Identifying the monetary transmission mechanism

A FAVAR approach in the case of Romania

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Motivation

- The accession of Romania to the EU in 2007 brought the availability of a large number of official data series

- The data rich environment is suitable for the implementation of the FAVAR methodology in order to assess the influence of monetary policy on a wide range of economic variables

- It is interesting to assess the way in which monetary shocks affect the Romanian economy in the context of European integration

Objectives

- To assess the impact of monetary policy shocks on a range of macroeconomic variables from different sectors
- To analyze the economic plausibility of estimated responses considering the specific characteristics of the Romanian economy
- To check the robustness of the results to changes in the number of unobservable factors and model lags

Literature review

- Bernanke, Boivin and Eliasz (2005) – laid out the FAVAR theory: using factor analysis to summarize information from a large number of data sets

- Belviso and Milani (2005) – tried to estimate a SFAVAR in which the factors had clear economic interpretation

- Ahmadi and Uhlig (2008) – assessed the effects of monetary policy in FAVAR framework with sign restrictions

- Mumtaz and Surico (2009) – used the FAVAR methodology in an open economy context and used different identification methods for the shocks

- Soares (2011) – analyzed the effects of monetary policy at the EU level using a FAVAR

Methodology – FAVAR theory

$$\begin{bmatrix} F_t \\ Y_t \end{bmatrix} = \Phi(L) \begin{bmatrix} F_{t-1} \\ Y_{t-1} \end{bmatrix} + v_t \qquad X_t = \Lambda^f F_t + \Lambda^y Y_t + e_t$$

Λ^f - matrix of factor loadings for unobserved factors $(N \times K)$

Λ^y – matrix of factor loadings for observable variables $(N \times M)$

X_t - informational time series $(N \times 1)$

v_t, e_t - error term vectors $((K+M) \times 1, N \times 1)$

F_t - unobserved factors $(K \times 1)$

Y_t - observed variables $(M \times 1)$

$$e_t \sim N(0, R)$$

$$v_t \sim N(0, Q)$$

Methodology – State Space Form

Defining: $\boldsymbol{X}_t' = (X_t', Y_t')'$ $\quad \boldsymbol{e}_t' = (e_t', 0)'$

$\boldsymbol{F}_t' = (F_t', Y_t')'$ $\quad \boldsymbol{R} = \mathrm{cov}(\boldsymbol{e}_t \boldsymbol{e}_t')$

We can write the equations in state-space form:

$$\boldsymbol{X}_t = \Lambda \boldsymbol{F}_t + \boldsymbol{e}_t$$

$$\boldsymbol{F}_t = \Phi(L) \boldsymbol{F}_{t-1} + \nu_t$$

$$\begin{bmatrix} X_t \\ Y_t \end{bmatrix} = \begin{bmatrix} \Lambda^f & \Lambda^y \\ 0_{M \times K} & I_{M \times M} \end{bmatrix} \begin{bmatrix} F_t \\ Y_t \end{bmatrix} + \begin{bmatrix} e_t \\ 0 \end{bmatrix}$$

$$\begin{bmatrix} F_t \\ Y_t \end{bmatrix} = \Phi(L) \begin{bmatrix} F_{t-1} \\ Y_{t-1} \end{bmatrix} + \nu_t$$

Methodology – State Space Form

- Taking the short-term interest rate as the observed variable (monetary policy instrument) the state space representation has the following form

$$\begin{bmatrix} X_{1,t} \\ \vdots \\ X_{N,t} \\ MPI_t \end{bmatrix} = \begin{bmatrix} \Lambda^{f,11} & \cdots & \Lambda^{f,K1} & \Lambda^{y,11} \\ \vdots & \ddots & \vdots & \vdots \\ \Lambda^{f,1N} & \cdots & \Lambda^{f,KN} & \Lambda^{y,1N} \\ 0 & \cdots & 0 & 1 \end{bmatrix} \begin{bmatrix} F_t^1 \\ \vdots \\ F_t^K \\ MPI_t \end{bmatrix} + \begin{bmatrix} e_{1t} \\ \vdots \\ e_{2t} \\ 0 \end{bmatrix}$$

Methodology – State Space Form

$$X_t = \bar{\Lambda}\bar{F}_t + e_t$$

$$\bar{F}_t = \Phi \bar{F}_{t-1} + \bar{v}$$ – AR(1) representation

$$\bar{\Lambda} = [\Lambda, 0, \ldots, 0]$$

$$\bar{F}_t = \left(F_t', F_{t-1}', \ldots, F_{t-d+1}'\right)'$$

Methodology – Estimation

- The model was estimated using a single step Bayesian likelihood approach:

$\theta = (\Lambda^f, \Lambda^y, R, \Phi(L), Q)$ - vector of model parameters

the parameters are treated as random variables in the Bayesian framework

- In order to obtain estimates for the parameters I used the Gibbs sampling (Carter-Kohn algorithm)

Methodology – Estimation

- We need obtain draws from the marginal posterior distributions

$$p(\theta) = \int p(\tilde{F}_T, \theta) d\tilde{F}_T \qquad p(\tilde{F}_T) = \int p(\tilde{F}_T, \theta) d\theta$$

where $p(\tilde{F}_T, \theta)$ is the joint posterior density and $\tilde{F}_T = \left(\bar{\boldsymbol{F}}_1, \bar{\boldsymbol{F}}_2, \ldots, \bar{\boldsymbol{F}}_T\right)$ $\qquad \tilde{X}_T = \left(X_1, X_2, \ldots, X_T\right)$

are the histories of the factors and data

Methodology – Gibbs sampling

- The priors for the implementation of algorithm were:

  - *Normal prior* for factor loadings
  - *Inverse Gamma* prior for the diagonal elements of R
  - *Normal prior* for VAR coefficients
  - *Inverse Wishart* prior for the non-zero elements of Q

Methodology – Gibbs sampling

- The factor estimates were obtained from the Kalman Filter

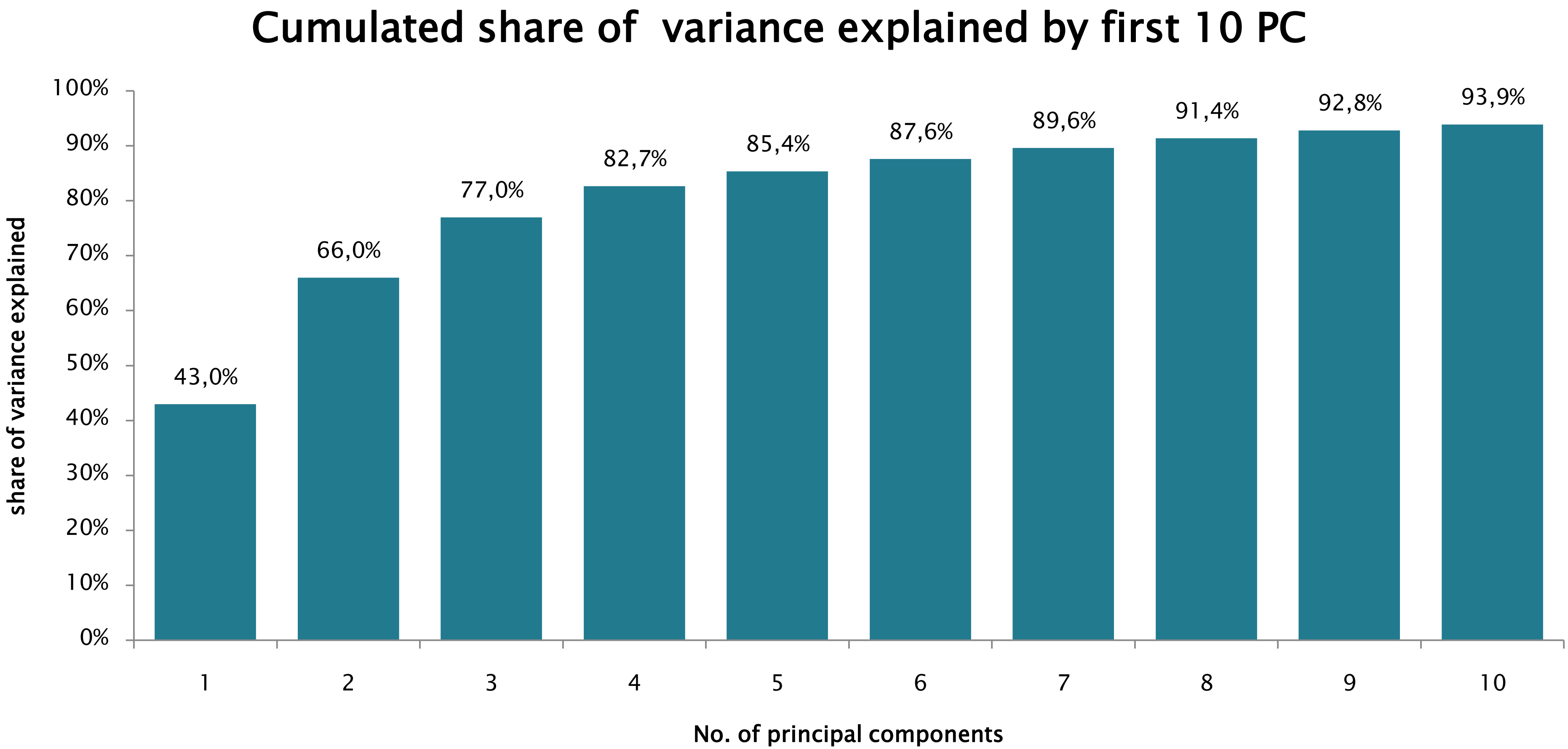
$$\bar{\boldsymbol{F}}_T \,\Big|\, \tilde{X}_T, \theta \sim N\left(\bar{\boldsymbol{F}}_{T|T}, P_{T|T}\right)$$

$$\bar{\boldsymbol{F}}_t \,\Big|\, \bar{\boldsymbol{F}}^{\bullet}_{t+1}, \tilde{X}_t, \theta \sim N\left(\bar{\boldsymbol{F}}_{t|t+1,\bar{\boldsymbol{F}}^{\bullet}_{t+1}}, P_{t|t+1,\bar{\boldsymbol{F}}^{\bullet}_{t+1}}\right)$$

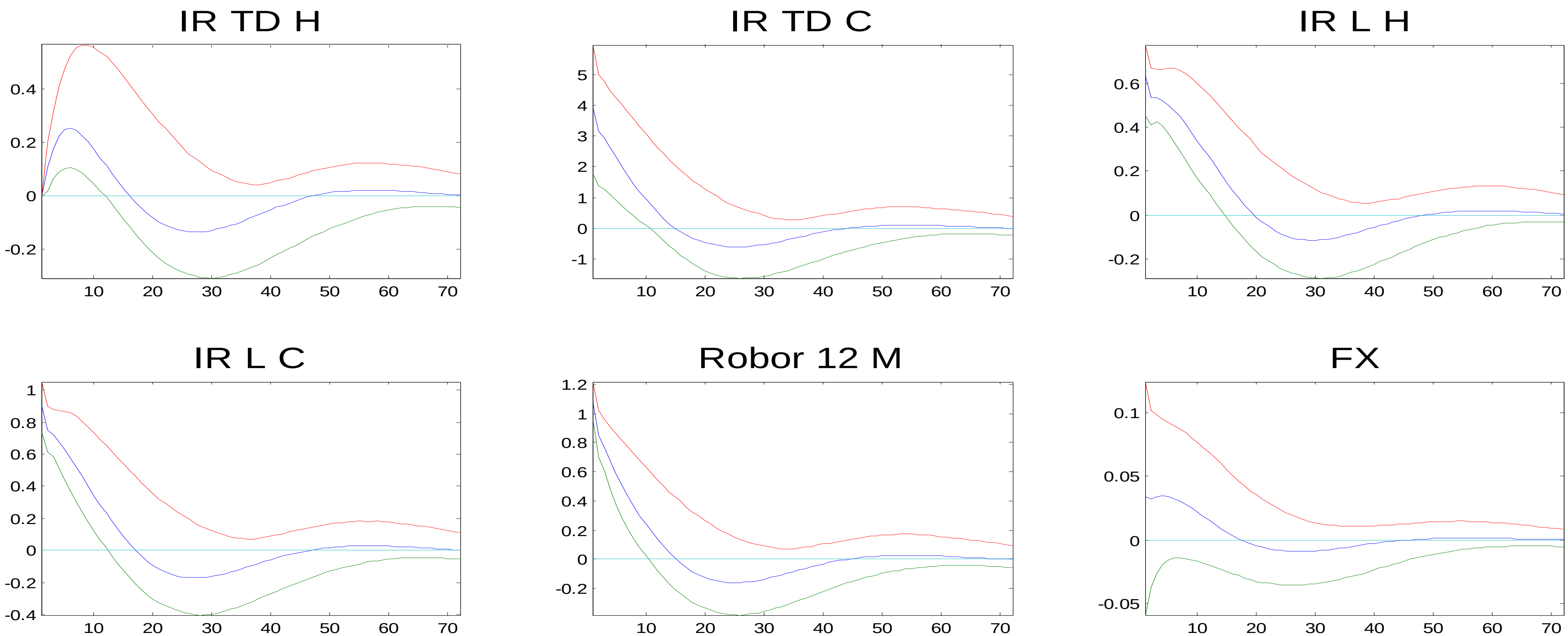
Empirical results – Data

- The data used in the analysis consists of a variety of macroeconomic variables related to real activity, prices and financial conditions
- The frequency of the data is *monthly*
- The sources of the data are: Eurostat, NBR database, NIS database
- Most series are transformed into YoY percentage changes, except for interest rates and variables originally expressed in percentages
- The sample covers the period 2008M1-2014M12 (84 observations)

Empirical results – variance explained by principal components

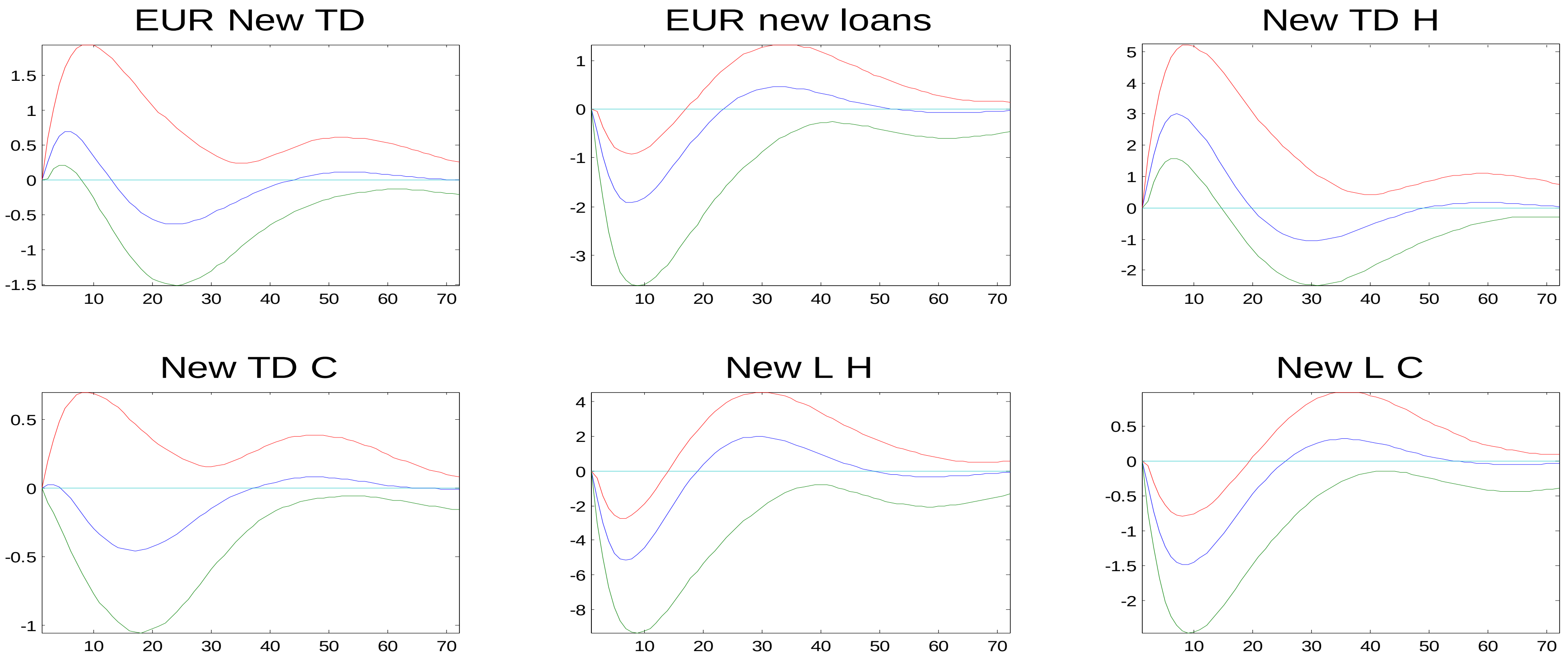


Empirical Results – IRFs for 2F-2L



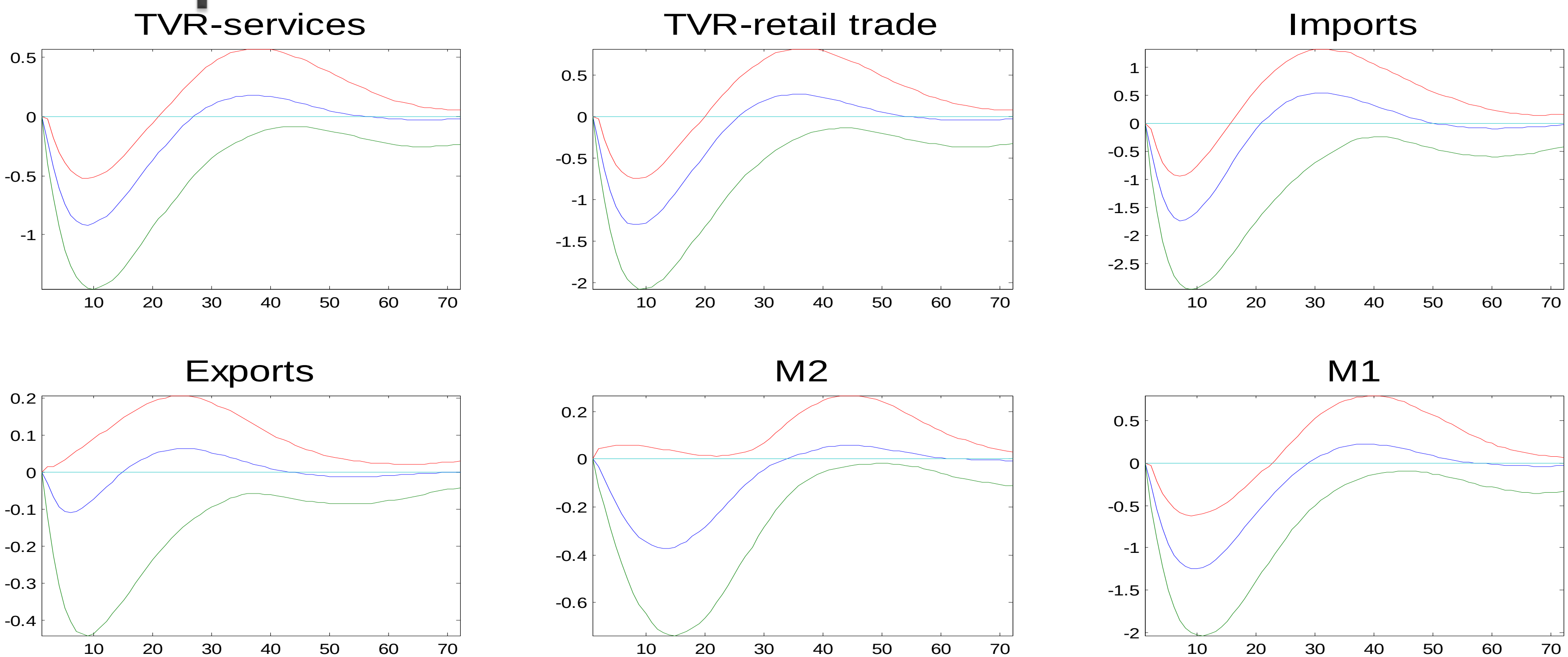
- Following the 1 st. dev. shock in the short term interest rate, all interest rates considered rise
- The response of the exchange rate seems to be different from what theory suggests

Empirical Results – IRFs for 2F-2L



- Lending slows, with decrease for household loans much more intense than in the case of corporate loans
- Higher interest rates lead to a growth in new term deposits

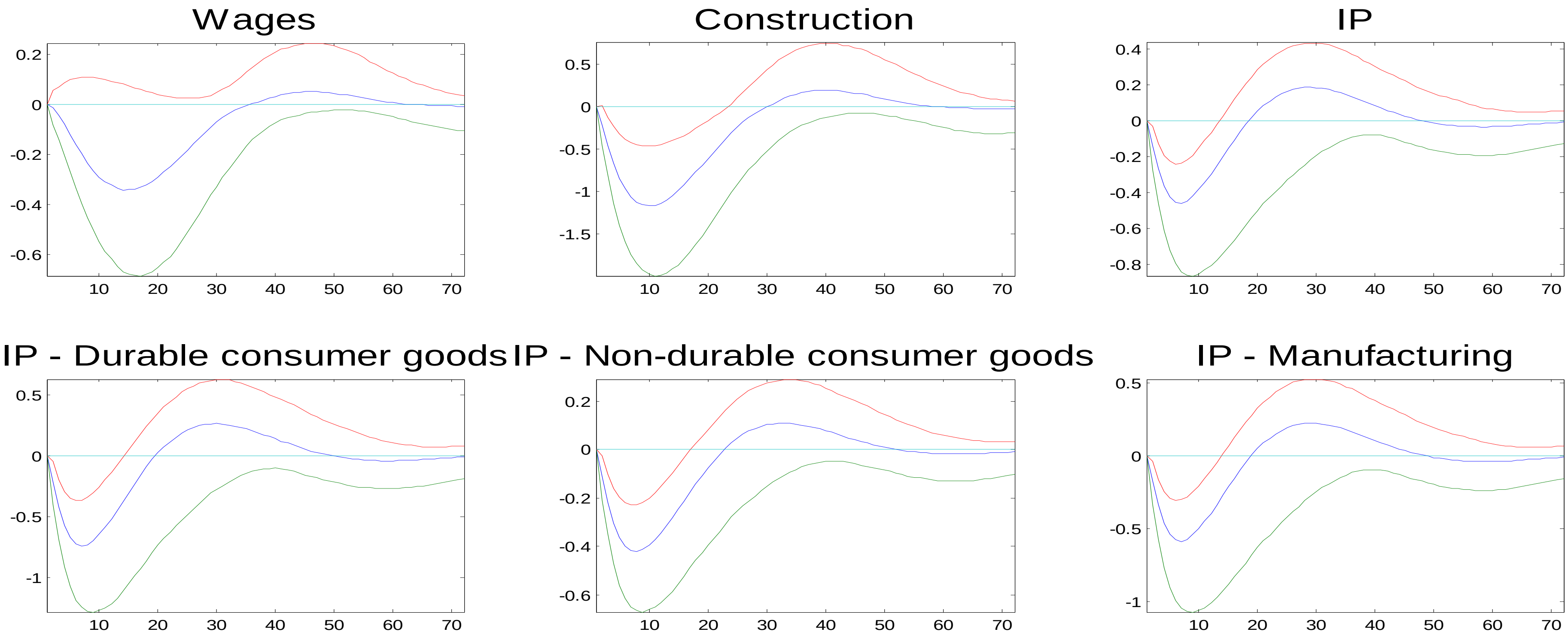
Empirical Results – IRFs for 2F-2L



•As lending decreases for both household and corporations, domestic demand indicators fall

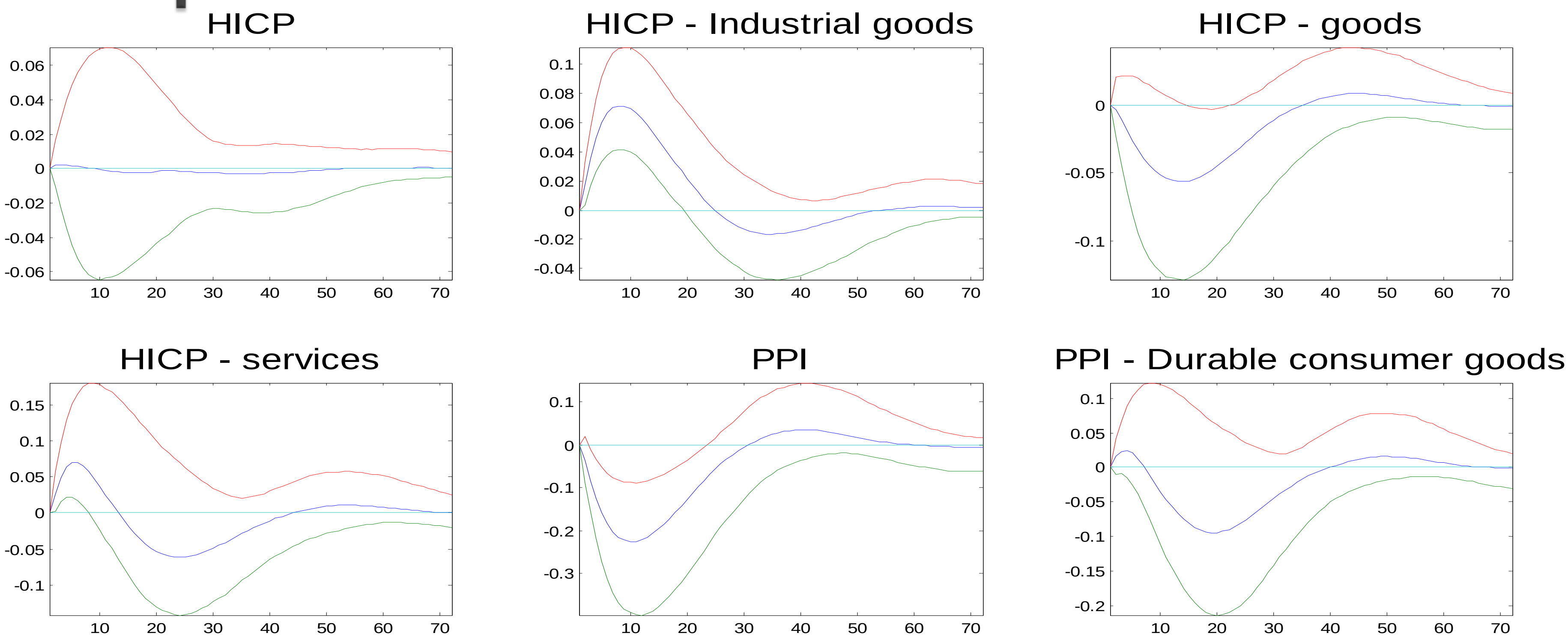
•Monetary aggregates decrease, in agreement with economic theory

Empirical Results – IRFs for 2F-2L



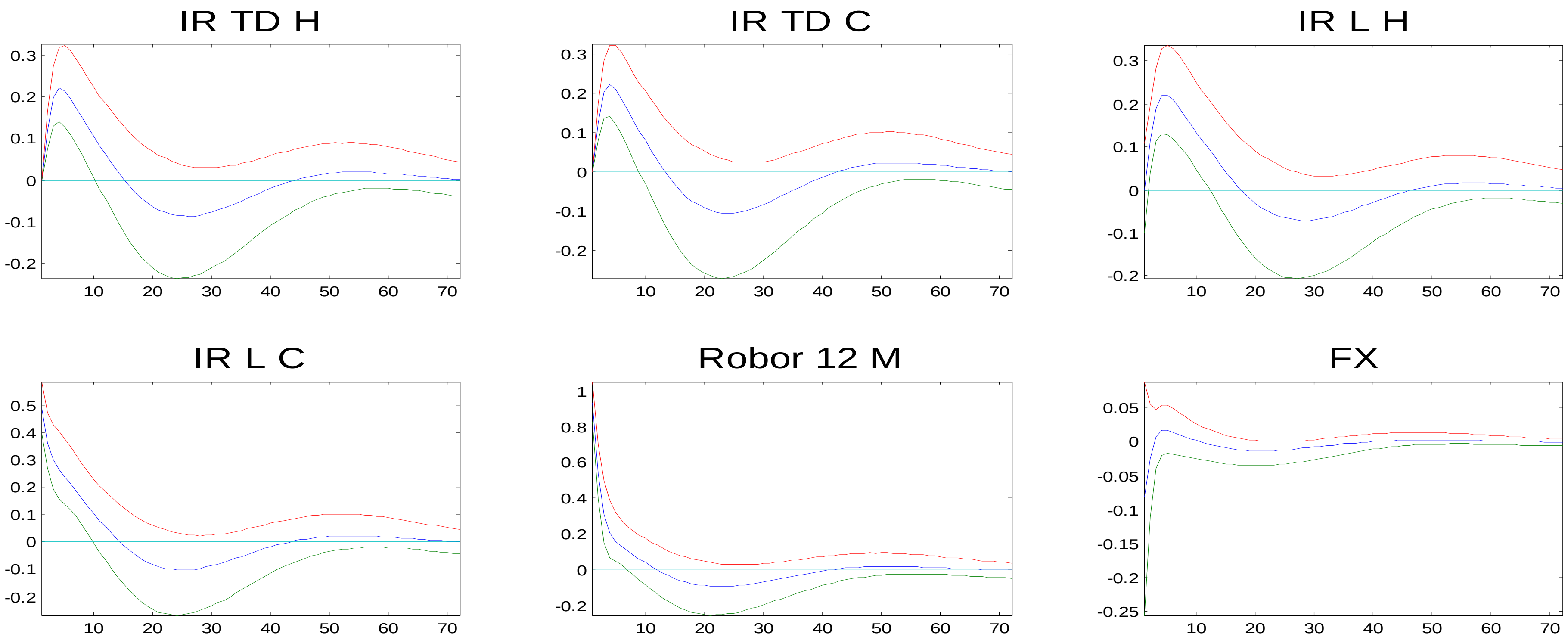
- The monetary tightening leads to an overall decrease in real activity variables, with industrial production decrease most significant for the durable consumer goods sector

Empirical Results – IRFs for 2F-2L



- Prices have diverse responses to the shock
- Responses of inflation measures not consistent with theory
- Possible explanations: important influence of shocks on the dynamics inflation for the period considered (droughts, oil shocks, tax rises)

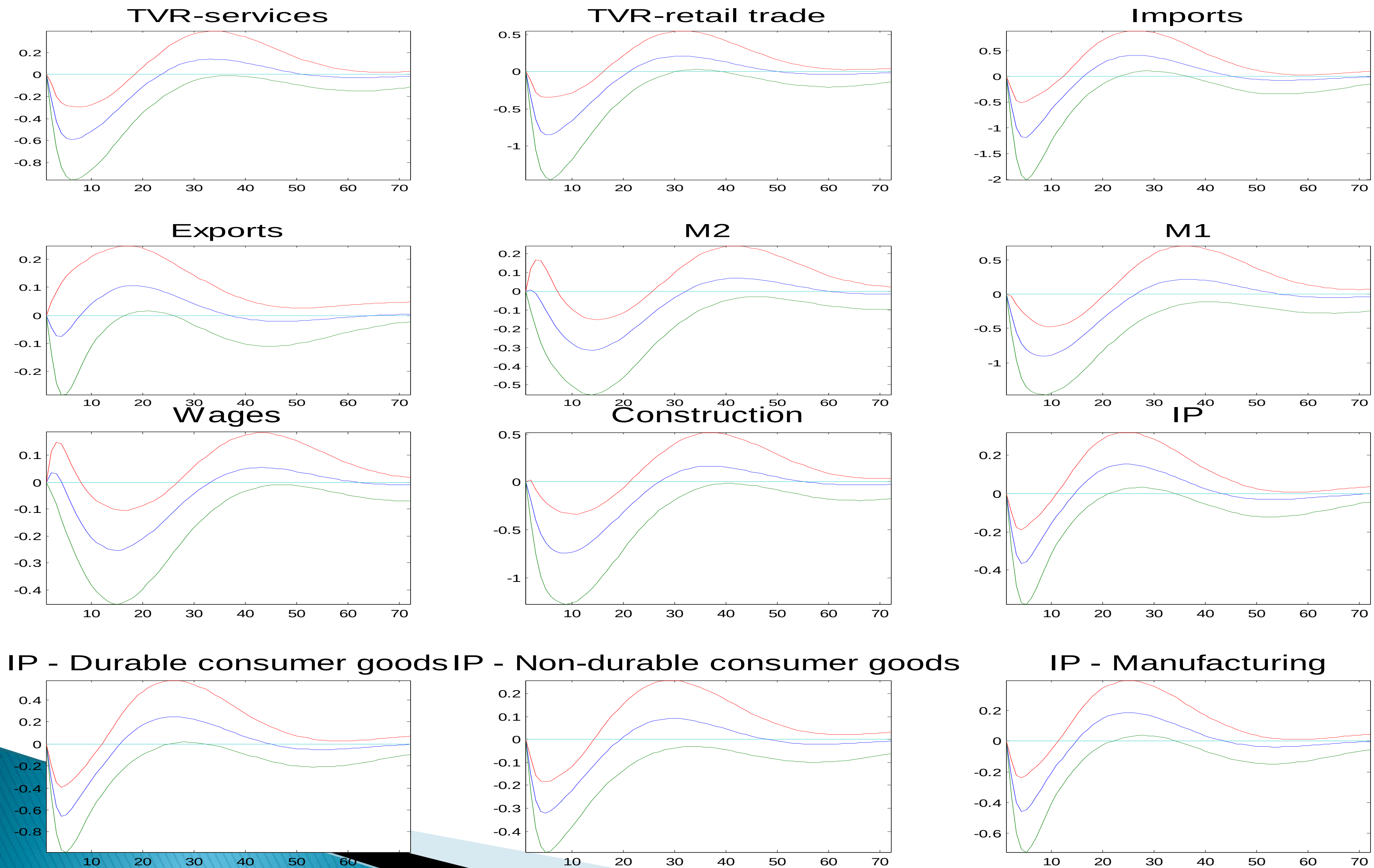
Robustness Check – 3F-2L



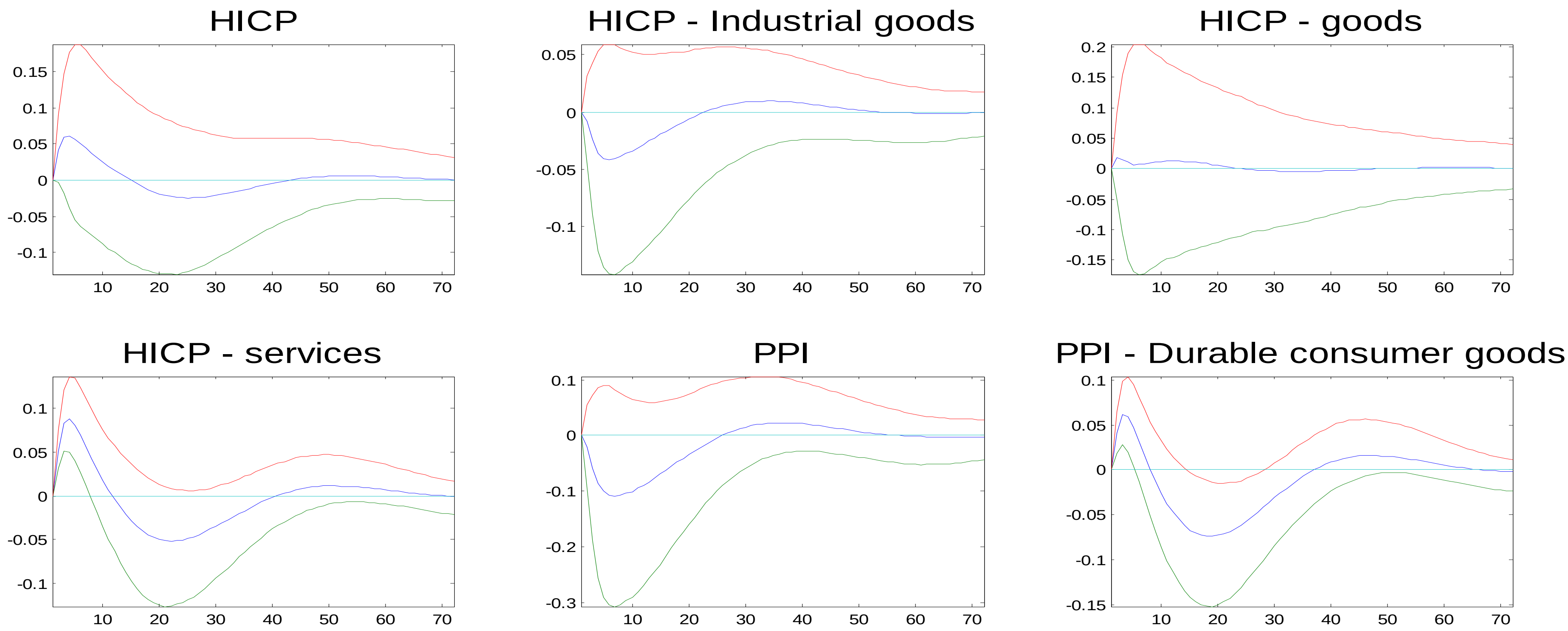
•Adding a factor does not change key results for the financial sector variables

•However, it appears that the extra factor changes the response of the exchange rate, making it economically plausible

Robustness Check – 3F-2L



Robustness Check – 3F-2L

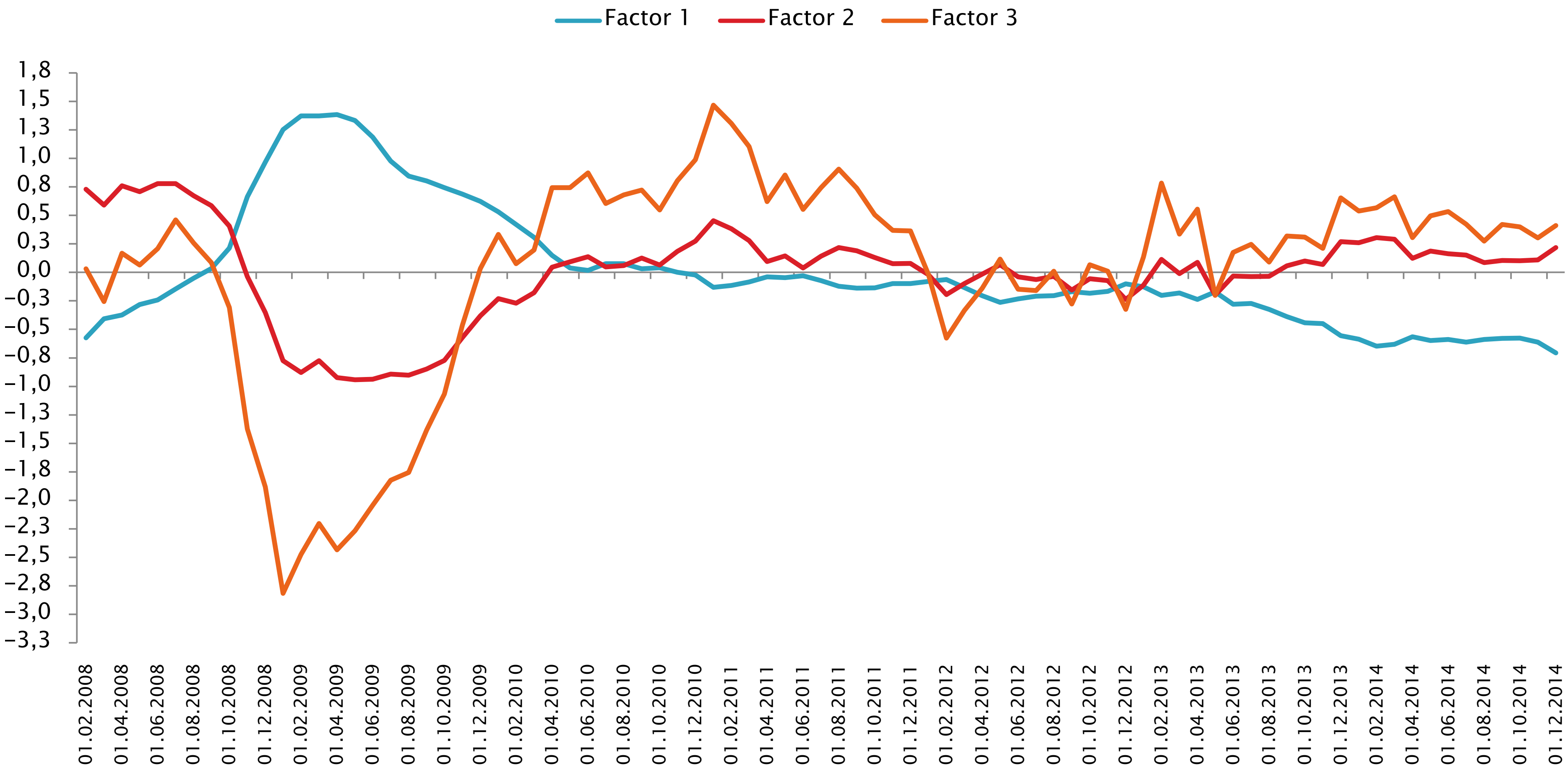


- The extra information obtained by adding a factor seems to have influenced the response of price variables, but they remain inconsistent from a theoretical point of view

Robustness Check – 3F–3L

- The model was also estimated with extra lags, and the key results were virtually the same
- In the case of an unexpected shock in the interest rate, banks adjust the interest rates they use for loans and liabilities accordingly, but with a lag for households
- The decrease in lending (due to higher costs) results in negative dynamics for domestic demand proxies
- Real economic activity decreases, with unemployment on the rise and industrial production down
- Prices do not have the expected response

3 Factors estimated via Gibbs sampling



Conclusions

- Most series respond in accordance with economic theory to a shock in the interest rate, and the results are generally robust

- Prices responses are very uncertain to interest rate shocks. Moreover, the inconsistent results also seem to be unstable. This could suggest an ineffectiveness of monetary policy in influencing inflation for the period considered

- One possible explanation resides in the fact that the sample had significant events

Drawbacks and further research directions

- Possible drawbacks: short sample, impossibility to assign economic meaning to the factors, noisy time period

- Further research: a FAVAR model with time-varying parameters, an open economy FAVAR so as to quantify the effects of external shocks on Romanian variables

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Thank you for your attention!