Monetary Economics

Lecture 16: unemployment in the new Keynesian model, part two

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2nd Semester 2014

This class

- Unemployment fluctuations in the new Keynesian model, part two
- Main reading:
  - Gali, *Unemployment Fluctuations and Stabilization Policies: A New Keynesian Perspective*, MIT Press, 2011, sections 1.3–1.4

This class

1- Solving the model with sticky wages and sticky prices

2- Responses to productivity and monetary policy shocks

3- Volatility and persistence of unemployment

- conditional second moments
- sensitivity to amount of nominal wage rigidity

Flexible price equilibrium

- Equilibrium variables defined relative to *natural* counterparts, i.e., values that would obtain in absence of *all* nominal rigidities

FLEXIBLE PRICE EQUILIBRIUM CONDITIONS:

$$c_t = y_t = a_t + (1-\alpha)n_t \qquad \text{goods market clearing}$$
$$\omega_t = a_t - \alpha n_t + \log(1-\alpha) - \mu^p \qquad \text{labor demand}$$
$$\omega_t = c_t + \varphi n_t + \xi_t + \mu^w \qquad \text{labor supply}$$

where $\omega_t \equiv w_t - p_t$ and where $\xi_t \equiv \log \chi_t$ is shock to labor supply

- Solve these for endogenous $\{c_t, y_t, n_t, \omega_t\}$ in terms of exogenous $\{a_t, \xi_t\}$ processes

- Also $u^n = \mu^w/\varphi$ (constant) and $l_t = n_t + u^n$

Flexible price equilibrium

- Solutions:

$$
\begin{aligned}
n_t &= -\frac{1}{1+\varphi}\xi_t + \overline{n} \\
c_t = y_t &= a_t - \frac{1-\alpha}{1+\varphi}\xi_t + \overline{y} \\
\omega_t &= a_t + \frac{\alpha}{1+\varphi}\xi_t + \overline{\omega}
\end{aligned}
$$

  where $\overline{n}, \overline{y}, \overline{\omega}$ are steady-state (constant) values

- AR(1) processes for supply-side shocks

$$
\begin{aligned}
a_{t+1} &= \rho_a a_t + \varepsilon^a_{t+1} \\
\xi_{t+1} &= \rho_\xi \xi_t + \varepsilon^\xi_{t+1}
\end{aligned}
$$

Sticky price equilibrium

- Exogenous variables
  - natural wage rate

$$\omega_t^n = a_t + \frac{\alpha}{1+\varphi}\xi_t + \overline{\omega}$$

  - natural interest rate

$$\begin{aligned} r_t^n &= \rho + \mathbb{E}_t\{\Delta y_{t+1}^n\} \\ &= \rho + (1-\rho_a)a_t - \frac{1-\alpha}{1+\varphi}(1-\rho_\xi)\xi_t \end{aligned}$$

  - monetary policy shock (another AR(1) process)

$$v_{t+1} = \rho_v v_t + \varepsilon_{t+1}^v$$

Sticky price equilibrium

- *Log linearized Euler equation*

$$i_t = \rho + \mathbb{E}_t \{\Delta c_{t+1}\} + \mathbb{E}_t\{\pi^p_{t+1}\}$$

or as usual, a dynamic IS curve

$$\tilde{y}_t = -(i_t - \mathbb{E}_t\{\pi^p_{t+1}\} - r^n_t) + \mathbb{E}\{\tilde{y}_{t+1}\}$$

where $\tilde{y}_t \equiv y_t - y^n_t$ is the output gap

Sticky price equilibrium

- *Price inflation Phillips curve*

$$\pi_t^p = \beta \mathbb{E}_t\{\pi_{t+1}^p\} + \kappa_p \tilde{y}_t + \lambda_p \tilde{\omega}_t$$

where $\tilde{\omega}_t \equiv \omega_t - \omega_t^n$ is the *wage gap* and where

$$\kappa_p \equiv \frac{\alpha}{1-\alpha}\lambda_p$$

- This uses the relationship

$$\mu_t^p - \mu^p \equiv p_t - \psi_t - \mu^p = -\frac{\alpha}{1-\alpha}\tilde{y}_t - \tilde{\omega}_t$$

Sticky price equilibrium

- *Wage inflation Phillips curve*

$$\pi_t^w = \beta \mathbb{E}_t\{\pi_{t+1}^w\} + \kappa_w \tilde{y}_t - \lambda_w \tilde{\omega}_t$$

where

$$\kappa_w \equiv \left(1 + \frac{\varphi}{1-\alpha}\right) \lambda_w$$

- This uses the relationship

$$\mu_t^w - \mu^w \equiv \omega_t - mrs_t - \mu^w = \tilde{\omega}_t - \left(1 + \frac{\varphi}{1-\alpha}\right) \tilde{y}_t$$

- Note: coefficient on wage gap is positive in price-inflation curve but negative in wage-inflation curve

Sticky price equilibrium

- *Unemployment*

$$\varphi(u_t - u^n) = \mu_t^w - \mu^w = \tilde{\omega}_t - \left(1 + \frac{\varphi}{1-\alpha}\right)\tilde{y}_t$$

- *Wage gap identity*

$$\tilde{\omega}_t = \tilde{\omega}_{t-1} + \pi_t^w - \pi_t^p - \Delta\omega_t^n$$

- *Interest rate rule*

$$i_t = \rho + \phi_\pi \pi_t^p + \phi_y \tilde{y}_t + v_t$$

- Six equations in six endogenous variables $\{\tilde{y}_t, \tilde{\omega}_t, \pi_t^p, \pi_t^w, u_t, i_t\}$. Can be solved with method of undetermined coefficients

Benchmark parameters

$$
\begin{aligned}
\beta &= 0.99 \text{ quarterly} \\
\varphi &= 5 \text{ curvature of labor disutility} \\
\alpha &= 1/4 \text{ decreasing returns to labor} \\
\\
\varepsilon_p &= 9 \text{ elasticity substitution goods} \\
\varepsilon_w &= 4.5 \text{ elasticity substitution labor} \\
\theta_p &= 3/4 \text{ price stickiness} \\
\theta_w &= 3/4 \text{ wage stickiness} \\
\\
\phi_\pi &= 1.5 \text{ inflation coefficient in policy rule} \\
\phi_y &= 0.5/4 \text{ output gap coefficient in policy rule} \\
\\
\rho_a = \rho_v = \rho_\xi &= 0.9 \text{ autoregressive coefficients for shocks}
\end{aligned}
$$

Implications of parameter choices

- Goods markup

$$\mathcal{M}_p = \frac{\varepsilon_p}{\varepsilon_p - 1} = 1.125 \qquad \text{(or 12.5\%)}$$

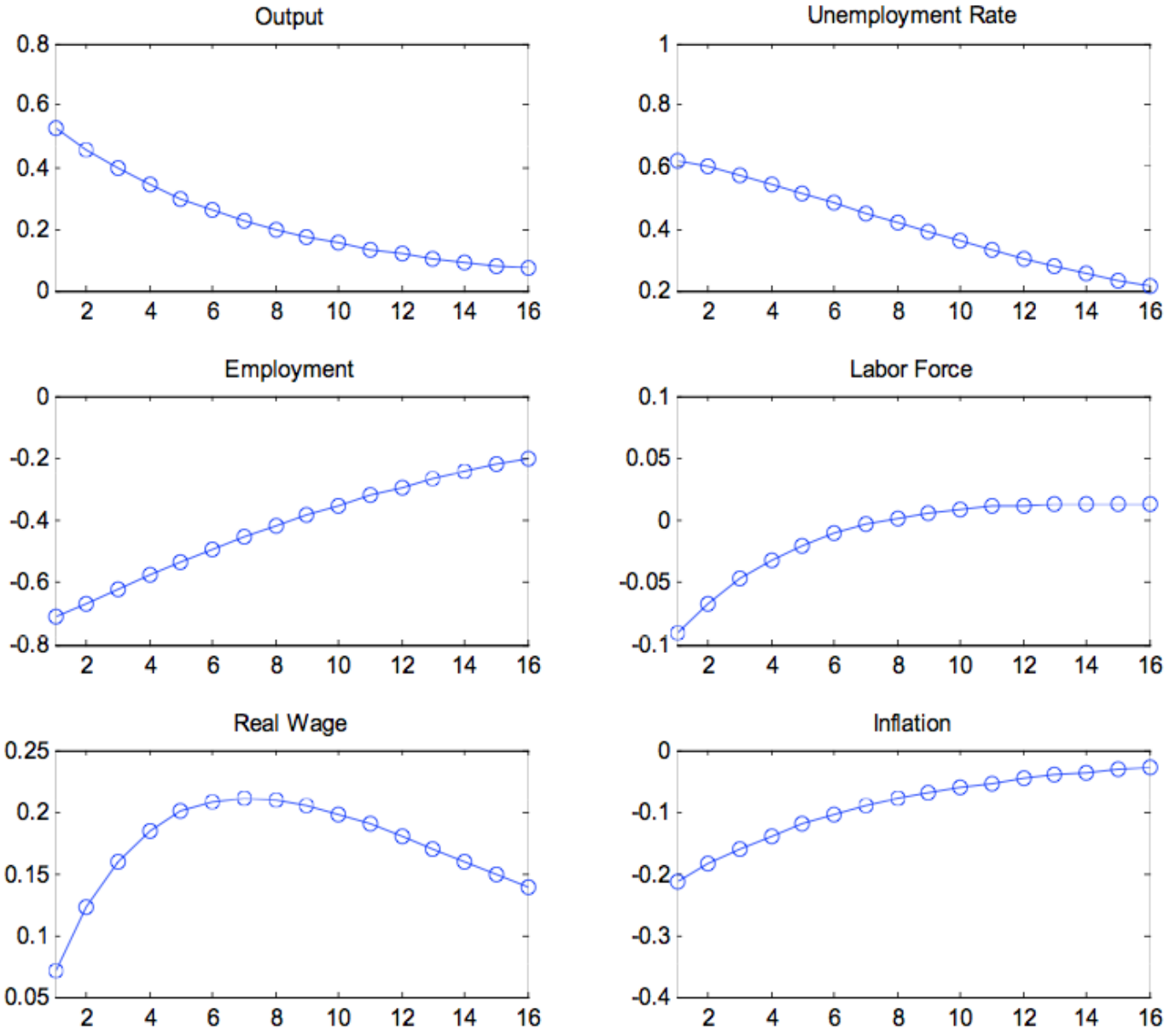
- Labor share

$$\frac{WN}{PY} = (1-\alpha)\frac{1}{\mathcal{M}_p} = 0.75\frac{1}{1.125} = 0.667$$

- Steady-state unemployment

$$\mathcal{M}_w = \frac{\varepsilon_w}{\varepsilon_w - 1} = \exp(\varphi u^n) \Rightarrow u^n = 0.05 \qquad \text{(or 5\%)}$$

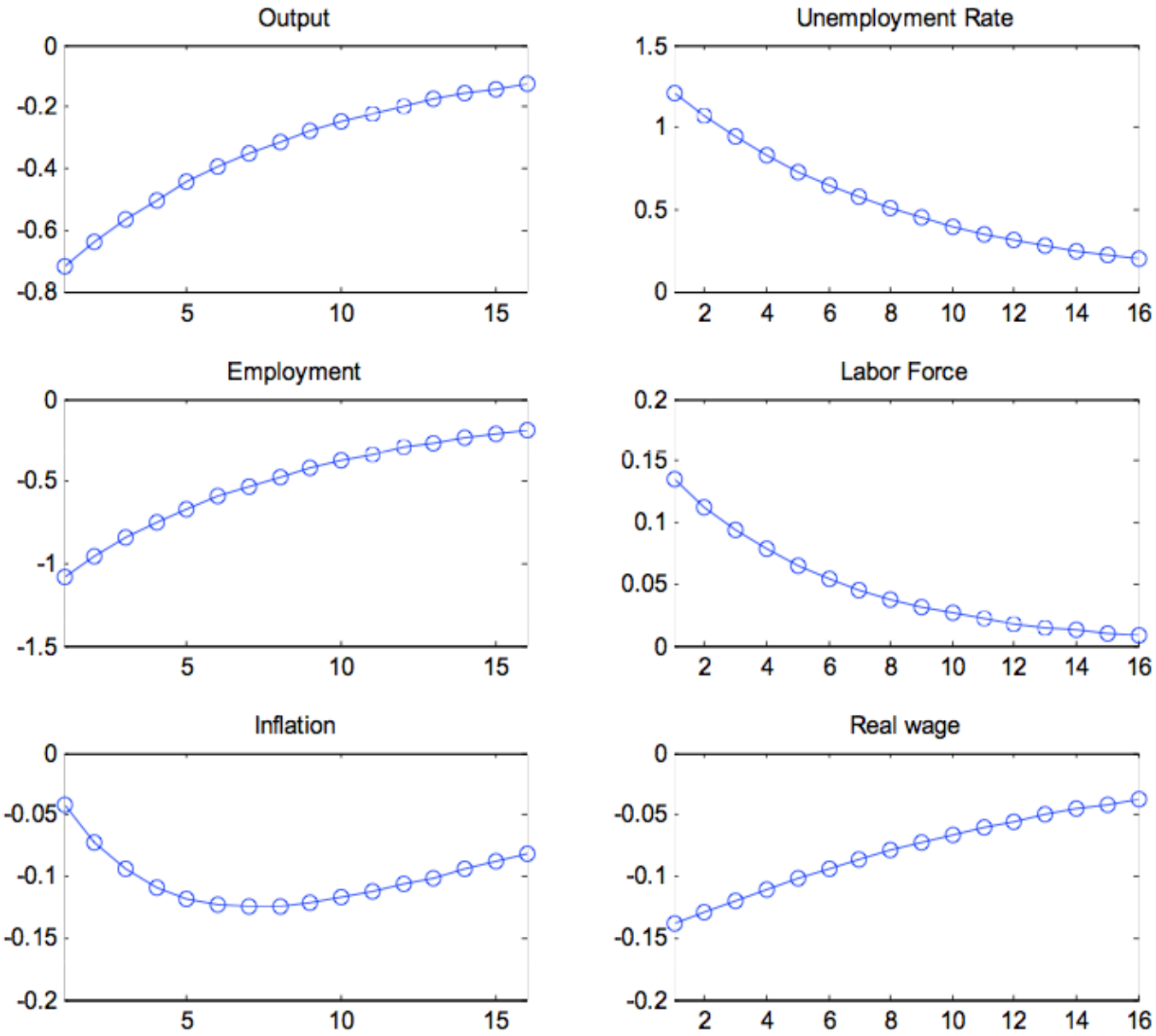
Response to a productivity shock ε_t^a



Response to a productivity shock ε_t^a

- Output increases, inflation falls
- Unemployment *rises*
  - employment falls a lot and labor force falls only a little
  - recall that productivity shocks often decrease short-run employment in standard new Keynesian models
- Real wage gradually rises
  - wages and prices both decline, the former because of the increase in unemployment
  - real wage rises because prices decline by more than wages

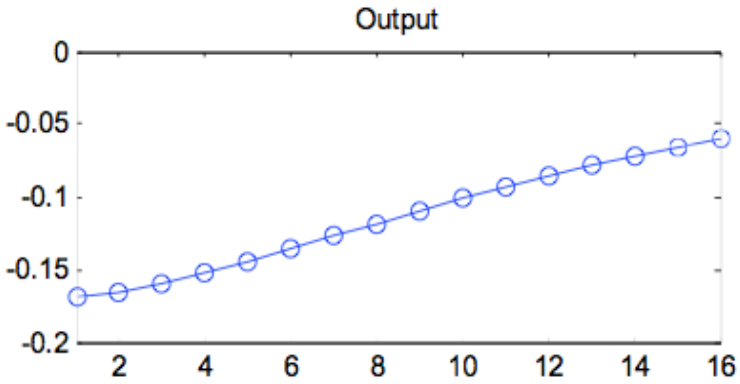
Response to a monetary policy shock ε_t^v

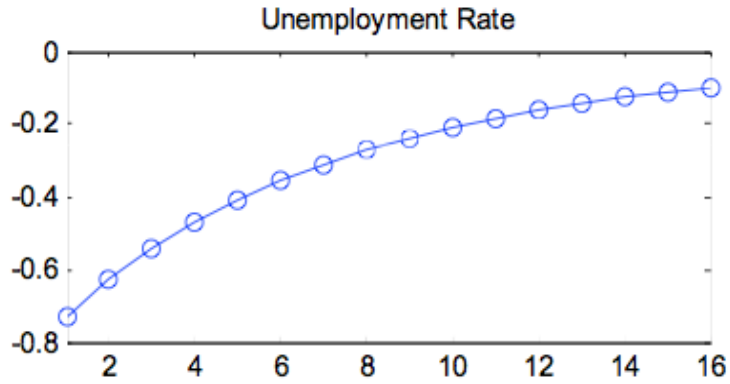


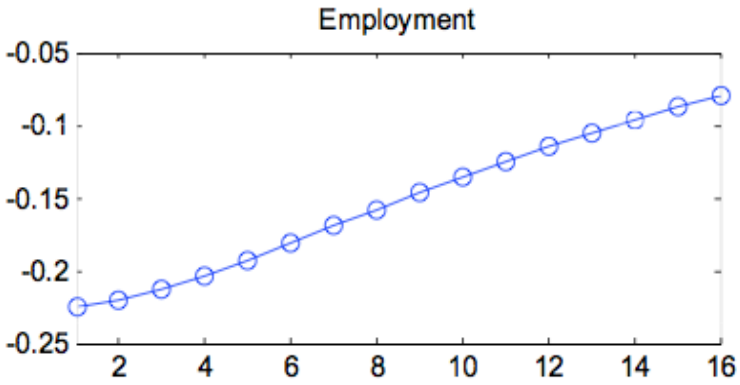
Response to a monetary policy shock ε_t^v

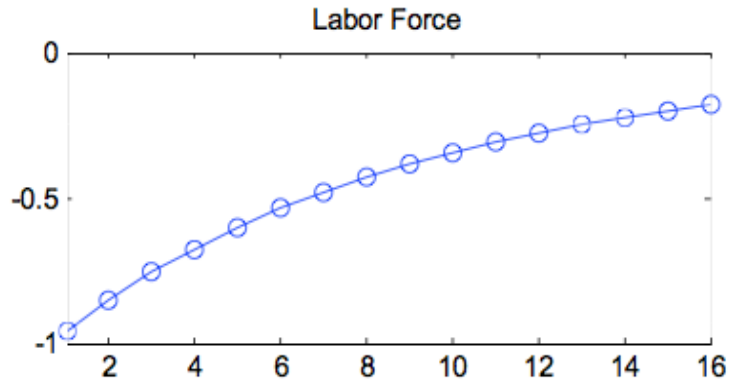
- Output and employment decline substantially
- Labor force increases a little — negative wealth effect
- Unemployment rises
- Real wage falls
- Price inflation falls

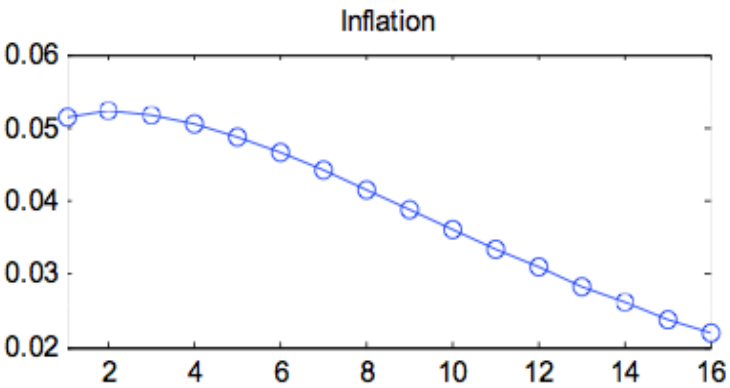
Response to a labor supply shock ε_t^{ξ}











Response to a labor supply shock ε_t^{ξ}

- Labor force falls
- Unemployment declines substantially
- Real wage increases, inflation increases
- Induces nominal interest rate rise, output and employment falls, but these effects small relative to initial labor supply shock

Second Moments

- Key statistics: standard deviations relative to output, and correlations with output

$$\frac{\sigma(x)}{\sigma(y)}, \qquad \text{and} \qquad \rho(x, y)$$

  all variables expressed as deviations from (HP) trend

- Data for US and Euro area

- Simulations *conditional on each type of shock*

Table 2. Second Moments: Model vs. Data (HP-Filtered)										
	U.S. Data		*Euro Data*		*Technology*		*Monetary*		*Labor Supply*	
	$\frac{\sigma(x)}{\sigma(y)}$	$\rho(x,y)$	$\frac{\sigma(x)}{\sigma(y)}$	$\rho(x,y)$	$\frac{\sigma(x)}{\sigma(y)}$	$\rho(x,y)$	$\frac{\sigma(x)}{\sigma(y)}$	$\rho(x,y)$	$\frac{\sigma(x)}{\sigma(y)}$	$\rho(x,y)$
Unemployment	0.46	−0.89	0.37	−0.81	1.30	0.96	1.68	−0.99	4.42	0.95
Employment	0.60	0.82	0.63	0.78	1.44	−0.98	1.49	0.99	1.49	0.99
Labor force	0.23	0.26	0.32	0.54	0.17	−0.92	0.17	−0.98	5.87	0.97
Real Wage	0.59	0.16	0.69	0.27	0.38	0.53	0.15	0.57	0.87	−0.75
Inflation	0.34	0.36	0.39	0.36	0.40	−0.99	0.20	0.99	0.31	−0.99

Data

- Employment more volatile than unemployment, itself more volatile than labor force
- All three are less volatile than output, as are real wage and inflation
- Unemployment strongly countercyclical, employment strongly procyclical
- Real wage and inflation weakly procyclical

Model

- Productivity shocks imply:
  - countercyclical employment and inflation, procyclical unemployment
  - excessively volatile employment and unemployment, excessively cyclical real wage
- Monetary policy shocks imply:
  - countercyclical unemployment, procyclical employment and inflation, **but**
  - excessively volatile employment and unemployment, excessively cyclical inflation
- None of these shocks alone provides a good account of the data

Comparative statics

- Implications of wage rigidities for unemployment dynamics?
- Consider monetary shocks alone
- Vary key parameter θ_w and consider implications for
  - *volatility*: the std dev of unemployment
    (relative to the benchmark model)
  - *persistence*: first-order autocorrelation of unemployment
  - *cyclicality*: correlation with output

Table 3. Wage Rigidities and Unemployment Fluctuations									
	Volatility			Persistence			Cyclicality		
θ_w :	0.1	0.5	0.75	0.1	0.5	0.75	0.1	0.5	0.75
$\rho_v = 0.0$	0.18	0.22	0.23	−0.16	−0.08	−0.07	−0.99	−1.0	−1.0
$\rho_v = 0.5$	0.24	0.39	0.42	0.20	0.34	0.37	−0.98	−0.99	−1.0
$\rho_v = 0.9$	0.15	0.54	1.0	0.40	0.62	0.68	−0.92	−0.99	−1.0

Results

- Volatility increases with degree of nominal wage rigidity
- Persistence increases with degree of nominal wage rigidity, need highly persistent shocks to obtain realistic persistence
- Cyclicality essentially independent of degree of nominal wage rigidity, unemployment always countercyclical

Next week

- Part II: Frictions in Banking and Financial Intermediation
- Background and overview of the global financial crisis.
- Readings
  - Brunnermeier, "Deciphering the liquidity and credit crunch 2007-2008" *Journal of Economic Perspectives*, 2009
  - Cecchetti, "Crisis and response: the Federal Reserve in the early stages of the financial crisis" *Journal of Economic Perspectives*, 2009
  - Coval, Jurek and Stafford "Economics of structured finance" *Journal of Economic Perspectives*, 2009

Readings available from the LMS