Academy of Economic Studies

Doctoral School of Finance and Banking

Identifying the Effects of a Monetary Shock on Romania's Economy Using Factor Augmented VAR

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Motivation

- The importance of the monetary policy, its systematic, significant and noticeable effects are a recognized fact in the contemporary economics. Any decision regarding the monetary policy is transmitted to the rest of the economy through multiple mechanisms and leads to strong, rapid and widespread effects over many variables such as prices, output and unemployment, which is, in fact, the primary objective of the monetary policy makers actions.

- The effect of a monetary policy shock on an economy is widely studied as an analysis through Auto-Regressive Vectors. In order to avoid the issues faced by the estimation of a small scale VAR model, we have assessed the effect of a monetary policy shock using the Factor Augmented VAR model, introduced by Bernanke et all. in 2005.

- We have identified the effect of the monetary shock on a wide range of Romanian macroeconomic variables and we have also compared the FAVAR results with those obtained by using a small scale VAR. The model robustness was tested to changes in the number of the unobserved factors and in the VAR variables.

Literature Review

- Sims (1980) – introduced the VAR model as a tool which is providing a coherent and credible approach to data description, forecasting, structural inference, and policy analysis. He also explained the so-called concept of “price puzzle” as a contractionary monetary policy shock which is followed by a slight increase in the price level rather than a decrease, such as standard economic theory predicts.

- Stock and Watson (1999) – showed that the dynamic factors explain the predictable variation in the major macroeconomic variables and outperform forecasting accuracy of the standard auto-regression approach. The Dynamic Factor Models were originally proposed by Geweke (1977) as a time-series extension of factor models previously developed for cross-sectional data

- Bernanke, Boivin and Eliasz (2005) – introduced the FAVAR econometric model as mix between the standard VAR model and the Dynamic Factor Model. The new model is defined as an estimation of a VAR model containing factors extracted from a large panel data by adding a number of observed variables having a persuasive effect on the economy; such as interest rate, the exchange rate or price index.

Econometric Framework

Factor Augmented Vector Auto-Regressive Model

$$\begin{bmatrix} \mathbf{F_t} \\ \mathbf{Y_t} \end{bmatrix} = \phi^*(\mathbf{L}) \begin{bmatrix} \mathbf{F_{t-1}} \\ \mathbf{Y_{t-1}} \end{bmatrix} + \mathbf{v_t} \quad \leftrightarrow \quad \phi(\mathbf{L}) \begin{bmatrix} \mathbf{F_t} \\ \mathbf{Y_t} \end{bmatrix} = \mathbf{v_t} \qquad \mathbf{v_t} \sim (\mathbf{0}, \mathbf{Q}) \qquad \text{- VAR part of the model} \qquad \mathbf{(1)}$$

$$\mathbf{X_t = \Lambda^f F_t + \Lambda^y Y_t + e_t} \qquad \mathbf{e_t \sim (0, R)} \qquad \text{- DFM part of the model} \qquad \mathbf{(2)}$$

Y_t – vector of M x 1 observable macroeconomic variables

X_t – vector of N x 1 economic time series

F_t – vector of K x 1 unobserved factors that capture most of the information contained in X_t

Λ^f – matrix of N x K factor loadings associated to the unobserved factors

Λ^y – matrix of N x M factor loadings associated to the observable factors

e_t , v_t – vector of error terms

Identification of the Factors

In order to estimate the FAVAR model (equations **(1)** and **(2)**), we will follow the "two-step" principal components approach. In the first step, C(Ft, Yt) is estimated using the first K + M principal components of Xt → C'(Ft, Yt); in the second step, equation **(1)** is estimated replacing Ft with Ft'.

The economic time series are divided into "slow-moving" and "fast-moving" series.

$\mathbf{C'(F_t, Y_t) = aC'^{*}(F_t) + bY_t + u_t}$ – the estimated common componenets $C'(F_t, Y_t)$ are regressed on the estimated „slow-moving" factors $C'^{*}(F_t)$ and on the observed variables Y_t

$\mathbf{F_t' = C'(F_t, Y_t) - b'Y_t}$ – F_t' is calculated as difference between $C'(F_t, Y_t)$ and $b'Y_t$

Data

- The analysis is based on monthly data covering the period August 2005 – December 2014. We collected 106 macroeconomic time series and the sources of data are Eurostat, National Bank of Romania, Bank of International Settlements and Bucharest Stock Exchange.

- The series were chosen from the following categories: real output, employment, prices, industrial turnover, exchange rates, interest rates, stock prices, balance of payments and external trade.

- The data were processed in four stages:

1) seasonally adjusted (through X-12 ARIMA and TRAMO/SEATS the ones from Eurostat)
2) expressed in real terms and transformed into index (in order to have consistency regarding the measuring scale)
3) transformed to account for stochastic or deterministic trends (the tests used are Augmented Dickey Fuller (ADF) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS))
4) standardized to have mean zero and unit variance (typical especially for principal component analysis)

Empirical Results

Figure 1 Cumulated Share Variance Explained by the First Eight Factors

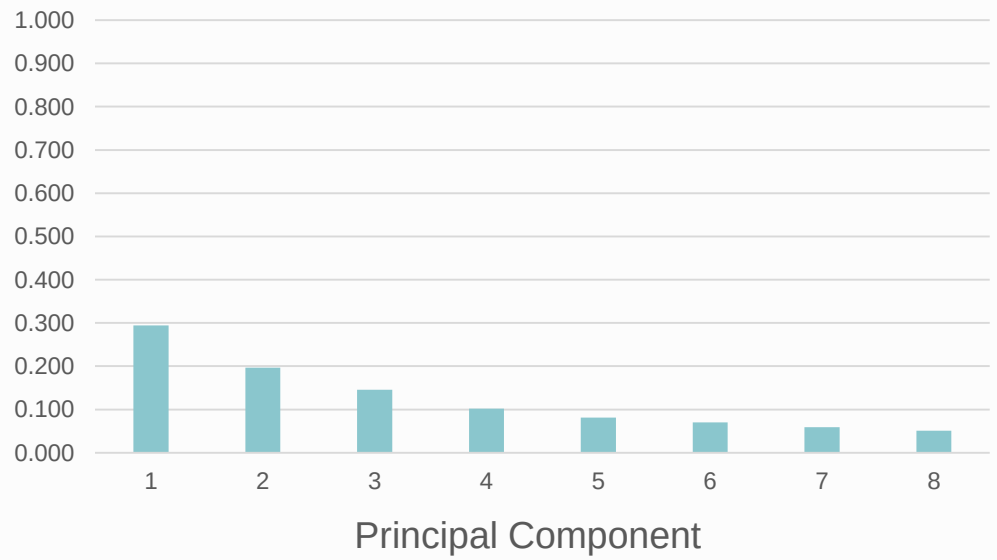
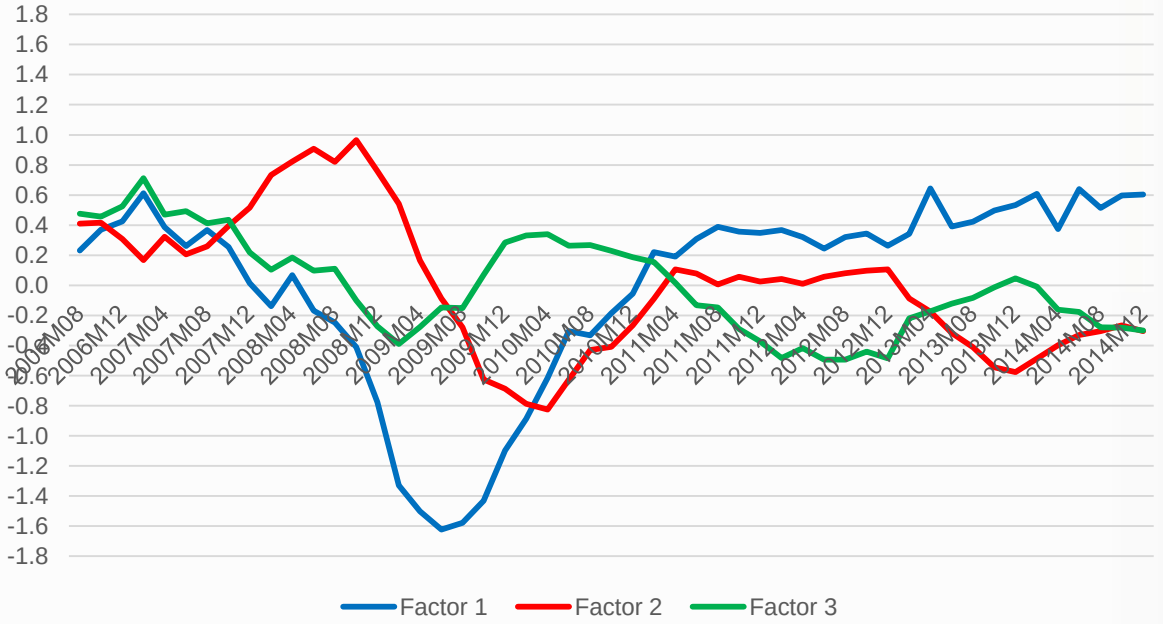
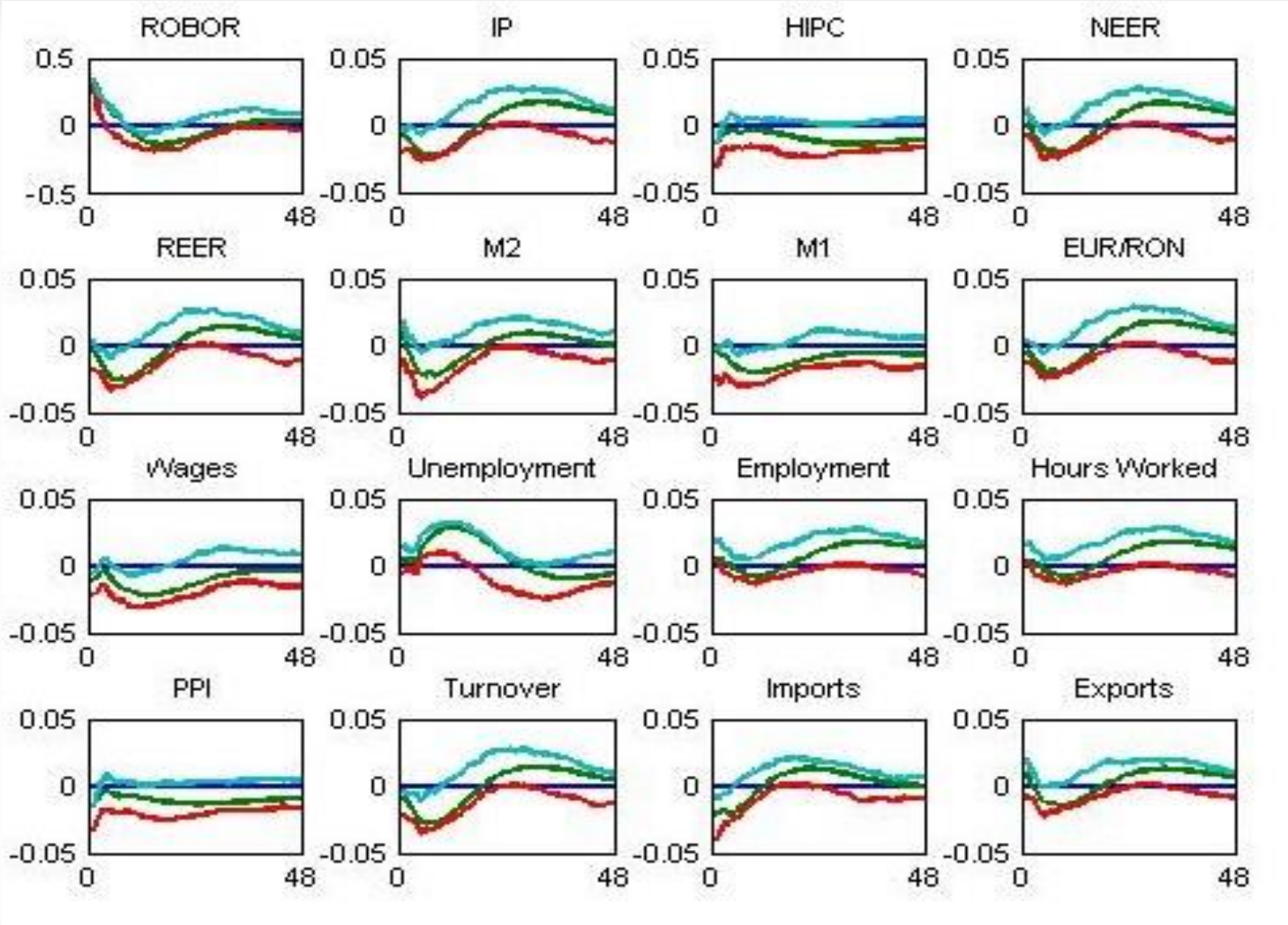


Figure 2 Monthly Variable Loadings on the First Three Principal Components

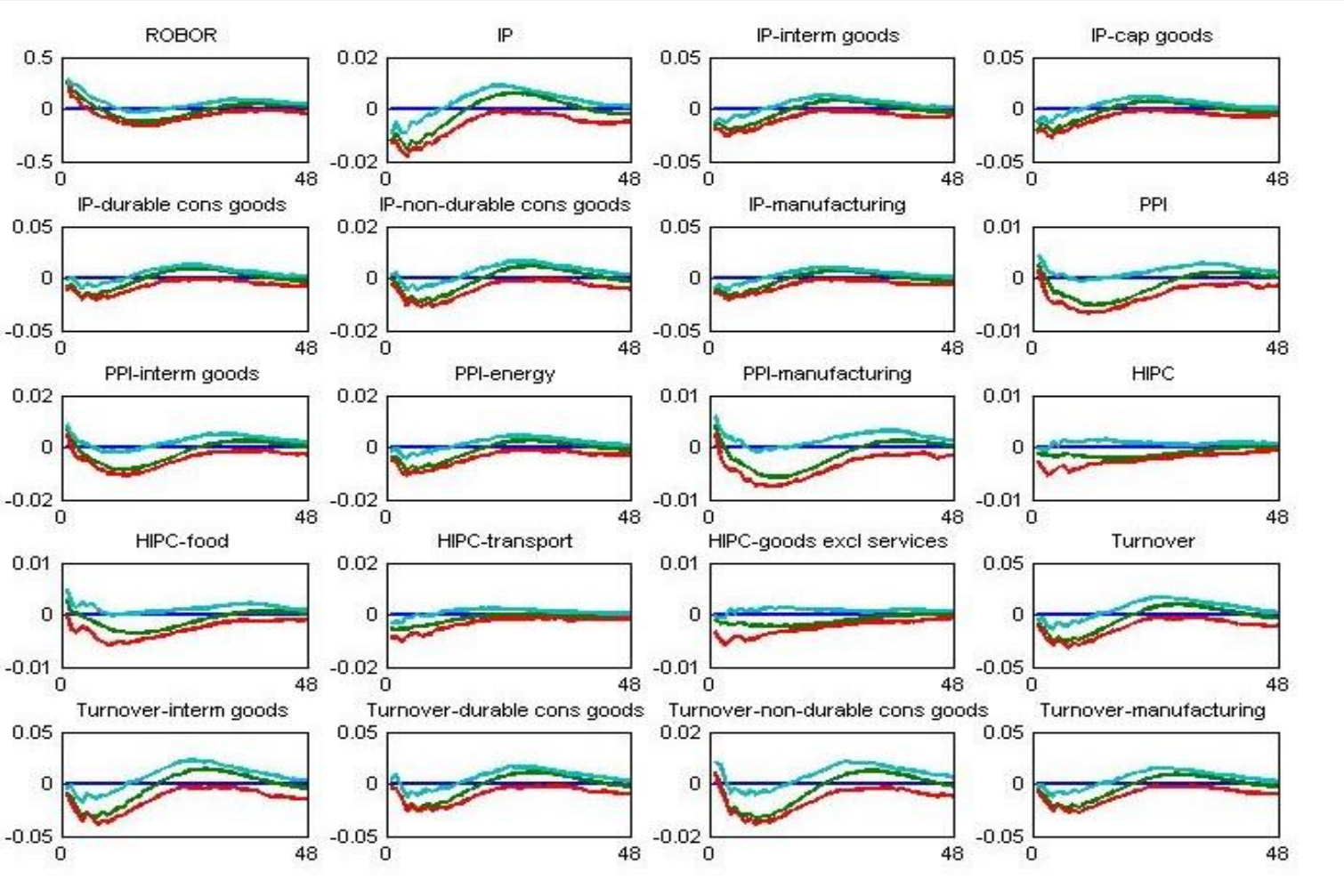


Impulse Responses to a Positive Monetary Shock
(Y_t = IP, HIPC, ROBOR 3M; K = 3)



- The reaction to an unexpected increase in the interest rate is in line with theoretical expectations.
- We observe a "price puzzle" in the response of HIPC.
- The relationship between the exchange rate and the external trade in explained by the unexpected change in the interest rate.
- Regarding the responses for the employment sector, we observe a correlation between the categories included in our analysis.

Impulse Responses to a Positive Monetary Shock
(Yt = IP, HIPC, ROBOR 3M; K = 3)

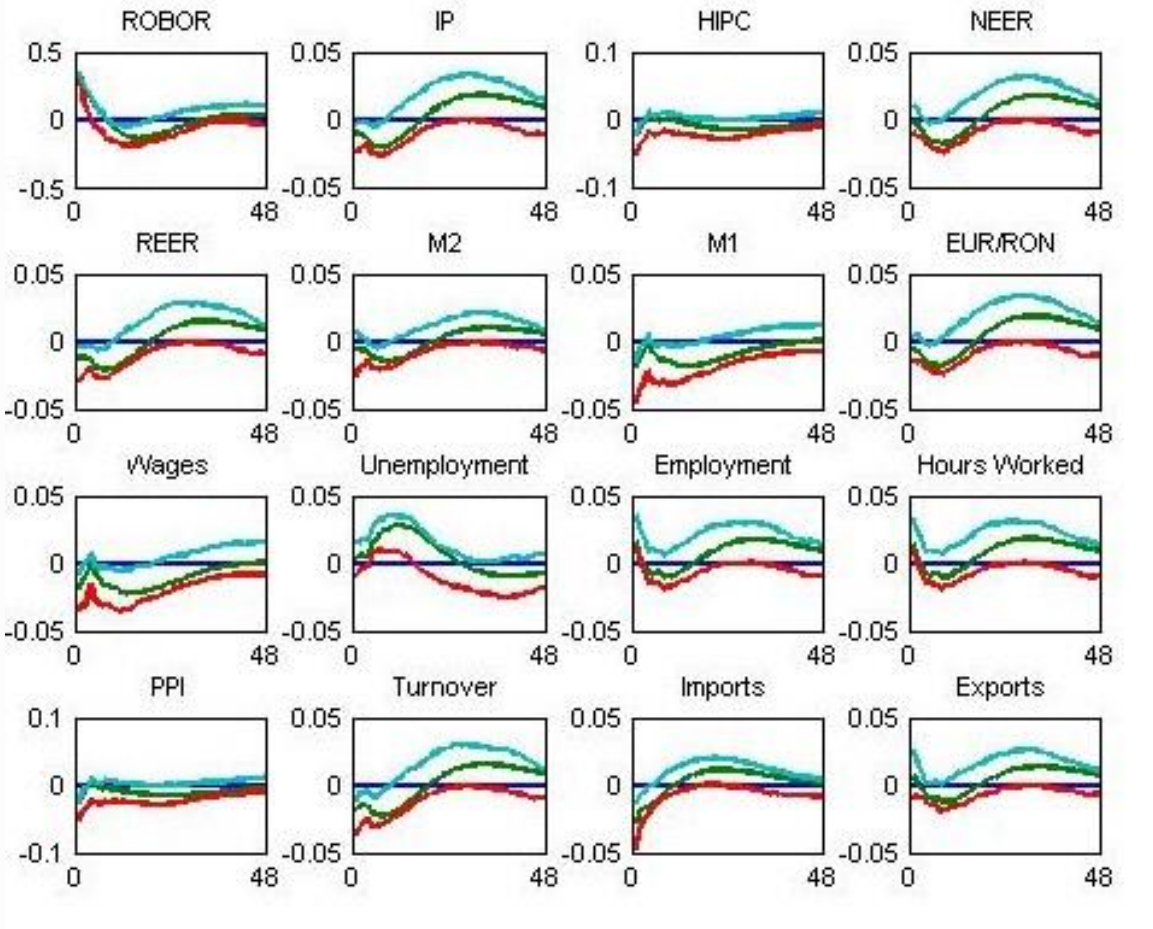


- The shock felt in total output is explained mainly by the industrial production of intermediate goods, and non-durable goods
- The fall in the producer price index is mainly explained by the price index of intermediate goods and manufacturing.
- The response of the HIPC from the food sector shows no “price puzzle”.
- The reaction of turnover is explained by all the categories selected, and the one from intermediate goods seems to have the highest impact.

Robustness Check

Impulse Responses to a Positive Monetary Shock

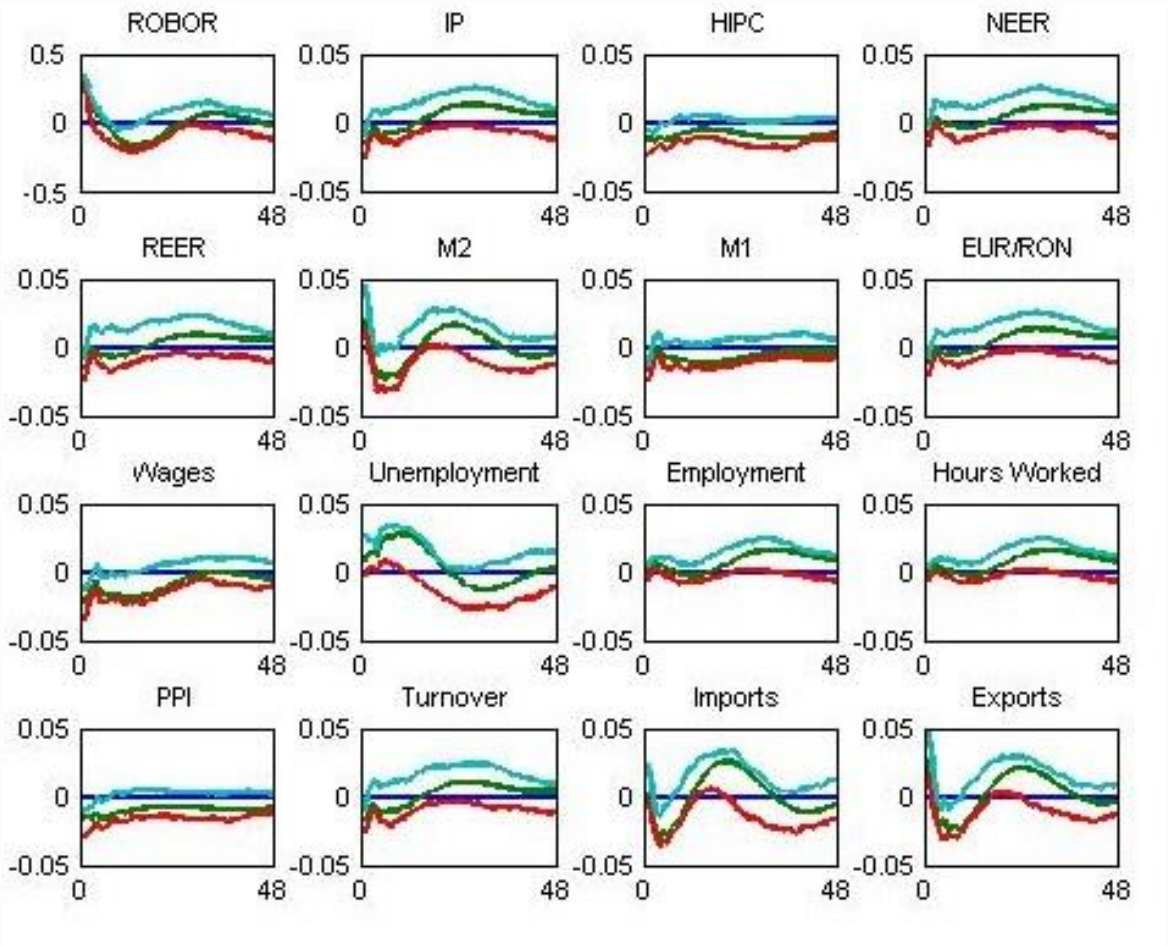
K=2; (Y = IP, HIPC, ROBOR)



Robustness Check

Impulse Responses to a Positive Monetary Shock

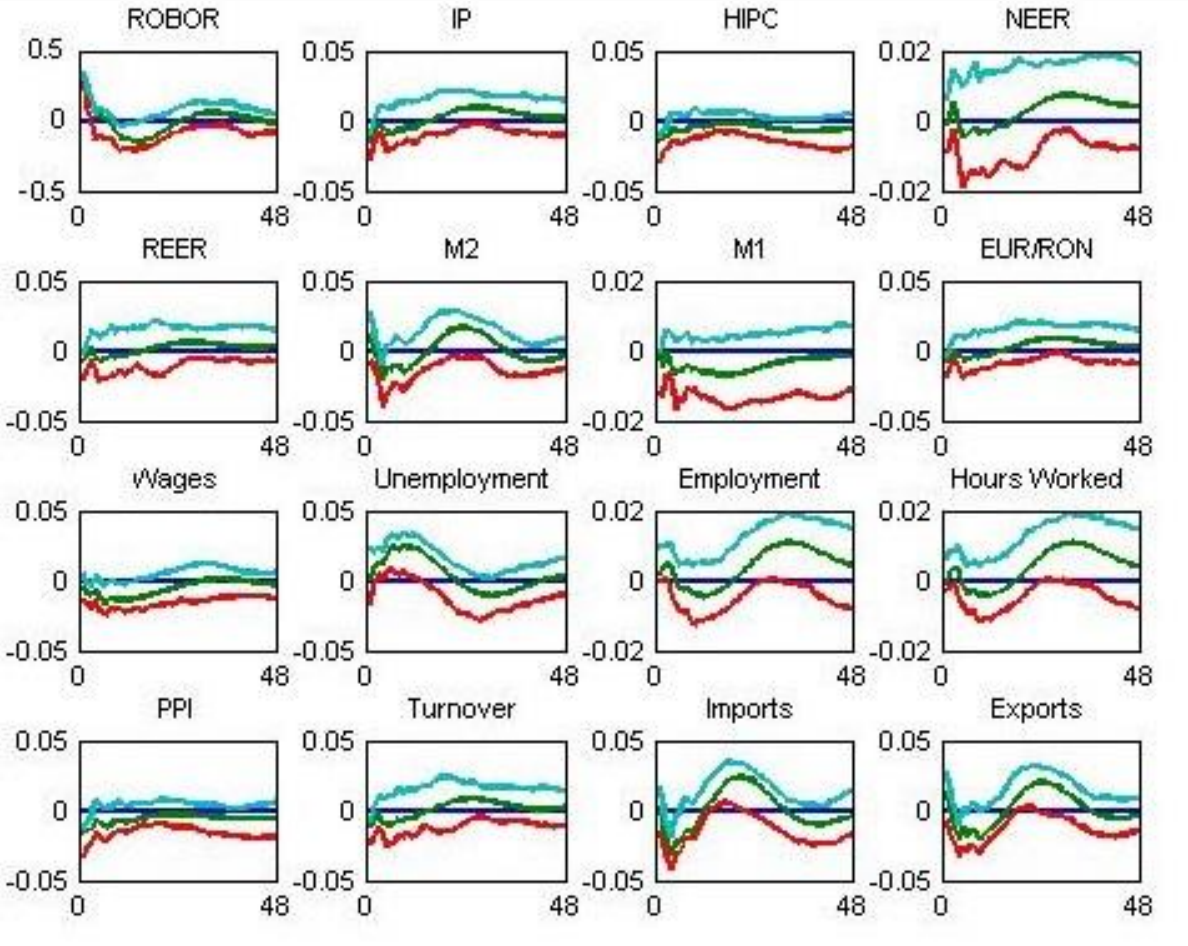
K=4; (Y = IP, HIPC, ROBOR)



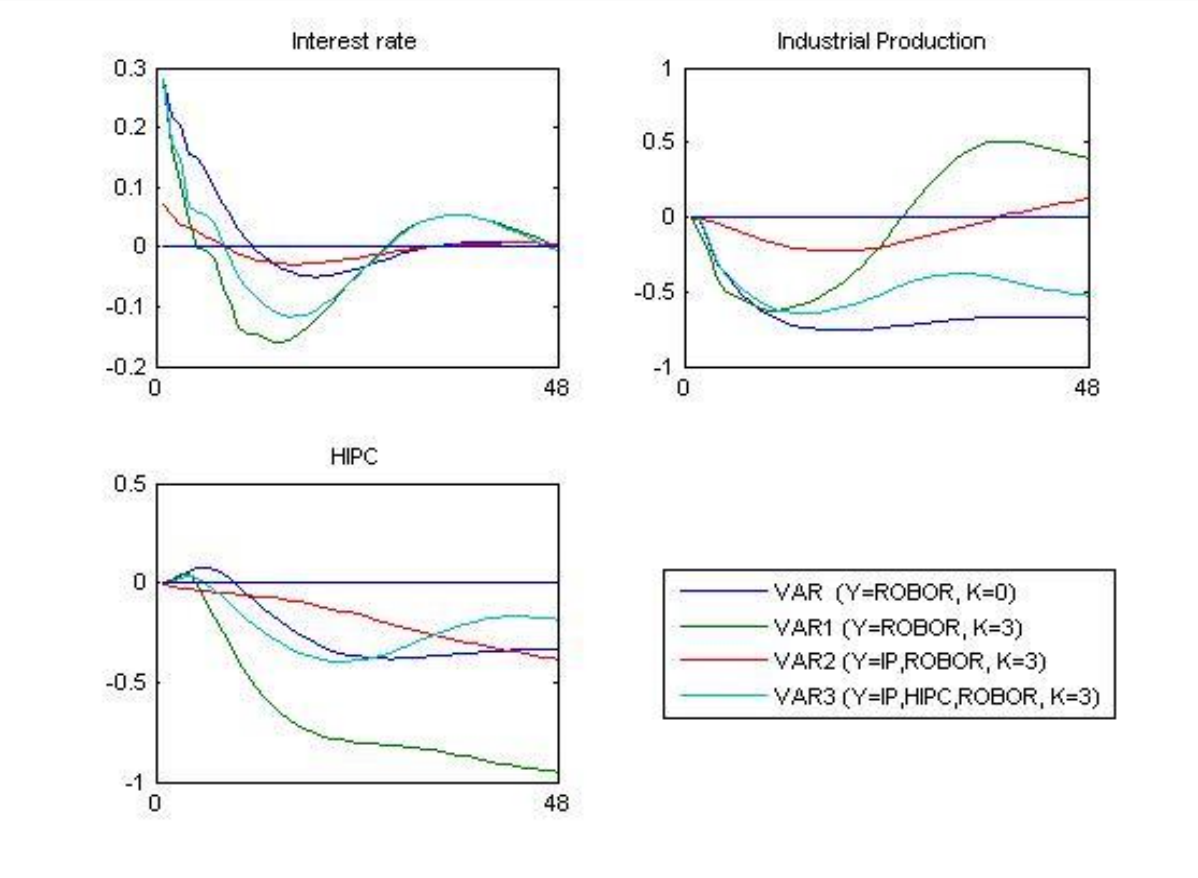
Robustness Check

Impulse Responses to a Positive Monetary Shock

K=5; (Y = IP, HIPC, ROBOR)



VAR – FAVAR Comparison



- The peak impact on output occurs almost 10 months after the shock and it is about 0.06 percent.
- The "price puzzle" can be observed in the responses of the HIPC. The concept is eliminated by estimating two models having the interest rate and / or the industrial production as observable variables in the Y vector.
- The basic remark given by the comparison is that the FAVAR model is successful in extracting relevant information from a large set of macroeconomic indicators.

Conclusions

- The impulse response functions obtained are generally in line with the available literature and are consistent with the conventional results.
- Including additional information through factors eliminates the “price puzzle” once we choose to use less observable factors and a number of unobserved factors with high explanatory power.
- Investments decrease in favor of savings at a higher interest rate, leading to a decrease in output; the level of imports increase and the one of exports decrease also following the appreciation of the national currency due to an increased demand for it once the level of the interest rate is increased.
- The production indexes are decreasing which is an expected behavior since the costs for the companies to continue with their activity are higher, as investments become less attractive.

Improvements

- Using the alternative method for estimating the FAVAR model (by Bayesian likelihood methods and Gibbs sampling in order to estimate the factors) or by using signs restrictions on variables.

- Study the dynamic effect on Romania's economy of an unanticipated increase in the short-term interest rate in the Euro Area / European Union, thus measure the international monetary policy shock transmission.

- Adding as observable variables time series for the credit sector. We could also take into account the consumer expectations index or the confidence index for different sectors or for the economy as a whole.

Thank you for your attention!

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