Evaluating Feedback Links Between the Financial and Real Sectors in a Small Open Economy

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Motivation

- Crisis and post-crisis experience focused public debate on the interactions between monetary policy, the real sector and finance.
- Formalized treatment
  - 'financial accelerator' framework of Bernanke and Gertler (1995)
  - the bank-lending channel (Bernanke and Blinder 1988)
  - the bank capital channel (Van den Heuvel 2002, Meh and Moran 2010)
  - interactions with regulation (e.g., Borio et al. 2001, Goodhart et al. 2004)
  - liquidity channel (e.g., Brunnermeier and Pedersen 2009),
  - risk-taking channel (BIS 2011)
- Other issues
  - economic convergence
  - post-Lehmann regime shifts

Motivation

- The contribution of this paper is threefold
  - Explicit focus on the non-linear interactions between the real sector and the financial sector
  - Methodology - we extend the single-equation Bayesian threshold model by Chen and Lee (1995) into the multiple-equation setting with block restrictions to account for external factors in a small open economy
  - Third, given that most of the related empirical studies have focused on developed economies, the study provides complementary evidence for a small emerging economy.

Outline of results

- Introduction of an alternative spread makes the results more intuitive (ref. report Brzezina)

- In some cases TVAR produces notably different GIRFs as compared to the baseline VAR
  - the direct impact of foreign factors on lending seems to be rather limited and eventually vanishes
  - while the responses to credit shocks are roughly similar across regimes, the reactions to the NPL shocks differ

- Sensitivity of GIRFs between regimes tends to differ.
- The direct impact of foreign production on NPL seems to be more pronounced in tighter credit spread regime

Structure of Presentation

- Relevant literature
- Estimation framework
- Data
- Results
- Conclusion

Empirical evidence

- DSGE models highly stylized (see Brázdik et al., 2011)
- A number of studies have employed VAR methodology linking macro-variables with selected indicators of bank performance
  - Credit risk literature with more or less frequent reference to stress-testing (e.g., Alves, 2005; Åsberg Sommar and Shahnazarian, 2008; Pesaran et al. (2006); Castrén et al. (2008))
  - Monetary policy models augmented by financial sector variables investigating the transmission channels from finance to the real economy (Gilchrist and Zakrajšek, 2011; Helbling et al., 2011; Meeks, 2012).
  - Empirical studies done on CEECs data, e.g., Franta et al. (2011) Vilagi and Tamási (2011),

Empirical evidence

- The scope for non-linear feedback has been studied to a somewhat lesser extent.
- Threshold VAR
  - Balke (2000), Atanasova (2003), Calza and Sousa (2006)
- Markov-switching VAR models
  - Kaufmann and Valderrama (2007), Kaufmann and Valderrama (2008),
- Higher-order approximation of a non-linear VAR by Drehmann et al. (2006).
- An integrated micro-macro framework by De Graeve et al. (2008)

Threshold Bayesian VAR

$$y_t = \Pi_1 x_t I[y_{t-d}^{thr} < r] + \Pi_2 x_t I[y_{t-d}^{thr} \geq r] + \varepsilon_t$$

$$t = 1,..,T \qquad \varepsilon_t \approx NI_p(0,\Omega)$$

- where y_t stands for a p×1 vector of endogenous variables, $x_t = [1, y_{t-1}^1,.., y_{t-1}^p,.., y_{t-k}^1 .., y_{t-k}^p]$ is a pk+1 vector of lagged variables, and Π_i is a p×(1+pk) matrix of coefficients with block exogeneity restrictions such that for n foreign and m domestic variables we have

$$\Pi_i = \begin{bmatrix} \Pi_{nn} & 0 \\ \Pi_{nm} & \Pi_{mm} \end{bmatrix}$$

- The block exogeneity assumption postulates that domestic shocks should

Threshold Bayesian VAR

- Normal-diffuse priors for the autoregressive coefficients following Kadiyala and Karlsson (1997)

$$\pi_i \approx N(\tilde{\pi}_i, \tilde{V}_i^{pr}) \qquad p(\Sigma_i) \propto |\Sigma_i|^{-(p+1)/2}$$

- for i=1,2, where π_i is a vector of stacked coefficients of the matrix Π_i, $\tilde{\pi}_i$ is a zero column vector with *p(1+pk)* rows, $\tilde{V}_i^{pr}$ are matrices with elements corresponding to the coefficients on their own lags equal to ϕ_0 / k^2 and elements on other lags equal to $\phi_0 \phi_1 \sigma_{i,q}^2 / (l^2 \sigma_{i,r}^2)$.

- The prior on the threshold parameter is assumed to follow a uniform distribution on the interval $\left[r_{q=0.1}, r_{q=0.9} \right]$.

- The prior for the delay parameter follows a multinomial distribution with the probability of a particular delay equal to $1/d_0$.

Generalized impulse responses

- Identification via Cholesky decomposition.
- Generalized impulse response functions (GIRFs) based on Koop, Pesaran and Potter (1996)
  - history dependency, take into account the size (and sign) of the shock, as well as its evolutionary path
- GIRF is defined as the effect of a one-time shock on the forecast of variables in the model.

$$GIRF_y(k, \varepsilon_t, \Omega_{t-1}) = E[Y_{t+k}|\varepsilon_t, \Omega_{t-1}] - E[Y_{t+k}|\Omega_{t-1}]$$

Generalized impulse responses

- **Computation algorithm**

1. Pick a collection of lagged endogenous variables at a particular date
2. Pick a sequence of shocks of dimension p x k, shocks drawn with replacement from estimated residuals
3. Simulate the evolution of Y_{t+k} over the whole evolution path – this is the baseline path
4. Substitute shock to the variable of interest in the first period and again simulate the evolution of Y_{t+k} over the whole evolution path
5. Repeat 2 to 4 B times
6. Repeat 1 to 5 R times and compute the average impulse response function (i.e., the average difference between 3 and 4)

- For our purposes B=100 and R=500

Data

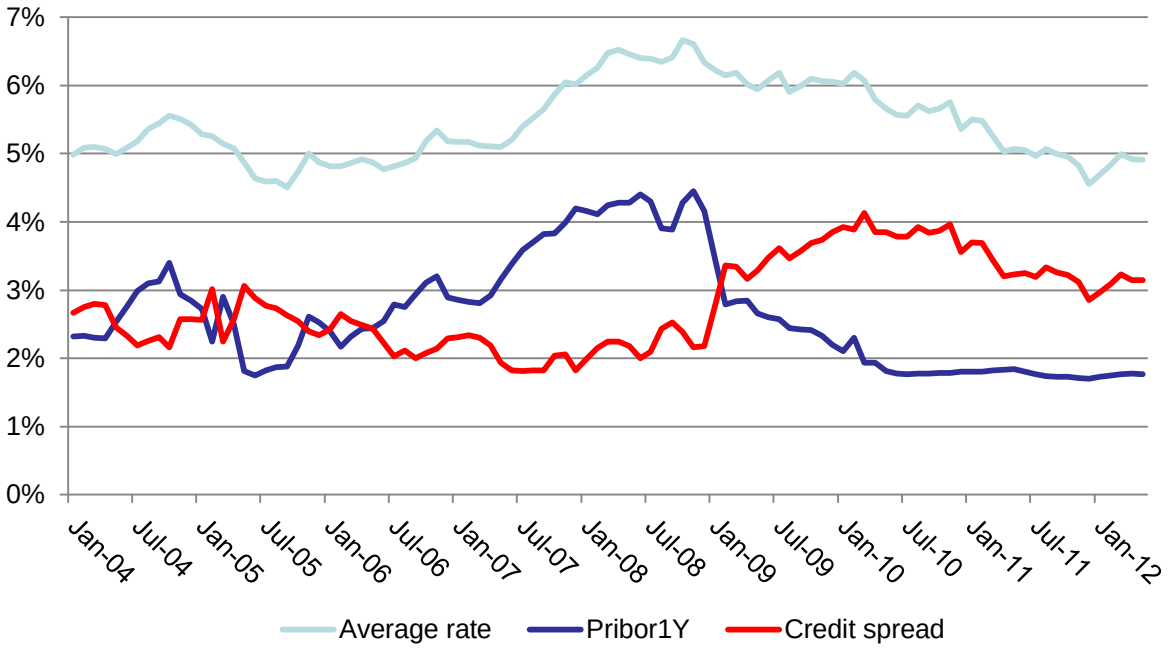
- Monthly frequency spanning 2002m1–2012m3
- Model variables follow similar policy studies on a small open economy (e.g. Borys et al., 2009; Havránek et al., 2010; Franta et al., 2011)
- Industrial production instead of real GDP or the output gap given monthly frequency of the data (e.g., Anastasova, 2003)
- Other domestic variables: 3M Pribor, CPI, CZK/EUR nominal exchange rate
- 3M Euribor and industrial production index of the 17 members of the European Union as of the end-2002 as controls for external environment
- Aggregate nominal credit and non-performing loans (NPL) as alternative measures of banking sector performance
  - To save on degrees of freedom, each indicator is employed in a separate model
- All variables except interest rates and NPL ratio expressed in logarithm
- Data sourced from the Czech Statistical Office, the ARAD database maintained by the Czech National Bank, and the Eurostat.

Threshold variable

- 3M Pribor in the submitted version

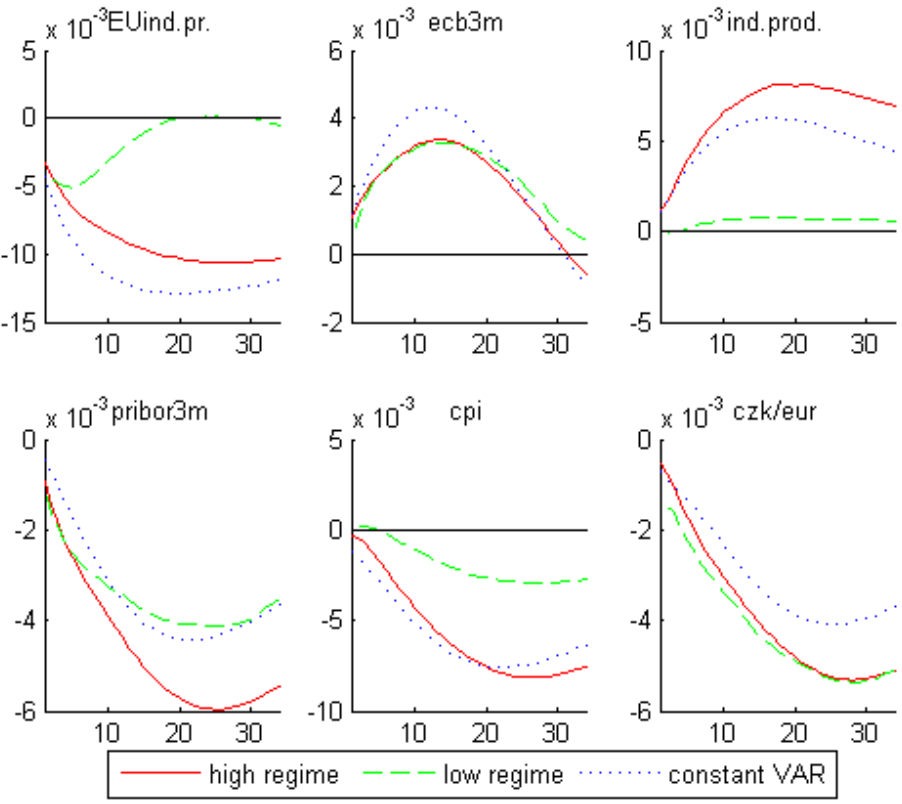
- Credit spread = average rate charged on loans (weighted by new credit in corporate and household sectors respectively) – 1Y Pribor

– Empirical studies relying on the TVAR framework use a measure of the credit spread (Balke, 2000; Atanasova, 2003) or credit growth (Calza and Sousa 2006) as a threshold variable to gauge credit market conditions

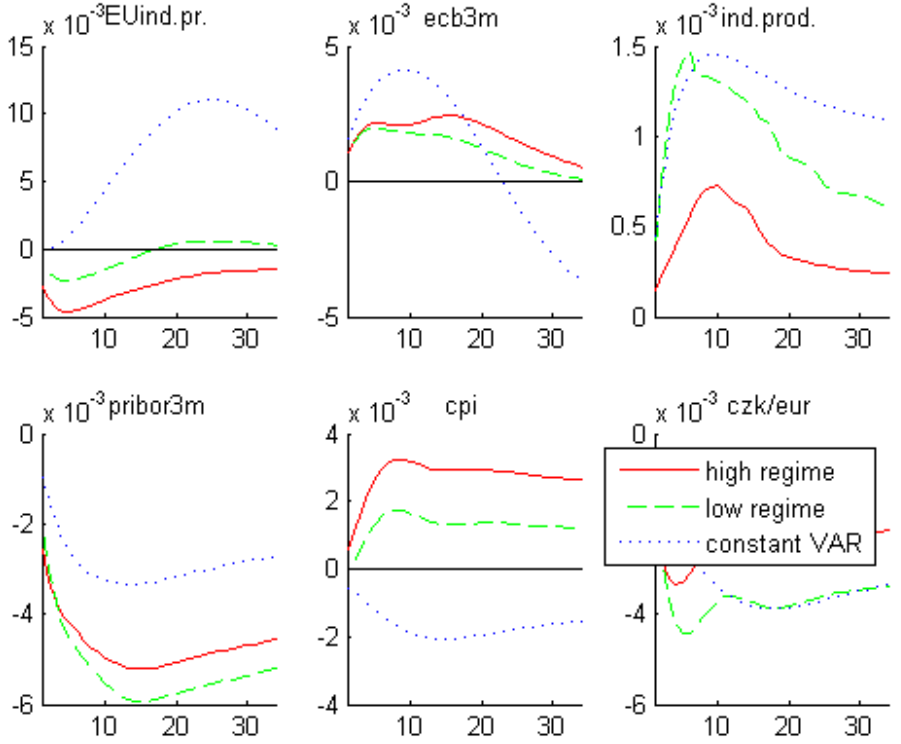


GIRFS from macroeconomic variables to credit

Threshold Pribor3m

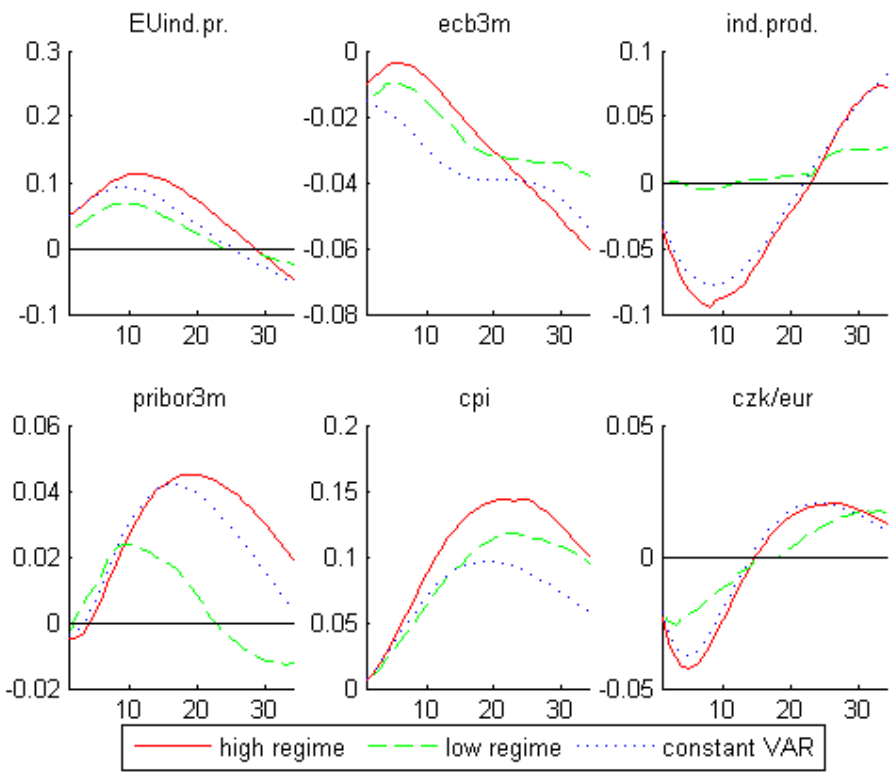


Threshold Credit spread

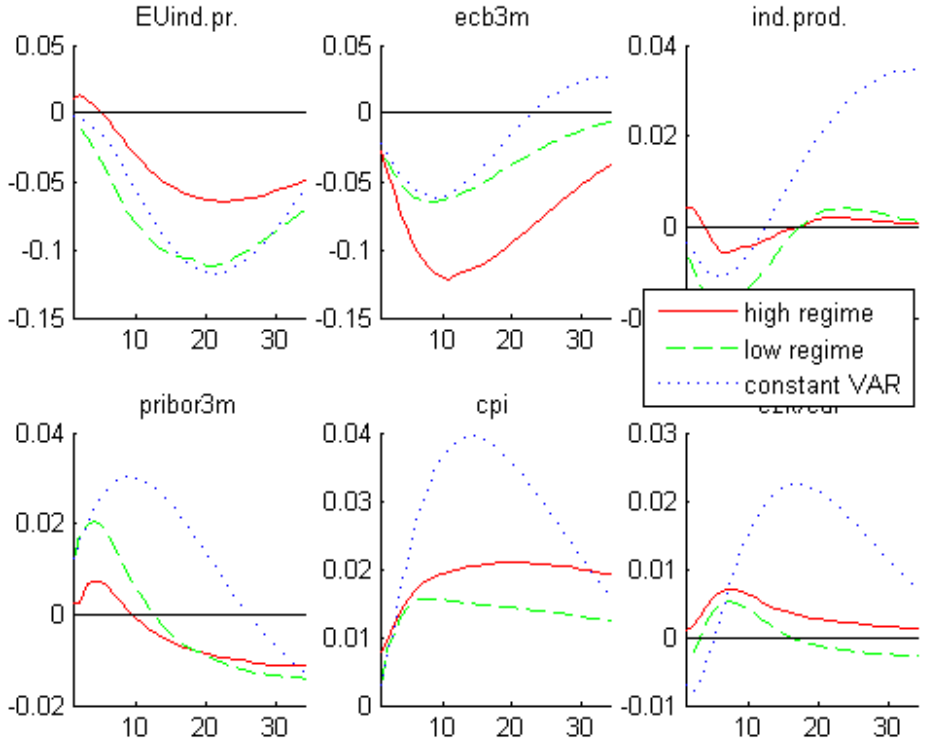


GIRFS from macroeconomic variables to NPL

Threshold Pribor3m

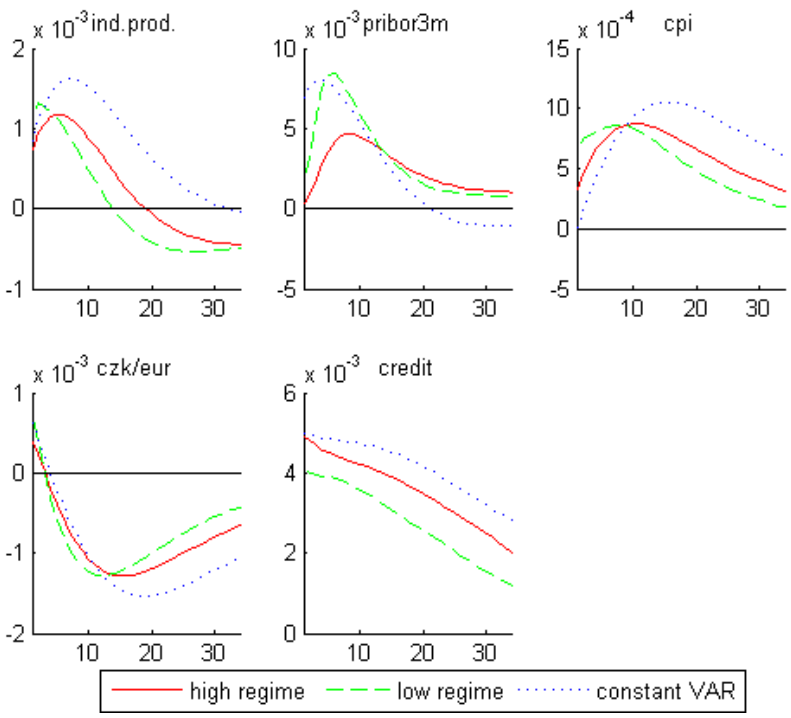


Threshold Credit spread

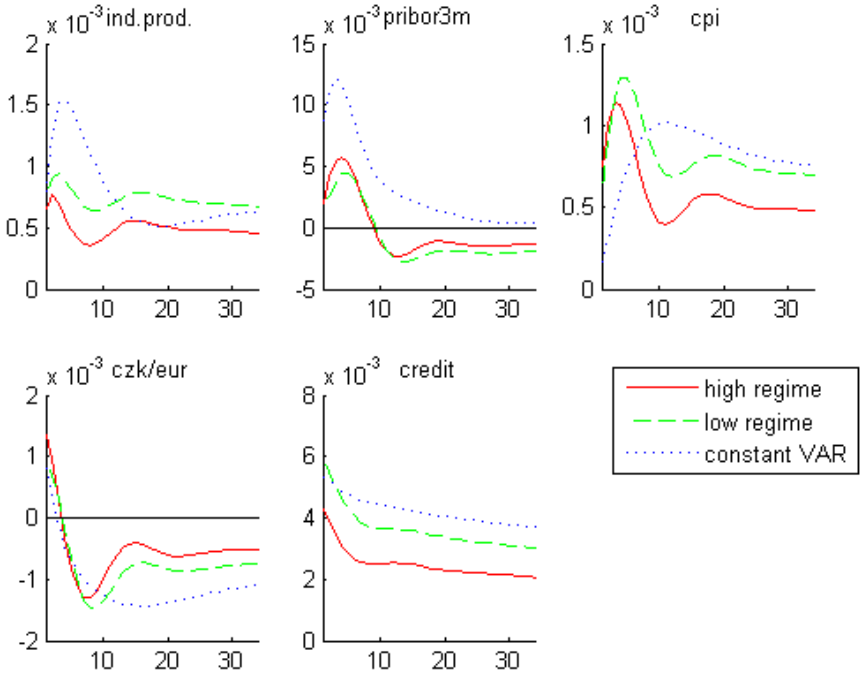


GIRFS from credit to macroeconomic variables

Threshold Pribor3m

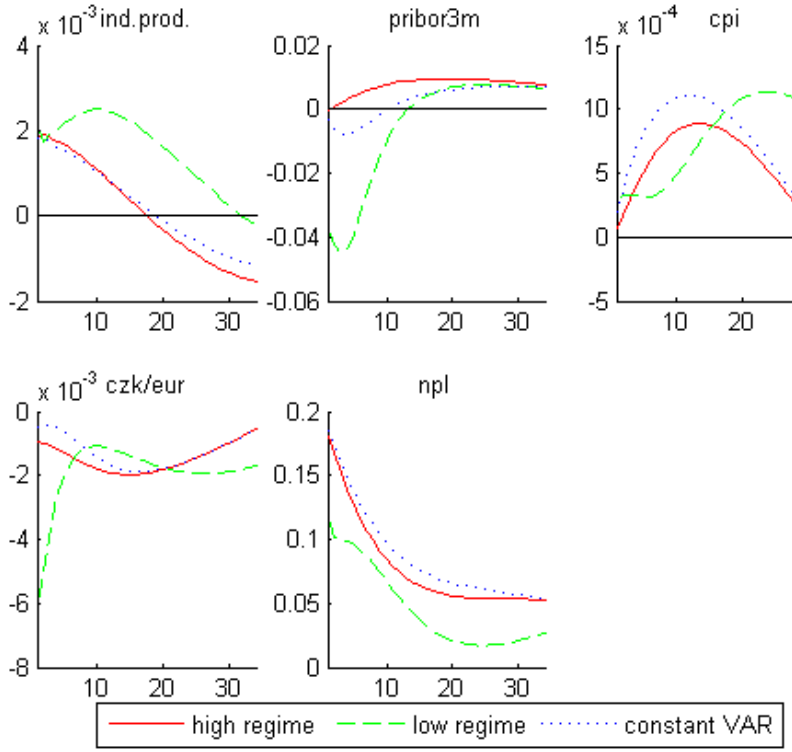


Threshold Credit spread

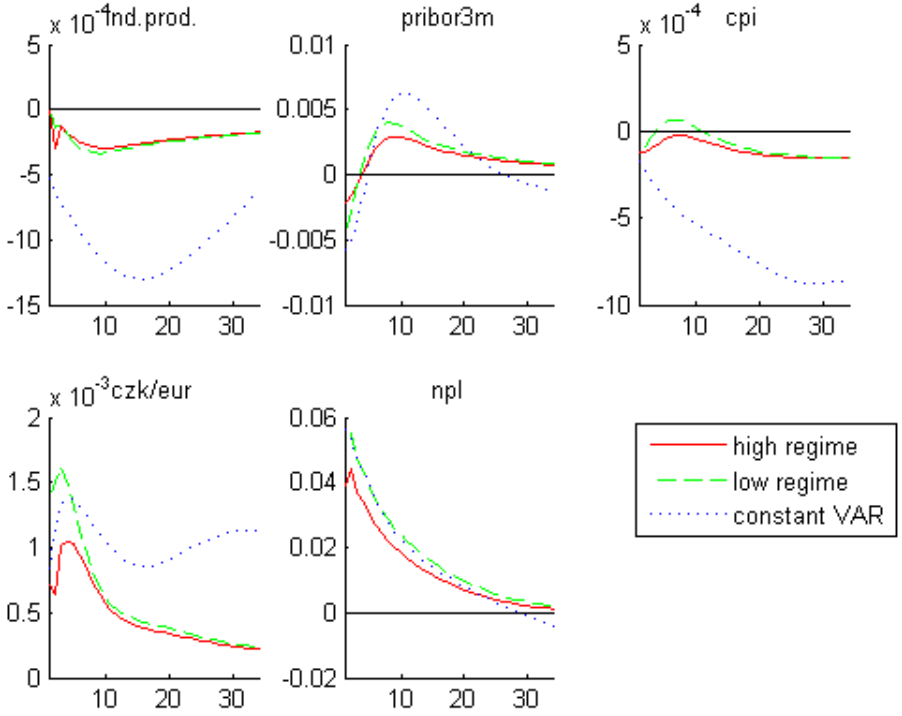


GIRFS from NPL to macroeconomic variables

Threshold Pribor3m



Threshold Credit spread



Conclusion

- Non-linearity matters
- Introduction of an alternative spread makes the results more intuitive (ref. report Brzezina)
- Asymmetry is often more pronounced when credit spread is used as a threshold variable
- In some cases TVAR produces notably different GIRFs as compared to the baseline VAR
  - the direct impact of foreign factors on lending seems to be rather limited and eventually vanishes
  - while the responses to credit shocks are roughly similar across regimes, the reaction to the NPL shocks differ
- Sensitivity of GIRFs between regimes tends to differ.
- The direct impact of foreign production on NPL seems to be more pronounced in tighter credit spread regime