Are There Asymmetric Effects of Monetary Policy?: An Estimated Financial Accelerator Model

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Motivation

- The Role of Financial Sector in Transmission Mechanism of Monetary Policy
- Problems of Standard VAR and Its Impulse Response Function.

There are evidences of the failure of monetary at fighting recessions e.g. the great depression and Japan long lasting recession.

- Liquidity trap, zero bound
- Pushing a string

Attempts to detect the asymmetric effects and type of the asymmetry

- Contractionary and Expansionary Policy (direction) : Calvo(1992)
- Moderate and Aggressive Policy(size) : Ravn and Sola (1997)
- Recession and Expansion (business cycle) : Garcia and Schaller (2002)

Attempts to explain the causes

- Sticky Price
  Rotemberg (1982) Calvo (1983) Ball and Mankiw (1994)
- Financial Friction
  Carlstrom and Feurst (1997), Bernanke et al. (1998), Kocherlakota (2000), and Florio (2006)
- Economic outlook

Gap in the literatures

- Link between empirical and theoretical work
- Model : partial or general equilibrium framework
- Solution method : linear- or log-linearized

Question

Do existing model really can explain the cause of asymmetry?

Ability of model

- Model : Provide enough curvature
- Solution method : preserve nonlinearity of the model

Framework

- New Keynesian DSGE model

Theory

- Convex supply curve :Calvo pricing
- Financial market friction : Bernanke, Gertler and Gilchrist (1999)
- Economic outlook :

Solution method

- Value function iteration
- Projection method
- Second Order Perturbation

Model

Model: Standard New Keynesian DSGE

- Household :
- Government :
- Monopolistic competition : Calvo pricing + 2^{nd} approximation $\rightarrow$ Nonlinear Phillips Curve
- Financial Friction : Bernanke, Gertler and Gilchrist (1999)
- Economic outlook :

Key equations

External Financial Premium : EFP

$$E_t(R^k_{t+1}) = S\left(\frac{Q_t K_{t+1}}{N_{t+1}}\right) R_t \text{ , } S(1) = 1 \text{ , } S'(\cdot) > 0 \text{ , } S''(\cdot) > 0$$

Nonlinear Phillips Curve

$$\theta \pi_t^{\varepsilon - 1} = 1 - (1-\theta)\frac{N_t}{D_t}^{1-\varepsilon} \quad (1)$$

$$N_t = \frac{\varepsilon}{\varepsilon - 1} MC_t Y_t + \frac{u_{c_{t+1}}}{u_{c_t}} \theta \beta \pi^{\varepsilon}_{t+1} N_{t+1} \quad (2)$$

$$D_t = Y_t + \frac{u_{c_{t+1}}}{u_{c_t}} \theta \beta \pi^{\varepsilon-1}_{t+1} D_{t+1} \quad (3)$$

$$A_t = \theta A_{t-1} \pi_t^{\varepsilon} + (1-\theta)\left(\frac{N_t}{D_t}\right)^{-\varepsilon} \quad (4)$$

Policy

$$\frac{R^n_t}{\bar{R}^n} = \left(\frac{R^n_{t-1}}{\bar{R}^n}\right)^{\rho_r} \left[\left(\frac{\pi_t}{\bar{\pi}}\right)^{\rho_\pi} \left(\frac{Y_t}{\bar{Y}}\right)^{\rho_y}\right]^{1-\rho_r} mp_t$$

Model Appendix

Model Appendix

Model.pdf

Solution Method

Perturbation Method

$$
\begin{aligned}
E_t & \quad f(\mathbf{y}_{t+1}, \mathbf{y}_t, \mathbf{x}_{t+1}, \mathbf{x}_t), \\
\mathbf{x}_t &= \{k_t, A_t\}, \\
y(k_t, A_t, \sigma) &\simeq \sum_{i,j,m} \frac{1}{(i+j+m)!} \frac{\partial^{i+j+m} c(k_t, A_t, \sigma)}{\partial k_t^i \partial A_t^j \partial \sigma^m}\Big|_{k_0, A_0, 0} (k_t - k^0)^i (A_t - A^0)^j \sigma^m.
\end{aligned}
$$

The forward rational expectation is solved by Blanchard and Kahn (1980) iteratively.

Estimation Method

Indirect Inference

Smith Jr (1993), Gourieroux et al. (1993), Gallant and Tauchen (1996), and Keane and Smith (2003).

$$
\begin{aligned}
DATA &\rightarrow VAR(\hat{\beta}) \\
Model(\theta) \rightarrow SimulatedData(\theta) &\rightarrow VAR(\tilde{\beta}(\theta)), \\
\hat{\theta} &\rightarrow VAR(\hat{\beta}) \approx VAR(\tilde{\beta}(\hat{\theta})),
\end{aligned}
$$

$$
\hat{\boldsymbol{\theta}} = \underset{\boldsymbol{\theta}}{\operatorname{argmin}} \left(\tilde{\boldsymbol{\beta}}_S(\boldsymbol{\theta}) - \hat{\boldsymbol{\beta}}_T\right)' \quad W \quad \left(\tilde{\boldsymbol{\beta}}_S(\boldsymbol{\theta}) - \hat{\boldsymbol{\beta}}_T\right),
$$

Table: Estimates

Description	Fixed Parameter	VAR	t-stat	SVAR	t-stat
ξ	**1.000**				
β	**0.990**				
ψ		0.632	132.785	0.793	191.755
σ_c		3.886	49.737	2.807	60.510
σ_n		1.763	2.552	2.629	11.047
ρ		1.949	18.592	2.289	17.917
α	**0.350**				
$(1-\alpha)(1-\Omega)$	**0.010**				
δ	**0.025**				
θ		0.774	288.084	0.744	540.435
ε		8.474	49.430	7.767	99.678
Ψ		10.608	9.749	12.952	40.947
ρ_{rn}		0.802	79.916	0.614	118.479
ρ_π		2.499	37.839	2.087	147.401
ρ_y		0.434	10.402	0.571	47.100
$\rho_{\varepsilon^{mp}}$		0.062	1.089	0.181	15.232
$\rho_a{}^*$		0.303	9.728	0.207	6.989
$\rho_g{}^*$		0.205	4.329	0.392	62.184
σ_{mp}		0.001	20.065	0.002	63.014
σ_a		0.006	21.539	0.002	41.416
σ_g		0.077	45.775	0.037	43.694
μ	**0.120**				
σ_ω	**0.271**				
γ	**0.979**				
Test Statistic		222.022		435.664	
Critical value : $\chi^2_{\alpha=.01}$		29.141		56.061	

Empirical Model

STVAR

$$
Y_t = A_0 + A(L)Y_{t-1} + f(s_t)(B_0 + B(L)Y_{t-1}) + u_t
$$

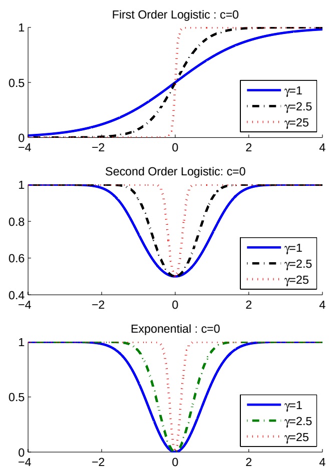
Transition Functions

$$
f(s_t) = \left(1 + exp\left\{\frac{-\gamma(s_t - c)}{\sigma_{s_t}}\right\}\right)^{-1}; \gamma > 0 \quad (5)
$$

$$
f(s_t) = \left(1 + exp\left\{\frac{-\gamma(z_t - c_1)(s_t - c_2)}{\sigma_{s_t}}\right\}\right)^{-1}; \gamma > 0, c_1 \leq c_2 \quad (6)
$$

$$
f(s_t) = \left(1 - exp\left\{\frac{-\gamma(s_t - c)^2}{\sigma_{s_t}}\right\}\right); \gamma > 0 \quad (7)
$$

Figure: Transition Functions



.

1. Run the standard regression to get the residual $\hat{\mathbf{u}}_t$

$$X_t = D_0 + \sum_{i=1}^{p} D_{1i} X_{t-i} + \mathbf{u_t}$$

2. Run the auxiliary regression to get the residual $\hat{\mathbf{v}}_t$

$$\begin{aligned} \hat{\mathbf{u}}_\mathbf{t} &= \Gamma_0 + \sum_{i=1}^{p} \Gamma_{1i} X_{t-i} + \sum_{i=1}^{p} \Gamma_{2i} s_t \iota'(n) X_{t-1} + \mathbf{v}_t \\ &+ \sum_{i=1}^{p} \Gamma_{3i} s_t^2 \iota'(n) X_{t-1} + \sum_{i=1}^{p} \Gamma_{4i} s_t^3 \iota'(n) X_{t-1} \end{aligned} \quad (8)$$

3. Test nested Hypothesis
   1. $H_{01} : \Gamma_2 = 0 | \Gamma_3 = \Gamma_4 = 0$,
   2. $H_{02} : \Gamma_3 = 0 | \Gamma_4 = 0$,
   3. $H_{03} : \Gamma_4 = 0$,

1. Set the initial state by picking a part of actual data : Ω^k_{t-1}.
2. Design a hypothesized shock : ϵ^*_0.
3. Randomly draw a q-period shock with replacement from the estimated residual: ϵ^j_t
4. Construct a benchmark path : $GI^{ki}_0(\Omega^k_{t-1}, 0, \epsilon^j_t)$.
5. Construct a hypothesized path : $GI^k_1(\Omega^{ki}_{t-1}, \epsilon^*_0, \epsilon^j_t)$.
6. Repeat steps 2-4 B times.
7. Repeat steps 1-5 R times.
8. Compute an average impulse response function GI by $\sum_k^R \sum_j^B (GI^k_1((\Omega^{ki}_{t-1}, \epsilon^*_0, \epsilon^j_t) - GI^{ki}_0(\Omega^k_{t-1}, 0, \epsilon^j_t))/BR$

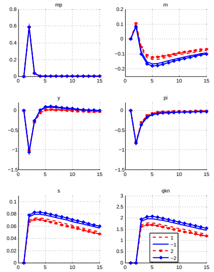
Types of asymmetry

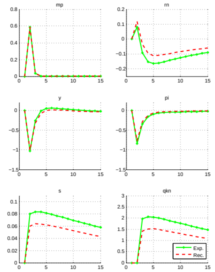
- Base case : + 1 s.d. of monetary policy shock
- Size : 2 s.d. of monetary policy shock, then scale the responses by half
- Sign : -1 s.d. of monetary policy shock, then flip the responses up or down

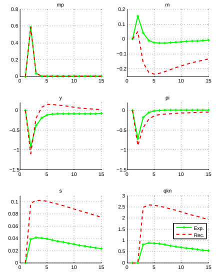
Business cycle : ± 4 % of output deviation from the steady state

- Response to +1sd of monetary policy shock (contractionary policy)
- Demand shock : government expenditure shock
- Supply shock : technology shock

Figure: Simulation Results

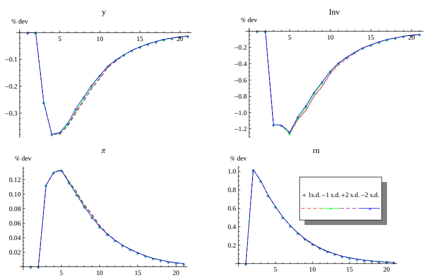

(a) Steady State


(b) Demand Shocks

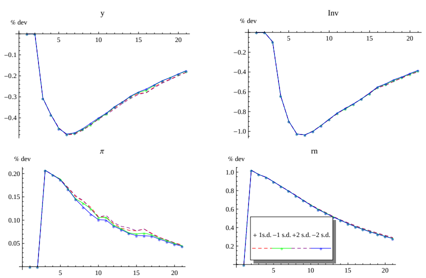

(c) Supply Shocks

Show more results

Figure: All States

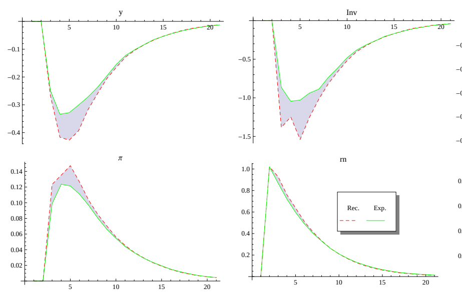


(a) Actual Data

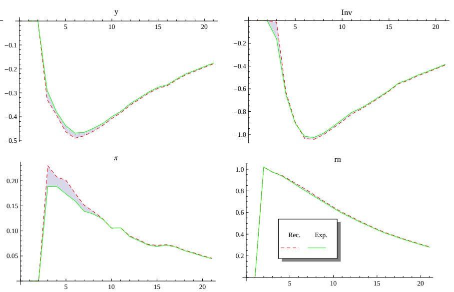


(b) Simulated Data

Figure: Comparing Expansions and Recessions

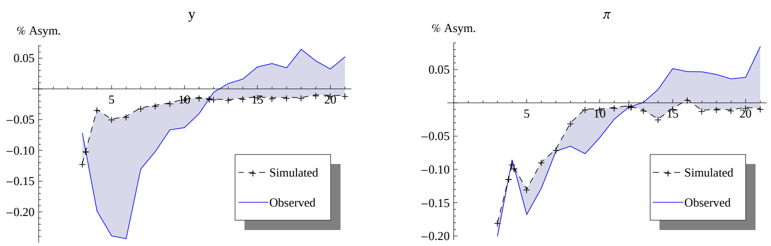


(a) Actual Data



(b) Simulated Data

Figure: Comparing the Asymmetry



Conclusion

- Asymmetric effect of monetary policy can be explained partially by a DSGE model with the 2nd order pertubation method.
- Source of asymmetric effect of monetary policy mostly comes from nonlinear Phillips curve.
- BGG model does not produce asymmetry as suggested.

Time varying risk volatility and change in economic outlook

- The welfare cost of business cycle is relatively constant in the current paper with a consumption habit preference. Introduce Epstien-Zim preference instead of using standard expected utility
- Even though the financial friction is considered, the market condition in the current model doesn't change. Use a higher degree approximation and/or allow GARCH process in idiosyncratic risk and technology.

Epstein-Zim preference + LR Risks

Epstein-Zin preferences.

$$U_t = \left[\left(c_t(1-l_t)^{\nu}\right)^{1-\frac{1}{\psi}} + \beta \left(E_t U_{t+1}^{1-\gamma} \right)^{\frac{1-\frac{1}{\psi}}{1-\gamma}} \right]^{\frac{1}{1-\frac{1}{\psi}}}, \tag{9}$$

where $\gamma \geq 1$ is the parameter that control risk aversion and $\psi \geq 0$ is the IES.
SDF

$$M_{t,t+1} = \left[\frac{V_{t+1}}{E_t(V_{t+1}^{1-\gamma})^{\frac{1}{1-\gamma}}} \right]^{\frac{1}{\psi}-\gamma} \beta \left(\frac{c_{t+1}}{c_t} \right)^{-\frac{1}{\psi}} \left(\frac{1-l_{t+1}}{1-c_t} \right)^{\nu(1-\frac{1}{\psi})} \tag{10}$$

Epstein-Zim preference + LR Risks

Long Run Risks:
Bansel and Yaron (2004) propose a long term risk in addition to a short run risk. Rudebusch and Swanson(2009) specify the long term and short term risk in Bansel and Yaron(2004) as

$$lnA_t^* = \rho_a^* \ln A_{t-1}^* + \varepsilon_t^*, \quad (11)$$

$$lnA_t = lnA_t^* + \varepsilon_t. \quad (12)$$

Higher order approximation

- 1st order eliminates all nonlinearity
- 2nd order produces non zero but constant volatility induces a constant precautionary saving.
- 3rd order allows time varying volatility as it captures the product term state variable and volatility (e.g. $x_t E_t(\varepsilon_t^2)$)
- At least up to 3rd approximation can preserve a time varying feature of the additional term of EZ preference.