td>$\Delta DD$</td>
<td>Demand deposit growth rate (%)</td>
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<tr>
<td>$\Delta TD$</td>
<td>Term deposit growth rate (%)</td>
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<td>Real total deposit growth rate (%)</td>
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<tr>
<td>$\Delta R_{DD}$</td>
<td>Real demand deposit growth rate (%)</td>
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<td>Real term deposit growth rate (%)</td>
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<tr>
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<td>Nominal exchange rate growth (country currency / euro), %</td>
</tr>
<tr>
<td>$\Delta ENEX$</td>
<td>Effective nominal exchange rate growth (foreign/country currency), %</td>
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<tr>
<td>$\Delta EREX$</td>
<td>Real effective exchange rate growth (growth = appreciation), %</td>
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## Stationarity tests, period: Q3.1999 – Q2.2008

<table>
<thead>
<tr>
<th>Factor</th>
<th>ADF Test</th>
<th>Critical value (5%)</th>
<th>PP Test</th>
<th>Critical value (5%)</th>
<th>Constant (C), Trend (T)</th>
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Annex 3

Results of regression $\Delta Y_t$ in relation to financial variables for a lag $n=4$ (equation 3). Period: Q3.1999 – Q2.2008

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Annex 4


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**Note:** Indicated probabilities p below the usual significance level of 0.05, which implies a causality between that factor and ΔY.

**Source:** Own calculations using EViews, based on IMF – International Financial Statistics and Eurostat.
Annex 5

GDP growth rate* (%)

* The GDP series used to compute the growth rate were first seasonally adjusted.
Source: Own calculation based on IMF – International Financial Statistics.

Real three-month interbank interest rate* (%)

* Seasonally adjusted data.
Source: Own calculations based on Eurostat data.
Annex 5 – cont.

**Real private credit growth rate (%)**


**Nominal exchange rate growth* (%)**

*Source:* Own calculations based on IMF – International Financial Statistics

* National currency / euro, growth = currency appreciation.
Annex 6

Coefficients of financial variables of MCI, using different orderings for Cholesky decomposition

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Source: Own calculations using EViews.

Note: The order within the IRF is in brackets before the variable.

Regression results* \( \Delta GDP = f(MCI) \)

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<tr>
<td>MCI 8</td>
<td>0.29</td>
<td>18.66</td>
<td>4.32</td>
<td>1.71</td>
<td>3.44</td>
<td>47</td>
</tr>
<tr>
<td>MCI 9</td>
<td>0.33</td>
<td>21.84</td>
<td>4.67</td>
<td>1.53</td>
<td>3.39</td>
<td>47</td>
</tr>
</tbody>
</table>

* I eliminated two extreme values of \( \Delta GDP \), from equations corresponding to Q1.2001 and Q1.2009.

** t test corresponding to the MCI coefficient.

Source: Own calculations using EViews.