

Intro 3c — Financial frictions model

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Description

This introduction estimates and interprets the parameters of a model that incorporates financial frictions. The model is an extension of the one in [\[DSGE\] Intro 3a](#).

Remarks and examples

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Remarks are presented under the following headings:

[The model](#)[Parameter estimation](#)[Policy and transition matrices](#)[Impulse responses](#)

The model

Equations (1)–(7) specify a model of financial frictions. The simplest such model places a wedge between two interest rates: the safe interest rate set by the central bank and the market interest rate that consumers and producers use.

$$\pi_t = \beta E_t \pi_{t+1} + \kappa x_t \quad (1)$$

$$x_t = E_t x_{t+1} - (i_t - E_t \pi_{t+1} - g_t) \quad (2)$$

$$r_t = \psi \pi_t + u_t \quad (3)$$

$$i_t = \chi r_t + e_t \quad (4)$$

$$g_{t+1} = \rho_g g_t + \xi_{t+1} \quad (5)$$

$$u_{t+1} = \rho_u u_t + \epsilon_{t+1} \quad (6)$$

$$e_{t+1} = \rho_e e_t + \eta_{t+1} \quad (7)$$

These are the linearized equations. The nonlinear equations are similar to those in [Writing down nonlinear DSGEs](#) in [\[DSGE\] Intro 1](#).

This model is an extension of the one worked in [\[DSGE\] Intro 1](#). It has an additional equation for the interest rate spread. As before, (1) specifies the inflation equation (a Phillips curve), (2) specifies the output gap equation (an Euler equation), and (3) specifies the equation for the safe interest rate (a Taylor rule). Equation (3) can be thought of as an equation that specifies the safe interest rate r_t . The new element is (4), which specifies an equation for the market interest rate i_t that enters the output gap equation. The market interest rate i_t is a function of the safe interest rate and a state variable e_t . The state variable e_t controls the interest rate spread and can be thought of as representing the state of the financial system. A large realization of e_t represents a large interest rate spread, indicating financial distress.

Parameter estimation

We estimate the parameters of the model in (1)–(7) using U.S. data on the Federal funds rate (safe rate set by the central bank), the high-grade corporate bond interest rate (a measure of market interest rates), and the inflation rate.

As is typical in these models, we constrain the parameter β to 0.96.

```
. use https://www.stata-press.com/data/r16/usmacro2
(Federal Reserve Economic Data - St. Louis Fed, 2017-01-15)
. constraint 1 _b[beta]=0.96
. dsge (p = {beta}*F.p + {kappa}*x)
> (x = F.x - (i - F.p - g), unobserved)
> (i = {chi}*r + e)
> (r = {psi}*p + u)
> (F.e = {rhoe}*e, state)
> (F.u = {rhou}*u, state)
> (F.g = {rhoz}*g, state),
> from(psi=2 chi=0.8) constraint(1)
(setting technique to bfgs)
Iteration 0: log likelihood = -4780.2037
Iteration 1: log likelihood = -1731.5956 (backed up)
Iteration 2: log likelihood = -1315.8819 (backed up)
Iteration 3: log likelihood = -1161.0796 (backed up)
Iteration 4: log likelihood = -1115.2257 (backed up)
(switching technique to nr)
Iteration 5: log likelihood = -1069.1254 (backed up)
Iteration 6: log likelihood = -1016.9948 (not concave)
Iteration 7: log likelihood = -980.93826 (not concave)
Iteration 8: log likelihood = -922.65912 (not concave)
Iteration 9: log likelihood = -914.78652 (not concave)
Iteration 10: log likelihood = -908.4795 (not concave)
Iteration 11: log likelihood = -905.35477 (not concave)
Iteration 12: log likelihood = -902.51101 (not concave)
Iteration 13: log likelihood = -900.48635 (not concave)
Iteration 14: log likelihood = -899.17535 (not concave)
Iteration 15: log likelihood = -897.88451 (not concave)
Iteration 16: log likelihood = -895.03731
Iteration 17: log likelihood = -891.34894
Iteration 18: log likelihood = -887.41441
Iteration 19: log likelihood = -882.82925 (not concave)
Iteration 20: log likelihood = -882.73272
Iteration 21: log likelihood = -882.20988
Iteration 22: log likelihood = -882.13462
Iteration 23: log likelihood = -882.13198
Iteration 24: log likelihood = -882.13195
```

DSGE model

Sample: 1955q1 - 2015q4

Number of obs = 244

Log likelihood = -882.13195

(1) [/structural]beta = .96

	OIM		z	P> z	[95% Conf. Interval]	
	Coef.	Std. Err.				
/structural						
beta	.96	(constrained)				
kappa	.0503238	.0184922	2.72	0.007	.0140796	.0865679
chi	.9067346	.1249748	7.26	0.000	.6617885	1.151681
psi	6.332415	2.56766	2.47	0.014	1.299893	11.36494
rhoe	.8478235	.0301215	28.15	0.000	.7887865	.9068605
rhou	.8153493	.0332519	24.52	0.000	.7501768	.8805218
rhoz	.9861866	.0099767	98.85	0.000	.9666327	1.005741
sd(e.e)	.8857022	.1343			.622479	1.148925
sd(e.u)	7.16076	2.933846			1.410528	12.91099
sd(e.g)	.3911864	.0358355			.3209501	.4614226

The persistence of the financial shock ρ_{oe} is estimated to be 0.85. The slope of the Phillips curve, κ , is somewhat flatter in this model than in the one in [DSGE] Intro 1. The coefficient on inflation in the interest rate equation is 6.3 and indicates that the central bank increases interest rates much more than one for one in response to movements in inflation.

Policy and transition matrices

We can read off the impact effect of shocks using the policy matrix. The response to the financial shock \mathbf{e} will be of most interest.

. estat policy

Policy matrix

	Delta-method		z	P> z	[95% Conf. Interval]	
	Coef.	Std. Err.				
P						
e	-.1832602	.0740955	-2.47	0.013	-.3284848	-.0380357
u	-.1584184	.0641356	-2.47	0.014	-.2841219	-.032715
g	.2096325	.1003838	2.09	0.037	.0128838	.4063812
x						
e	-.6776679	.3498926	-1.94	0.053	-1.363445	.0081091
u	-.6839457	.2783497	-2.46	0.014	-1.229501	-.1383903
g	.2218675	.1284759	1.73	0.084	-.0299406	.4736756
i						
e	-.0522472	.040321	-1.30	0.195	-.1312748	.0267805
u	-.0028753	.0041244	-0.70	0.486	-.0109589	.0052083
g	1.203672	.0979354	12.29	0.000	1.011722	1.395622
r						
e	-1.16048	.1361163	-8.53	0.000	-1.427263	-.8936968
u	-.003171	.0045309	-0.70	0.484	-.0120515	.0057094
g	1.32748	.2224889	5.97	0.000	.8914098	1.76355

Importantly, the financial shock causes r to fall by more than i , indicating an increase in the interest rate spread. Inflation also falls, as does the output gap. It is the fall in the inflation rate that causes the central bank's interest rate to fall on impact of the shock.

Impulse responses

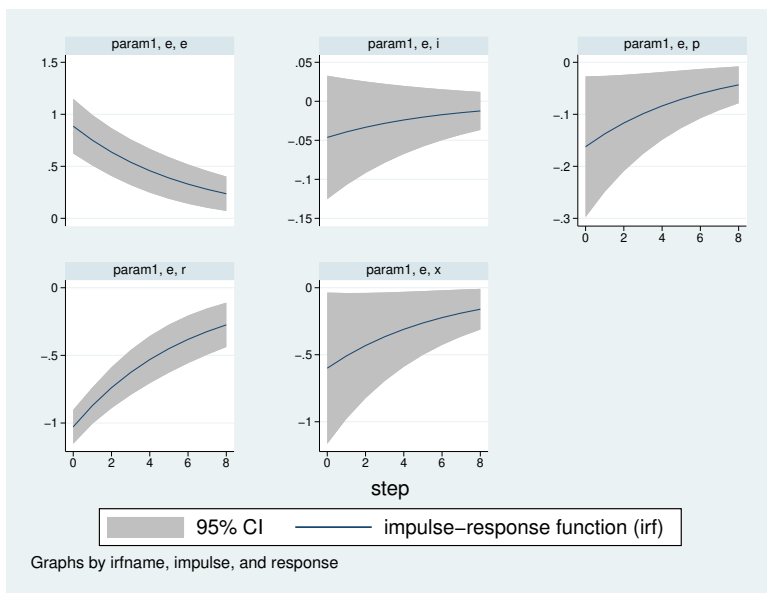
We use the `irf set` command to set `finirf.irf` as the active IRF file and then use `irf create` to create and store the impulse responses under the name `param`.

```
. irf set finirf
(file finirf.irf created)
(file finirf.irf now active)

. irf create param1
(file finirf.irf updated)
```

Finally, we graph the impulse response to a financial shock.

```
. irf graph irf, irf(param1) impulse(e) response(e x p i r) byopts(yrescale)
```



The top middle panel shows the effect of the shock to the e equation on e itself. The shock represents a persistent increase in the spread between the two interest rates. The increased interest rate spread causes both the output gap and inflation rate to fall. The safe interest rate r falls dramatically, and the combined effect of the increased spread e and reduced safe interest rate r causes the market interest rate i to be little changed.

Also see

[DSGE] [Intro 1](#) — Introduction to DSGEs

[DSGE] [Intro 3a](#) — New Keynesian model

[DSGE] [Intro 3b](#) — New Classical model

[DSGE] [dsge](#) — Linear dynamic stochastic general equilibrium models

[DSGE] [dsge postestimation](#) — Postestimation tools for dsge