Unemployment Fluctuations and Stabilization Policies: A New Keynesian Perspective

Lecture I: A Simple Model of Unemployment and Inflation Dynamics

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The New Keynesian Approach to Monetary Policy Analysis

- Methodology

  - dynamic, stochastic, general equilibrium frameworks
  - optimization by individual agents
  - rational expectations

- Keynesian ingredients

  - monopolistic competition $\Rightarrow$ "demand constraints"
  - nominal rigidities $\Rightarrow$ non-neutrality of monetary policy

- Resulting framework:

  - fits existing evidence on the effects of shocks
  - suitable for analysis of alternative monetary policy rules
  - yields new insights (e.g. management of expectations)
  - adopted by many central banks

- Shortcomings

Unemployment and the New Keynesian Model

- Standard NK model ⇒ no reference to unemployment (like RBC)
- Search and Matching models ⇒ no role for monetary policy (like RBC)
- Recent literature ⇒ labor market frictions + nominal rigidities

  ⇒ unemployment + role for monetary policy

  Positive analysis: Walsh, Trigari, Gertler-Sala-Trigari,...
  Normative analysis: Blanchard-Galí, Thomas, Faia,...

- The approach here:

  - builds on Galí (2009)
  - reformulation of the *standard* NK model (Erceg et al. (2000))
  - no search frictions; central role of nominal wage rigidities

Outline of the Lectures

- Lecture I: A Simple Model of Unemployment and Inflation Dynamics

  What are the implications of the NK model for unemployment?
  What is the role of nominal wage rigidities in accounting for unemployment fluctuations?

- Lecture II: Unemployment, the Output Gap and the Welfare Costs of Fluctuations

  How does the output gap vary over time?
  How do fluctuations affect welfare?

- Lecture III: Unemployment and Monetary Policy Design in the NK Model

  Can monetary policy be improved by using information on unemployment?

A Model of Unemployment and Inflation Fluctuations

Households

- Representative household with a continuum of members, indexed by $(i, j) \in [0, 1] \times [0, 1]$
- Continuum of differentiated labor services, indexed by $i \in [0, 1]$
- Disutility from (indivisible) labor: $\chi_t j^{\varphi}$, where $\varphi \geq 0$
- Full consumption risk sharing within the household
- Household utility: $E_0 \sum_{t=0}^{\infty} \beta^t \; U(C_t, \{N_t(i)\}, \chi_t)$

$$U_t(C_t, \{N_t(i)\}, \chi_t) \equiv \log C_t - \chi_t \int_0^1 \int_0^{N_t(i)} j^{\varphi} \, dj \, di$$

$$= \log C_t - \chi_t \int_0^1 \frac{N_t(i)^{1+\varphi}}{1+\varphi} \, di$$

where $C_t \equiv \left(\int_0^1 C_t(z)^{1-\frac{1}{\epsilon_p}} \, dz \right)^{\frac{\epsilon_p}{\epsilon_p - 1}}$ and $\chi_t \equiv \exp\{\xi_t\}$ is a preference shifter

- Budget constraint

$$\int_0^1 P_t(z)C_t(z)\ dz + Q_t B_t \leq B_{t-1} + \int_0^1 W_t(i)N_t(i)\ di + \Pi_t$$

- Two optimality conditions

$$C_t(z) = \left(\frac{P_t(z)}{P_t}\right)^{-\epsilon} C_t$$

where $P_t \equiv \left(\int_0^1 P_t(z)^{1-\epsilon_p} dz\right)^{\frac{1}{1-\epsilon_p}}$ and

$$Q_t = \beta E_t \left\{ \frac{C_t}{C_{t+1}} \frac{P_t}{P_{t+1}} \right\}$$

Wage Setting

- Nominal wage for each labor type reset with probability $1 - \theta_w$ each period
- Average wage dynamics

$$w_t = \theta_w w_{t-1} + (1 - \theta_w) w_t^*$$

- Optimal wage setting rule

$$w_t^* = \mu^w + (1 - \beta\theta_w) \sum_{k=0}^{\infty} (\beta\theta_w)^k E_t \left\{ mrs_{t+k|t} + p_{t+k} \right\}$$

where $\mu^w \equiv \log \frac{\epsilon_w}{\epsilon_w - 1}$ and $mrs_{t+k|t} \equiv c_{t+k} + \varphi \; n_{t+k|t} + \xi_{t+k}$

- Wage inflation equation

$$\pi_t^w = \beta E_t\{\pi_{t+1}^w\} - \lambda_w(\mu_t^w - \mu^w)$$

where $\pi_t^w \equiv w_t - w_{t-1}$, $\mu_t^w \equiv w_t - p_t - mrs_t$, and $\lambda_w \equiv \frac{(1-\theta_w)(1-\beta\theta_w)}{\theta_w(1+\epsilon_w\varphi)}$.

Introducing Unemployment

- Participation condition for an individual (i,j):

$$\left(\frac{1}{C_t}\right)\left(\frac{W_t(i)}{P_t}\right) \geq \chi_t\, j^{\varphi}$$

- Marginal participant, $L_t(i)$, given by:

$$\frac{W_t(i)}{P_t} = \chi_t C_t L_t(i)^{\varphi}$$

- Taking logs and integrating over i,

$$w_t - p_t = c_t + \varphi l_t + \xi_t$$

where $l_t \equiv \int_0^1 l_t(i)\, di$ is the model's implied (log) aggregate participation

Introducing Unemployment

- Unemployment rate

$$u_t \equiv l_t - n_t$$

- Average wage markup and unemployment

$$\begin{aligned} \mu_t^w &= (w_t - p_t) - (c_t + \varphi n_t + \xi_t) \\ &= (w_t - p_t) - (c_t + \varphi l_t + \xi_t) + \varphi\ (l_t - n_t) \\ &= \varphi u_t \end{aligned}$$

- Under flexible wages:

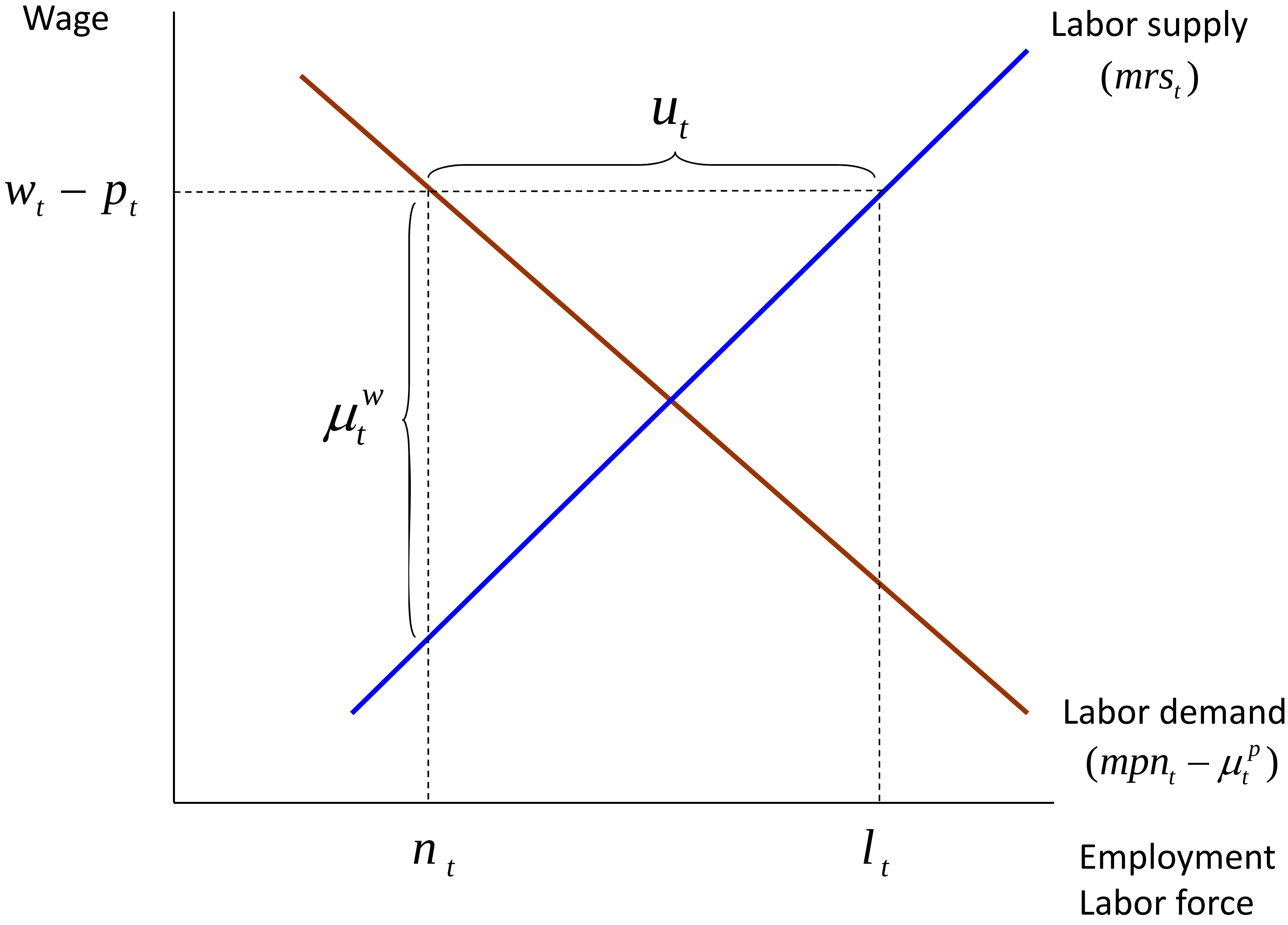
$$\mu^w = \varphi u^n$$

$\Rightarrow u^n$: *natural* rate of unemployment

- The nature of unemployment and its fluctuations
- A New Keynesian Wage Phillips Curve

$$\pi_t^w = \beta E_t\{\pi_{t+1}^w\} - \lambda_w \varphi (u_t - u^n)$$

Figure 1. The Wage Markup and the Unemployment Rate



Firms and Price Setting

- Continuum of firms, $z \in [0,1]$, each producing a differentiated good.
- Technology

$$Y_t(z) = A_t N_t(z)^{1-\alpha}$$

where $N_t(z) \equiv \left(\int_0^1 N_t(i,z)^{1-\frac{1}{\epsilon_w}} di \right)^{\frac{\epsilon_w}{\epsilon_w - 1}}$

- The price of each good reset with a probability $1 - \theta_p$ each period
- Average price dynamics

$$p_t = \theta_p p_{t-1} + (1-\theta_p) p_t^*$$

- Opimal price setting rule

$$p_t^* = \mu^p + (1 - \beta\theta_p) \sum_{k=0}^{\infty} (\beta\theta_p)^k E_t\{\psi_{t+k|t}\}$$

Firms and Price Setting

- Implied price inflation equation

$$\pi_t^p = \beta E_t\{\pi_{t+1}^p\} - \lambda_p(\mu_t^p - \mu^p)$$

where

$$\mu_t^p \equiv p_t - \psi_t,$$

$$\psi_t \equiv w_t - (a_t - \alpha n_t + \log(1-\alpha))$$

and

$$\lambda_p \equiv \frac{(1-\theta_p)(1-\beta\theta_p)}{\theta_p} \; \frac{1-\alpha}{1-\alpha+\alpha\epsilon_p}.$$

Equilibrium

- Non-Policy block

$$\widetilde{y}_t = E_t\{\widetilde{y}_{t+1}\} - (i_t - E_t\{\pi_{t+1}\} - r_t^n)$$

$$\pi_t^p = \beta E_t\{\pi_{t+1}^p\} + \kappa_p \widetilde{y}_t + \lambda_p \widetilde{\omega}_t$$

$$\pi_t^w = \beta E_t\{\pi_{t+1}^w\} + \kappa_w \widetilde{y}_t - \lambda_w \widetilde{\omega}_t$$

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

where $\widetilde{y}_t \equiv y_t - y_t^n$, $\omega_t \equiv w_t - p_t$ and $\widetilde{\omega}_t \equiv \omega_t - \omega_t^n$

- Policy block

$$i_t = \rho + \phi_\pi \pi_t^p + \phi_y y_t + v_t$$

- Natural equilibrium

$$
\begin{aligned}
\omega_t^n &= a_t + \left(\frac{\alpha}{1+\varphi}\right)\xi_t \\
y_t^n &= a_t - \left(\frac{1-\alpha}{1+\varphi}\right)\xi_t \\
r_t^n &= \rho + E_t\{\Delta a_{t+1}\} - \left(\frac{1-\alpha}{1+\varphi}\right)E_t\{\Delta \xi_{t+1}\}
\end{aligned}
$$

- Exogenous processes for $\{a_t\}$, $\{\xi_t\}$, and $\{v_t\}$
- Unemployment

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

Nominal Wage Rigidities and Unemployment Fluctuations: Simulations

Baseline calibration

	Description	*Value*	*Target*
φ	Curvature of labor disutility	5	Frisch elasticity 0.2
α	Index of decrasing returns to labor	1/4	
ϵ_w	Elasticity of substitution (labor)	4.52	$u^n = 0.05$
ϵ_p	Elasticity of substitution (goods)	9	$S = \frac{1-\alpha}{\epsilon_p/(\epsilon_p-1)} = 2/3$
θ_p	Calvo index of price rigidities	3/4	avg. duration $= 4$
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ϕ_p	Inflation coefficient in policy rule	1.5	Taylor (1993)
ϕ_y	Output coefficient in policy rule	0.125	Taylor (1993)
β	Discount factor	0.99	
ρ_i	Persistence exogenous processes	0.9	

Nominal Wage Rigidities and Unemployment Fluctuations: Simulations

- Impulse responses and conditional second moments
- The role of wage rigidities as a source of unemployment volatility and persistence

Figure 1a. Dynamic Responses to a Technology Shock

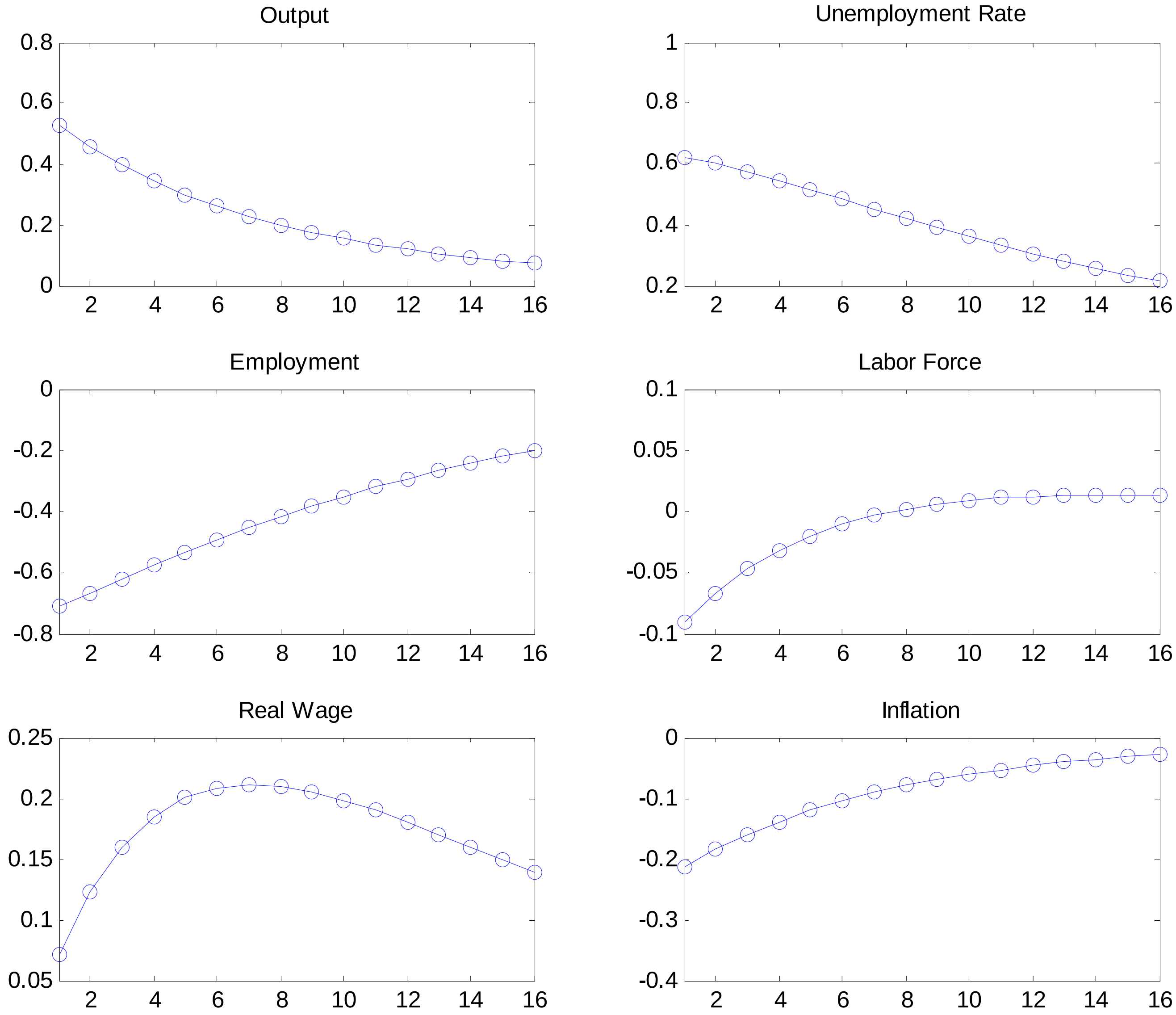

Figure 1b. Dynamic Responses to a Monetary Shock

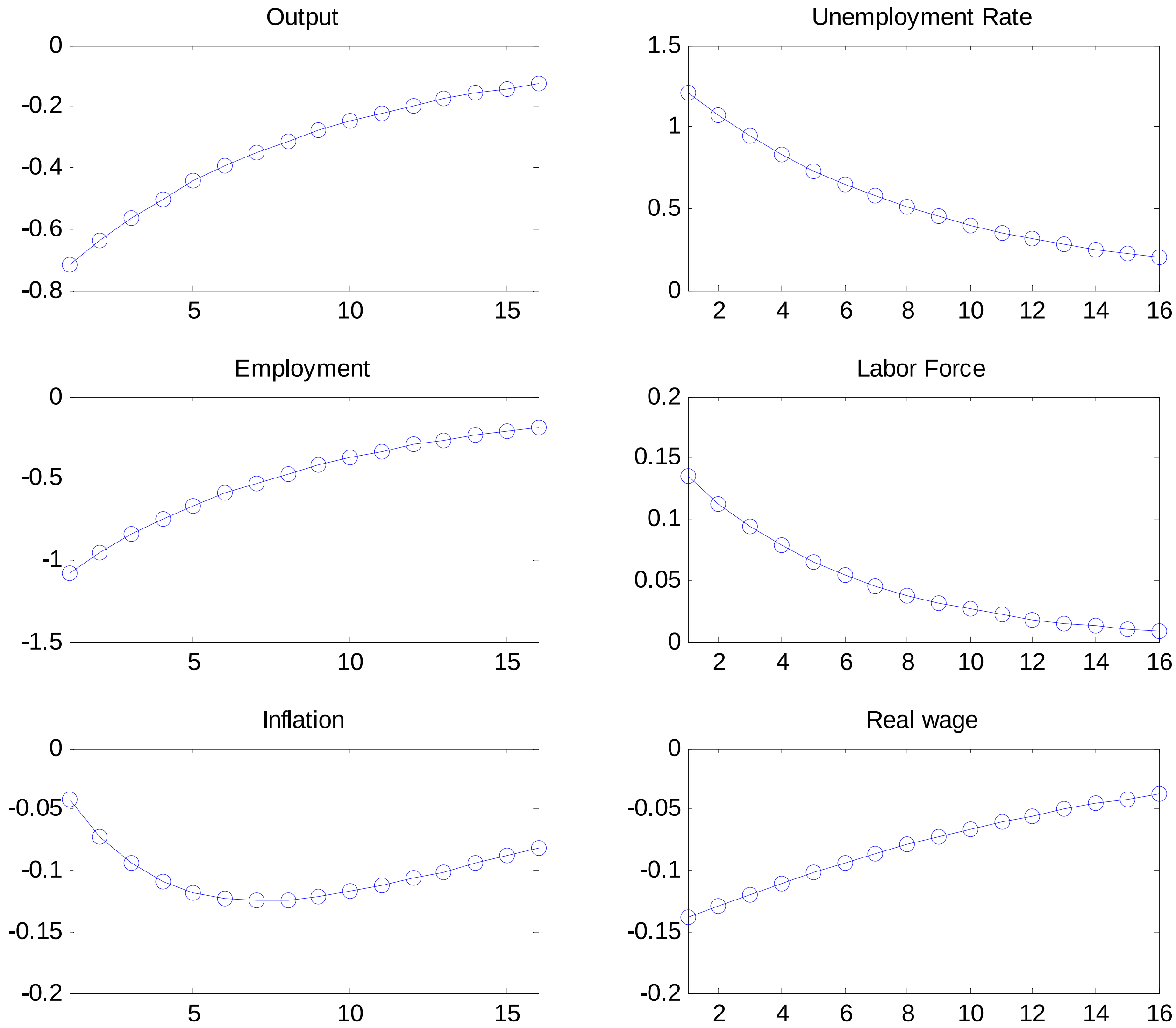

Figure 1c. Dynamic Responses to a Labor Supply Shock

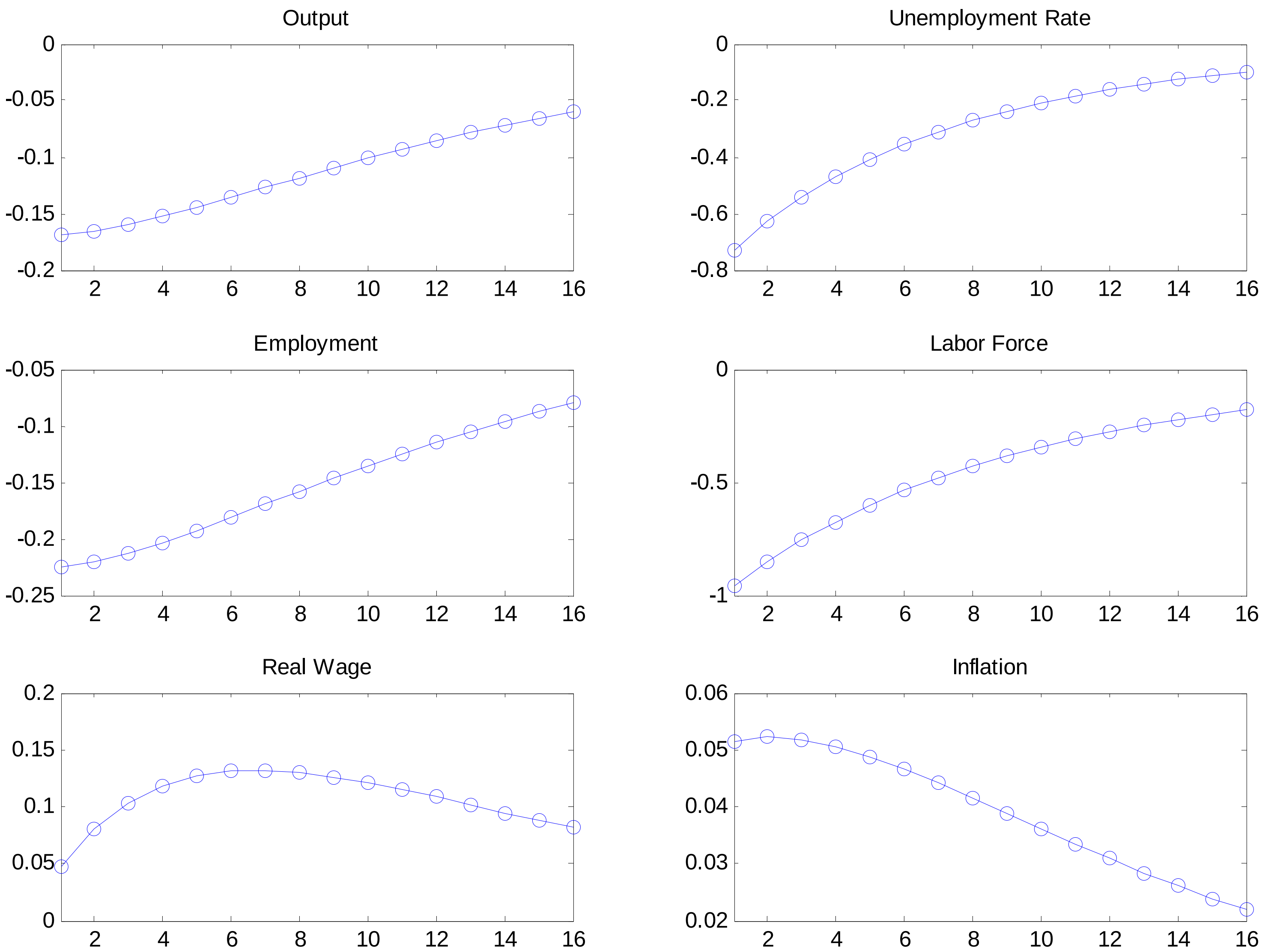

Table 2. Second Moments: Model vs. Data (HP-Filtered)										
	U.S. Data		*Euro Data*		*Technology*		*Monetary*		*Labor Supply*	
	$\frac{\sigma(x)}{\sigma(y)}$	$\rho(x,y)$	$\frac{\sigma(x)}{\sigma(y)}$	$\rho(x,y)$	$\frac{\sigma(x)}{\sigma(y)}$	$\rho(x,y)$	$\frac{\sigma(x)}{\sigma(y)}$	$\rho(x,y)$	$\frac{\sigma(x)}{\sigma(y)}$	$\rho(x,y)$
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

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

Summary and Conclusions

- Reformulation of the standard New Keynesian model, with an explicit introduction of unemployment
- Nominal wage rigidities $\Rightarrow$ source of unemployment fluctuations
- Simulations: realistic nominal wage rigidities may, *in themselves*, be a significant source of unemployment fluctuations, of size and persistence comparable to those found in postwar U.S. data.
- Further research: need to understand the role of additional factors

  - real wage rigidities
  - search frictions
  - variations in the natural rate (Galí-Smets-Wouters)