Predicting Brazil's economic indicators: a two model comparison

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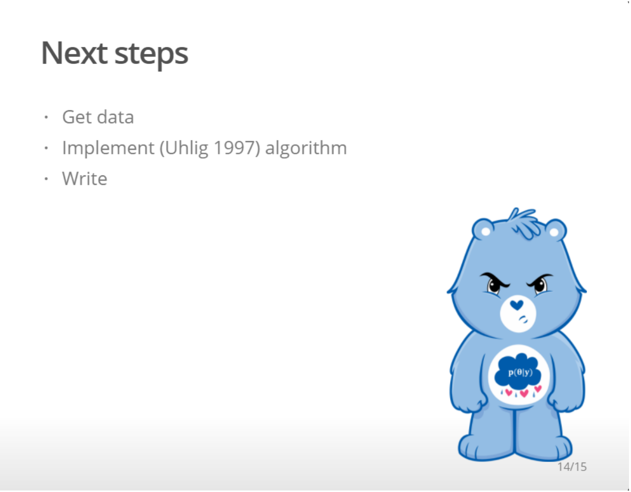
UFSC - PPGECO

Bayesian Econometrics - Seminar 2

04 July 2017

Previously...

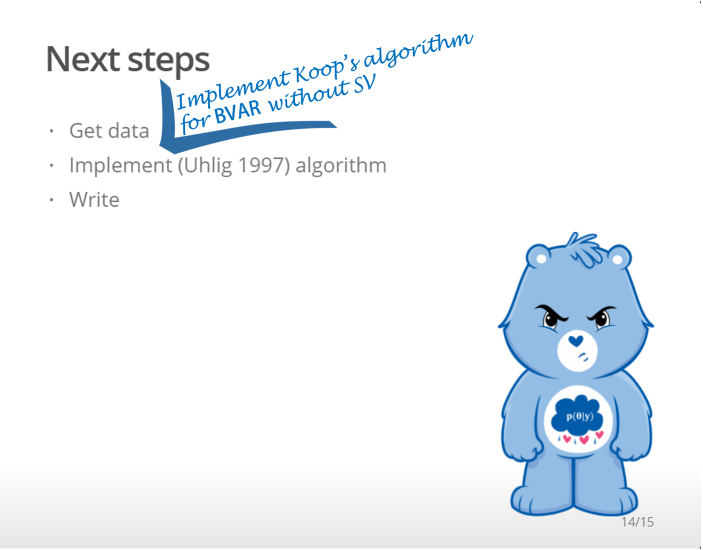
On Bayesian Econometrics Seminar 01



Last slide from the previous seminar (prior)

Previously...

On Bayesian Econometrics Seminar 01



Last slide from the previous seminar (posterior)

Contents

Motivation

- ~~Bayesian VARs are pretty awesome~~
- "*Relatively simple and inexpensive to use*" [Litterman, 1986]
  - Tend to generate good predictions
  - Allow to give probabilities to different economic theories instead of using only one
  - There is no tradeoff between DF and the number of explanatory variables
- Don not impose restrictions on the parameters [Bańbura et al., 2008]
  - This allows to capture complex data relationships

Objective

To compare the predictions from simple BVAR and the BVAR with stochastic volatility for 1, 3 and 12 months ahead.

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To compare the predictions from simple BVAR and the BVAR with stochastic volatility for 1, 3 and 12 months ahead.

Data description

- 4 variables:
  - **IBC-Br** (*index, monthly, without seas. adj.* - BACEN)
  - **IPCA** (*index, monthly* - IBGE)
  - **SELIC** (*%, monthly, over.* - BACEN)
  - **Exchange Rate** (*R$/US$, monthly, com., buy, average* - BACEN)
- Range: from 01/2003 to 04/2017
- Transformation: raw data became index w/ base in 01/2003 and annual variations were calculated
- Lags: 1
- Forecasting: 3 steps

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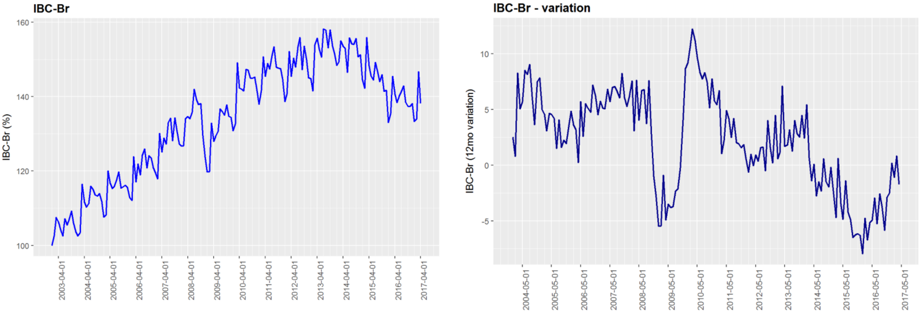
Data description[1]

IBC-Br

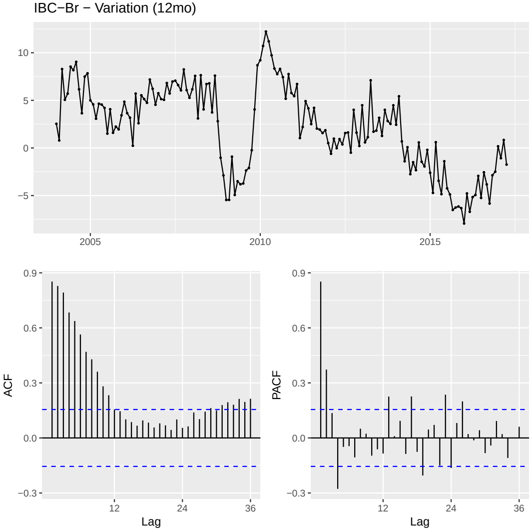


IBC-Br raw (left) and annual var. (right)

[1] Codes are available in Aisha's github repo.

Data description

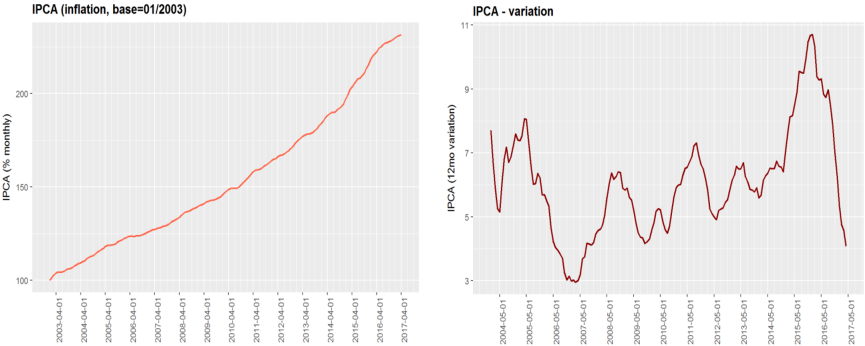
IBC-Br



ACF and PACF for IBC-Br (an. var.)

Data description

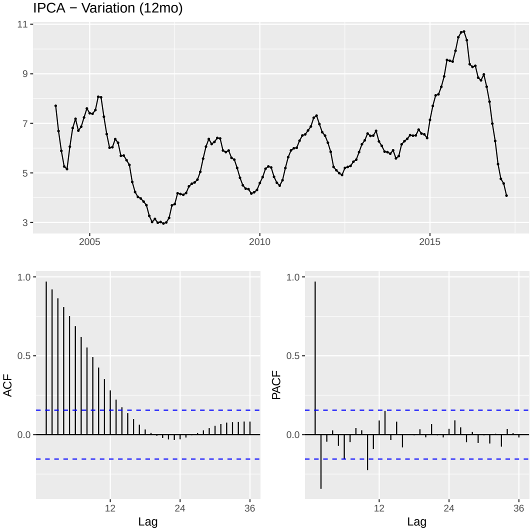
IPCA



IPCA raw (left) and annual var. (right)

Data description

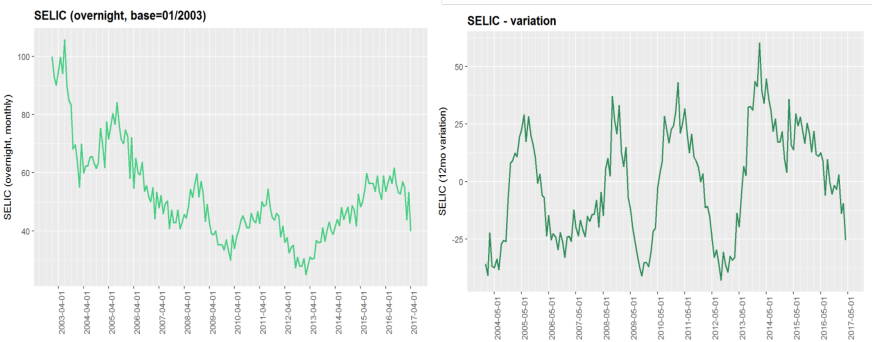
IPCA



ACF and PACF for IPCA (an. var.)

Data description

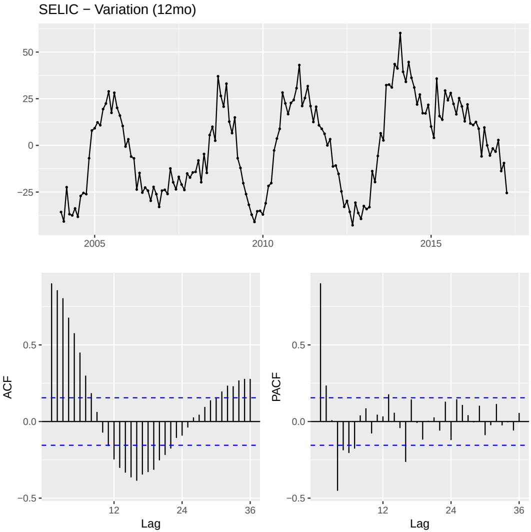
SELIC



SELIC raw (left) and annual var. (right)

Data description

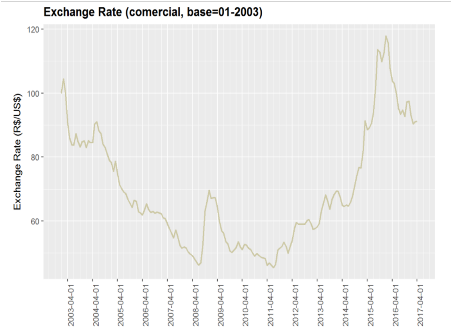
SELIC

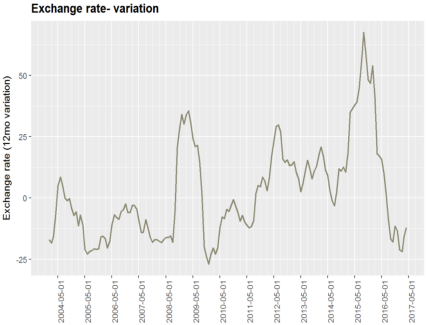


ACF and PACF for SELIC (an. var.)

Data description

Exchange rate

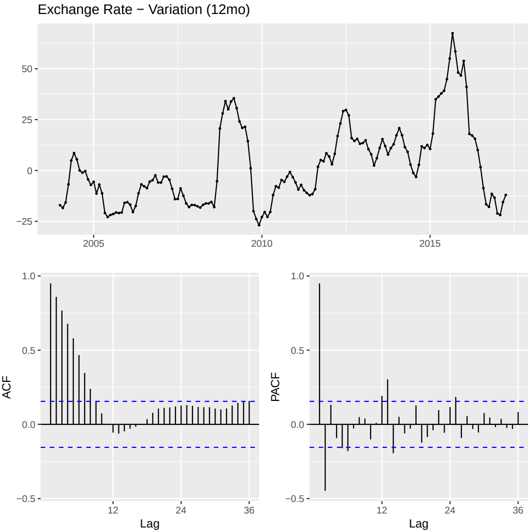




Ex. rate raw (left) and annual var. (right)

Data description

Exchange rate



ACF and PACF for Ex. Rate (an. var.)

Data description

Statistic	N	Mean	St. Dev.	Min	Max
IBC-Br	160	136.08	14.00	102.54	158.22
IBC-Br (12mo var)*	160	2.20	4.44	–7.94	12.23
IPCA	160	158.41	35.60	107.71	231.50
IPCA (12mo var)	160	6.06	1.67	2.96	10.71
SELIC	160	49.41	12.34	25.02	84.13
SELIC (12mo var)*	160	–0.75	24.09	–42.77	60.18
Ex. rate	160	67.80	17.66	45.47	117.86
Ex. rate (12mo var)*	160	2.20	19.69	–26.91	67.47

* Rejected the null hypothesis of non-stationarity using ADF test with 5 lags and $\alpha = 0.05$.

BVAR

Model

- We can write the VAR model using a multivariate regression model system:

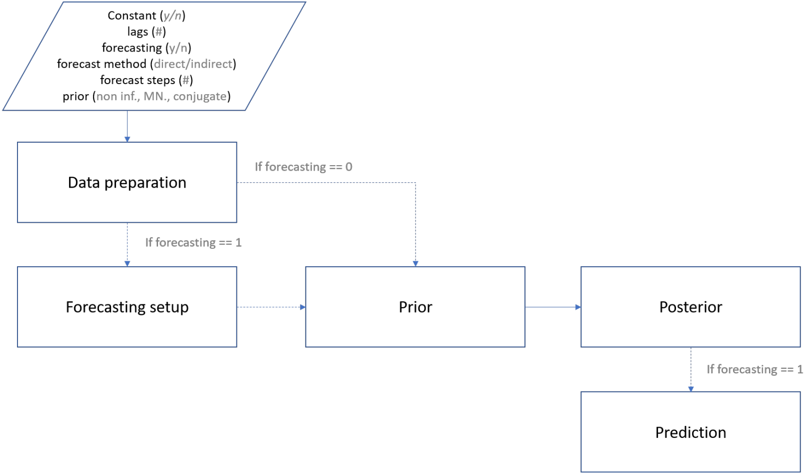
$$Y_t = \beta_{(0)} C_t + \underbrace{\beta_{(1)} Y_{t-1} + \ldots + \beta_{(k)} Y_{t-k}}_{B' X_t} + \epsilon_t \qquad \epsilon_t \sim I\mathcal{N}(0, \Sigma) \qquad (1)$$

- So, using the data, the model (for one lag) is given by:

$$\begin{bmatrix} \text{IBCBr}_t \\ \text{IPCA}_t \\ \text{SELIC}_t \\ \text{CAM}_t \end{bmatrix} = \underbrace{\begin{bmatrix} \phi_0^{\text{IBCBr}_t} \\ \phi_0^{\text{IPCA}_t} \\ \phi_0^{\text{SELIC}_t} \\ \phi_0^{\text{CAM}_t} \end{bmatrix}}_{\beta_{(0)} C_t} + \underbrace{\begin{bmatrix} \phi_{11} & \phi_{12} & \phi_{13} & \phi_{14} \\ \phi_{21} & \phi_{22} & \phi_{23} & \phi_{24} \\ \phi_{31} & \phi_{32} & \phi_{33} & \phi_{34} \\ \phi_{41} & \phi_{42} & \phi_{43} & \phi_{44} \end{bmatrix} \begin{bmatrix} \text{IBCBr}_{t-1} \\ \text{IPCA}_{t-1} \\ \text{SELIC}_{t-1} \\ \text{CAM}_{t-1} \end{bmatrix}}_{B' X_t} + \begin{bmatrix} \epsilon_t^{\text{IBCBr}_t} \\ \epsilon_t^{\text{IPCA}_t} \\ \epsilon_t^{\text{SELIC}_t} \\ \epsilon_t^{\text{CAM}_t} \end{bmatrix}$$

BVAR

Code structure[2]

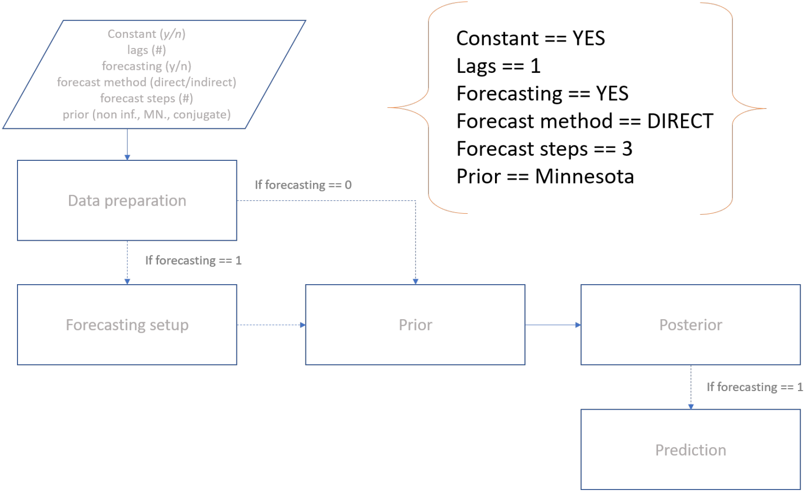


Koop's code structure

[2] Codes are available in Aisha's github repo.

BVAR

Code structure[3]



Algorithm's setup used in this work

[3] Codes are available in Aisha's github repo.

BVAR

Minnesota Prior

OLS estimators

↓

Hyperparameters for the variance of α

$$\bar{\alpha}_1 = \bar{\alpha}_2 = 0.5$$
$$\bar{\alpha}_3 = 10^2$$

→

Estimate four AR(1)

↓

Calculate

$$\underline{V}_{i_{jj}} = \begin{cases} a_1 / r^2 & \text{for own variable coef. where r is the lag} \\ a_2 / r^2 \; \sigma_{ii} / \sigma_{jj} & \text{for coef. with lag r from variable j in equation i} \\ \alpha_3 \sigma_{ii} & \text{for exogenous' variables coef.} \end{cases}$$

Minnesota Prior structure

BVAR Results

Posterior

- Posterior means

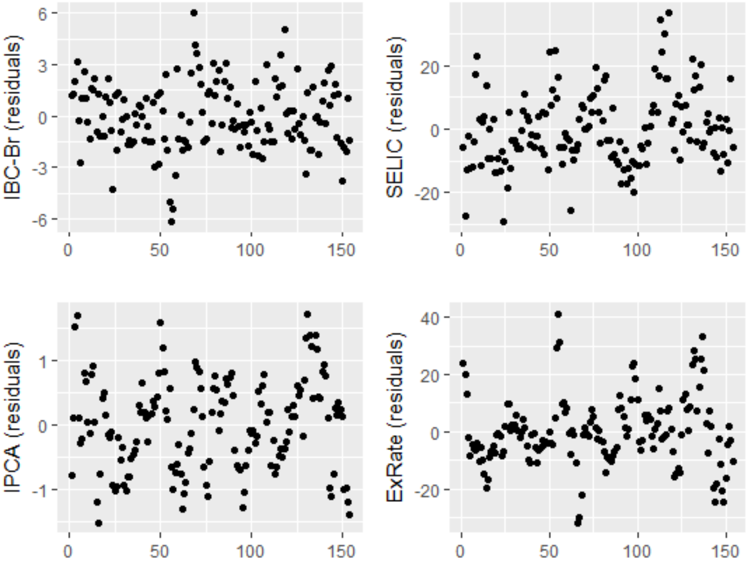
	IBC-Br	IPCA	SELIC	EXRate
Cons	3,61	0,05	-26,98	-2,48
IBC-Br$_{-1}$	0,47	0,08	1,91	0,50
IPCA$_{-1}$	-0,39	0,88	3,77	0,30
SELIC$_{-1}$	-0,05	0,00	0,76	0,10
EXRate$_{-1}$	-0,06	0,02	0,04	0,81

$$\alpha | Y, \widehat{\Sigma} \sim \mathcal{N}(\bar{\alpha}_{MN}, \bar{V}_{MN})$$

$$\bar{\alpha}_{MN} = \bar{V}_{MN} \left[\underline{V}_{MN}^{-1} \underline{\alpha}_{MN} + \left(\widehat{\Sigma}^{-1} \otimes X \right)' Y \right]$$

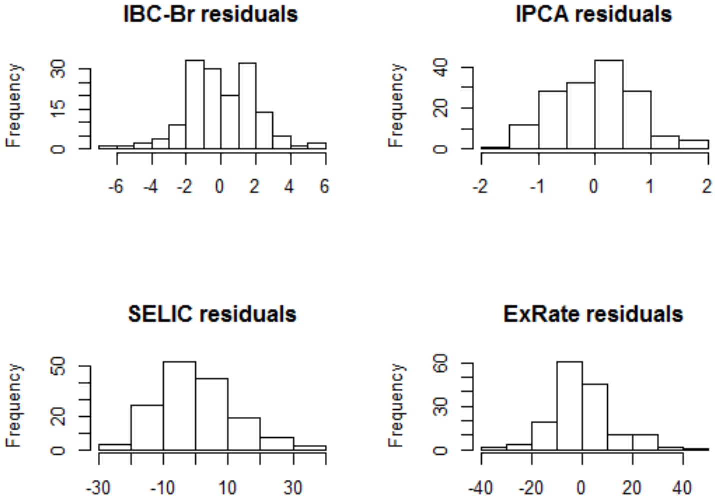
BVAR

Residuals



BVAR

Residuals



Next Steps

1. ~~Get data~~
2. ~~Implement the BVAR model~~
3. Implement Uhlig's model
4. (Understand and) Compare results
5. Write

References I

Bańbura, M., Giannone, D., and Reichlin, L. (2008).
Large bayesian VARs.
Working Paper - European Central Bank.

Litterman, R. (1986).
Forecasting with bayesian vector autoregressions — five years of experience.
International Journal of Forecasting, 2(4):497–498.