The Academy of Economic Studies
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Financial stress and its impact on economic activity in Romania

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Motivation

- One of the objectives of constructing a financial stress index is to help policymakers identifying stress levels in the financial system that can be a serious concern
- The importance of financial stress arises from its potential adverse effect on the real economy. Even if in some cases the high levels of financial stress are not necessarily followed by economic downturn it is still possible threat to the growth of the real economy
- Since the financial stress is not directly observable it is necessary to build an index that reflects the stress component of the financial markets variables
- The European Central Bank (ECB) and the Federal Reserve have created several indicators with the purpose of measuring “the current state of instability, i.e. the current level of frictions, stresses and strains in the financial system”

Objectives

- Construct a Financial Stress Index for Romania including financial variables for the banking sector, securities market, stock market and foreign exchange market

- I follow the approach of Cardarelli, Elekdag and Lall (2011)

- Estimate a Vector Autoregressive model to explore the effects of financial stress on economic activity

- Assess the macroeconomic impact of: - a financial stress shock

  - a monetary policy shock

Literature review

- Only few studies on the subject prior to the financial crises; the literature was derived from previous studies on early warning indicators for banking crises & financial stress
- Bordo et al. (2001) pioneered the financial stress literature → financial conditions index to determine the frequency of financial crises in historical data
- Iling M. and Ying L . - among the first researchers who have developed a financial stress indicator (developed FSI for Canada where the data covered equity, bond, foreign exchange and banking sector)
- **Financial stress** is defined as "the force exerted on economic agents by uncertainty and changing expectations of loss in financial markets and institutions. Financial stress is a continuum, measured with an index called the Financial Stress Index (FSI), where extreme values are called financial crises."
- Interesting findings are brought by Cardarelli et. al. - periods of financial disturbance brought by banking distress are more likely to be associated with deep downturns than periods of stress mainly related to securities or foreign exchange markets

Literature review

- Vector autoregressive models have become an important econometric tool in order to appraise the effects of monetary and fiscal policy shocks
- Based on VAR approach, Van Aarle (2003) estimated the impact of fiscal and monetary policy for the members of Economic and Monetary Union highlighting different reactions among various countries of the Euro Area
- The empirical evidence on central bank's reactions to financial instability is rather scant.
- Baxa, Horvath and Vasicek (2010) studied the reaction of central bank inflation targeting to financial stress → normally do not react to financial stress but their behavior changes in times of large and longer stress
- Mallick and Sousa (2011) use two identifications in a Bayesian VAR and sign restriction VAR to examine the real effects of financial stress

Methodology

- **Financial stress index**: equal-variance-weighted average of seven variables, grouped into three categories:
- 1**. Banking** – related subindex formed by:

  - the beta of banking sector = correlation between return of banking sector stock index and the overall stock market index

  - TED spread=difference between interbank rates and the yield on treasury bills

  - the slope of the yield curve = difference between the short and long term yields on government issued securities
- 2. **Securities market** – related subindex:

  - corporate bond spreads = difference between corporate bond yields and LT government bond yields

  - stock market return

  - time-varying stock market volatility
- 3. **Foreign exchange** – related subindex:

  - time-varying volatility of real effective exchange rate

A VAR model with the FSI

- The baseline reduced VAR model can be written: $Y_t = c + \sum_{i=1}^{p} A_i Y_{t-1} + U_t$
- Y_t is the vector of n endogenous variable given by $Y_t = [y_t \pi_t i_t s_t]'$
- y_t is the GDP growth
- π_t is the inflation
- i_t is the short term interest rate
- s_t is the indicator for financial market conditions (FSI)
- FSI is ordered last which implies that it reacts contemporaneously to all variable in the system
- The ordering also implies that the monetary policy shocks do not have an impact, contemporaneously, on output or inflation

Data

- Monthly data from 2000 M1 to 2011 M12 (IMF database, BVB)
- Variables in VAR:

y_t annual growth rate of the log of real GDP used: $Y_t = \log(Y_t) - \log(Y_{t-12})$

p_t annual growth rate of log of price level used: $p_t = \log(P_t) - \log(P_{t-12})$

i_t money market rate (monthly average of overnight money)

S_t financial stress index computed as below

- Financial stress variables:

Bank stress:

- normalized beta between return of Transylvania Bank shares and BET-C

$$\beta = \frac{\operatorname{cov}(TLV, BET-C)}{VAR(BET-C)}$$

- covariance is estimated through a Multivariate Garch model:

$$vech(H_t) = c + \sum_{j=1}^{q} A_j vech(r_{t-j} r_{t-j}^{'}) + \sum_{j=1}^{p} B_j vech(H_{t-j})$$

- normalized TED spread= ROBOR 3M – Treasury bill yield (3M)
- inverted term spread=difference between deposit rate and lending rate

Stock market stress:

- Monthly return of stocks (BET-C index) computed as $R_{t+1} = \ln\left(\frac{S_{t+1}}{S_t}\right)$
- Volatility of monthly returns for BET-C index derived from GARCH (1,1)

$$\sigma_t^2 = \omega + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-i}^2 + \sum_{j=1}^{p} \beta_j \sigma_{t-j}^2$$

Foreign exchange stress:

- Volatility of monthly changes in the REER derived from GARCH (1,1) specification

Preliminary analysis

- for the series of returns of BET_C, TLV, REER specific tests to check the suitability of models as GARCH were applied

- **Descriptive statistics**

	BET-C return	TLV return	REER return
Skewness	-0.709341	-0.262743	0.911201
Kurtosis	5.736343	5.822031	4.437976
Jarque-Bera	57.0014	49.43996	32.33357
Probability	0	0	0

- Testing for **stationarity**:

	BET-C	Prob.*	TLV	Prob.*	REER	Prob.*
ADF test statistic	-7.4793	0.0000	-9.1945	0.0000	-6.0434	0.0000
1% critical value	-3.4765		-3.4765		-3.4771	
5% critical value	-2.8817		-2.8817		-2.8820	
10% critical value	-2.5776		-2.5776		-2.5777	

- Testing for **serial correlation**:

BET-C

Sample: 2000M01 2011M12
Included observations: 144

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.436	0.436	27.893	0.000
		2	0.139	-0.063	30.734	0.000
		3	0.195	0.196	36.394	0.000
		4	0.109	-0.061	38.182	0.000
		5	0.103	0.099	39.774	0.000
		6	-0.029	-0.176	39.904	0.000
		7	-0.043	0.055	40.188	0.000

TLV

Sample: 2000M01 2011M12
Included observations: 144

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.250	0.250	9.1835	0.002
		2	0.051	-0.013	9.5642	0.008
		3	-0.006	-0.016	9.5688	0.023
		4	-0.118	-0.119	11.649	0.020
		5	-0.121	-0.067	13.859	0.017
		6	0.008	0.064	13.868	0.031
		7	-0.067	-0.087	14.547	0.042

REER

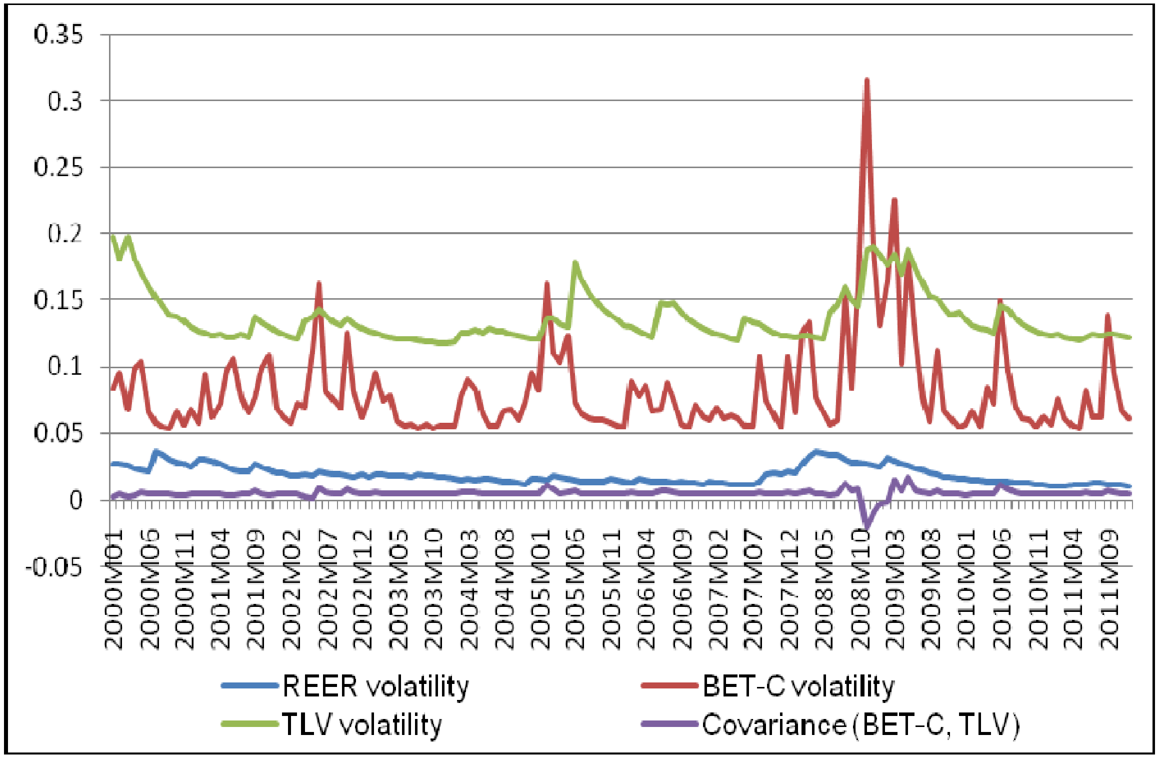
Sample: 2000M01 2011M12
Included observations: 144

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.355	0.355	18.563	0.000
		2	0.243	0.134	27.303	0.000
		3	-0.005	-0.149	27.307	0.000
		4	0.037	0.057	27.507	0.000
		5	-0.027	-0.021	27.618	0.000
		6	0.077	0.086	28.530	0.000
		7	0.142	0.130	31.645	0.000

- Testing for **heterosckedasticity**:

Breusch-Godfrey Serial Correlation LM Test:			
BET-C			
F-statistic	1.37	Prob.	0.18
Obs*R-squared	15.32	Prob. Chi-square	0.02
TLV			
F-statistic	2.10	Prob.	0.02
Obs*R-squared	22.78	Prob. Chi-square	0.03
REER			
F-statistic	1.36	Prob.	0.19
Obs*R-squared	11.76	Prob. Chi-square	0.01

- Graph of BET-C, TLV, REER volatility and covariance between BET-C and TLV



Estimation of GARCH (1,1) model for BET-C return and REER return

GARCH(1,1) for BET-C return:

Dependent Variable: L_BET_C
Method: ML - ARCH
Date: 05/21/12 Time: 23:03
Sample (adjusted): 2000M02 2011M12
Included observations: 143 after adjustments
Convergence achieved after 10 iterations
Presample variance: backcast (parameter = 0.7)
GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
AR(1)	0.408088	0.093059	4.385257	0.0000
Variance Equation				
C	0.000835	0.000778	1.072540	0.2835
RESID(-1)^2	0.143130	0.075435	1.897402	0.0578
GARCH(-1)	0.698469	0.198080	3.526205	0.0004

R-squared	0.185675	Mean dependent var	0.011046
Adjusted R-squared	0.185675	S.D. dependent var	0.080614
S.E. of regression	0.072746	Akaike info criterion	-2.423847
Sum squared resid	0.751467	Schwarz criterion	-2.340970
Log likelihood	177.3050	Hannan-Quinn criter.	-2.390170
Durbin-Watson stat	1.875649		

Inverted AR Roots .41

GARCH(1,1) for REER return:

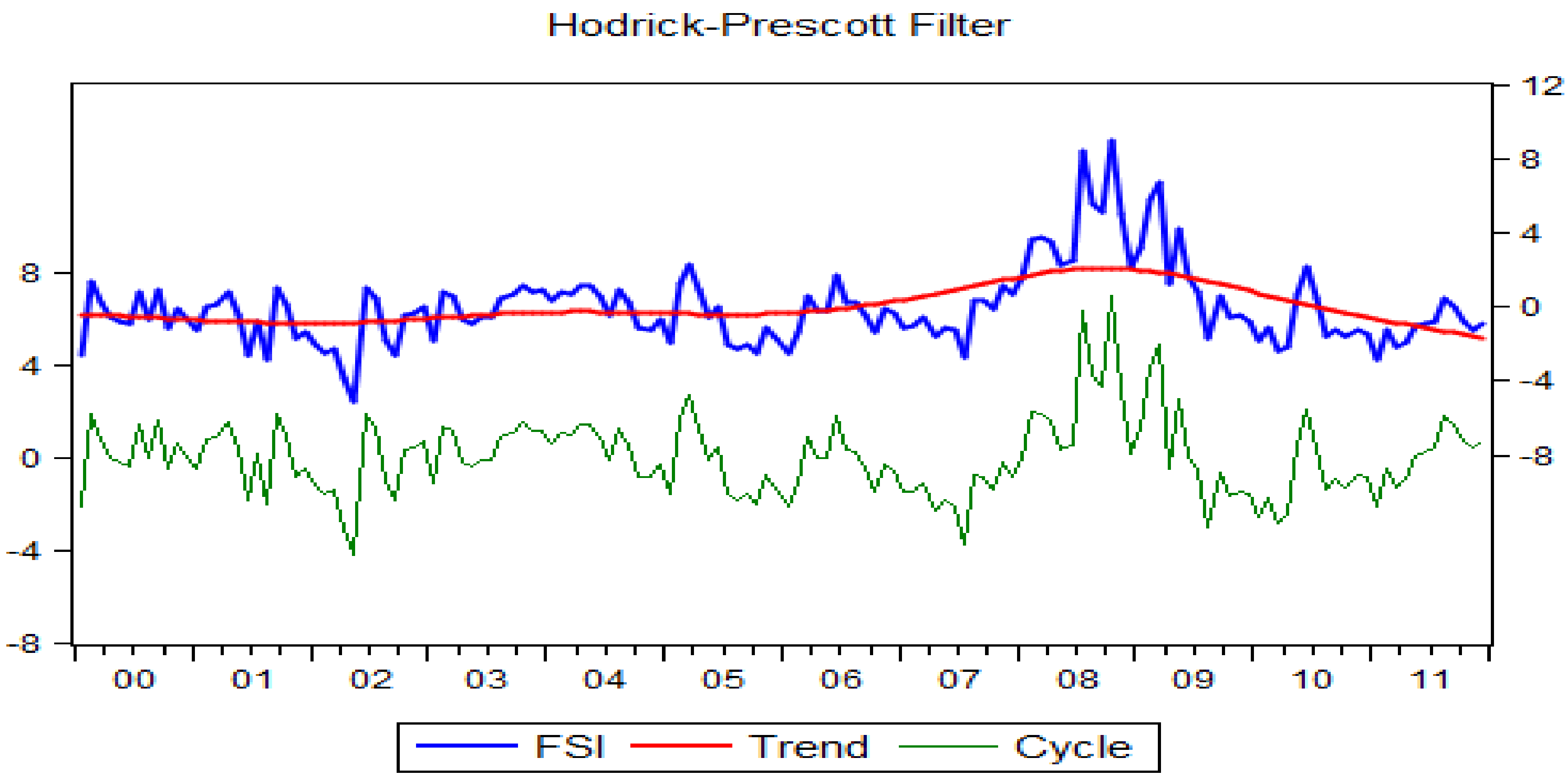
Dependent Variable: L_REER
Method: ML - ARCH (Marquardt) - Normal distribution
Date: 05/22/12 Time: 23:23
Sample (adjusted): 2000M02 2011M12
Included observations: 143 after adjustments
Convergence achieved after 22 iterations
Presample variance: backcast (parameter = 0.7)
GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
AR(1)	0.485813	0.074228	6.544908	0.0000
Variance Equation				
C	1.44E-05	9.80E-06	1.469030	0.1418
RESID(-1)^2	0.132699	0.047554	2.790510	0.0053
GARCH(-1)	0.816944	0.049614	16.46607	0.0000

R-squared	0.088800	Mean dependent var	0.006236
Adjusted R-squared	0.088800	S.D. dependent var	0.021336
S.E. of regression	0.020366	Akaike info criterion	-5.104326
Sum squared resid	0.058900	Schwarz criterion	-5.021449
Log likelihood	368.9593	Hannan-Quinn criter.	-5.070648
Durbin-Watson stat	2.287740		

Inverted AR Roots .49

- **Graph of financial stress index for Romania during 2000-2011:**



- High stress periods are defined by periods when the FSI exceeds its mean by more than one standard deviation: 2008 M1 – 2009 M6

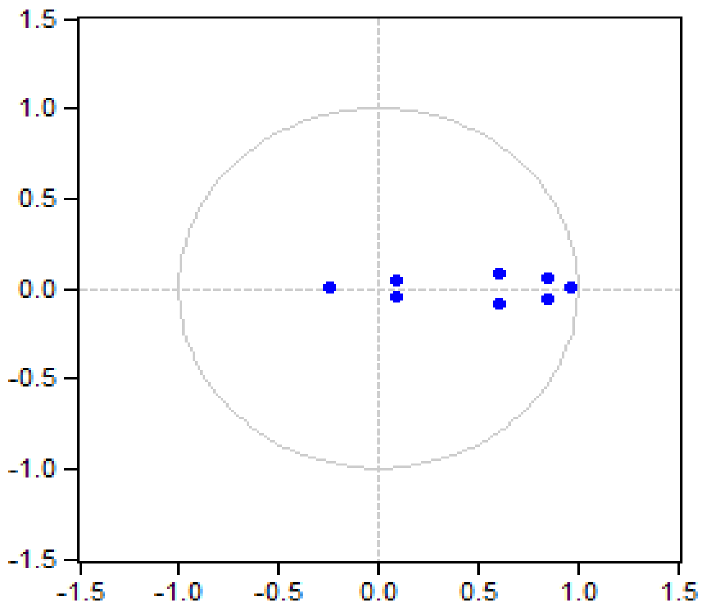
- The index captures the high stress episodes seen in the past

- Variables in levels are used in the VAR specification

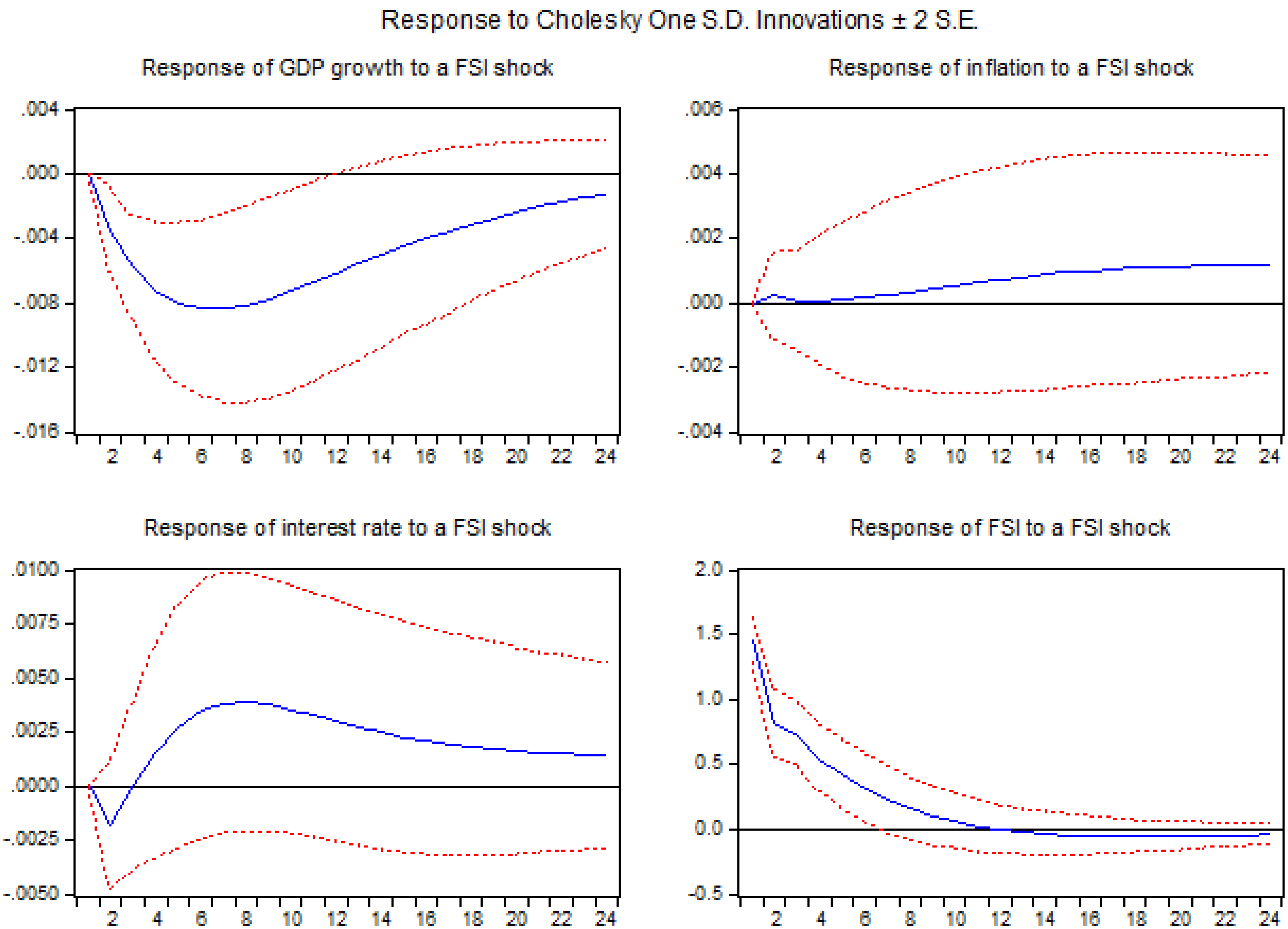
	GDP growth	Prob.*	Inflation rate	Prob.*	Interest rate	Prob.*	FSI	Prob.*
ADF test statistic	-2.803	0.061	-5.074	0.000	-3.440	0.011	-2.899	0.048
1% critical value	-3.478		-3.476		-3.477		-3.477	
5% critical value	-2.882		-2.882		-2.882		-2.882	
10% critical value	-2.578		-2.578		-2.578		-2.578	

- VAR stability

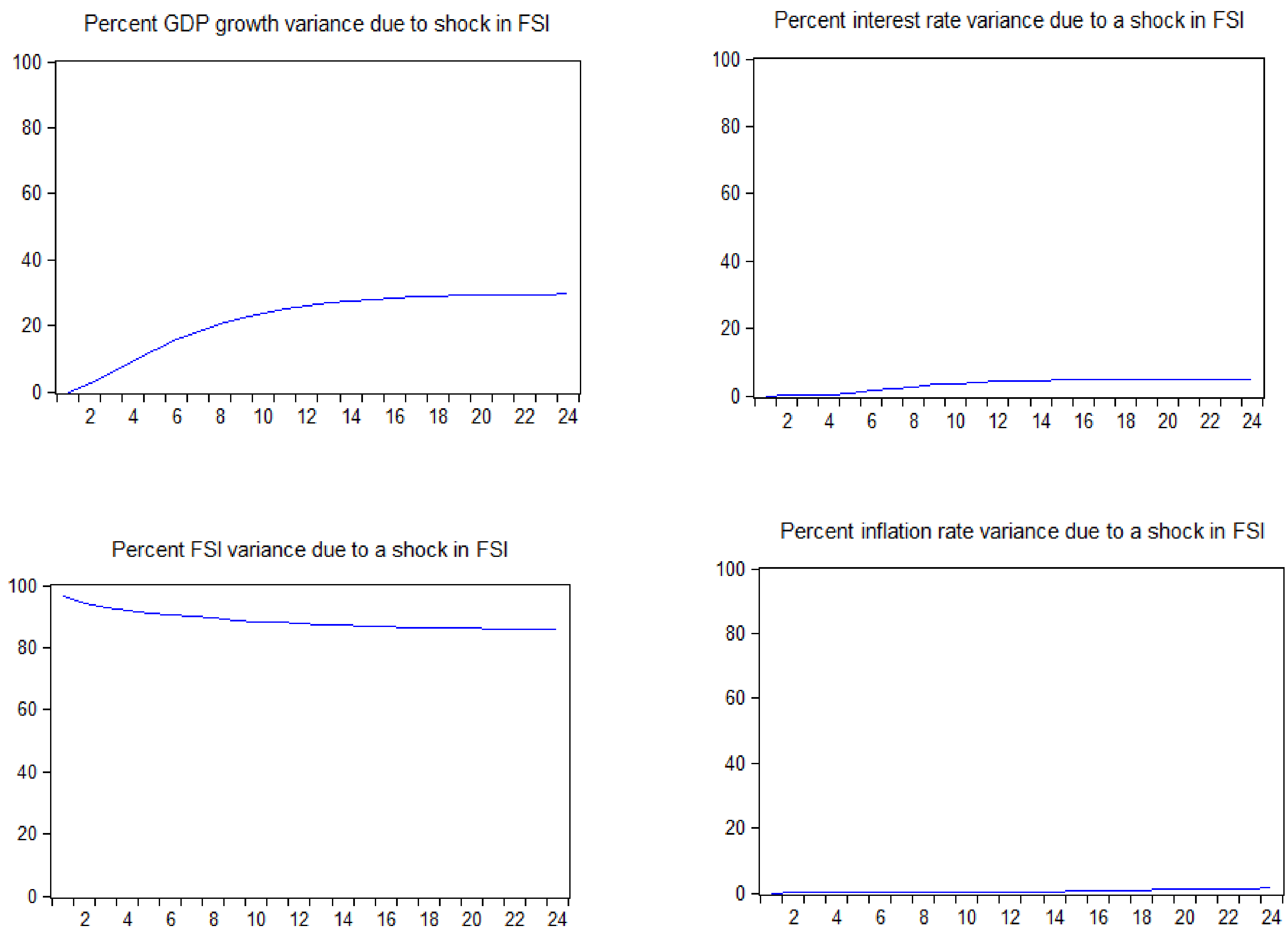
Inverse Roots of AR Characteristic Polynomial



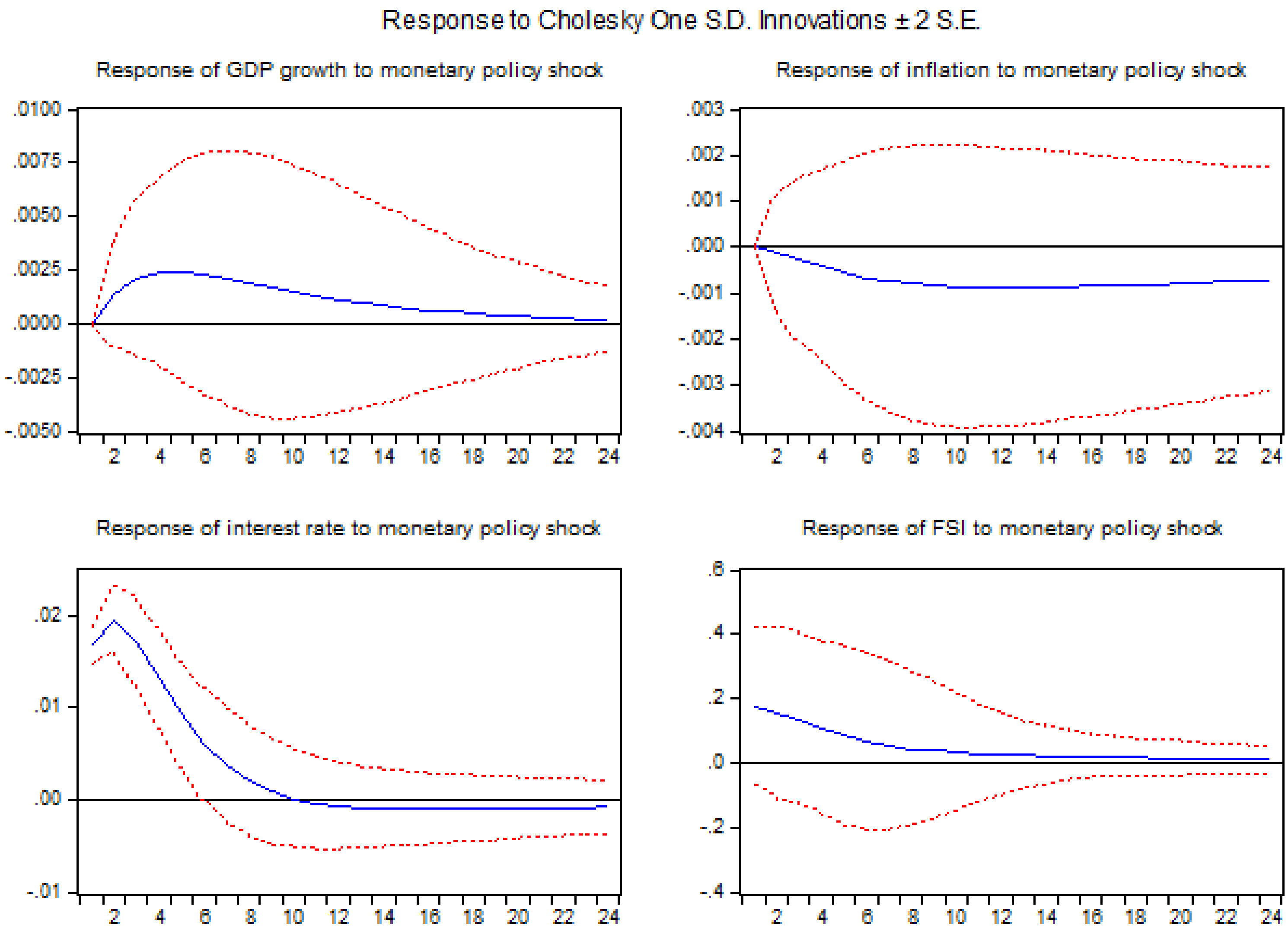
Impulse response after a shock to the Financial Stress



Variance decomposition after a financial stress shock



Impulse response after a monetary policy shock



Results

- Following a positive **shock in financial stress**, real GDP growth falls - after 8 months the effect is the largest reducing real GDP growth by 0.8 p.p.

- The impact on interest rate is less persistent and after an initial increase it converges back to its primary level

- Deterioration of financial stress conditions negatively impacts the inflation rate which increases though only after a few months. The effect is persistent

- At a horizon of 8 quarters shocks in financial stress explains about:

  - 30 percent of variation in real GDP growth
  - 5 percent of the variation in interest rate
  - only a few percentage points in inflation rate

Results

- The interest rate is used as the **monetary policy instrument**
- After a contractionary monetary policy, real GDP growth falls even if not immediately but after approximately 3-4 months
- Inflation begins to fall in response to a contractionary monetary policy shock
- The responses to a monetary policy shocks are not significant from statistical point of view
- The monetary policy contraction explains only a small fraction of the variation of the FSI, real GDP growth and inflation rate (5% or less)

Conclusions

- This paper develops a financial market stress indicator for Romania during 2000-2011
- The aim of the indicator is to provide a quick, clear and intuitive assessment of the current state of the financial system
- The FSI built captures the high stress periods seen in the past in Romania
- The increase in financial stress has shown to have large effects in economic activity, dampening the real GDP growth
- No significant impact of the monetary policy changes in the face of high financial stress nor a meaningful contribution in explaining the fluctuations in the data
- Detected in early stages, the impact of financial stress can be mitigated by adequate fiscal and monetary measures.

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Thank you!