Assessing structural changes in the monetary policy transmission mechanism brought by the global financial crisis – the case of Romania

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Abstract

The present article establishes an overarching goal of identifying and analyzing variations as well as structural shifts induced by the global crisis. The econometric framework employed is a Time-Varying Parameter Vector Autoregression (TVP-VAR) with stochastic volatility, comprised of two elements: flexible parameters, which capture adjustments in monetary policy transmission, and a set of equations, crucial in assessing the manner in which these adjustments affect the economy. By specifying a small model replicating the main stylized facts of the Romanian economy, the results uncover significant changes in impulse-response functions in the aftermath of the crisis, followed by a relatively stable evolution.

Key words: TVP-VAR, stochastic volatility, structural changes, time-varying impulse response functions, Bayesian estimation;
JEL classifications: C30, E44, E52, F41.

1 Introduction

The paradigm shift induced by the recent financial crisis remains a widely debated subject among policymakers and researchers alike, due to its implications in understanding the economic, social and behavioral effects manifested at consumer as well as aggregate level. In this context, monetary policy conduit can act as a buffer, dampening external shocks that affect a country's economy and, consequently, reducing the final welfare costs on society. However, in order to efficiently achieve its objectives, central banks must have robust assessments of the transmission channels to the real economy. The monetary policy transmission mechanism remains one of the most widely debated academic subjects in recent academic literature, due to its fundamental implications in determining the monetary policy stance, at a certain point in time, as well as efficiently assessing monetary policy future conduit and its implications on the real economy.

In order to implement monetary policy actions, central banks are required to define, beforehand, the mechanisms through which monetary policy impacts the real economy and inflation. Evaluating the general monetary policy stance of a central bank, in a certain period of time, as well as the instruments it employs in achieving its fundamental goals by considering the impact of these general characteristics on the economy, are essential aspects of the transmission mechanism, as highlighted by Boivin et al. (2010). In the case of Romania, as well

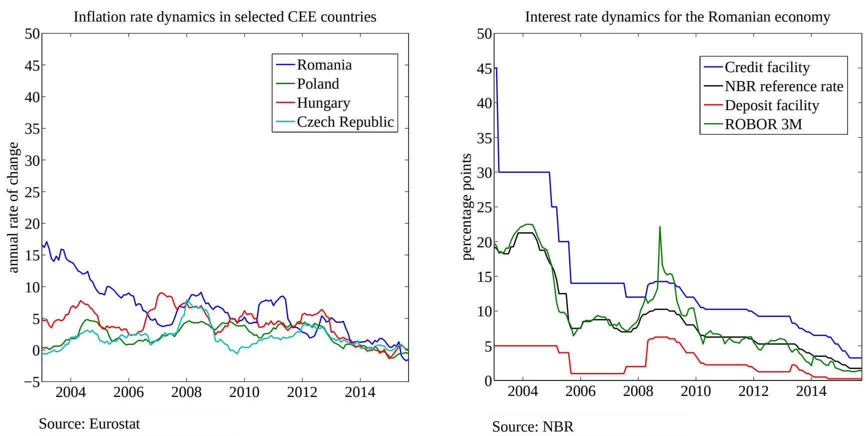

Figure 1: *Inflation and interest rate dynamics*

as other CEE countries, there is solid evidence that supports the hypothesis that the transmission mechanism has changed substantially in the last decade (Figure 1). The transition from a closed economy to an integrated open market has conveyed a set of gradual and structural changes, beginning in 1998 with the current account liberalization and continuing with the capital account liberalization, a process gradually implemented between 2001 and 2006. The accelerated globalization process towards an open economy, followed by the restructuring of the banking system, which benefited from a significant flow of investments, culminated with the European Union integration, finalized in 2007.

Other several factors, both domestic and external, are able to explain the inflation rate reduction in the last decade. On the domestic front, one can highlight several institutional changes, the strong administrated floating exchange rate regime and the announcement of the definitive adoption of the inflation targeting framework for the conduct of monetary policy in 2005.

Therefore, the monetary policy transmission mechanism has evolved and adapted as a natural consequence of the economic developments implemented in Romania, during this transition period. Until 2000, recession doubled by high inflation and volatile interest rates led to the start of a financial disintermediation process, in which monetary policy acted mainly through its exchange rate channel. After a period of relative instability, the disintermediation process was finally halted and the interest rate and credit channel made a significant recovery, as highlighted by Antohi et al. (2003), although their effectiveness was limited by the excess structural liquidity of the banking system.

The permanence of structural and institutional changes in Romania's economy determined frequent and uncommon distortions of the monetary transmission mechanism, impairing its efficiency. Furthermore, in comparison to other emerging economies, the postponement in the introduction and expansion of market principles and mechanisms, together with the delay in the process of macroeconomic stabilization, slowed the formation of the traditional bounds between the monetary framework and the real economy.

Taking into consideration Romania's economic context of perpetual structural changes implemented with the primary goal of converging with the Eurozone, the fact that scientific literature on this subject is rather scarce is quite surprising. Moreover, it is of paramount importance that policy-makers understand and measure the transmission mechanism effectiveness, especially in financial distress times, in which the impact of monetary policy actions has not been exhaustively investigated in economic literature. Under this framework, the present study aims to uncover the main characteristics of the monetary policy reaction function, as well as estimate and analyze its dynamic, in a time frame marked by numerous developments in the Romanian economy.

The paper is organized as follows: section 2 offers a brief overview of existing academic literature on the subject, section 3 describes the empirical model, sections 4 and 5 concentrate on data description and estimated results followed by the main conclusions of the analysis, detailed in section 6.

2 Literature Review

Monetary macroeconomics is based on the study of interest rates and their impact on price, monetary aggregates and global demand behavior, but also on exchange rate dynamics, in the case of open economies. Starting from the seminal contribution formulated by Sims (1980), vector autoregressive models have benefited from a wide range of empirical applications and research papers, many of them employing the above mentioned variables in order to uncover the impact of monetary policy actions on the real economy. In these studies, monetary policy decisions are treated as deviations from the monetary policy rule and modelled as exogenous shocks, with a neutral effect on the policymakers' response to macroeconomic conditions, therefore providing an unaltered experiment for quantifying the effectiveness of the transmission mechanism. Consequently, empirical researchers focus on simulating shocks, alongside identifying the systematic components of monetary policy, formalized in a monetary policy rule such as Taylor's Rule.

In general, vector autoregressive models offer a credible approach in describing the monetary policy transmission mechanism, yet it cannot be used in successfully assessing its conduit in time, because it falls under the shortcomings described by the well-known Lucas Critique[1].

Consequently, several approaches have been proposed in monetary policy research literature in order to overcome the aforementioned shortcomings, such as splitting the model in subsamples and investigating changes in the monetary policy transmission mechanism, employed by Clarida et al. (2000), or directly modelling the coefficient dynamics of the system through Kalman filtering techniques. Moreover, in the context of assessing structural changes by allowing time variation on the model parameters can be done in several specifications distinguished by the economic motivations behind the shift dynamics. Consequently, starting from the hypothesis of capturing sudden shifts in the transmission mechanism, Markov Switching VAR models (Sims and Zha, 2006) can provide efficient solutions, whereas gradual changes in the structure of the economy can be identified in a Time-varying Parameter VAR framework (Cogley and Sargent, 2005). The main drawback of Cogley and Sargent's approach is given by the constant volatility hypothesis, which eliminates the possibility of heteroskedastic shocks and the nonlinearity in the relations among the variables of the model.

In order to address the issues identified in empirical literature, the VAR methodology was extended by incorporating concepts such as parameter time-variation or stochastic volatility inserted in the variance of the model's shocks. A decisive contribution in this line of research was brought by Primiceri (2005), who formulated a flexible model for estimating and interpreting the dynamics of monetary policy systematic and nonsystematic components and their effects on the economy. The novel technique employed in Primiceri's model involves introducing time variation in both model parameters and covariance matrix of the innovations, a crucial element in distinguishing changes that appear in the size of the exogenous shocks from monetary policy transmission mechanism shifts.

Recently, structural changes in the monetary policy transmission mechanism have been studied for emerging market economies from the CEE region, in time-varying parameter framework. Franta et al. (2012) investigate the evolution of MPTM in the Czech Republic over a period between 1996 and 2010 and find that aggregate output and prices have become increasingly responsive to monetary policy shocks, possibly reflecting financial sector deepening, more persistent monetary policy shocks and overall economic development associated with disinflation. The authors also evaluate exchange rate pass-through, an important component in the overall assessment of monetary policy transmis-

[1] Lucas (1976) showed that, following a shift in economic policy, individual agents change their behavior in order to optimally adapt to the new conditions. It follows naturally that evaluating changes in policy based on estimated coefficients from historical data is unfeasible, due to the fact that these coefficients will be in turn influenced by changes in the agents behavior.

sion, and come to the conclusion that pass-through has weakened somewhat over time, suggesting improved credibility of inflation targeting in the Czech Republic with anchored inflation expectations.

A similar approach was employed by Arratibel and Michaelis (2014) in order to analyze whether the reaction of output and prices to interest rate and exchange rate shocks has undergone significant changes across time. Focusing on the Polish economy and constructing a dataset spanning over the 1999-2012 period, the empirical results show that output appears more responsive to an monetary policy shock at the beginning of the timeframe and that, starting with 2000, absorbing this shock has become less costly in terms of output, notwithstanding some reversal in the aftermath of the global financial crisis. Similarly, consumer prices appear more responsive to a monetary policy shock during the first half of the sample, when Poland experienced high inflation and, finally, exchange rate shocks on prices seem to slightly decrease in time.

3 The Empirical Model

3.1 General TVP-VAR Framework

Starting from the seminal work of Cogley and Sargent (2002), and allowing for a more flexible framework as in Primiceri (2005), I define the TVP-VAR model by including the two main components required to address the time-varying characteristics of the monetary policy transmission mechanism: the variable parameters that measure the changes that appear in the transmission mechanism and the multiple equation model which describes the economy:

$$Y_t = c_t + \sum_{j=1}^{P} B_{j,t} Y_{t-j} + v_t \tag{1}$$

$$\beta_t = \{c_t, B_{1,t}, B_{2,t}, ..., B_{P,t}\} \tag{2}$$

$$\beta_t = \mu + F\beta_{t-1} + e_t, \quad VAR(e_t) = Q \tag{3}$$

where Y_t is the vector of endogenous variables of size $(M \times 1)$, c_t represents the time-varying free-term vector of equal size, $B_{i,t}$ denote the time-varying coefficients included in a $(M \times M)$ matrix and v_t are the normally distributed innovations with covariance matrix Ω_t, decomposed as follows:

$$A_t \Omega_t A_t^{'} = \Sigma_t \Sigma_t^{'} \tag{4}$$

The approach adopted follows Primiceri (2005), in allowing for time variation in both the additive innovations and the simultaneous interactions among variables. The simultaneous interaction is captured through the coefficients of the lower triangular matrix A_t. The elements of A_t follow a random walk process:

$$a_{ij,t} = a_{ij,t-1} + u_{j,t}, \quad Var(u_t) = R \tag{5}$$

Considering the decomposition of Ω_t, the above equation becomes:

$$Y_t = c_t + \sum_{j=1}^{P} B_{j,t} Y_{t-j} + A_t^{-1} \Sigma_t \varepsilon_t, \quad \varepsilon \sim N(0, I_n) \tag{6}$$

The elements of the matrix Σ_t have been modeled as geometric random walks in order to reduce the **dimensionality** of the problem and to focus on **permanent shifts**, rather than of transitory moves:

$$ln(h_{i,t}) = ln(h_{i,t-1}) + \eta_{i,t}, \quad Var(\eta_{i,t}) = z_i \tag{7}$$

3.2 Estimation Methodology

Taking into account the high nonlinearity as well as rich parametrization of the model, classical maximization of the log-likelihood function can prove unfeasible in estimating TVP-VAR models. Instead, Bayesian estimation techniques are used to sample from the joint posterior distribution of the parameters. One of the main advantages brought by this type of estimation resides in its efficient results in the case of unobservable components models, for which the distinction between parameters and shocks is less clear.

The estimation was performed under a Bayesian framework: the system was partitioned into three distinct blocks: a state-space representation for the VAR coefficients, one for the elements of the matrix containing the contemporaneous interactions among variables and another for the stochastic volatilities. While the first two blocks allowed for an estimation methodology using a multi-move Gibbs sampler, in the latter case the use of the Metropolis-Hastings algorithm was necessary to obtain draws from the posterior conditional distributions of the time-varying standard deviations of the shocks.

Blake and Mumtaz (2012) formulate a solution based on previous work done by Primiceri (2005) by applying Gibbs sampling and Independence Metropolis-Hastings MCMC algorithms to sample from the conditional posterior distribution of a parameter. This algorithm proves very useful in situations when Gibbs sampling cannot be directly applied, due to a high order of complexity in the sampling procedure or in situations in which the posterior distribution is unknown.

Independence Metropolis-Hastings algorithm for estimating the stochastic volatility works by iterating the following steps, until convergence is reached:

1. Choose a candidate density from which is easier to generate values;
2. Accept the newly generated value with probability α[2] ; if $\alpha < u(0,1)$, reject the new draw (i.e. keep the draw from the previous iteration);

[2] In the general case, the acceptance probability for the Independence MH algorithm is $\alpha = min\left(\frac{(p(\Phi^{G+1})/q(\Phi^{G+1}/\Phi^{G}))}{(p(\Phi^{G})/q(\Phi^{G}/\Phi^{G+1}))}, 1\right)$ where $p(\Phi)$ is the posterior density function and $q(\Phi)$ is the candidate density.

3. Repeat these steps M times.

The retained values will come from the desired posterior density function of the parameter, or target density.

4 Dataset

Replicating the main stylized facts of the Romanian economy in a Time-varying Parameter VAR model requires identifying the main channels of monetary policy transmission mechanism to the real economy. In a reduced form robust framework, I chose to include real GDP, a measure of economic activity, the HICP index as a measure of price dynamics, the 3-month ROBOR, for the short term interest rate, and the nominal effective exchange rate (NEER), computed for 42 trading partners, as exchange rate dynamics are essential for emerging market economies. The model is estimated in levels on a timeframe spanning from 2005 to 2015, in order to eliminate potential inconsistency resulting from erroneously imposing cointegration restrictions. The approach leads to relevant results as unit root presence in the time series does not affect the likelihood function in the Bayesian estimation framework (Sims et al., 1990).

Furthermore, in order to overcome sample length issues, I use the entire sample in prior selection, a strategy proposed in academic literature by Canova (2007) for limited availability of statistical information, in which choosing a small training sample can lead to significant changes in the model's output. Moreover, in order to conserve degrees of freedom one lag is used for the estimation. The estimation results are extracted from 100,000 iterations of the Metropolis-Hastings within Gibbs sampler after discarding the first 50,000 iterations for convergence.

5 Results

The time-varying impulse response function (IRF) analysis demonstrates that the empirical results are in line with the widely accepted theoretical foundations: in response to a standard unitary interest rate shock, aggregate output and prices fall, while nominal effective exchange rate initially rises. From this perspective, the results are similar to Franta et al. (2012) or Arratibel and Michaelis (2014). Taking into account time variation, the significant effects of the recent financial crisis on economic activity can be hastily identified through a visual inspection of the impulse-response analysis (Figure 2). The sample can be divided in two distinct periods: a heightened response regime, which leads to permanent output loss, in the aftermath of the global crisis, followed by a smooth transition to a stable regime, characterized by increasing shock absorbance in the case of output and, consequently, reducing the overall cost.

Regarding the effect of a monetary policy shock on prices (Figure 2), they exhibit a very large degree of time variation across the sample, mainly due to

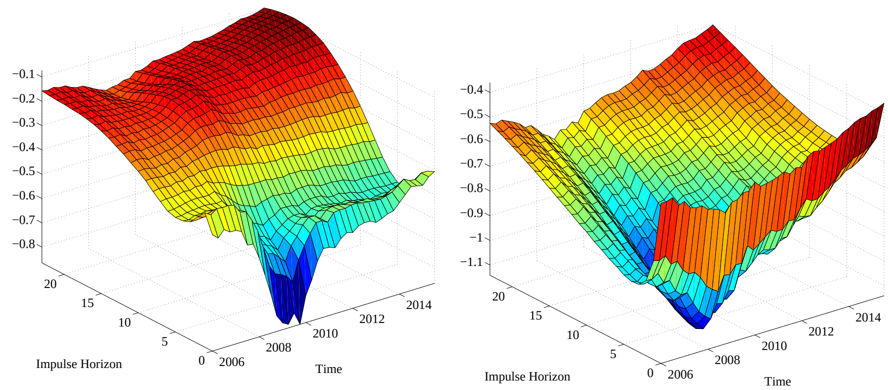

Figure 2: *Time-varying IRFs of GDP (left) and HICP (right) to a monetary policy shock*

the sustained disinflationary process underwent by the Romanian economy in the analysed time period, with a substantial contribution in the anchoring of inflation expectations brought by the adoption of the NBR's inflation targeting strategy. This process may have contributed to enhancing the central bank's credibility and explain the weaker impulse responses observed after the dissipation of the global financial crisis effects. The impact of a monetary policy shock

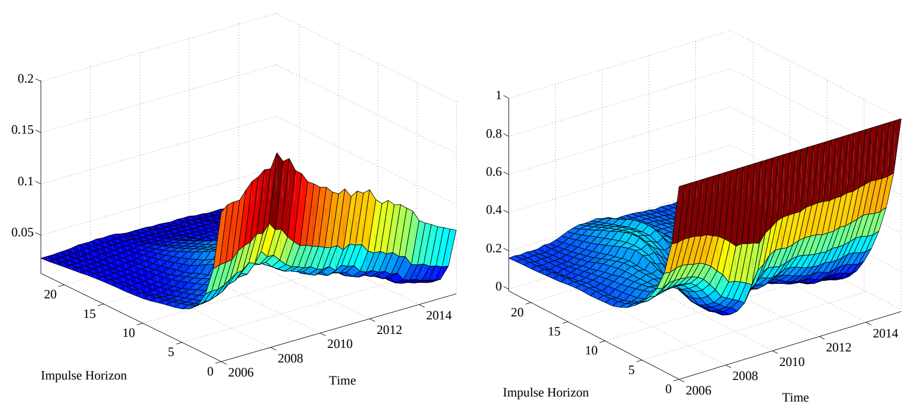

Figure 3: *Time-varying IRFs of NEER (left) and ROBOR (right) to a monetary policy shock*

on the nominal effective exchange rate (Figure 3) is, as expected, initially positive, and reaches a stable level of absorption after approximately 5 quarters, in the first half of the sample. The effects of the increased volatility between 2008 and 2010 are translated into significantly higher responses during the aforementioned timeframe. The second half of the sample displays a steady decline in responsiveness, coupled with a shock persistency decrease, highlighting a potential improvement in the overall monetary policy transmission mechanism. Finally, the effect of the monetary policy shock on the interest rate is relatively stable, notwithstanding the sudden jump in interest rates in 2009 (Figure 1). Overall, monetary shock persistency presents stable behavior throughout the entire analysed timeframe.

6 Conclusions

Starting from the idea that, in the case of Romania, as well as other CEE countries, there is solid evidence supporting the hypothesis that the transmission mechanism has changed substantially in the last decade, I estimate a TVP-VAR model with a robust structure, able to capture the main dynamics of shock transmission. By specifying a small model replicating the main stylized facts of the Romanian economy, the results uncover significant changes in impulse-response functions in the aftermath of the crisis, followed by a relatively stable evolution. The main results demonstrate that the sample can be divided in two distinct periods: a heightened response regime, which leads to permanent output loss, followed by a smooth transition to a stable regime, characterized by an increase in shock absorbance in the case of output, lowering the potential economic costs of an interest rate increase.

Another relevant result refers to the effects of a monetary policy shock on prices, which display a high degree of time variation across the sample of time-varying impulse response functions, mainly due to the sustained disinflationary process underwent by the Romanian economy in the analysed time period, with an important contribution brought by the adoption of the NBR's inflation targeting strategy.

In conclusion, the results of the present study, in accordance to other similar analyses for other CEE economies, highlight the fact financial markets play a significant role in macroeconomic dynamics and that financial stability is a prerequisite for the efficient implementation of monetary policy decisions.

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