10. THE IMPACT OF THE US AND EURO AREA FINANCIAL SYSTEMIC STRESS TO THE ROMANIAN ECONOMY

Corina SAMAN[1]

Abstract

This paper analyzes the transmission of financial systemic stress from the US and Euro Area to Romania. We employ recently developed composite indicators of systemic stress (CISS for the Euro Area and NFCI for the US), which reflect financial conditions from different financial sectors.

The results from a time-varying Bayesian vector autoregression with stochastic volatility indicate that the degree of transmission depends significantly on the time and on the level of stress. The analysis reveals that Romania responds negatively, similarly to the developed economies, to the financial systemic stress as regards the real economy, but differently as regards the monetary policy. Finally, the results emphasize that financial interconnectedness with the Euro Area is more important than that with the US.

Keywords: financial stress, transmission, financial crises, Romania, Bayesian time-varying VARs.

JEL Classification: E44, F30, G10, C11

1. Introduction

The transmission of real and financial shocks through cross-border became an important issue to study especially after the recent financial crisis triggered recession all over the world. The propagation of shocks at high speed and intensity in the financial system turned systemic risk into an important issue to measure and to asses the way it propagates through international linkages to different areas. The transmission of financial shocks to GDP growth has increased gradually consistent with financial globalization and increase in financial openness (Eickmeier *et al*., 2011).

In recent years, systemic risk indexes were constructed to measure financial market stress over multiple dimensions of risks that could arrive through different channels. One such index is the National Financial Condition Index (NFCI) that is a measure

[1] *Institute for Economic Forecasting, Romanian Academy. Email: csaman@ipe.ro*

constructed by the Federal Reserve Bank of Chicago as a weighted average of a large number of variables (105 measures of financial activity), which includes variables describing money markets, debt and equity markets and the traditional and "shadow" banking systems. Positive values of the NFCI indicate financial conditions that are tighter than historical average, while negative values indicate financial conditions that are looser than average.

To capture the changes in the Euro Area financial conditions the European Central Bank (ECB) constructed the Composite Indicator of Systemic Stress (CISS), which included interest rate series, yield spreads, volatilities of stock prices and return correlations. An increase in the value of the index is considered as a signal of deterioration of Euro Area financial conditions.

In this paper the focus of the analysis is on impulse response functions generated by a shock in the US and Euro Area systemic financial stress on real output, money market interest rate, stock index, real exchange rate and inflation. This paper relates to the recent empirical literature that analyzes the impact of financial shocks on the real economy of advanced economies*, e.g.*, Gilchrist *et al*. (2009), Hubrich and Tetlow (2012), and Eickmeier *et al*. (2011) or to the paper of Fink and Schüler (2015), which show that a typical emerging economy responds to systemic financial stress similar negative effects to the US. The relation between variables is modeled as a time-varying coefficients vector autoregression, where the coefficients evolve according to a transition equation and the variance of the forecast errors changes over time.

2. Data and empirical methodology

2.1. Dataset

In order to capture the effects of a financial turmoil in a systemic level, we employ data from three markets: real sector, money market, and equity market. In all cases, we use monthly data, ranging from January 2000 to July 2015. The selection of variables is based, partly, on previous work on systemic risk issues, as well as on variables that are important for the formulation of the state of the financial system.

For Romania, we consider five different variables, measuring real economic activity, interest rates, inflation and stock market, respectively. The time series applied for this purpose are real Industrial Production Index (q), the money market interest rate (i), the real effective exchange rate based on Consumer Price Index (s), the return on stock exchange rate BET (b), and the consumer price index (p).

Industrial Production Index and Consumer Price Index have been computed as the non-annualized month-over-month rates of growth of the relevant series. The interest rate and real effective exchange rate have then been rescaled in order to make it conceptually comparable with the other series by defining the monthly non-annualized rates (r_t) from the annualized month-on-month figures (r_t^A) as $r_t = (1 + r_t^A)^{1/12}$.

All variables are employed in levels. The data are obtained from IMF Financial Statistics and seasonally adjusted when necessary.

2.2 Systemic risk indexes

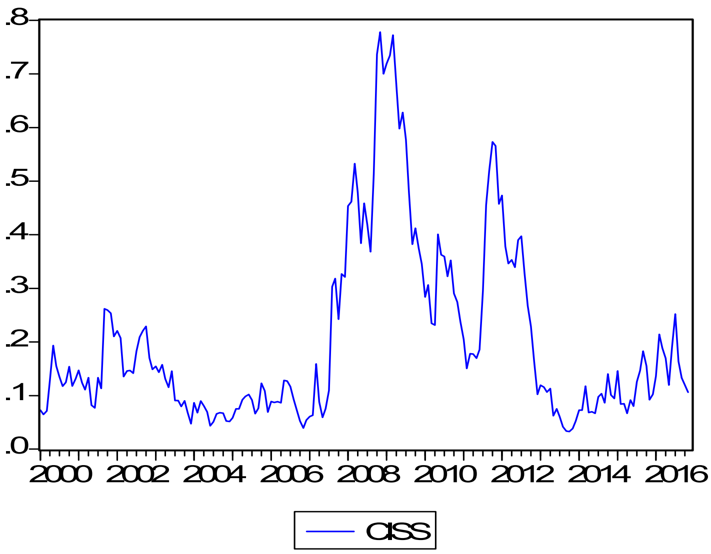
This paper uses two indicators of systemic risk from the US and Euro Area. Given the fact that the measures of the systemic financial stress are the key variable of this analysis, more details are provided below.

The graph in Figure 1 represents the aggregate Euro Area Financial Stress Index (CISS). The period covered ranges from January 2000 to July 2015 so it includes, both, the evolution during the global financial crisis and the debt crisis faced by the members of the monetary union. The index indicates massive fluctuations in the level of financial stress during the financial crisis, which reached its climax in the third quarter of 2008.

Further on identify the presence of sovereign debt crisis that has been taking place in the European Union between the end of 2009 and the moment on September 2012 when the ECB calmed financial markets by announcing free unlimited support for all Eurozone countries involved in a sovereign state bailout/precautionary programme.

Figure 1.

Euro Area Financial Stress Index (CISS)



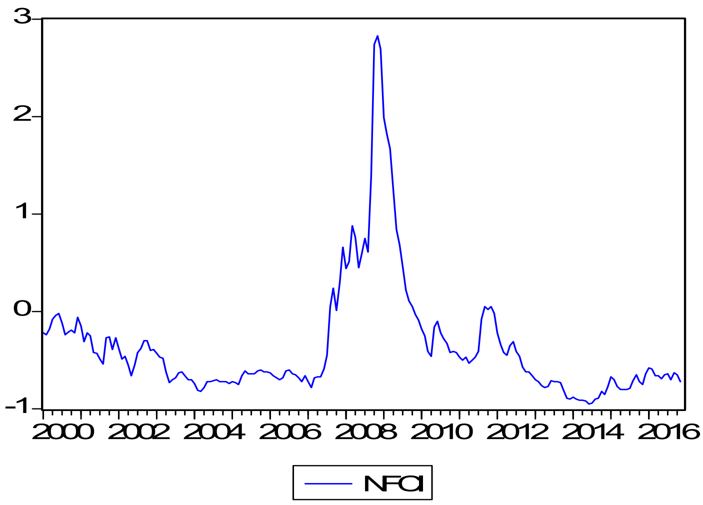
The Federal Reserve Bank of Chicago constructs a measure of US financial conditions to monitor the stability of the whole US financial system, with a focus on risk, liquidity in money market, debt market and banking system. The NFCI is constructed as a weighted average of a series of financial indicators (105), allowing for variation in the frequency and availability of the time series. In general, the NFCI measures overall financial conditions, it does not contain variables that represent the US monetary policy.

Figure 2 displays the NFCI from 1999M1 to 2012M6. An increase in its value means a deterioration of the US financial conditions. For example, could reflects a rise in default or credit risk (a rise in the US commercial paper spreads, the US interest rate swap spreads, or the TED spreads), or a rise in uncertainty in equity market described by the VIX, a volatility measure of the US stock market. Further, could represents a decrease in the credit conditions for consumers and businesses. Positive values of the index indicate tighter financial conditions for the US compared to the historical average and negative values represent episodes of ease.

The US financial condition index presented in Figure 2 shows the evolution of financial crisis from the middle of 2007, which increases the financial stress, and the peak of the financial crisis, which coincides with the bankruptcy of Lehman Brothers in the second half of 2008.

Figure 2.

US Financial Stress Index (NFCI)



2.3. Methodological approach

The model used is the following time-varying VAR(*p*):

$$Y_t = B_{0,t} + \sum_{j=1}^{p} B_{j,t} Y_{t-j} + \varepsilon_t \qquad (1)$$

Where the vector of variables Y_t is defined as $Y_t = [q_t, p_t, i_t, f_t, s_t, b_t]'$ with $q_t, p_t, i_t, f_t, s_t, b_t$ being industrial production index, consumer price index, money market interest rate, systemic stress index of the US or of the Euro Area, real effective exchange rate, and the return on Romanian stock index BET. The overall sample period is 2000:M1-2015:M6 and the lag order *p=1*.

The innovations in (1) ε_t are zero-mean normally distributed, with covariance matrix Ω_t, decomposed as follows:

$$Var(\varepsilon_t) \equiv \Omega_t = {A_t}^{-1} H_t ({A_t}^{-1})' \quad (2)$$

Following previous literature, *e,g*., Cogley and Sargent (2005), Primiceri (2005), Gambetti, Pappa, and Canova (2006) the vector β_t of the VAR's time-varying parameters is presumed to evolve according to:

$$\beta_t = \{B_{0,t}, B_{1,t}, B_{2,t}, \dots, B_{p,t}\} \;\; \beta_t = \beta_{t-1} + \eta_t, \quad VAR(\eta_t) = Q \quad (3)$$

$$p(\beta_t | \beta_{t-1}, Q) = I(\beta_t) f(\beta_t | \beta_{t-1}, Q) \quad (4)$$

where $I(\beta_t)$ discards unstable draws, enforcing non-explosive paths of the endogeneous variables.

The time-varying matrices H_t and A_t are diagonal and lower triangular, respectively.

$$H_t = \begin{pmatrix} h_{1,t} & 0 & \cdots & 0 \\ 0 & h_{2,t} & \ddots & 0 \\ \vdots & \ddots & \ddots & 0 \\ 0 & \cdots & 0 & h_{6,t} \end{pmatrix} \quad A_t = \begin{pmatrix} 1 & 0 & \cdots & 0 \\ a_{21,t} & 1 & \ddots & 0 \\ \vdots & \ddots & \ddots & 0 \\ a_{61,t} & \cdots & a_{65,t} & 1 \end{pmatrix} \quad (5)$$

with the diagonal elements of H_t evolving as geometric random walks and the non-zero elements of A_t follow a driftless random walk process:

$$h_t = \{ h_{1,t}, h_{2,t}, \dots, h_{6,t} \} \quad \ln(h_{i,t}) = \ln(h_{i,t-1}) + \mu_{i,t} \quad VAR(\mu_t) = Z \quad (6)$$

$$a_t = \{ a_{21,t}, a_{31,t}, \dots, a_{65,t} \} \quad a_{ij,t} = a_{ij,t-1} + u_t \quad VAR(u_t) = S \quad (7)$$

The VAR model described is estimated using Bayesian methods. The prior distributions of initial values β_0, h_0, and a_0 are assumed to be normal and independent. To calibrate the priors a time-invariant version of the VAR is estimated using first 60 observations from 2000 M1 to 2005 M1 obtaining the estimated parameters $\hat{\beta}_{OLS}$, the estimated covariance matrix $\hat{\Sigma}_{OLS} = CC'$, where C is the lower-triangular Choleski factor.

The priors are as in Primiceri (2005) and Benati and Mumtaz (2007):

$$\beta_0 \sim N[\hat{\beta}_{OLS}, 4V(\hat{\beta}_{OLS})],\ lnh_0 \sim N[\ln(vec(c_{ii}^2)), 4V(I_6)], a_0 \sim N[\bar{a}_{OLS}, V(\bar{a}_{OLS})] \quad (8)$$

The three matrices Q, S, and Z are presumed to follow an inverted Wishart distribution calibrated the same as in Primiceri (2005) and Benati and Mumtaz (2007).

$Q \sim IW({Q_0}^{-1}, d_0)$, with $Q_0 = \gamma \Sigma_{OLS}$ (9)

The matrix S is assumed block-diagonal, the five blocks $S_i, i = 1, . . ,5$ refers to the five lines of non-zero and non-one elements of A_t that evolve independently. S_i Are assumed to follow inverted Wishart distributions with minimum degree of freedom and scale matrices calibrated as $S_i \sim IW\left({\bar{S_i}}^{-1}, i\right),\ i = 1, . . ,5$.

The element of matrix Z, which hold the variances of the stochastic volatility innovations are assumed to be inverse-Gamma.

The identification strategy relies on imposing the following sign restrictions on the contemporaneous impacts of the structural shocks on the endogenous variable. This is in line with Canova and de Nicolo (2002), Peersman (2005), and Uhlig (2005) which have used a similar strategy when considering the impact of monetary policy shock. We postulate that the impact of a positive systemic financial stress shock to be non-positive on inflation, and on the rates of growth of output. This assumptions are motivated by previous empirical results of Fink, and Schüler (2015), which shows that typical emerging market economy experienced negative effect in response to US systemic financial stress. Also Eickmeier *et al*. (2011) shows that a decline of financial conditions reflects negatively on economic growth in European countries.

3. Empirical analysis

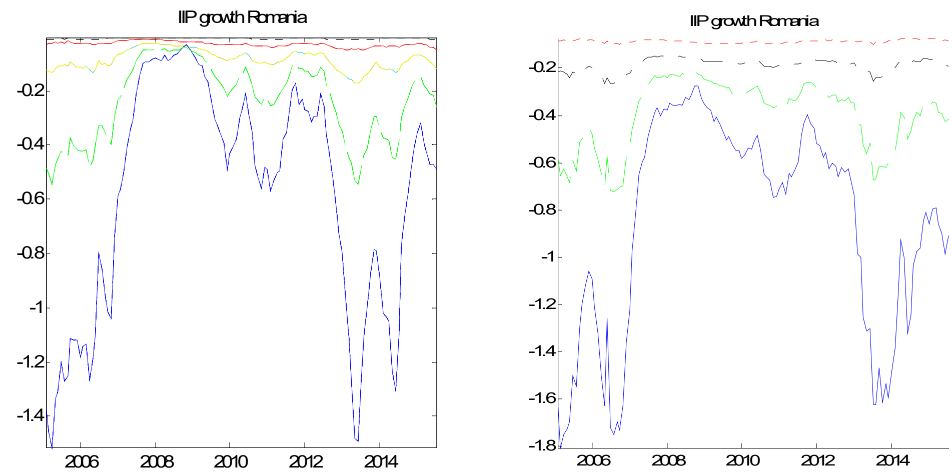
The time-varying regression with stochastic volatilities are estimated using simulated data by drawing 5,000 samples after the initial 10,000 are discarded by assuming priors as explained in the methodological section.

I simulate a positive shocks emerged from the systemic risk indexes to the Romanian economy. Differently from a standard VAR model, the impulse responses are computed for all points in time (t) because we have estimated coefficients for each t. Impulse responses are calculated to an initial shock equal to the mean of stochastic volatility as explained in Nakajima (2011).

The responses are drawn in a time-series manner by showing the size of the impulses for one- to three- and six-months and one-year horizons over time. The time-varying nature of the macroeconomic dynamics between the variables is shown in the impulse responses, in figures 1 to 5. The left panel shows how Romanian economy reacts to a US systemic financial stress (NFCI) shock of size one standard deviation. It should be noted that one standard deviation represent approximatively half the shock experienced in mid-2007 and less than one fifth of the shock encountered in the climax of the financial crises. The positive deviation of the US systemic risk indicate the worsening of the actual and the expected financial conditions for economic agents, the increase in uncertainty in all financial markets. This leads indirectly to a decline in Romanian industrial production, a decrease in real effective exchange rate and stock market return. Moreover, the impact is time-varying, being more pronounced at the beginning and the end of the time period. In the years 2005 to 2007 the US experience very little fluctuation in systemic risk and a light financial conditions compared to its historical average (see figure 2), so the world's economies weren't prepared to face a dramatic change in the financial stress. A shock of one standard deviation detremines about 1.5 percentage point decrease in industrial production in 2005 and 2013, the effect reduces to nearly zero in 6-months horizon. The impact is milder between 2008 to 2012 showing that the economy is more prepared to face such shock, the financial crisis' lesson seems to have been learned. However, in 2013-2014 the impact of a shock in the systemic risk is again more marked.

Figure 3

Responses of Industrial Production Index to a Unitary Systemic Risk Shock

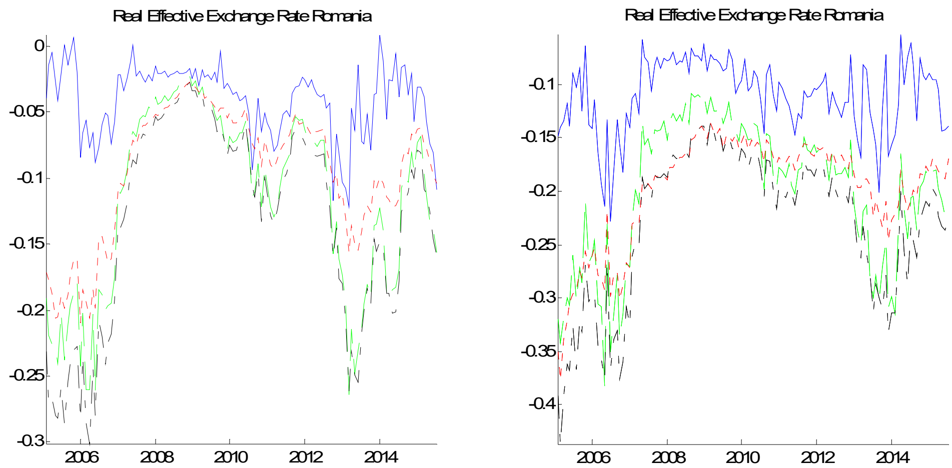


Note: Left panel and Right panel represents the response to a shock in NFCI, and CISS respectively. One month (solid line, blue), Three months (dashed line, green), Six month (dash-dot line, black), and One year (dotted line, red)

The right panel of figures 3-7 represents the impact of a unitary shock from the Euro Area's composite indicator of systemic stress (CISS). The responses of all variables to this impulse is very much the same as to the US index, but more pronounced.

Figure 4

Responses of Exchange Rate to a Unitary Systemic Risk Shock

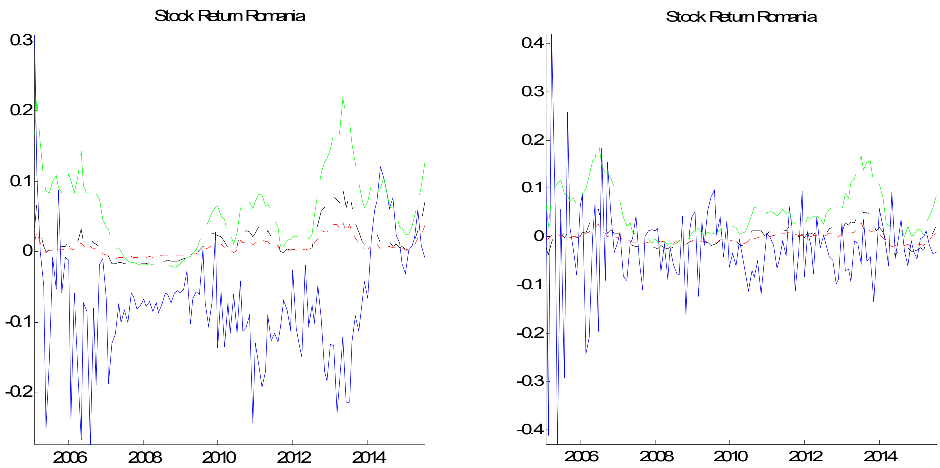


Note: Left panel and Right panel represents the response to a shock in NFCI, and CISS respectively. One month (solid line, blue), Three months (dashed line, green), Six month (dash-dot line, black), and One year (dotted line, red)

The one-month ahead drop in the exchange rate (s) is less than 0.1, 0.2 percentage points in all years for a shock in NFCI and CISS, respectively. It continues to decrease in the following months horizon with a more sharply trend in the years 2005, 2006, and 2013, but still important in all the time for the sample under analysis. We find evidence of an exchange rate depreciation in response to a US-NFCS or a Euro Area–CISS shock. The impact of the shock is present in the long-run being still effective after 24 month (the horizon in this analysis).

Figure 5

Responses of Stock Prices to a Unitary Systemic Risk Shock



Note: Left panel and Right panel represents the response to a shock in NFCI, and CISS respectively. One month (solid line, blue), Three months (dashed line, green), Six month (dash-dot line, black), and One year (dotted line, red)

The international financial linkages of the US and the Euro Area imply a fall in Romanian financial markets' returns. The transmission dynamics from the systemic stress indices to the stock return is in the same line with that of the real effective exchange rate, but more acute in the first month with a strong contemporaneous drop while the longer-run response is insignificant different from zero, which was expected because stock market incorporates information and adapts very quickly.

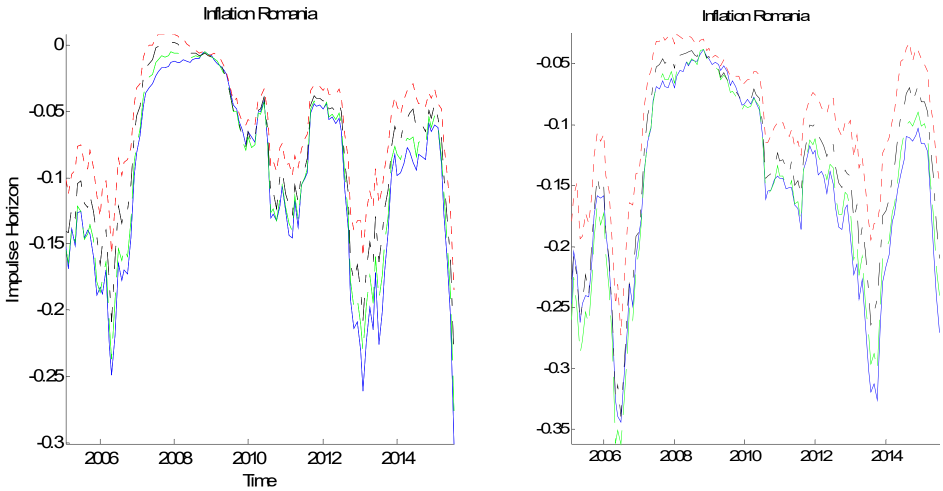
In all the years, the response of inflation is negative being more significant in 2006, and 2013 and rather minor during financial crisis but have a long-run effect in the 24 month horizon.

The responses to a worsening of US or Euro Area financial conditions aggregate is manifested by a fall in demands and investment, so the prices fall in the domestic economy and through international linkages a fall in the world price levels leads to a reduced inflation in all countries.

We noticed a reaction in the money market (figure 7) in order to absorb the negative real effect of the Euro Area systemic stress shock in the years 2008-2014 with a long-run effect in 2008 and 2009. In response to the deterioration of financial conditions in the US this kind of reaction is more present in 2005 and 2014.

Figure 6

Responses of Inflation to a Unitary Systemic Risk Shock



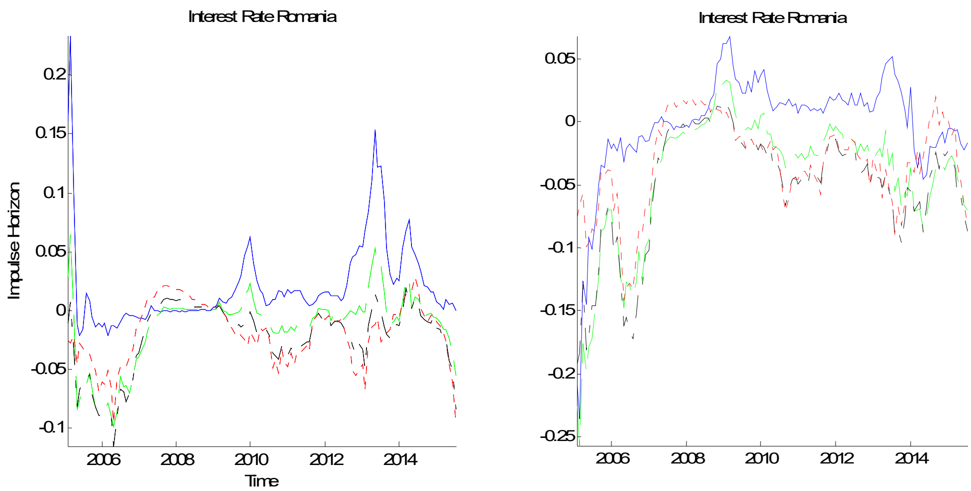
Note: Left panel and Right panel represents the response to a shock in NFCI, and CISS respectively. One month (solid line, blue), Three months (dashed line, green), Six month (dash-dot line, black), and One year (dotted line, red)

As response to financial crisis the advanced economies of North America and Europe promote an expansionary monetary policy. From figure 1 we see that Romania reacts to raising uncertainty in international financial system by increasing interest rate in one month to six month horizon to assuage the downward pressure on the currency (figure 4). This is typical for a small open economy which depends on foreign capital, so it must react to cross-border capital flows.

The impact of a positive shock in US systemic risk is more pronounced in 2013, when the depreciation of the currency is 0.25 points in three-six month horizon. An increase in money market interest rate could be interpreted as an instrument to stabilize capital flows and to reduce vulnerability to the exogenous shocks - for example the one generated by to FED announcement on the intention to taper quantitatrive easing.

Figure 7

Responses of Interest Rate to a Unitary Systemic Risk Shock



Note: Left panel and Right panel represents the response to a shock in NFCI, and CISS respectively. One month (solid line, blue), Three months (dashed line, green), Six month (dash-dot line, black), and One year (dotted line, red)

The stochastic volatilities of the variables (figures A1 and A2 in the Appendix) are presented with posterior 68% probability band because the 90% or 95% bands can be misleading if the distribution is skewed due to non-linearity.

The stochastic volatilities of inflation, interest rate, and return on stock index seem to be similar for the two models, and stochastic volatility of short-term interest rates implies the changing variance of the monetary policy shock. Two major hikes in the interest rate volatility are observed around the beginning of 2005, 2009 and 2010, and the volatility stays quite low from the rest of the analyzed sample.

4. Conclusion

The analysis reveals that Romania responds negatively to the financial systemic stress, similarly to evidence from developed economies in previous studies, as regards the real economy, but differently in respect of monetary policy. The responses of the Romanian economy are significant and they have the expected sign. This is in line with the evidence that emerging countries are vulnerable to international financial shocks.

The empirical applications for the Romanian data showed the time-varying nature of the dynamic relationships between macroeconomic variables and the indices of systemic risk.

The impact of the Euro Area Composite Indicator of Systemic Stress (CISS) is more strongly than that of the US National Financial Conditions Index (NFCI). This emphasize that financial interconnectedness with the Euro Area is tighter than that with the US.

Acknowledgement

This work was supported by a grant of Ministry of National Education, CNCS – UEFISCDI, project number PN-II-ID-PCE-2012-4-0631.

References

Baumeister, C. Durinck, E. and Peersman, G., 2008. Liquidity, Inflation and Asset Prices in a Time-Varying Framework for the Euro Area. *National Bank of Belgium Working Paper* Research No. 142.

Benati, L. and Mumtaz, H., 2007. U.S. Evolving Macroeconomic Dynamics a Structural Investigation. *European Central Bank, Working Paper Series*, no. 746.

Blake, A. and Mumtaz, H., 2012. Applied Bayesian Econometrics for Central Bankers, *CCBS Technical Handbook No. 4*, Bank of England.

Canova, F. and de Nicolo, G., 2002. Monetary disturbances matter for business fluctuations in the G-7. *Journal of Monetary Economics*, 49(6), pp.1131-1159.

Carter, C. K. And R. Kohn 1994. On Gibbs Sampling for State Space Models, *Biometrika*, 81(3), pp. 541-553.

Cogley, T. and Sargent, T.J.,52002. Drifts and Volatilities: Monetary Policies and Outcomes in the Post WWII U.S. *Review of Economic Dynamics*, pp.262—302.

De Bandt, O. and P. Hartmann 2000. Systemic Risk: A Survey, *ECB Working Paper No. 35*.

Eickmeier, S. Lemke, W. Marcellino, M., 2011. The Changing International Transmission of Financial Shocks: Evidence from a Classical Time-Varying FAVAR. *Deutsche Bundesbank Discussion Paper* 04.

Fink, F. Schüler, Y.S., 2015. The transmission of US systemic financial stress: Evidence for emerging market economies. *Journal of International Money and Finance*, 55, pp.6-26

Gambetti, L. Pappa, E. and Canova, F., 2006. The Structural Dynamics of US Output and Inflation: What Explains the Changes?, *Journal of Money, Credit and Banking*, 40(2-3), pp.369-388.

Gilchrist, S., Yankov, V., Zakrajsek, E., 2009. Credit market shocks and economic fluctuations: evidence from corporate bond and stock markets*. J. Monet. Econ*., 56, pp.471-493.

Hakkio, C. Keeton W., 2009: Financial Stress: What Is It, How Can It Be Measured, and Why Does It Matter? *Federal Reserve Bank of Kansas City, Economic Review*, 94(2), pp.5–50.

Hollo, D. Kremer, M,.Lo Duca M., 2012. CISS - A Composite Indicator of Systemic Stress in the Financial System. *European Central Bank, Working Paper Series*, no 1426.

Hubrich, K. Tetlow, R.J., 2012. Financial Stress and Economic Dynamics: The Transmission of Crises. In: *Finance and Economics Discussion Series*, 82. The Federal Reserve Board.

Jacquier, E. Polson, N. and Rossi, P., 2004. Bayesian analysis of stochastic volatility models. *Journal of Business and Economic Statistics*, 12, 371—418.

Lo Duca M. Peltonen T., 2011: Macro-financial Vulnerabilities and Future Financial Stress: Assessing Systemic Risks and Predicting Systemic Events. *ECB, Working Paper Series*, no. 1311.

Mackowiak, B., 2007. External shocks, U.S. monetary policy and macroeconomic fluctuations in emerging markets. *J. Monet.Econ.,* 54, pp.2512-2520.

Negro, Marco Del and Schorfheide,F., 2004, Priors from General Equilibrium Models for VARS, *International Economic Review*, 45(2), pp.643—673.

Nakajima, J. 2011. Time-Varying Parameter VAR Model with Stochastic Volatility: An Overview of Methodology and Empirical Applications, *Institute for Monetary and Economic Studies Discussion Paper Series*, 2011-E-9.

Peersman, G., 2005. What caused the early millennium slowdown? Evidence based on vector autoregressions. *Journal of Applied Econometrics*, 20, pp.185-207.

Primiceri, G. 2005. Time Varying Structural Vector Autoregressions and Monetary Policy, *Review of Economic Studies*, 72(3), 821-852.

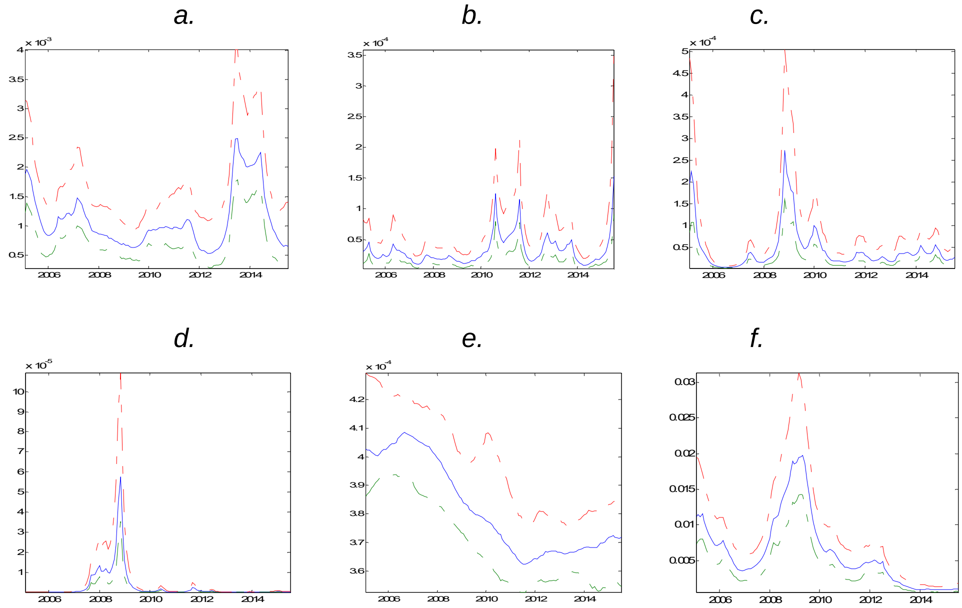
Sims, C.A. Zha, T., 1998. Bayesian methods for dynamic multivariate models. *Int. Econ. Rev.*, 39, pp.949-968.

Uhlig, H., 2005. What are the Effects of Monetary Policy on Output? Results from an Agnostic Identification Procedure. *Journal of Monetary Economics*, 52(2), pp.381-419.

Appendix

Figure A1

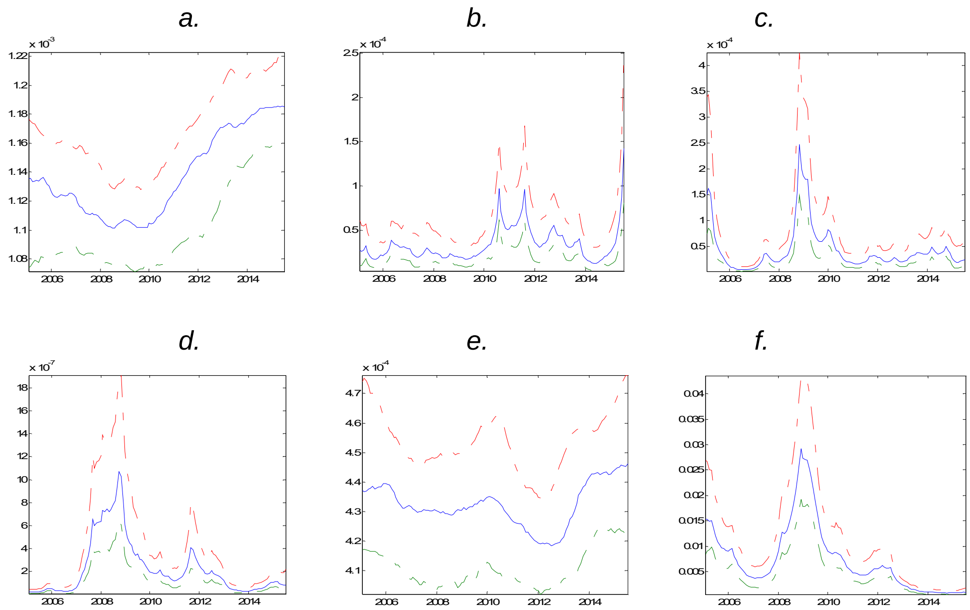
The stochastic volatilities for the model with the US Systemic Stress Index NFCI



Note: a. Industrial Production Index (q); b. Inflation (p); c. Interest rate (i); d. US Systemic Stress Index (NFCI); e. Real Effective Exchange rate (s); f. Return of BET stock exchange index. The dashed lines represent 68% probability band.

Figure A1

The stochastic volatilities for the model with the Euro Area Systemic Stress Index CISS



Note: a. Industrial Production Index (q); b. Inflation (p); c. Interest rate (i); d. US Systemic Stress Index (NFCI); e. Real Effective Exchange rate (s); f. Return of BET stock exchange index. The dashed lines represent 68% probability band.