

Intro 4g — Correlated state variables

[Description](#)[Remarks and examples](#)[Also see](#)

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](#)[Parameter estimation](#)

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

$$y_t = E_t y_{t+1} + \alpha p_t + g_t \quad (1)$$

$$p_t = z_t \quad (2)$$

$$g_{t+1} = \rho_g g_t + \rho_{gz} z_t + \xi_{t+1} \quad (3)$$

$$z_{t+1} = \rho_z z_t + \epsilon_{t+1} \quad (4)$$

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 = 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

	OIM		z	P> z	[95% Conf. Interval]	
	Coef.	Std. Err.				
/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