Title

intro 4g — Correlated state variables

Description

Many models include correlated state variables. We illustrate how to specify correlated state variables in a model of output growth y_t and inflation p_t.

Remarks and examples

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Remarks are presented under the following headings:

The model

We model output growth y_t and inflation p_t as functions of domestic and international factors. The domestic factor g_t that drives output growth is a first-order autoregressive process that is also affected by the international factor z_t. The international factor that drives inflation is a simple first-order autoregressive process.

Mathematically, the model is

$$y_t = E_t y_{t+1} + \alpha p_t + g_t \tag{1}$$
$$p_t = z_t \tag{2}$$
$$g_{t+1} = \rho_g g_t + \rho_{gz} z_t + \xi_{t+1} \tag{3}$$
$$z_{t+1} = \rho_z z_t + \epsilon_{t+1} \tag{4}$$

Equation (1) specifies that output growth depends on expected future output growth $E_t y_{t+1}$, inflation p_t, and the domestic factor g_t. This equation has the form of an aggregate demand curve, and the parameter α is referred to as the slope of the aggregate demand curve. It should be negative. Equation (2) specifies that inflation is entirely driven by the international factor z_t. Equations (3) and (4) specify that the factors g_t and z_t follow a first-order vector autoregressive process with parameters ρ_g, ρ_{gz} and ρ_z and with shocks ξ_{t+1} and ϵ_{t+1}. The factors z_t and g_t are the state variables, and p_t and y_t are the observed control variables.

Parameter estimation

From the U.S. macroeconomic data, we use the GDP-growth data in y and the inflation data in p and estimate the parameters of this model.

```
. dsge (y = E(F.y) + {alpha}*p + g)
>      (p = z)
>      (F.g = {rho_g}*g + {rho_gz}*z, state)
>      (F.z = {rho_z}*z, state)
(setting technique to bfgs)
Iteration 0:   log likelihood = -2106.7245
Iteration 1:   log likelihood = -1563.7386  (backed up)
Iteration 2:   log likelihood = -1363.6417  (backed up)
Iteration 3:   log likelihood = -1289.3079  (backed up)
Iteration 4:   log likelihood = -1274.5732  (backed up)
(switching technique to nr)
Iteration 5:   log likelihood = -1175.4471  (not concave)
Iteration 6:   log likelihood = -1121.5017  (not concave)
Iteration 7:   log likelihood = -1111.6839  (not concave)
Iteration 8:   log likelihood = -1104.5102  (not concave)
Iteration 9:   log likelihood = -1098.5517  (not concave)
Iteration 10:  log likelihood = -1085.8018  (not concave)
Iteration 11:  log likelihood =  -1074.273  (not concave)
Iteration 12:  log likelihood = -1071.4913  (not concave)
Iteration 13:  log likelihood = -1069.9378  (not concave)
Iteration 14:  log likelihood = -1060.2549  (not concave)
Iteration 15:  log likelihood =  -1057.046
Iteration 16:  log likelihood = -1040.5911  (not concave)
Iteration 17:  log likelihood = -1028.4304  (not concave)
Iteration 18:  log likelihood = -1023.5103  (not concave)
Iteration 19:  log likelihood = -1021.3008
Iteration 20:  log likelihood = -1018.6421  (not concave)
Iteration 21:  log likelihood = -1017.6527
Iteration 22:  log likelihood =  -1017.315
Iteration 23:  log likelihood =  -1017.164
Iteration 24:  log likelihood = -1017.1592
Iteration 25:  log likelihood = -1017.1592

DSGE model

Sample: 1955q1 - 2015q4                         Number of obs     =        244
Log likelihood = -1017.1592
```

	Coef.	OIM Std. Err.	z	P>|z|	[95% Conf.	Interval]
/structural						
alpha	-.1130023	.1554398	-0.73	0.467	-.4176587	.1916541
rho_g	.335777	.0610763	5.50	0.000	.2160696	.4554843
rho_gz	.0443504	.09013	0.49	0.623	-.1323013	.221002
rho_z	.8626566	.0319007	27.04	0.000	.8001324	.9251807
sd(e.g)	2.184805	.2241105			1.745557	2.624054
sd(e.z)	1.146947	.0519234			1.045179	1.248715

The slope of the aggregate demand curve, α, is estimated to be negative as we expected, but the confidence interval is wide and includes zero. The imprecision in rho_gz has caused imprecision in the estimate of α.

Also see

[DSGE] **intro 2** — Learning the syntax

[DSGE] **intro 4** — Writing a DSGE in a solvable form