

Monetary Policy and Unemployment: A New Keynesian Perspective

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Introducing unemployment in the Standard NK model

- Reformulation of the *standard* NK model $\Rightarrow$ unemployment
- Alternative to recent literature: labor market frictions + nominal rigidities
- Some applications:
 - An empirical model of wage inflation and unemployment dynamics [2]
 - Unemployment and the measurement of the output gap [1]
 - Unemployment and the design of monetary policy [1]
 - Revisiting the sources of fluctuations in the Smets-Wouters model [3]
 - Understanding the high persistence of European unemployment [4]

References

- [1] *Unemployment Fluctuations and Stabilization Policies: A New Keynesian Perspective* (2011, MIT Press)
- [2] "The Return of the Wage Phillips Curve" *Journal of the European Economic Association*, 2011.
- [3] "An Estimated New Keynesian Model with Unemployment," (with F. Smets and R. Wouters), *NBER Macroeconomics Annual* 2011
- [4] "Insider-Outsider Labor Markets, Hysteresis, and Monetary Policy," unpublished manuscript.

A Model of Unemployment and Inflation Fluctuations

Households

- Representative household with a continuum of members, indexed by $(j, s) \in [0, 1] \times [0, 1]$
- Continuum of occupations, indexed by $j \in [0, 1]$
- Disutility from (indivisible) labor: χs^φ , for $s \in [0, 1]$, where $\varphi \geq 0$
- Full consumption risk sharing within the household
- Household utility: $E_0 \sum_{t=0}^{\infty} \beta^t U(C_t, \{\mathcal{N}_t(j)\}; Z_t)$

$$\begin{aligned} U(C_t, \{\mathcal{N}_t(j)\}; Z_t) &\equiv \left(\frac{C_t^{1-\sigma} - 1}{1-\sigma} - \chi \int_0^1 \int_0^{\mathcal{N}_t(j)} s^\varphi ds dj \right) Z_t \\ &= \left(\frac{C_t^{1-\sigma} - 1}{1-\sigma} - \chi \int_0^1 \frac{\mathcal{N}_t(j)^{1+\varphi}}{1+\varphi} dj \right) Z_t \end{aligned}$$

$$\text{where } C_t \equiv \left(\int_0^1 C_t(i)^{1-\frac{1}{\epsilon_p}} di \right)^{\frac{\epsilon_p}{\epsilon_p-1}}$$

- Budget constraint

$$\int_0^1 P_t(i) C_t(i) di + Q_t B_t \leq B_{t-1} + \int_0^1 W_t(j) \mathcal{N}_t(j) dj + D_t$$

- Two optimality conditions

$$C_t(i) = \left(\frac{P_t(i)}{P_t} \right)^{-\epsilon_p} C_t$$

where $P_t \equiv \left(\int_0^1 P_t(i)^{1-\epsilon_p} di \right)^{\frac{1}{1-\epsilon_p}}$, implying $\int_0^1 P_t(i) C_t(i) di = P_t C_t$.

$$Q_t = \beta E_t \left\{ \left(\frac{C_{t+1}}{C_t} \right)^{-\sigma} \left(\frac{Z_{t+1}}{Z_t} \right) \left(\frac{P_t}{P_{t+1}} \right) \right\}$$

Wage Setting

- Nominal wage for each occupation 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

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

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

- 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 (j, s) :

$$\frac{W_t(j)}{P_t} \geq \chi C_t^\sigma s^\varphi$$

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

$$\frac{W_t(j)}{P_t} = \chi C_t^\sigma L_t(j)^\varphi$$

- Aggregate labor force (in logs):

$$w_t - p_t = \sigma c_t + \varphi l_t + \xi$$

where $w_t \simeq \int_0^1 w_t(j) dj$ and $l_t \equiv \int_0^1 l_t(j) dj$

Introducing Unemployment

- Unemployment rate

$$u_t \equiv l_t - n_t$$

- Average wage markup and unemployment

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

- Under flexible wages:

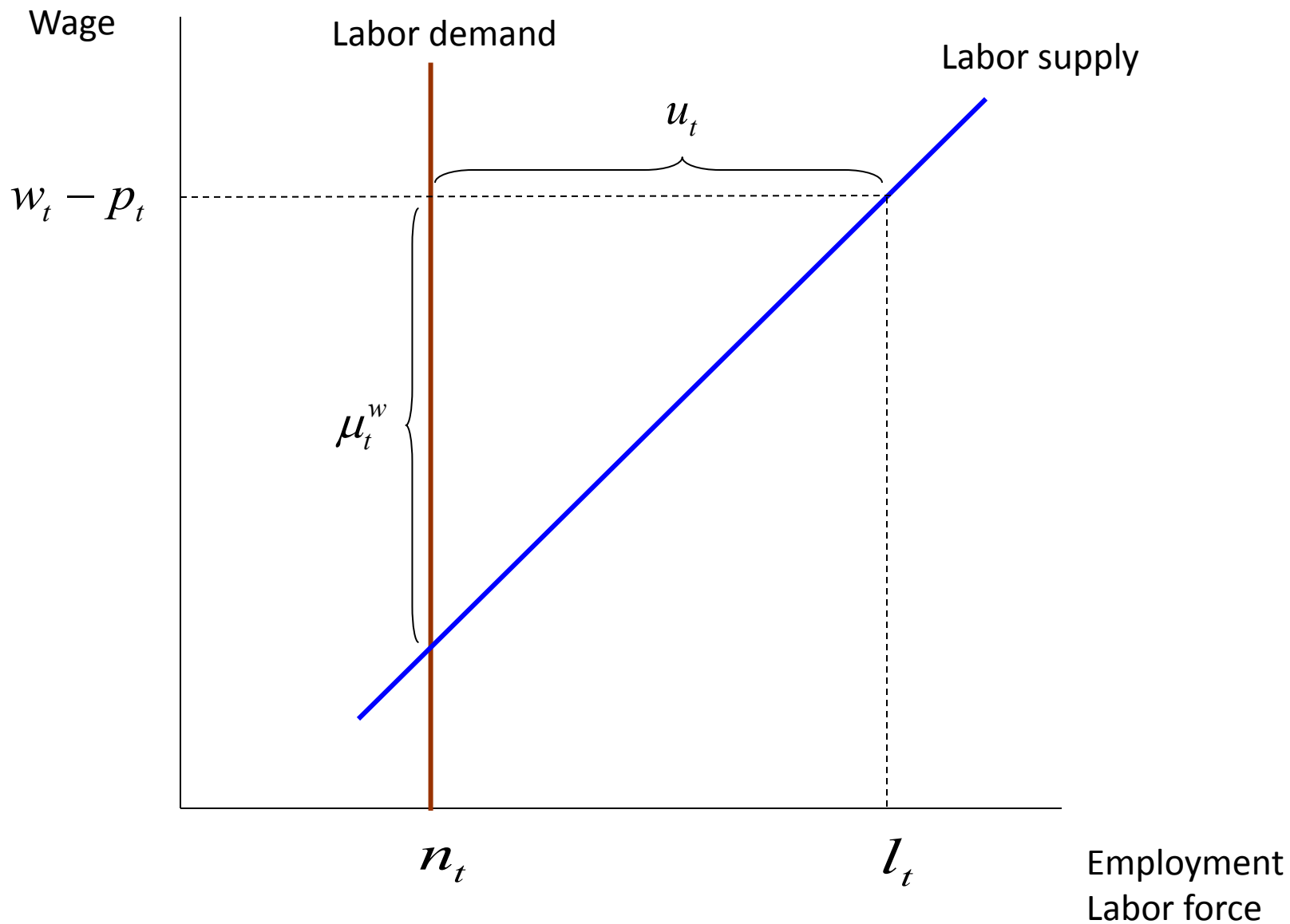
$$\mu^w = \varphi u^n$$

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

- A New Keynesian Wage Phillips Curve

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

Figure 7.1 The Wage Markup and the Unemployment Rate



Firms and Price Setting

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

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

$$\text{where } N_t(i) \equiv \left(\int_0^1 N_t(i, j)^{1-\frac{1}{\epsilon_w}} dj \right)^{\frac{\epsilon_w}{\epsilon_w-1}}$$

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

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

- Optimal 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

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

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

$$\pi_t^w = \beta E_t\{\pi_{t+1}^w\} - \lambda_w \varphi \hat{u}_t$$

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

$$\begin{aligned}\varphi \hat{u}_t &= \hat{\mu}_t^w \\ &= \tilde{\omega}_t - (\sigma \tilde{c}_t + \varphi \tilde{n}_t) \\ &= \tilde{\omega}_t - \left(\sigma + \frac{\varphi}{1-\alpha} \right) \tilde{y}_t\end{aligned}$$

- Policy block

Example:

$$i_t = \rho + \phi_p \pi_t^p + \phi_y \hat{y}_t + v_t$$

- Natural equilibrium

$$\hat{y}_t^n = \psi_{ya} a_t$$

$$r_t^n = \rho - \sigma(1 - \rho_a) \psi_{ya} a_t + (1 - \rho_z) z_t$$

$$\hat{\omega}_t^n = \psi_{wa} a_t$$

with $\psi_{ya} \equiv \frac{1+\varphi}{\sigma(1-\alpha)+\varphi+\alpha}$ and $\psi_{wa} \equiv \frac{1-\alpha\psi_{ya}}{1-\alpha} > 0$.

- Exogenous $AR(1)$ processes for $\{a_t\}$, $\{z_t\}$, and $\{v_t\}$

- Calibration

Baseline calibration

	<i>Description</i>	<i>Value</i>	<i>Target</i>
φ	Curvature of labor disutility	5	Frisch elasticity 0.2
α	Index of decreasing returns to labor	1/4	
ϵ_w	Elasticity of substitution (labor)	4.5	$u^n = 0.05$
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
θ_w	Calvo index of wage rigidities	3/4	avg. duration = 4
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_a	Persistence: technology shocks	0.9	
ρ_z	Persistence: demand shocks	0.5	
ρ_v	Persistence: monetary shocks	0.5	

- Dynamic Effects of Monetary Policy Shocks on Labor Markets
 - Impulse responses
 - Wage rigidities and the volatility and persistence of unemployment

Figure 7.2 Response of Labor Market Variables to a Monetary Policy Shock

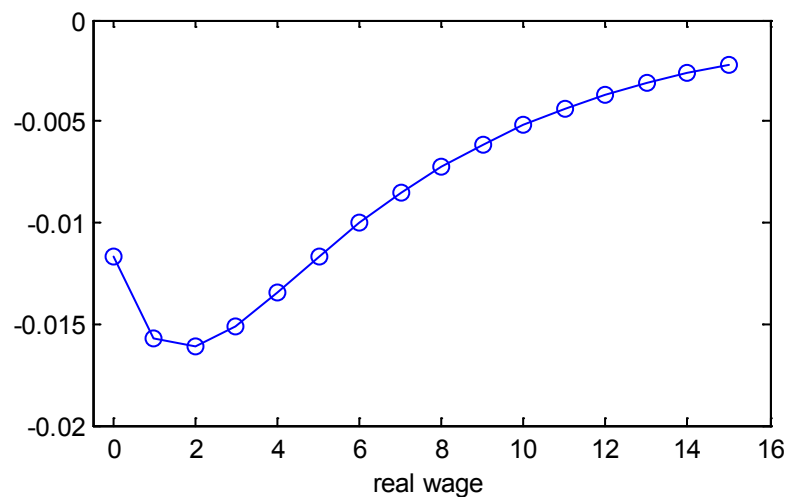
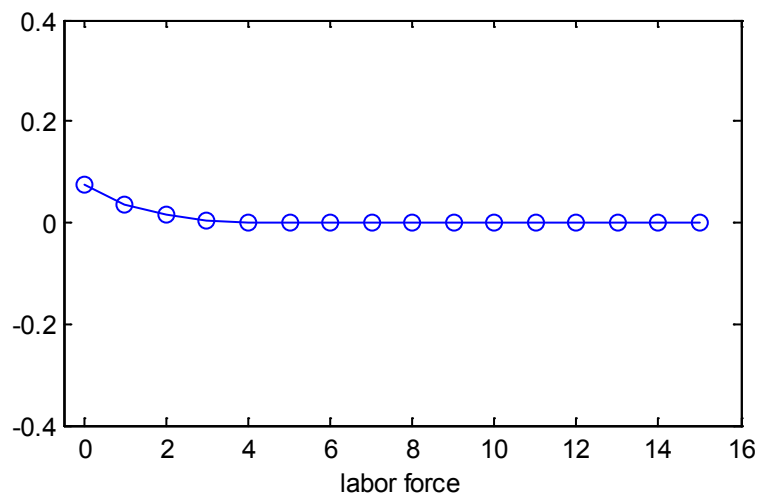
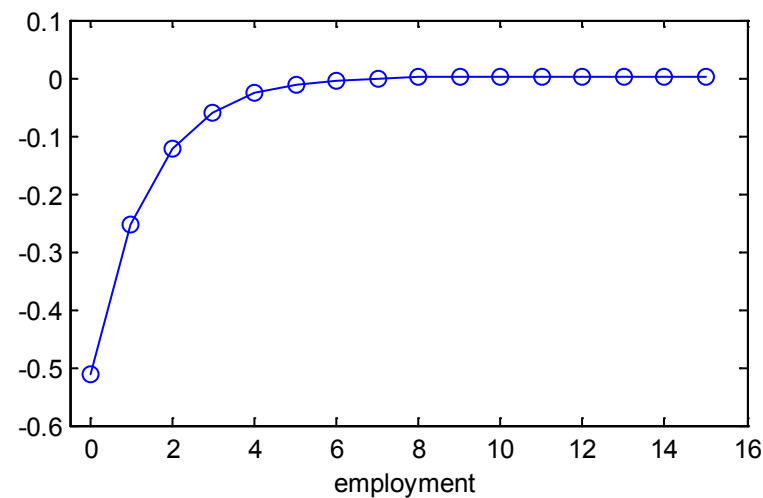
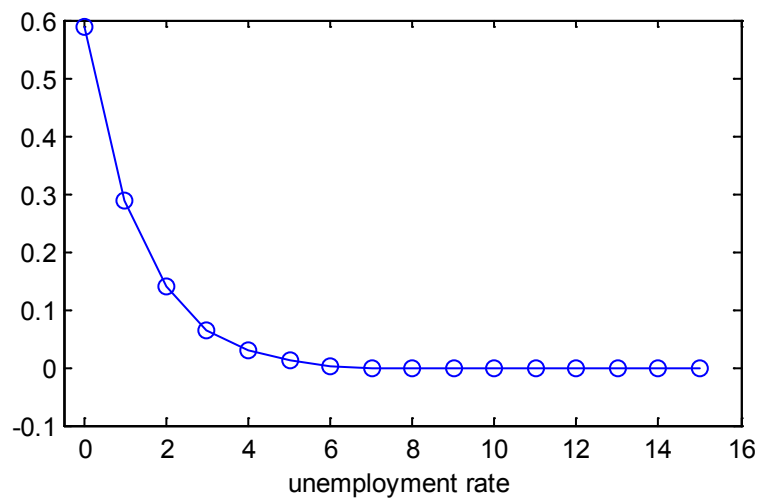


Table 7.1 Wage Rigidities and Unemployment Fluctuations

	Volatility			Persistence			Cyclicalilty		
$\theta_w :$	0.1	0.5	0.75	0.1	0.5	0.75	0.1	0.5	0.75
$\rho_v = 0.0$	0.25	0.32	0.33	-0.14	-0.02	-0.01	-0.99	-0.99	-0.99
$\rho_v = 0.5$	0.36	0.60	0.67	0.24	0.44	0.48	-0.96	-0.99	-0.99
$\rho_v = 0.9$	0.31	1.24	2.47	0.51	0.80	0.87	-0.77	-0.98	-0.99

- Optimal Monetary Policy Problem

$$\min \frac{1}{2} E_0 \sum_{t=0}^{\infty} \beta^t \left(\left(\sigma + \frac{\varphi + \alpha}{1 - \alpha} \right) \tilde{y}_t^2 + \frac{\epsilon_p}{\lambda_p} (\pi_t^p)^2 + \frac{\epsilon_w (1 - \alpha)}{\lambda_w} (\pi_t^w)^2 \right)$$

subject to:

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

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

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

- Optimality conditions

$$\left(\sigma + \frac{\varphi + \alpha}{1 - \alpha}\right) \tilde{y}_t + \varkappa_p \zeta_{1,t} + \varkappa_w \zeta_{2,t} = 0 \quad (1)$$

$$\frac{\epsilon_p}{\lambda_p} \pi_t^p - \Delta \zeta_{1,t} + \zeta_{3,t} = 0 \quad (2)$$

$$\frac{\epsilon_w(1 - \alpha)}{\lambda_w} \pi_t^w - \Delta \zeta_{2,t} - \zeta_{3,t} = 0 \quad (3)$$

$$\lambda_p \zeta_{1,t} - \lambda_w \zeta_{2,t} + \zeta_{3,t} - \beta E_t \{\zeta_{3,t+1}\} = 0 \quad (4)$$

- Unemployment equation

$$\varphi \hat{u}_t = \tilde{\omega}_t - \left(\sigma + \frac{\varphi}{1 - \alpha}\right) \tilde{y}_t$$

- Impulse responses: Optimal vs. Taylor
- A simple rule with unemployment (vs. optimal policy)

$$i_t = 0.01 + 1.5\pi_t^p - 0.5\hat{u}_t \quad (5)$$

Figure 7.3 Optimal Policy vs. Taylor Rule: Technology Shocks

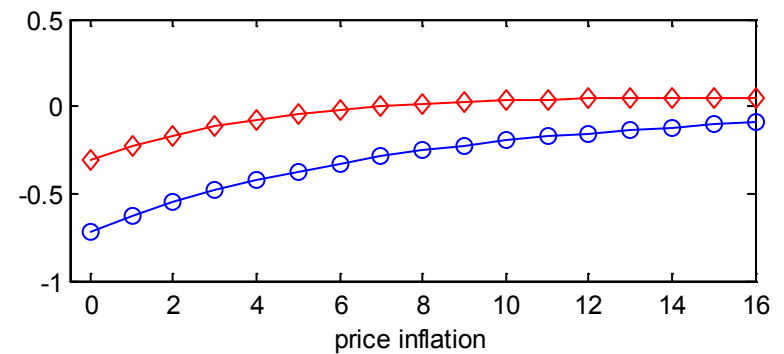
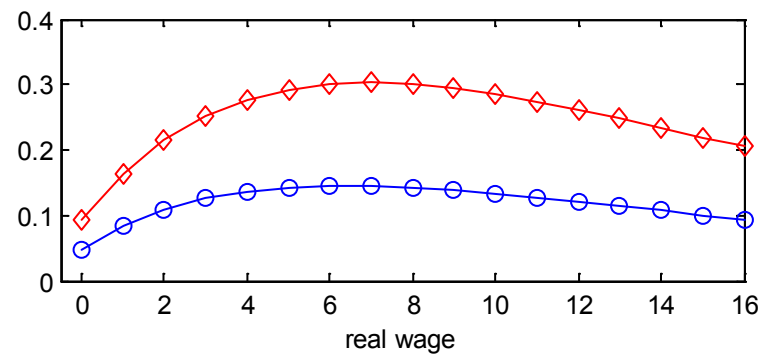
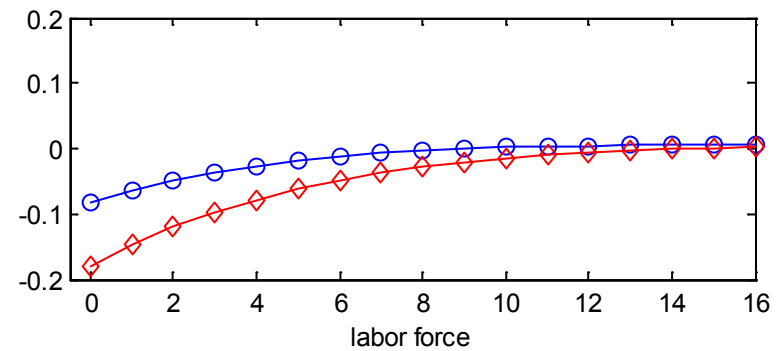
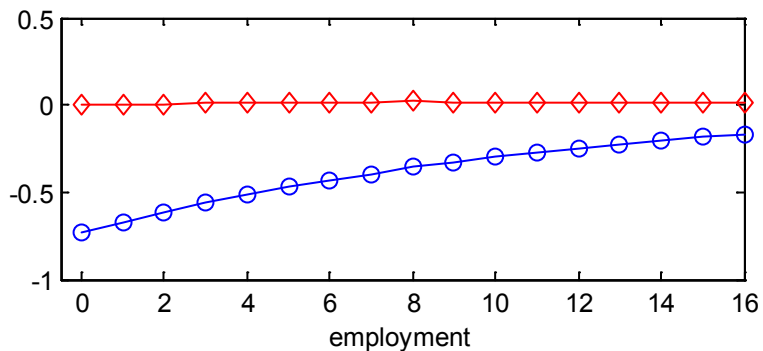
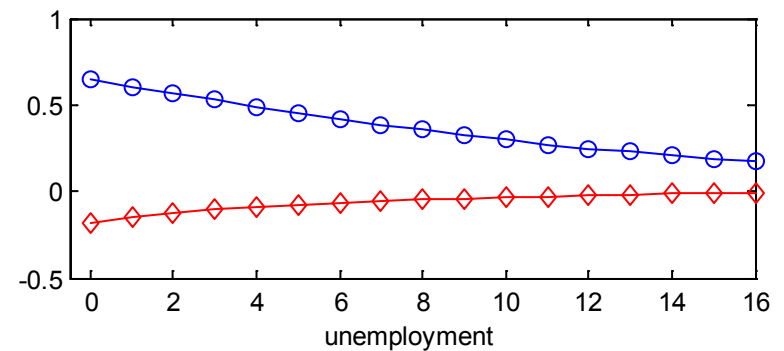
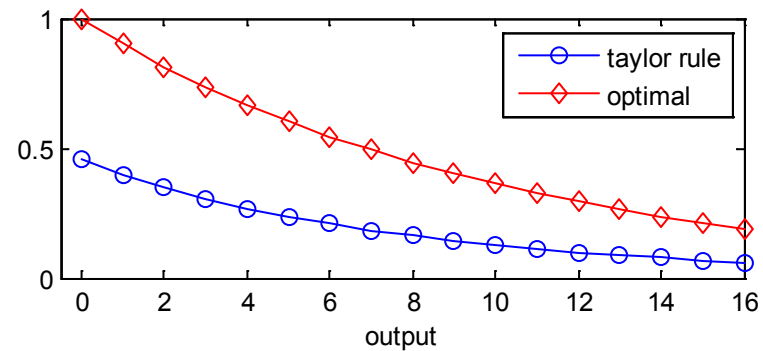


Figure 7.4 Optimal Policy vs. Taylor Rule: Demand Shocks

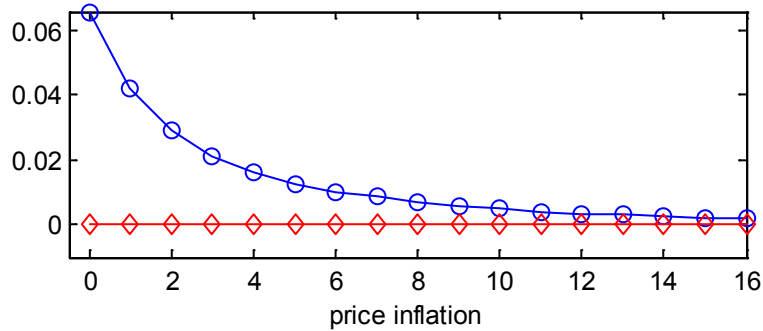
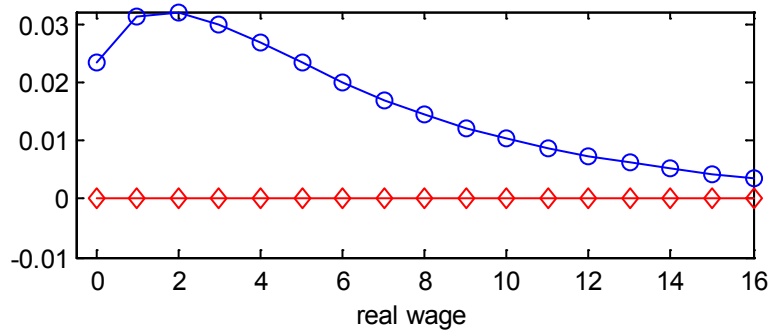
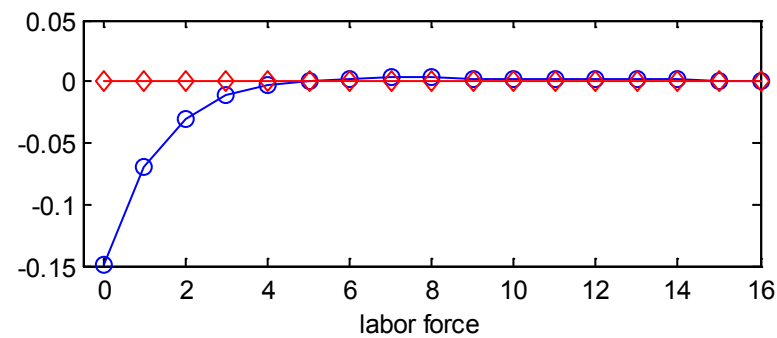
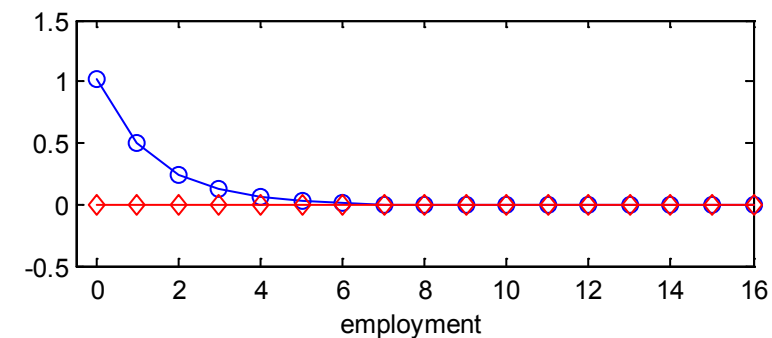
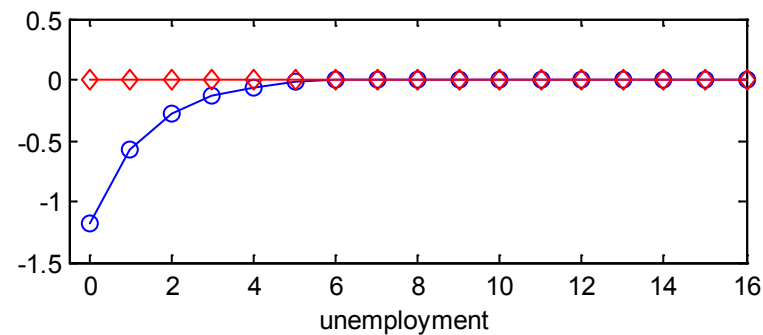
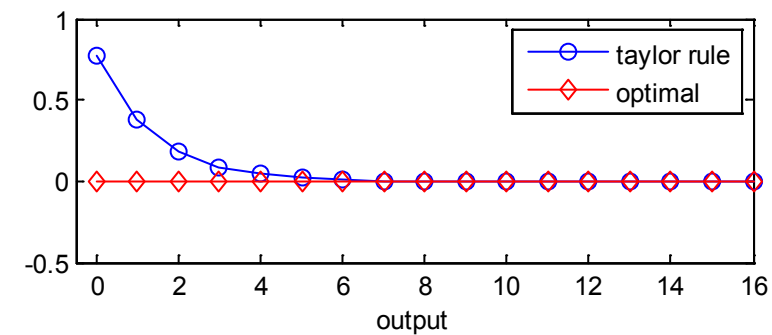


Figure 7.5 Optimal Policy vs. Simple Rule: Technology Shocks

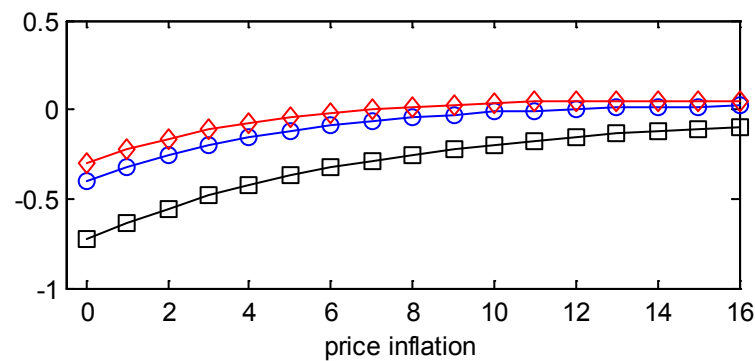
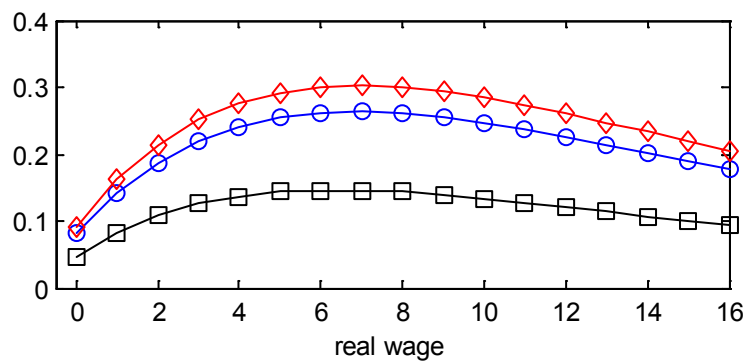
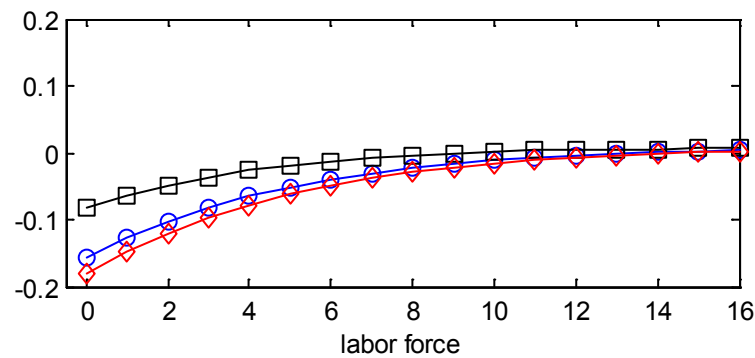
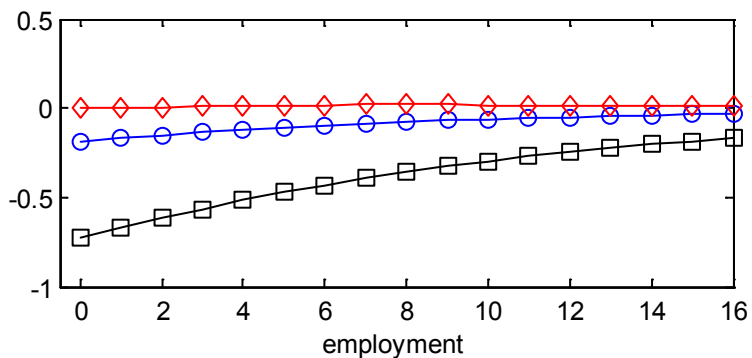
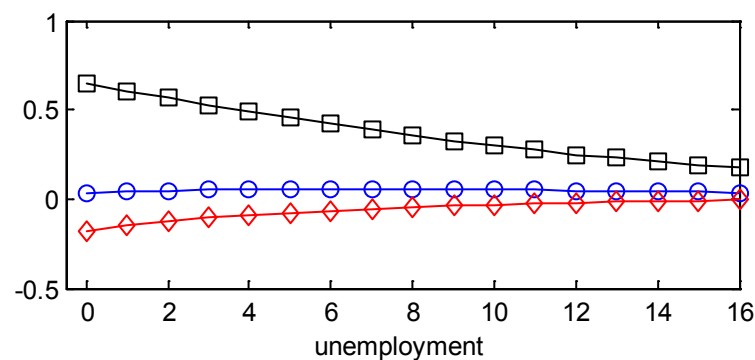
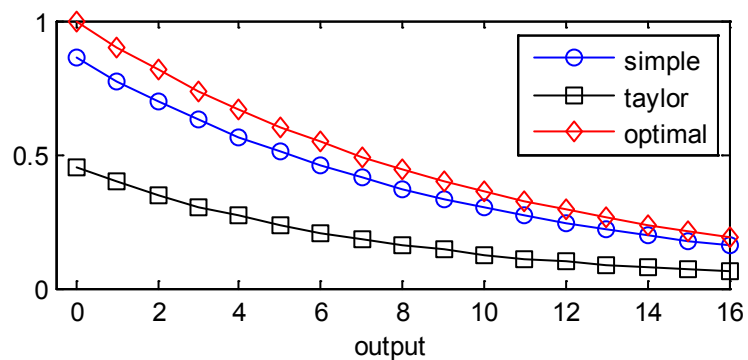


Figure 7.6 Optimal Policy vs. Simple Rule: Demand Shocks

