VAR model—the impact of a macroeconomic policy on inflation and economic activity

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This classes are based on:


You can find link to this article as well as the data for the classes on the web pages www.wne.uw.edu.pl/~krogiak or www.wne.uw.edu.pl/~pwojciek. You should copy BASICS.wf1 and VAR_rusek.wf1 into chosen folder.

1 Macroeconometric background

The purpose of the cited paper is to investigate the impact of a macroeconomic policy regime on inflation and economic activity. Because they analyse the country in transition (where dynamism of changes makes it difficult to identify the relevant relationships), authors refrain from using structural model and as alternative they use VAR model.

Questions to the paper:

1. What are the results of structural change in demand inherent in the first phase of transition process and what is the explanation for them?

2. What could be the outcomes for inflation and output of too loose and too restrictive policy of determination of nominal level of aggregate demand?

2 Econometric analysis in Eviews

Definition (VAR model): set of linear dynamic equations where each variable is specified as a function of an equal number of lags of itself and all other variables in system.
2.1 VAR specification and estimation

Now open the workfile named BASICS.wf1. To display data description click on Details+/-.

We will estimate the following VAR model:

\[ x_t = \Pi_1 x_{t-1} + \Pi_2 x_{t-2} + \Pi_3 x_{t-3} + \Pi_4 x_{t-4} + \epsilon_t, \]

where \( x \) is a vector of endogenous variables containing: \( \text{ip} \) – industrial production, \( m1 \) – money stock: M1 and \( \text{tb3} \) – interest rate.

To specify a VAR model in Eviews select Quick/Estimate VAR... . You see now the VAR Specification dialog box Basics (the remaining dialog tabs are relevant for VEC models). You should define the structure of the VAR:

- **VAR Type**: the Unrestricted VAR (about VEC will talk during the next classes);
- **Endogenous and Exogenous Variables**: enter the endogenous variables and if you want to include some structure in your VAR model then add exogenous variables as well. Default Eviews include as exogenous variable \( c \) that is the constant. In our example we estimate the unrestricted VAR using as endogenous the following variables: \( \text{ip}, m1 \) and \( \text{tb3} \);
- **Estimation Sample**: set the sample of estimation to 1959m01 to 1989m12;
- **Lag Intervals for Endogenous**: define the range of lags, for example the lag pair 1 4, tells the Eviews to use the first through fourth lags of endogenous variables (you can add any number of lag intervals).

Click OK to see estimation results. Each column corresponds to an equation in the VAR, you can see estimated coefficients, their standard errors and \( t \)-statistics. Below you have standard OLS regression statistics for each equation and the summary statistics for the VAR model as a whole.
Diagnostic Views  Now you should analyse the appropriateness of the estimated VAR. Explore the following menus:

View/Lag Structure/...
...AR Roots Graph...

This view reports inverse roots of the characteristic AR polynomial. VAR model is stationary if all roots have absolute value less than one and lie inside the unit circle. There should be (number of variables)×(number of lags) of roots visible on the graph. As you can see from the graph, in our model, there are three roots lying on the unit circle, so this suggests that our model is not stable, e.g., the influence of the shock for some variables may not decrease over time.

...Granger Casuality...

You can test if the endogenous variable can be treated as exogenous. The Chi-sq is $\chi^2$ (Wald) statistics for the joint significance of each of the other lagged endogenous variables. Prob. is the p-value of that statistics. According to that test all variables in our model may be treated as exogenous.

...Lag Exclusion Tests...

For each lag, the $\chi^2$ (Wald) statistic for the joint significance of all endogenous variables at that lag is reported for each equation separately and jointly (last column). The test suggests that jointly all four lags of all endogenous variables are statistically significant. So according to that test we do not have to exclude any lag.

...Lag Length Criteria...

Specify the maximum lag to test for and then you will see various information criteria for all lags up to the specified maximum. Three of five available tests select seventh lag order, one selects two lags and one tests suggests that there should be 4 lags in model included. You can change lag length to 10.

View/Residual Tests/...
Correlogram...

Displays pairwise cross-correlograms for the estimated residuals for the specified number of lags. You can display the matrix of pairwise cross-correlograms (Graph) or in the tabular form, ordered by variables (Tabulate by Variable) or ordered by lags (Tabulate by Lag).

Normality Test...

Reports the multivariate extensions of the Jarque-Bera residual normality test, which compares the third and fourth moments of the residuals to those from the normal distribution. For the multivariate test, you must choose a factorization of the residuals that are orthogonal to each other. We reject the hypothesis that residuals are normally distributed.

Impulse Response Function
**Definition:** An impulse response function traces the effect of a one-time shock to one of the innovations on current and future values of the endogenous variables.

The innovations $\epsilon_t$ are usually correlated, so in order to interpret the impulses (associate them with a specific variable) it is common to apply a transformation, so that they become uncorrelated. Eviews provides several options for the choice of transformations. We will not discuss them now.

For example, a two-variable VAR(1) model, you can rewrite as

$$z_t = \sum_{i=0}^{\infty} \phi_i \epsilon_{t-i},$$

where $z_t = \begin{bmatrix} x_t \\ y_t \end{bmatrix}$ is a vector of endogenous variables, $\phi_i = \begin{bmatrix} \phi_{11}^{(i)} & \phi_{12}^{(i)} \\ \phi_{21}^{(i)} & \phi_{22}^{(i)} \end{bmatrix}$, $\epsilon_t = \begin{bmatrix} \epsilon_{1t} \\ \epsilon_{2t} \end{bmatrix}$, $\text{cov}(\epsilon_1, \epsilon_2) = 0$.

Matrices: $\phi_i$ are called the impulse response functions, vector $\epsilon_t$ is called innovations.

**Interpretation:**

$\phi_{21}^{(0)}$ – expected instantaneous impact of a one-unit change in $\epsilon_{1t}$ on $y_t$.

$\phi_{21}^{(1)}$ – expected one-period response of a one-unit change in $\epsilon_{1t-1}$ on $y_t$.

$\sum_{i=0}^{p} \phi_{11}^{(i)}$ – the cummulated effect of a change in $\epsilon_{1t-1}$ on the sequence of $\{x_{t+i}\}$, $i = 1, 2, \ldots, p$

To obtain impulse response functions click on View/Impulse Response... or Impulse from the VAR toolbar. You will see the dialog box with two tabs:

**Display**, in which you should decide on:

- the display format (table or graph—choose Multiple Graphs); if you want to display standard errors check also the method of deriving them—analytically (Analytic (asymptotic)) or via simulations (Monte Carlo),
- the variables for which you wish to generate impulses (Impulses) and the variables for which you wish to observe the responses (Responses),
- the number of periods to trace the response function (enter 36 periods).

**Impulse Definition** tab provides several options for transforming the impulses, we will use default option (see Eviews 5 User’s Guide p.714-715 or your lecture notes for details). The default option—Cholesky—imposes an ordering of the variables in the VAR and attributes all of the effect of any common component to the variable that comes first in the VAR system. Note that responses can change dramatically if you change the ordering of the variables.
Variance Decomposition

**Definition:** separates the variation in an endogenous variable into the component shocks to the VAR. In other words, the *variance decomposition* provides information about the relative importance of each random innovation in affecting the variation of the variables in the VAR.

Click on **View/Variance Decomposition**... and provide similar information as for impulse responses.

**Forecasting** It is possible to formulate the conditional forecasts using VAR results. We will create a model of the estimated VAR, click Proc/Make Model:

Then you can proceed with the model as during our first classes. Let us for example find out, what would happen if we had the M1 cut. Firstly, we should make the M1 exogenous (in VAR model all variables are endogenous). To do that, just delete the M1 equation from the model. Check it, use right mouse button and choose delete:
Now, the M1 is exogenous in your model. Go to the Variables View to check it.

**Task:** Solve the model. Create new scenario, then override M1 in the chosen period and give it some new value. Compare the results with those obtained on original series.

**PLEASE, LEARN MORE ABOUT THE ABOVE MENTIONED TOPICS READING CHAPTER 24 OF Eviews 5 User’s Guide.**

### 3 Assisted work

Open the file `rusek_var.wf1`. We will analyse Polish data series: industrial production (as a proxy for the level of economic activity), industrial production price index and government consumption (as a proxy for the macroeconomic policy stance).

1. Show on the line graph annualised rates of growth (ith quarter of a current year over ith quarter of the previous year) of GOV CONS, IP and PPI.
2. Check for stationarity of the data (perform ADF test with constant).
3. Specify and estimate the following VAR

   \[ x_t = \pi_0 + \sum_{i=1}^{p} \pi_i x_{t-i} + \epsilon_t, \]

   where \( x_t \) is a vector of GOV CONS, IP and PPI.
4. Diagnose this VAR (use diagnostic views). Choose the appropriate lag length?
5. Perform the Granger Casualty test.

   **Conclusion (example):** None of the variables causes government consumption, but hypothesis that GOV CONS and PPI causes IP can not be rejected at the 5 percent significance level.
6. Calculate variance decomposition over 12 months ahead for each variable.  
Conclusions (examples): In the short period (up to two quarters) most of the forecast errors in industrial production dynamics is explained by its own innovations. In the longer term the impact of government consumption’s innovations on IP forecast errors reaches fast 50 percent. The impact of innovations in IP on GOV\_CONS’s forecast error remains small (below 3 percent).

Find other conclusions and try to interpret the results. Compare the paper, p.17-19.

7. Show impulse response function.

Find some conclusions and try to interpret the results. Compare the paper, p.19–21.

8. Conditional forecasts:

(a) Make a model of the VAR
(b) Delete the equation for government consumption from the model= Make the government consumption exogenous
(c) Solve the model in sample 2000Q1 to 2006Q4
(d) Create new scenario
(e) Reduce government consumption growth rate by 10% (in comparison to baseline) in period 2000Q1 to 2006Q4
(f) Solve the model in that scenario
(g) Compare the results of that scenario and baseline
(h) Try to interpret the results