MONETARY AND FISCAL POLICY INTERACTIONS
IN THE CONTEXT OF EUROPEAN INTEGRATION:
EMPIRICAL EVIDENCE FOR THE ROMANIAN
ECONOMY

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Abstract
This paper uses a Vector Autoregressive (VAR) model identified by sign restrictions to analyze the interactions between monetary and fiscal policies in Romania, in the context provided by the European accession and integration. We employ a VAR model comprising output, inflation rate, a measure of the fiscal stance and the short-term interest rate. To circumvent the lack of a structural model, we identify the VAR model by using sign restrictions imposed on the impulse response functions. More specifically, we force the monetary shock to determine a negative response in the output-gap and in inflation and the fiscal shock to determine a positive response in the output-gap and in inflation. The results of the VAR model create a complete picture of how a) monetary and fiscal policies react to output and inflation; b) interest rate reacts to fiscal shocks; c) fiscal policy reacts to interest rate shocks. Combining b) and c) indicate whether the monetary and fiscal policies act as complements or substitutes. Our findings suggest that, while the monetary policy reacts promptly to inflation, the government conducts a pro-cyclical fiscal policy.

Keywords: monetary policy; fiscal policy; vector autoregression (VAR); sign restrictions; structural shocks

JEL codes: E58, E62, E63

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1. Introduction

The interactions between monetary and fiscal policies are important in many respects.

First, each of the two policies influences the other’s chances for success and modifies its action context. Fiscal policy affects monetary policy in various ways: through its short-run impact on aggregate demand and on labor conditions, through its long-run effects on the conditions for economic growth and low inflation, and through its impact on general confidence in monetary policy. It is of a great importance for the monetary policy whether a tax cut is financed by a corresponding cut of expenditures or by a corresponding increase in government debt. Monetary policy may be accommodative to fiscal policy or counteractive. As a consequence, the achievement of the major policy objectives – price stability and sustainable growth – depends essentially on the architecture of the policy mix.

Second, the delegation of monetary and fiscal policy responsibilities to different and independent organizations (both at national as well as at supra-national level) increases the importance of the coordination of the monetary and fiscal authorities’ policy actions. The separation of powers between fiscal and monetary authorities raises the question of how the two policies interact when the policy makers’ objectives differ. More specific, for the Romanian economy situated in the context provided by the European accession and integration, among the constraints on the efficacy of the inflation targeting strategy adopted in 2005 by the National Bank (NBR) are restraining fiscal dominance, fiscal consolidation and a better coordination between monetary and fiscal policy. National concerns regarding the interactions between monetary and fiscal policies formulated at the level of the decision or macroeconomic analysis institutions as: NBR, Ministry of Public Finance (MPF) and National Forecasting Commission (NFC) (re)state the importance of correlating the actions of macroeconomic policy.

Third, monetary and fiscal policy interactions gained recently a central place in the debates related to the functioning of optimum currency areas (OCA). While there is no centralized fiscal policy at the European Union (EU) level, neither a formal coordination in order to obtain a certain fiscal stance for the euro zone, there is a common monetary policy promoted by the European Central Bank (ECB). The attention awarded by the euro zone member states to the problem of the interactions between the monetary and fiscal policy inside the European Monetary Union (EMU) led to the Stability and Growth Pact (SGP) as a
control framework for the dynamics of monetary-fiscal interactions. Once integrated in the European Monetary Union (EMU), Romania will only retain fiscal sovereignty.

In this paper we use the Vector Autoregressive (VAR) framework to model the monetary and fiscal policy interactions. We set up a VAR model comprising the output, the inflation rate, a measure of the fiscal stance and the short-term interest rate as endogenous variables.

VAR is considered to be a well suited empirical tool to understand the stochastic and dynamic macroeconomic system entailing variables which respond to present and past random shocks (see Mountford and Uhlig, 2005).

Modeling the monetary and fiscal interactions in a VAR model faces, however, several criticisms. Mountford and Uhlig (2002) emphasize that a government change may determine the expectation of a fiscal policy shift before the new fiscal stance is detected in the VAR. The lack of a structural model makes the interpretation of the empirical correlations between policy instruments difficult.

The difficulty of using VAR to model the interactions between the monetary and fiscal policy is mainly caused by the fiscal part. The movements in fiscal variables may be responses to fiscal policy shocks, but may also be the simply automatic movements in response to other shocks such as business cycles or monetary policy shocks. Another important issue is the necessity to clearly define the fiscal policy shock.

We eliminate automatic responses to business cycles by measuring the fiscal stance by using the cyclical-adjusted balance (CAB). To circumvent the lack of a structural model, we identify the VAR model by using sign restrictions imposed on the impulse response functions. More specifically, we force the monetary shock to determine a negative response in the output-gap and in inflation and the fiscal shock to determine a positive response in the output-gap and in inflation.

The results of the VAR model create a complete picture of how a) monetary and fiscal policies react to output and inflation; b) interest rate reacts to fiscal shock; c) fiscal policy reacts to interest rate shock. Combining b) and c) indicate whether the monetary and fiscal policies act as complements or substitutes. Our findings suggest that, although the policy variables play a sizable role in the development of the Romanian output and inflation, their innovations are mainly structurally driven. Also, while the monetary authority is preoccupied
by its inflation objective, the government may have a different goal, conducting a fiscal policy inline with the business cycle.

The paper is comprised of three sections. Section 2 reviews the related literature, section 3 presents the econometric methodology, and the last section offers the results and concludes.

2. Literature review

Semmler and Zhang (2004) divide the studies on the interactions of monetary and fiscal policies into four main trends: the fiscal theory of price level determination (FTPL), strategic interactions between monetary and fiscal policies, monetary and fiscal policy interactions in open economies, and empirical research on monetary and fiscal policy interactions.

A relatively new research trend, fiscal theory of price level asserts the importance of the fiscal policy influence on the price level in models in which one might expect prices to depend only on monetary variables. Developed mainly by Leeper (1991), Sims (1994), and Woodford (1994, 1995), FTPL is the object of recent studies as Leeper and Yun (2005) and Davig and Leeper (2005). Fiscal theory of prices challenges the Barro-Ricardo equivalence using a supplementary channel, namely the (re)evaluation of the nominal governmental debt. FTPL differs from the classical methods which deviate from Barro-Ricardo equivalence – market imperfections, consumer’s myopia, and tax distortions – by combining in a particular way monetary and fiscal policies.

Another way to think about the ways monetary and fiscal policies interact is using game-theoretic tools. In such an approach, fiscal authorities and monetary authorities are viewed as game-players. Examples of the researches exploring the monetary-fiscal interactions from a strategic point of view include Buti et al. (2001), van Aarle et al. (1995, 2002), and Dixit and Lambertini (2003).

The analysis of monetary and fiscal policy interactions has also been extended to open economies. We mention Leith and Wren-Lewis (2001), Melitz (1997), van Aarle et al. (2002), Beetsma and Jensen (2002).

The empirical contributions in the area of monetary-fiscal interactions rely heavily on VAR techniques. For instance, Muscatelli et al. (2001) examine the interactions between the monetary and fiscal instruments applying the VAR econometric methodology to the G7
economies. Their methodology allows the observation of the monetary and fiscal policy answers to instrumental shocks. Canzoneri *et al.* (2000) study the fiscal regime of the U.S. with VAR models. Melitz (1997, 2000), Wyplosz (1999), von Hagen *et al.* (2001) use cross-sectional or panel data to examine the relations between monetary and fiscal policies along the business cycle, considering that the two tend to evolve together (i.e. are strategic complements), or in opposite directions (i.e. are strategic substitutes). Muscatelli *et al.* (2004) provide a structural economic interpretation for monetary-fiscal interactions and argue that the perspective on the monetary-fiscal actions depends essentially on the type of structural model applied to the real data. Semmler and Zhang (2004) investigate the interactions between the monetary and fiscal policies in the euro area.

A lot of efforts have been dedicated in the VAR literature to the way one can recover the economic meaningful and orthogonal shocks from the correlated ones obtained from the estimation of the reduced form. As it concerns the methods used to identify structural shocks, notable contributions belong to Sims (1980), advocating the recursive approach, Blanchard and Quah (1989), introducing long-run restrictions and Gali (1992) which propose a mix of short- and the long-run restrictions.

Recent studies (see e.g. Canova and de Nicolo, 2002; Faust, 1998; Uhlig, 2005) propose to identify VAR models using sign and shape restrictions imposed on the impulse response functions. Their common idea is to force the estimated VAR system to deliver impulse response functions consistent with theory.

3. **Data and empirical methodology**

We will further discuss a series of technical aspects regarding modeling the monetary-fiscal interactions in a VAR framework. VAR methodology is a popular instrument for the econometric modeling of the economic phenomena characterized by the lack of clear distinction between endogenous and exogenous variables. The lags associated with the formulation of budget policies, and those usually thought to characterize the macroeconomic effects of tax and spending decisions, make the VAR framework in principle better suited to analyze the process of fiscal transmission than in the case of monetary policy changes (Muscatelli *et al.*, 2001).

However, using VAR in an empirical analysis comprising fiscal policy poses two major problems: the measure of fiscal policy to be used and the way the VAR model is identified.
3.1 Measuring the fiscal stance

Being largely politically determined, especially in the case of a country like Romania, fiscal policy is characterized more by discretion than by rules and by approaches closer to politics than to economics. As a consequence, it is difficult to define a systematic action of government in fiscal terms. Usually the fiscal stance is described using variables as government revenues, expenditures, debt, and deficit, or their corresponding ratios to GDP.

Government revenues and expenditures include a series of components which are influenced by the business cycle. The budgetary components which are influenced by the business cycle act as automatic stabilizers, reducing the volatility of the aggregate output. To possess a clear image of the fiscal stance in an economy, which is distinct of the business cycle influence, we employ the cyclically-adjusted balance (CAB) or structural deficit. CAB is defined as the deficit which would prevail when GDP is at its potential level. Hagemann (1999) defines the structural deficit as the residual balance after purging the actual balance of the estimated budgetary consequences of the business cycle.

Girouard and Andre (2005) represent the CAB ratio to potential GDP \( b^* \) formally as:

\[
b^* = \left[ \sum_{i=1}^{4} T_i^* \left( Y^*/Y \right)^{\gamma_{i,Y}} - G \left( U^*/U \right)^{\gamma_{U,Y}} + X \right]/Y^* ,
\]

where \( T_i^* \) is the cyclically-adjusted component of the \( i \)-th category of tax, \( Y \) the level of output, \( G \) the actual current primary government expenditures, \( U \) the level of unemployment, \( X \) nontax revenues minus capital and net interest spending, \( \gamma_{i,Y} \) the elasticity of the \( i \)-th tax category with respect to the output gap, and \( \gamma_{U,Y} \) the elasticity of current primary government expenditure with respect to the ratio of structural unemployment. The " denotes structural or potential levels. Four different types of taxes are distinguished in the cyclical adjustment process: personal income tax; social security contributions; corporate income tax and indirect taxes. Among the public expenditures only the unemployment-related transfers are treated as cyclically sensitive.

3.2 VAR identification by imposing sign restrictions

The flexibility of VAR due to the lack of support from a theoretical model is also the source of its major drawback. Every VAR analysis with structural intentions must necessarily include a way to transform the estimated correlated shocks into structural, orthogonal ones.
To present the VAR identification problem and the way it is solved by using sign restrictions, let’s assume an \((n \times 1)\) vector process \(x_t\), that contains the economic variables of interest. The reduced-form representation of the model can be expressed as:

\[
B(L)x_t = e_t, \quad E[e_t e_t'] = \Omega,
\]

where \(B(L) = I - \sum_{i=1}^{p} B_i L^i\), \(L x_t = x_{t-1}\), \(I\) is the \((n \times n)\) identity matrix, and \(p\) is the number of lags. The symmetric and positive definite matrix \(\Omega\) describes the covariance structure of the reduced form innovations. Because \(\Omega\) is, in general, non-diagonal, one can not give a structural interpretation to the estimated residuals. If the VAR model is invertible, it can be written in the following Wold representation form:

\[
x_t = B(L)^{-1} e_t = D(L)e_t.
\]

(3)

The structural representation of the VAR model can be written as follows:

\[
A(L)x_t = e_t, \quad E[e_t e_t'] = \Sigma,
\]

where \(A(L) = A_0 - \sum_{i=1}^{p} A_i L^i\), and \(\Sigma\) is a diagonal matrix.

A structural VMA(\(\infty\)) representation similar to (3) can be written:

\[
x_t = A(L)^{-1} e_t = C(L)e_t,
\]

(5)

where \(C(L) = \sum_{i=0}^{\infty} C_i L^i\). To produce economic relevant impulse response functions and variance decompositions, one must transform the reduced form into the structural one.

Combining (2) and (4) gives

\[
A_i = A_0 B_i, \quad 1 \leq i \leq p, \quad e_t = A_0 e_t.
\]

(6)

Relation (6) shows that in order to completely identify the structural system it suffices to identify the \(A_0\) matrix, satisfying

\[
A_0^{-1} \Sigma (A_0^{-1})' = \Omega.
\]

(7)

The problem of identifying the structural VAR models is caused by the fact that there is no unique solution of (7). If \(\Omega\) can be decomposed as \(\tilde{\Omega}\tilde{\Omega}' = \Omega\), it can also be decomposed as \((\tilde{\Omega}S)(\tilde{\Omega}S)' = \Omega\), where \(S\) is any orthogonal matrix. The differences between alternative methods to identify the VAR models are generated by the decision regarding the additional criterion allowing the determination of the \(A_0\) matrix.
Among the several methods to identify the structural shocks we mention: Cholesky decomposition, imposing short- and long-run restrictions, imposing a factorial structure.

One of the newest approaches to VAR identification is to impose sign and shape restrictions on the impulse response functions. There is a great degree of flexibility in this approach, but this flexibility comes with certain costs. The exact number of restrictions cannot be determined, the tests on restrictions are not feasible, and there are a lot of methodological choices to be dealt with: the initial decomposition matrix, the procedure to produce orthogonal matrices or how to select a single model.

To implement the shape and sign restriction one needs an apparatus to generate orthogonal matrices $S$ and also an inference instrument capable of selecting from the candidates matrices. An initial decomposition matrix $\tilde{\Omega}$ can be produced by Cholesky factorization and orthogonal matrices can be generated by successive rotations. The inference on the impulse response functions may be based on bayesian methods or on the minimization of a penalty function (see Uhlig, 2005). The latter is more suitable in analyses focused on recovering structural shocks.

Canova and de Nicolo (2002) propose to use $S = \prod_{1 \leq i < j \leq n} Q_{i,j}(\theta_j), \; \theta_j \in [0,2\pi]$, where the matrix $Q_{i,j}(\theta_j)$ is defined as:

$$
Q_{i,j} = \begin{pmatrix}
1 & 0 & 0 & \cdots & 0 & 0 \\
0 & 1 & 0 & \cdots & 0 & 0 \\
\vdots & \vdots & \vdots & \cdots & \vdots & \vdots \\
0 & 0 & \cos\theta_j & \cdots & -\sin\theta_j & 0 \\
\vdots & \vdots & \vdots & \cdots & 1 & \vdots \\
0 & 0 & \sin\theta_j & \cdots & \cos\theta_j & 0 \\
\vdots & \vdots & \vdots & \cdots & \vdots & \vdots \\
0 & 0 & 0 & 0 & 0 & 1
\end{pmatrix}.
$$

To implement the sign and shape restrictions we combine methodologies in Canova and de Nicolo (2002) and in Uhlig (2005). We use the penalty function approach in Uhlig (2005) to select a single matrix from the entire set of the rotation matrices yielding feasible impulse response functions.

We estimated the reduced form VAR using quarterly data from 1998Q1 to 2006Q3. Where needed, the data were seasonally adjusted. The variables included were: real GDP, inflation, interest rate and cyclically-adjusted balance. Real GDP is expressed in logs, interest
rate in percents, and CAB in percent of GDP. Inflation is the 4-quarter (log) difference in the Harmonized chain-type Index of Consumer Prices and interest rate is the three months money market interest rate. CAB was computed using potential GDP extracted with a Christiano-Fitzgerald frequency filter and the elasticities published by the Romanian Ministry of Finance in the Convergence Programme 2006-2009.

Applying the standard unit-root tests we found the variables to be $I(1)$, excepting CAB which is $I(0)$. To grasp an eventual cointegration relation, the VAR was estimated in levels, including an intercept and a trend, and with 2 lags, as indicated by the information criteria.

4. Results and concluding remarks

The analysis is conducted in the following way. First, we define by assumptions the restrictions to be imposed to yield the structural shocks. The monetary policy shock determines the interest rate to go up, and the GDP and inflation to go down for four quarters. The fiscal policy shock determines the CAB to go up for four quarters, and the inflation and GDP to go up in the third and fourth quarter. The supply shock makes the GDP to grow four quarters after the shock, the demand shock making the inflation to grow four quarters after the shock.

Second, we simulate 50000 possible combinations of six rotation angles and we retain the ones satisfying the most of the 28 resulting restrictions on the impulse response functions. If there are more combinations satisfying the same maximal number of restrictions we select using a penalty function approach.

To have a benchmark for our results, we also analyze the impulse response functions from the reduced form VAR, namely, the generalized impulse response functions. Figure 1 depicts the generalized and sign identified impulse response functions of the monetary and fiscal policy variables to the other variables included in VAR, while Figure 2 depicts the impulse response functions for GDP and inflation.

Observing the impulse response functions, several conclusions can be formulated in respect to: (i) the impact of monetary and fiscal policy on GDP and on inflation; (ii) the reaction of monetary and fiscal policy to the developments in GDP and in inflation; (iii) the way the two policies interact with each other.

First, the introduction of the fiscal policy variable in a standard monetary VAR model for Romania doesn’t alter much the conclusions of such a model. However, as one can see in
Figure 2, the sign identification scheme solves the usual price puzzle, and the equivocué GDP reaction to the interest rate in the generalized identification. The reactions of GDP and inflation to CAB are the expected ones. A pro-cycliclical fiscal measure worsening the structural position ends up in higher production and inflation.

**Figure 1 The response impulse functions for the policy variables**

Source: Author’s calculation.

Second, the most significant interest rate response is that to inflation, while the GDP doesn’t play an important role. Although with the generalized impulse responses it looks like neither the fiscal stance doesn’t play an important role in the monetary decision, with sign impulse responses the situation is different. The monetary authority reacts with an increase in the interest rate to a deterioration of the structural budgetary position.

Third, while the monetary policy responds promptly to inflation with an increase in the interest rate, the fiscal policy is more oriented to GDP, acting pro-cyclically. The new monetary policy framework promoted in Romania since August 2005, direct inflation targeting regime, succeeded in a disinflation process at a sustainable pace while maintaining consistent
economic growth and increasing the credibility of the process of designing and implementing the macroeconomic policy.

**Figure 2 The response impulse functions for GDP and inflation**

*Source: Author’s calculation.*

But, on the other side, although the government had declared that “the fiscal policy is designed to support the convergence objectives, by maintaining the budgetary deficit at a prudent level, by stimulating improved collection rates, and by promoting measures for enlarging the tax base with a view to consolidate public revenues on a sustainable basis” (see the Convergence Programme of Romania for 2006-2009), the latest developments show that the real fiscal stance may hamper the long-term disinflation objective to favor different objectives more short-term oriented.
References


