Monetary Policy and Unemployment

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Introduction

Background

- New Keynesian models $\Rightarrow$ no unemployment (like RBC)
- Search and Matching models $\Rightarrow$ no role for monetary policy (like RBC)
- Recent literature $\Rightarrow$ labor market frictions + nominal rigidities

  $\Rightarrow$ unemployment + role for monetary policy

Two Questions

- How do labor market frictions affect the transmission of monetary policy and its optimal design?
- How does the presence of nominal rigidities influence the dynamic effects of real shocks in an economy with labor market frictions?

Table 1: Nominal Rigidities and Labor Market Frictions

	Positive	Normative
Flexible Wages	Chéron-Langot (2000) Walsh (2005) Trigari (2009) Andrés-Doménech-Ferri (2006)	
Sticky Wages	Trigari (2006) Christoffel-Linzert (2005) Gertler-Sala-Trigari (2008)	Blanchard-Galí (2009) Thomas (2008) Faia (2008, 2009)

Objectives

- Describe essential ingredients of the new class of models
- Address two previous questions using a tractable model
- Relate to main findings in the literature

Novel element

- Variable labor market participation
- Should unemployment play a significant role in the design of monetary policy? (vs. employment, output gap).

Summary of Main Findings

- Quantitatively realistic labor frictions are likely to have, *by themselves*, a limited impact on the economy's equilibrium dynamics
- Main role of labor market frictions: to make room for wage rigidities
- The introduction of sticky prices, combined with a realistic Taylor rule, in a model with labor market frictions and flexible Nash-bargained wages has a limited impact on the economy's equilibrium dynamics. (exception: monetary non-neutralities). The optimal policy is one of strict inflation targeting.
- When realistic nominal wage stickiness is introduced, the optimal policy involves moderate deviations from price stability.
- Unemployment gap fluctuations: independent source of welfare losses. An optimized simple interest rate rule calls for *some* stabilizing policy response to such fluctuations.

A Model with Labor Market Frictions and Nominal Rigidities

Households

$$\max E_0 \sum_{t=0}^{\infty} \beta^t \left(\log C_t - \frac{\chi}{1+\varphi} L_t^{1+\varphi} \right)$$

where

$$L_t = N_t + \psi U_t$$

$$N_t = (1-\delta) N_{t-1} + x_t U_t^0$$

$$U_t \equiv (1 - x_t) U_t^0$$

Firms: Final Goods

Technology

$$Y_t(i) = X_t(i)$$

Calvo price setting

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

Optimal price setting rule

$$p_t^* = \mu^p + (1 - \beta\theta_p) \sum_{k=0}^{\infty} (\beta\theta_p)^k \; (E_t\{p_{t+k}^I\} - \tau)$$

Price inflation equation

$$\pi_t^p = \beta \; E_t\{\pi_{t+1}^p\} - \lambda_p \; \widehat{\mu}_t^p$$

where $\widehat{\mu}_t^p \equiv p_t - (p_t^I - \tau) - \mu^p$

Firms: Intermediate Goods

Technology

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

where

$$N_t(j) = (1-\delta)N_{t-1}(j) + H_t(j) \tag{1}$$

Hiring cost

$$G_t = \Gamma x_t^{\gamma}$$

where $x_t \equiv H_t / U_t^0$

Aside: Relation to matching function approach (with posting cost Γ).

$$M(V_t, U_t) = V_t^{\varsigma} U_t^{1-\varsigma} \implies G_t = \Gamma\, x_t^{\frac{1-\varsigma}{\varsigma}}$$

Optimal Hiring Policy

$$
\begin{aligned}
MRPN_t(j) &= \frac{W_t(j)}{P_t} + G_t - (1-\delta)\ E_t\left\{\Lambda_{t,t+1}\ G_{t+1}\right\} \\
&\equiv \frac{W_t(j)}{P_t} + B_t
\end{aligned}
$$

where $MRPN_t(j) \equiv (P_t^I / P_t)\ (1-\alpha) A_t N_t(j)^{-\alpha}$

Labor Market Frictions, Price Markups, and Inflation Dynamics

$$
\widehat{\mu}_t^p = -s_t^n - \Phi\ (\widehat{b}_t - \widehat{\omega}_t)
$$

where $\Phi \equiv \frac{B}{(W/P)+B}$ and

$$
\widehat{b}_t = \frac{\gamma}{1-\beta(1-\delta)}\ \widehat{x}_t - \frac{\beta(1-\delta)}{1-\beta(1-\delta)}\ (\gamma E_t\{\widehat{x}_{t+1}\} - \widehat{r}_t)
$$

Calibration: $\Phi \simeq 0.006$ $\Rightarrow$ negligible effect of labor market frictions on markup measures (Krause et al.)

Monetary Policy

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

Participation Condition

Value of unemployment

$$\mathcal{V}_t^U = x_t \int_0^1 \frac{H_t(z)}{H_t} \mathcal{V}_t^N(z) dz + (1 - x_t) \left(-\psi MRS_t + E_t \left\{ \Lambda_{t,t+1} \mathcal{V}_{t+1}^U \right\} \right)$$

Optimal participation condition: $\mathcal{V}_t^U = 0$ for all $t \Longrightarrow$

$$\psi \ MRS_t = \frac{x_t}{1 - x_t} \int_0^1 \frac{H_t(z)}{H_t} \mathcal{S}_t^H(z) \ dz$$

Wage Determination: The Case of Flexible Wages

Nash bargaining

$$\xi \ \mathcal{S}_t^H(j) = (1-\xi) \ \mathcal{S}_t^F(j)$$

Symmetric equilibrium

$$\frac{W_t}{P_t} = \xi \ MRS_t + (1-\xi) \ MRPN_t$$

Wage Determination: The Case of Sticky Wages

Staggered nominal wage setting à la Calvo (applied to firms)

Wages bargained at the individual level withing each firm

New hires paid average firm wage

Nash bargaining

$$\xi \ \mathcal{S}^{H}_{t|t} = (1-\xi) \ \mathcal{S}^{F}_{t|t}$$

which implies

$$E_t \left\{ \sum_{k=0}^{\infty} ((1-\delta)\theta_w)^k \Lambda_{t,t+k} \ \left(\frac{W_t^*}{P_{t+k}} - \Omega^{tar}_{t+k|t} \right) \right\} = 0$$

where

$$\Omega^{tar}_{t+k|t} \equiv \xi \ MRS_{t+k} + (1-\xi) \ MRPN_{t+k|t}$$

Sustainability of the fixed wage

$$W_t^* \in [\underline{W}_{t+k|t}, \overline{W}_{t+k|t}]$$

where

$$\underline{W}_{t+k|t} \equiv P_{t+k} \left(MRS_{t+k} - (1-\delta) E_{t+k} \left\{ \Lambda_{t+k,t+k+1} (\theta_w \mathcal{S}^H_{t+k+1|t} + (1-\theta_w) \mathcal{S}^H_{t+\right.\right.$$

$$\overline{W}_{t+k|t} \equiv P_{t+k} \left(MRPN_{t+k|t} + (1-\delta) \; E_{t+k} \left\{ \Lambda_{t+k,t+k+1} \; G_{t+k+1} \right\} \right)$$

Log-linearized wage inflation equation

$$\pi_t^w = \beta(1-\delta)\ E_t\{\pi_{t+1}^w\} - \lambda_w\ (\widehat{\omega}_t - \widehat{\omega}_t^{tar})$$

where

$$\widehat{\omega}_t^{tar} = (1-\Upsilon)\ (\widehat{c}_t + \varphi\widehat{l}_t) + \Upsilon\ (-\widehat{\mu}_t^p + a_t - \alpha\ \widehat{n}_t)$$

with $\Upsilon \equiv \frac{(1-\xi)MRPN}{W/P}$ and $\lambda_w \equiv \frac{(1-\beta(1-\delta)\theta_w)(1-\theta_w)}{\theta_w\ (1-\Upsilon(1-\Phi))}$.

Relation to New Keynesian wage inflation equation

$$\pi_t^w = \beta\ E_t\{\pi_{t+1}^w\} - \lambda_{ehl}\ (\widehat{\omega}_t - \widehat{mrs}_t)$$

where $\widehat{mrs}_t = \widehat{c}_t + \varphi\widehat{n}_t$

Aggregate Demand and Output

$$Y_t = C_t + G_t H_t$$

$$Y_t = \frac{1}{D_t^p D_t^w} \; A_t N_t^{1-\alpha}$$

where

$$D_t^p \equiv \int_0^1 \left(\frac{P_t(i)}{P_t} \right)^{-\epsilon} di \geq 1$$

$$D_t^w \equiv \left[\int_0^1 \left(\frac{N_t(j)}{N_t} \right)^{1-\alpha} dj \right]^{-1} \geq 1$$

Calibration

- $N = 0.59$, $L = 0.62$ $\Rightarrow$ $u = 0.05$
- $x = 0.7$ $\Rightarrow$ $\delta \simeq 0.12$ (BG)
- $\alpha = 1/3$
- $\beta = 0.99$,.$\varphi = 5$
- $\theta_p = 0.75$, $\theta_w = 0.75$
- $\phi_p = 1.5$, $\phi_y = 0.5/4$ (Taylor)
- $G = 0.045\ (W/P)$ (HM and Shimer, based on Silva and Toledo)
- $\gamma = 1$ (BG)

Free parameters

- $\xi = 0.5 \Rightarrow \psi = 0.041$ (efficient)
- $\xi = 0.05 \Rightarrow \psi = 0.82$ (preferred)

Analysis of Equilibrium Dynamics

- Responses to monetary and technology shocks (baseline calibration).
- The role of labor market frictions
- The role of price stickiness
- The role of wage stickiness

Figure 3a. The Effects of Monetary Policy Shocks: Sticky Wages (ξ=0.05)

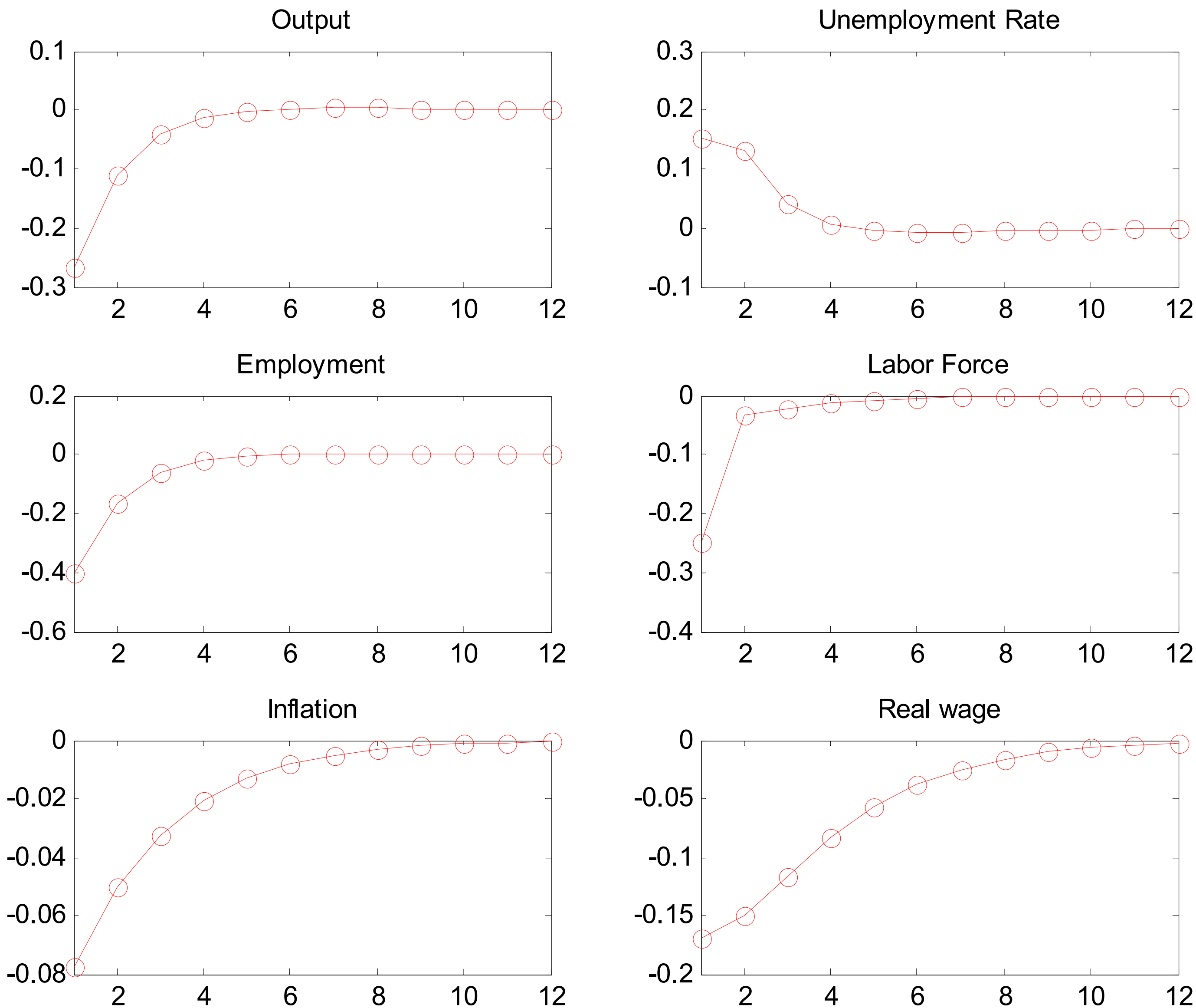


Figure 3b. The Effects of Technology Shocks: Sticky Wages (ξ=0.05)

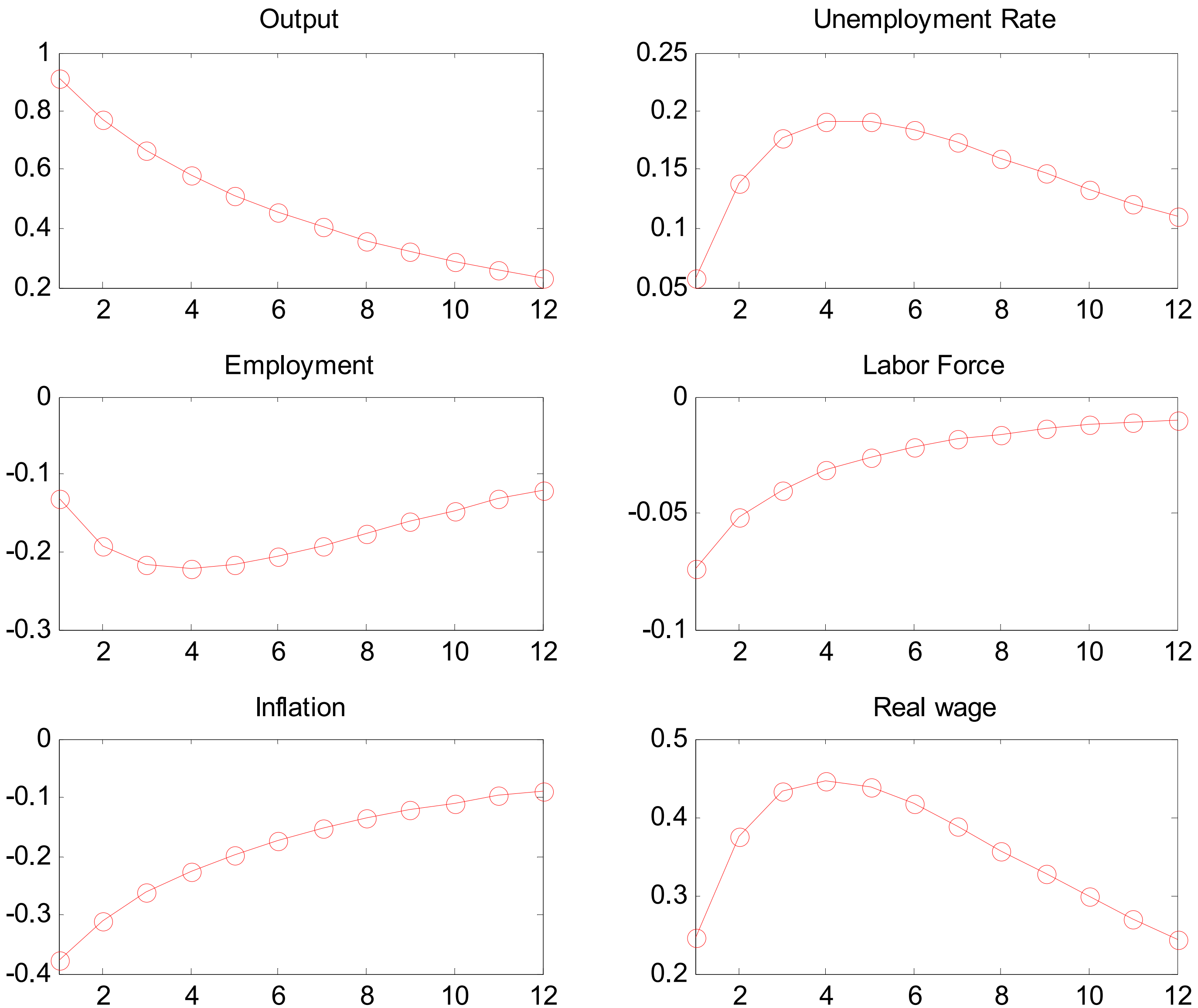


Figure 4a. The Role of Labor Market Frictions

Flexible Wages, Monetary Policy Shock

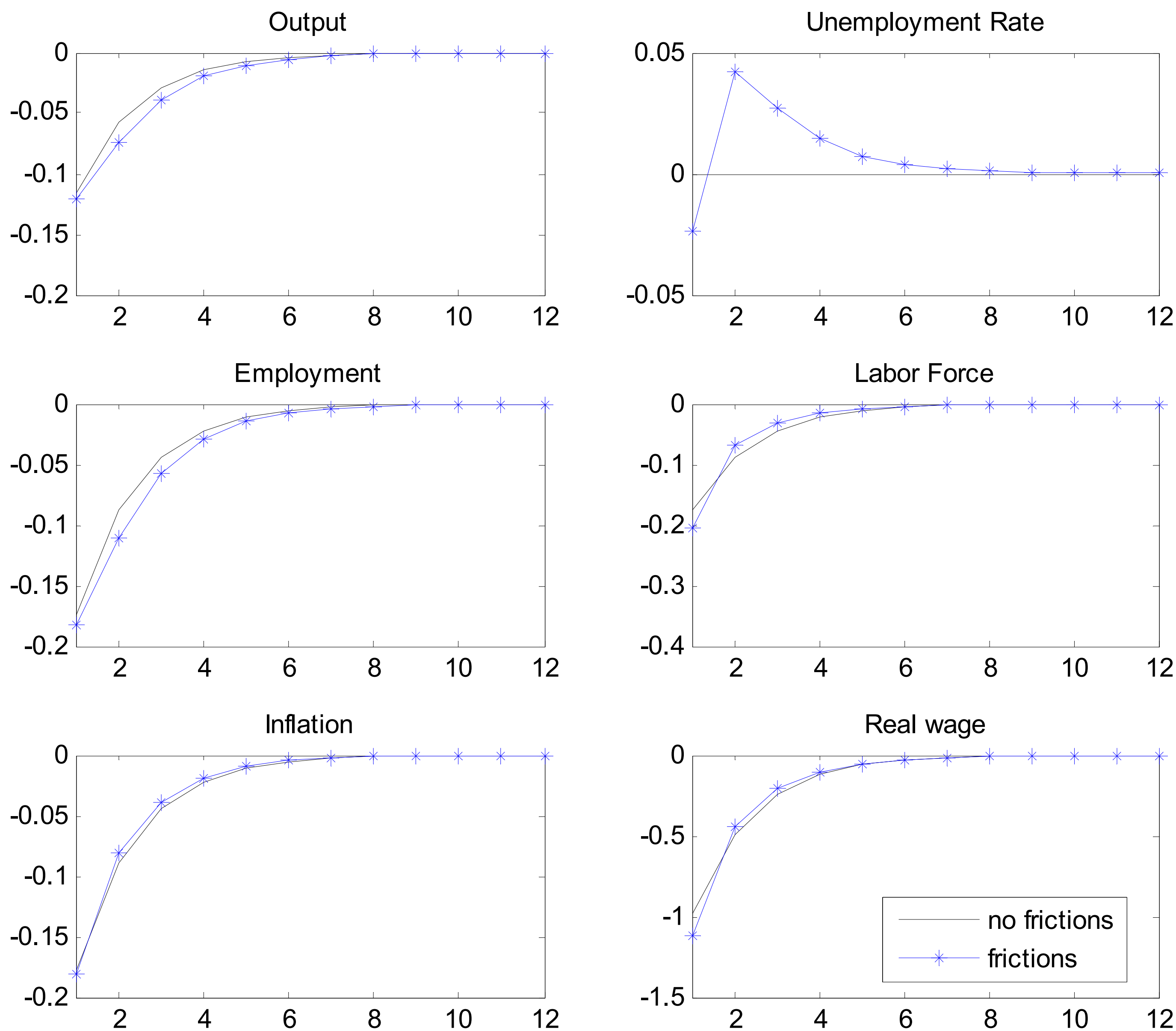


Figure 4b. The Role of Labor Market Frictions

Flexible Wages, Technology Shock

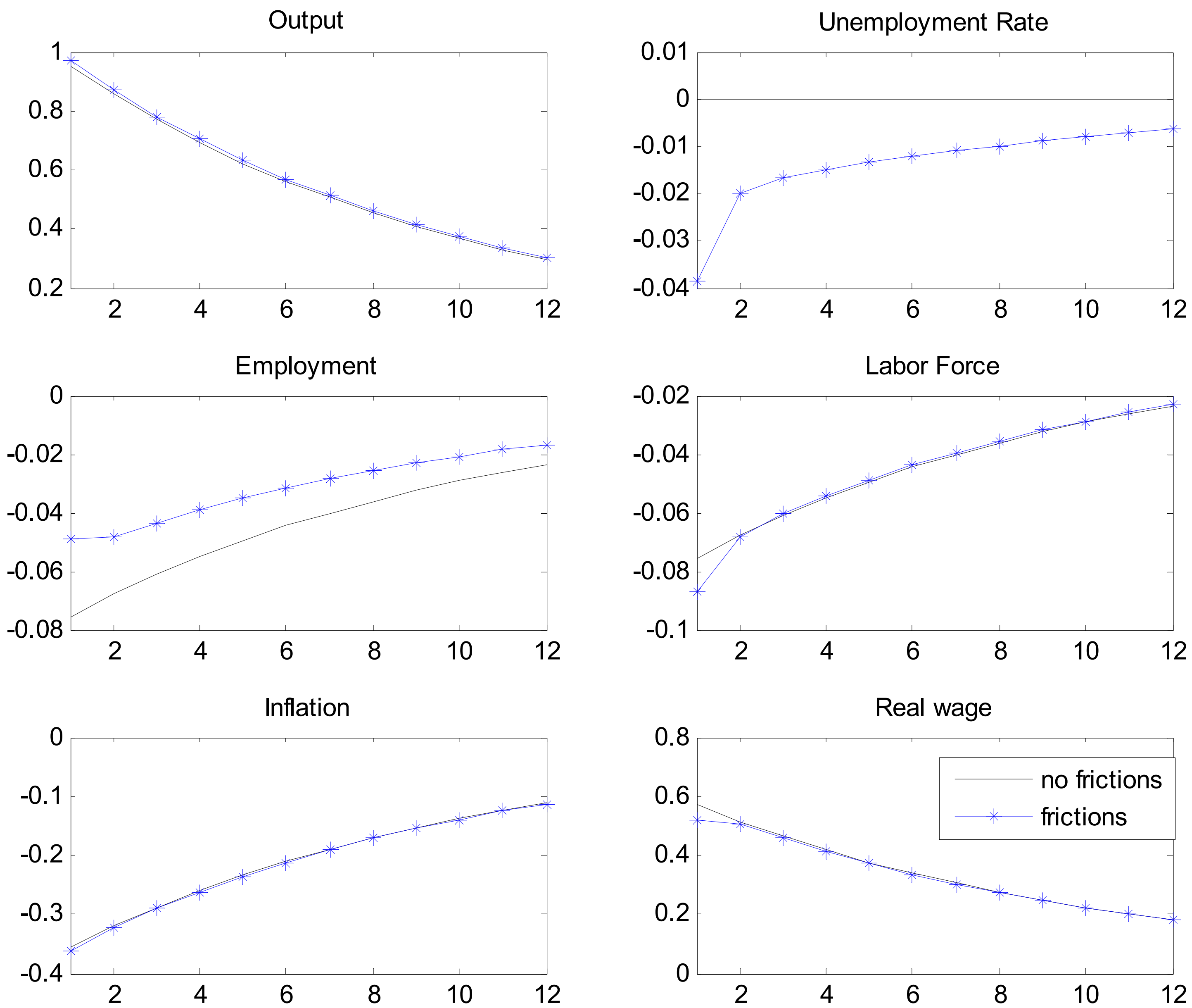


Figure 5a. The Role of Price Stickiness

Flexible Wages, Monetary Policy Shock

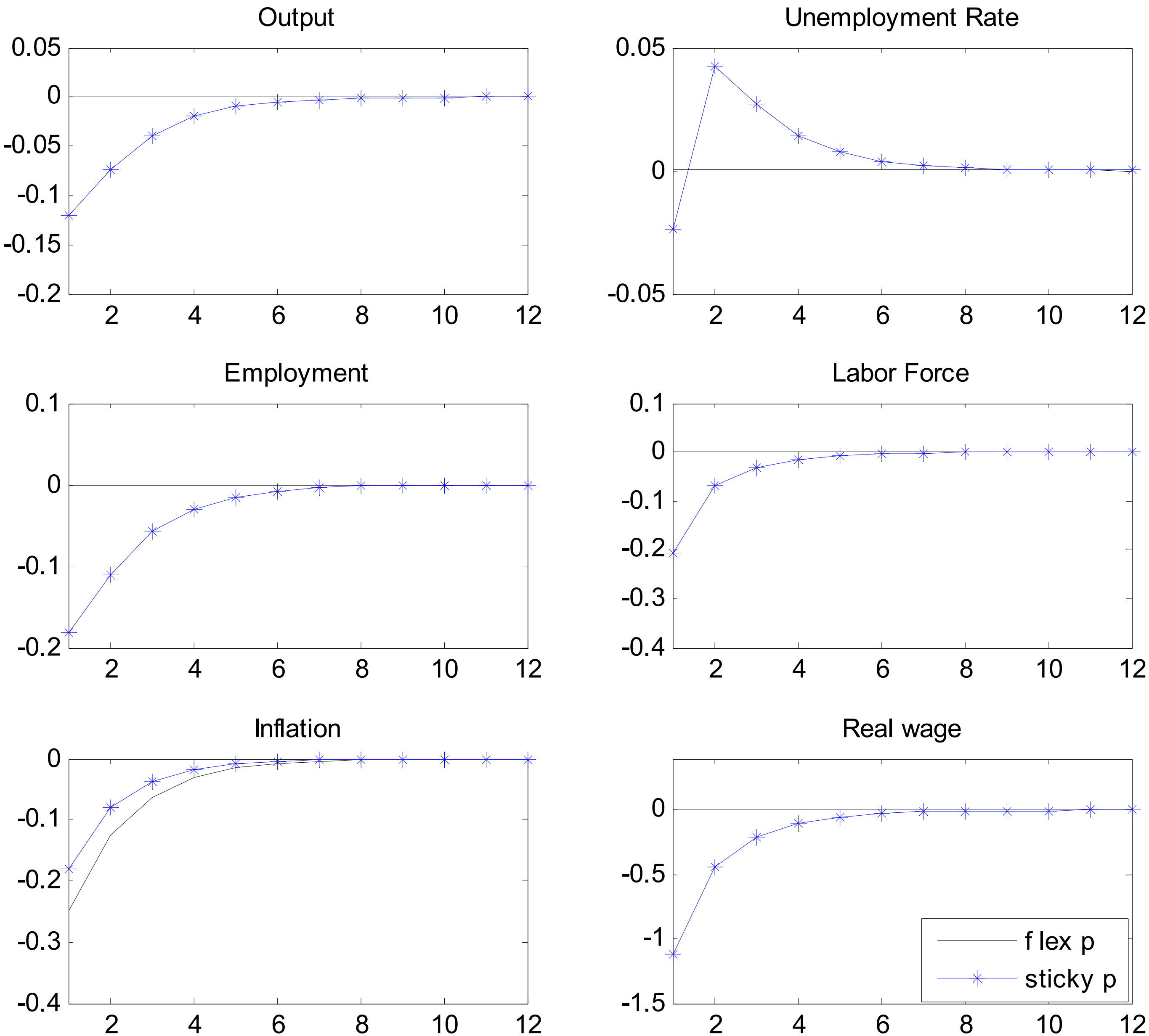


Figure 5b. The Role of Price Stickiness

Flexible Wages, Technology Shock

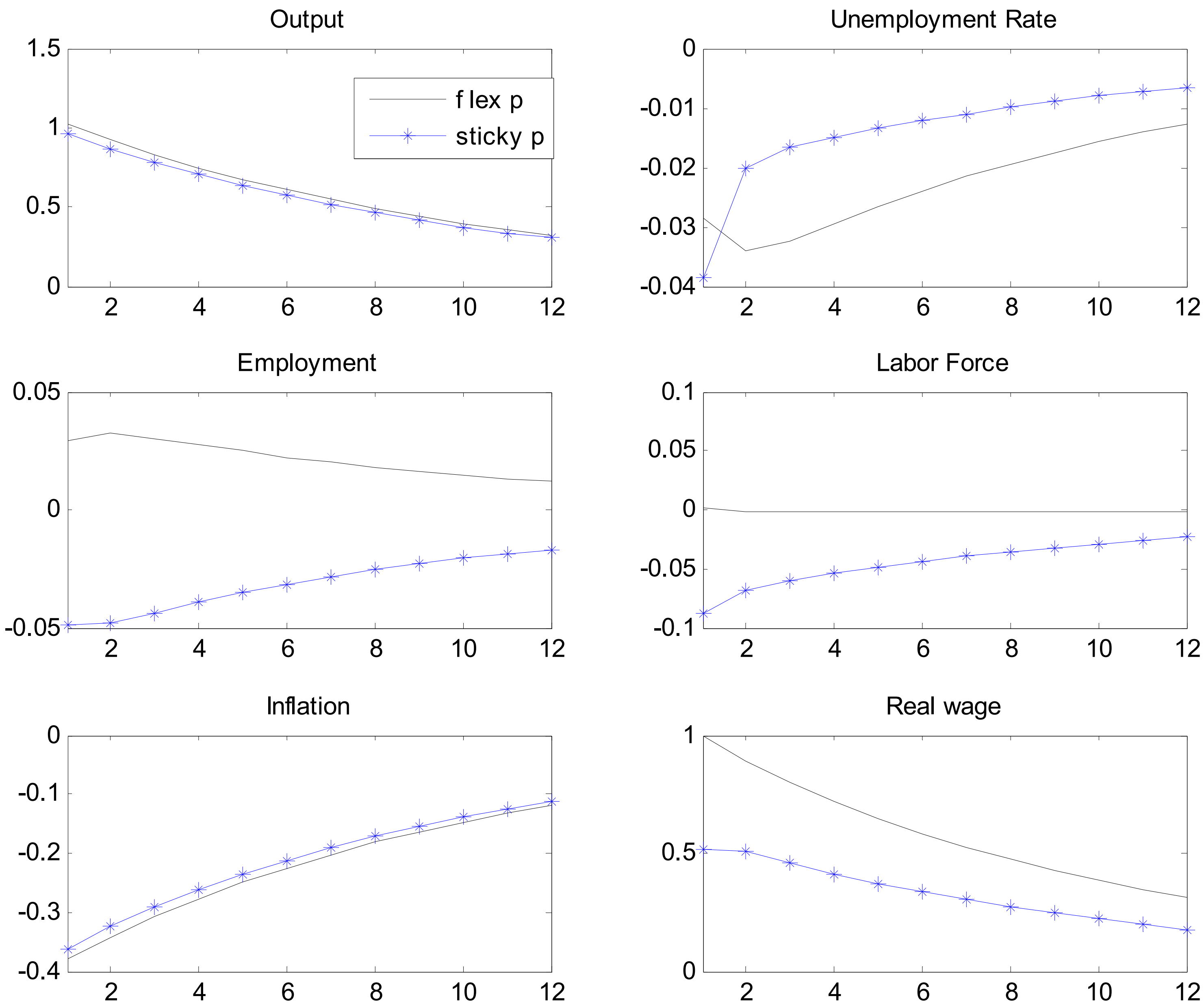


Figure 6a. The Role of Wage Stickiness

Sticky Prices, Monetary Policy Shock

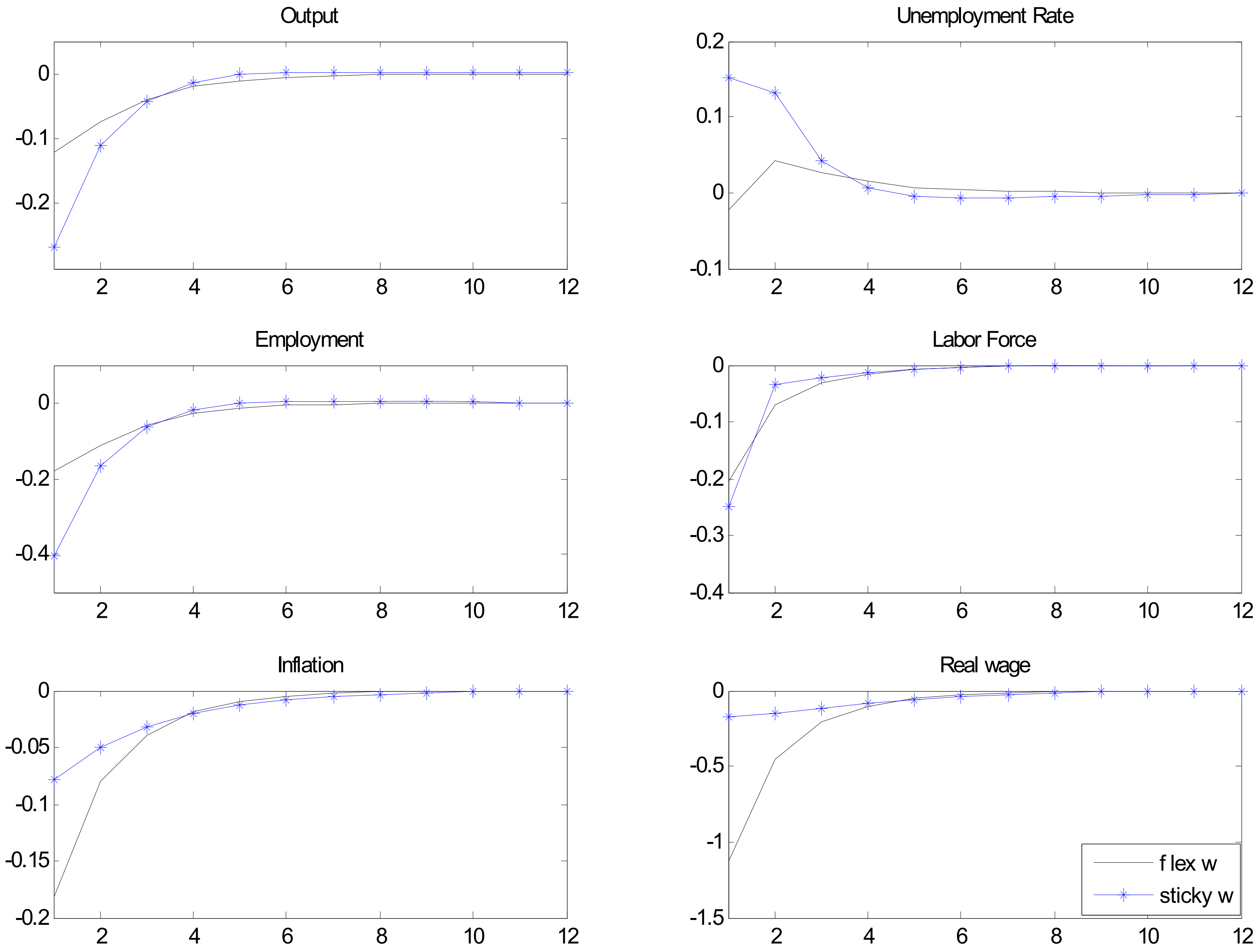
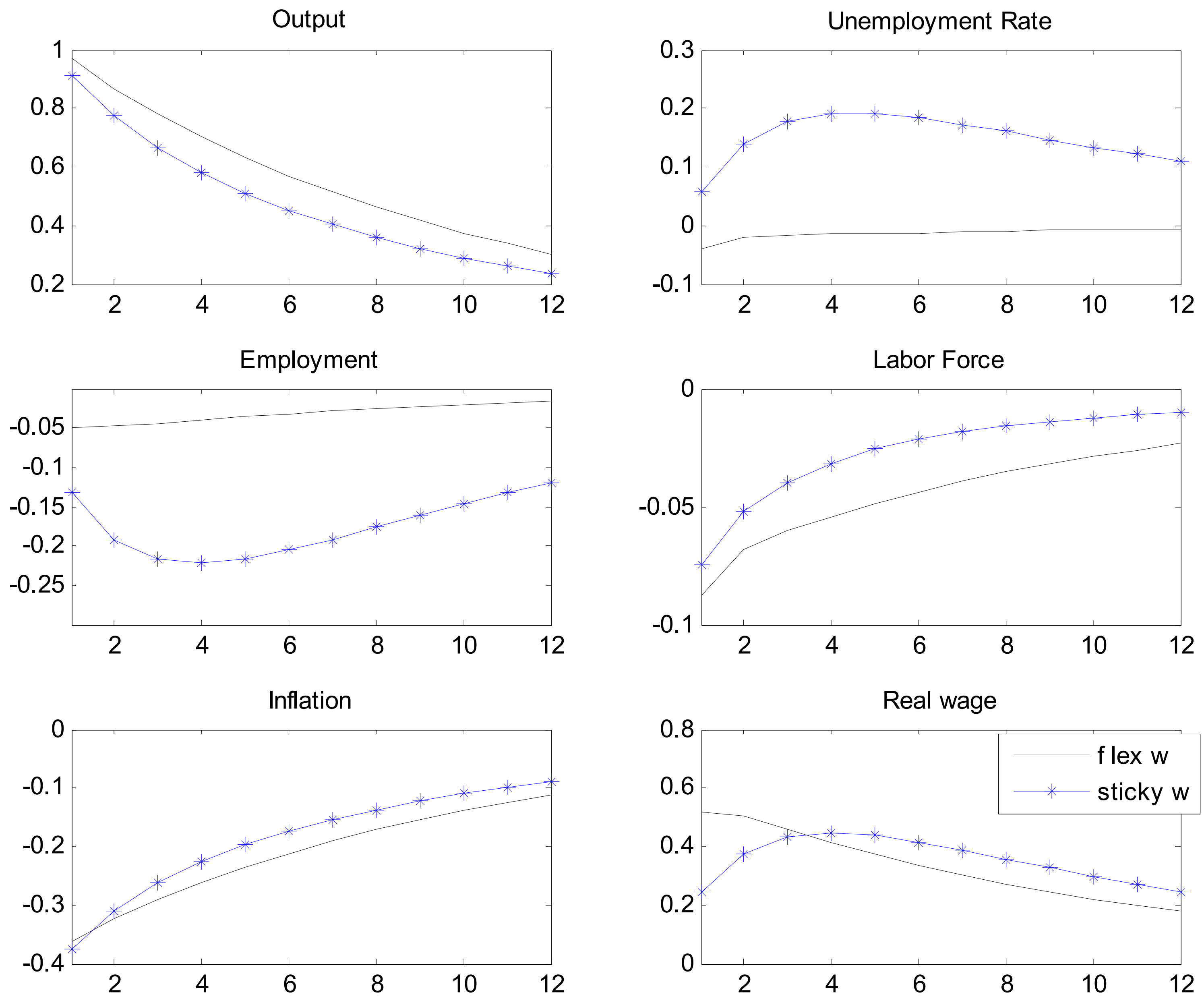


Figure 6b. The Role of Wage Stickiness

Sticky Prices, Technology Shock



Optimal Monetary Policy Design

Welfare losses around efficient steady state

$$\frac{1}{2}\ E_0 \sum_{t=0}^{\infty} \beta^t\ L_t$$

where

$$\begin{aligned} L_t \quad = \quad & \frac{\epsilon}{\lambda_p}\ (\pi_t^p)^2 + \frac{(1-\Phi)^2(1-\alpha)}{\alpha\lambda_w^*}\ (\pi_t^w)^2 \\ & + \frac{(1+\varphi)(1-\Omega)N}{(1-\alpha)L}\ \left(\widetilde{y}_t + \frac{(1-\alpha)\psi U}{N}\widetilde{u}_t\right)^2 \end{aligned}$$

Optimal policy

- flexible wages: strict inflation targeting (BG)
- sticky wages: deviations from price stability

Optimized simple rule

$$i_t = 1.51\ \pi_t^p - 0.10\ y_t + 0.01\ \pi_t^w - 0.025\ u_t$$

Figure 7. Monetary Policy Design: Optimal vs. Taylor

Sticky Prices and Wages, Technology Shock

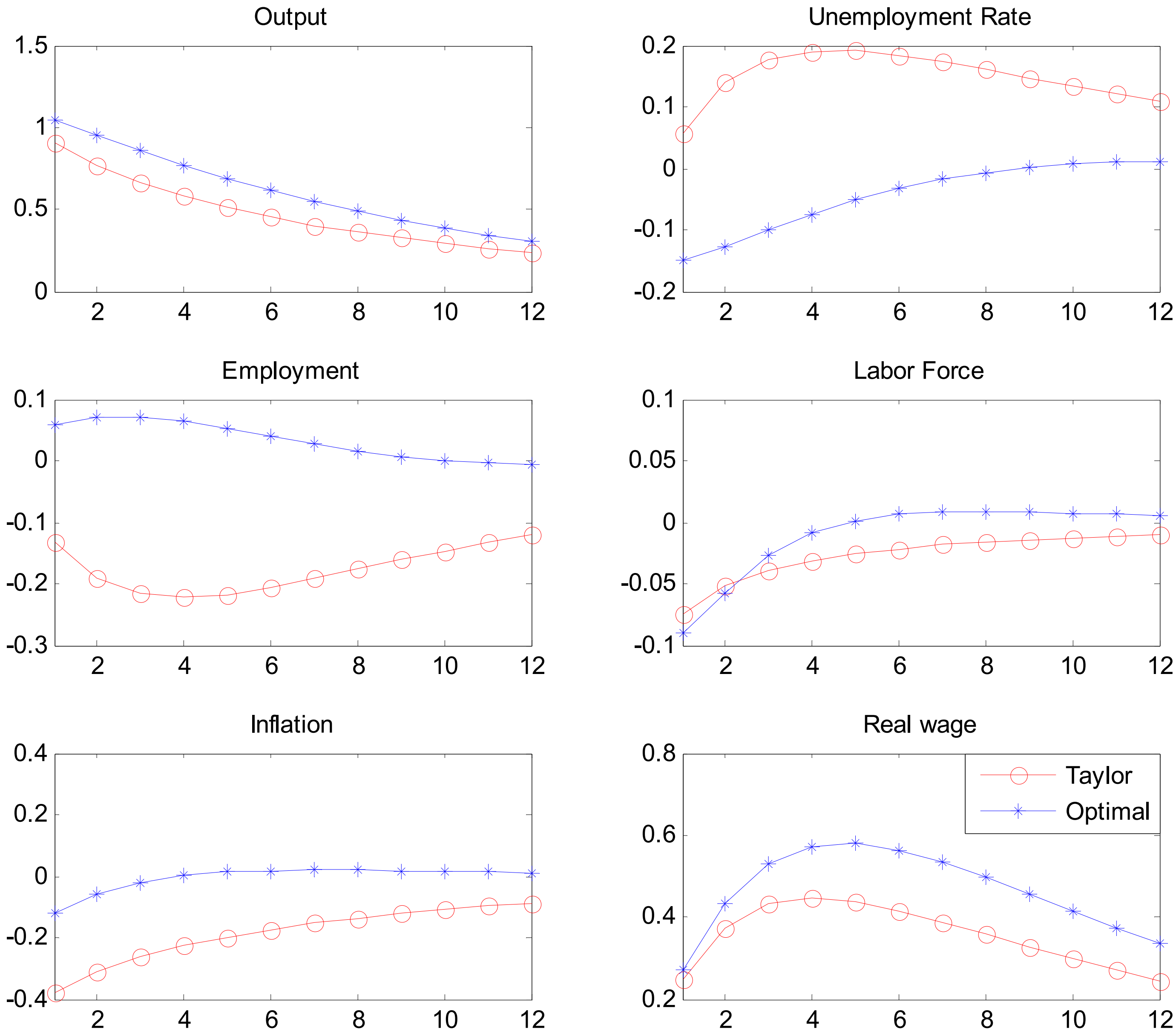
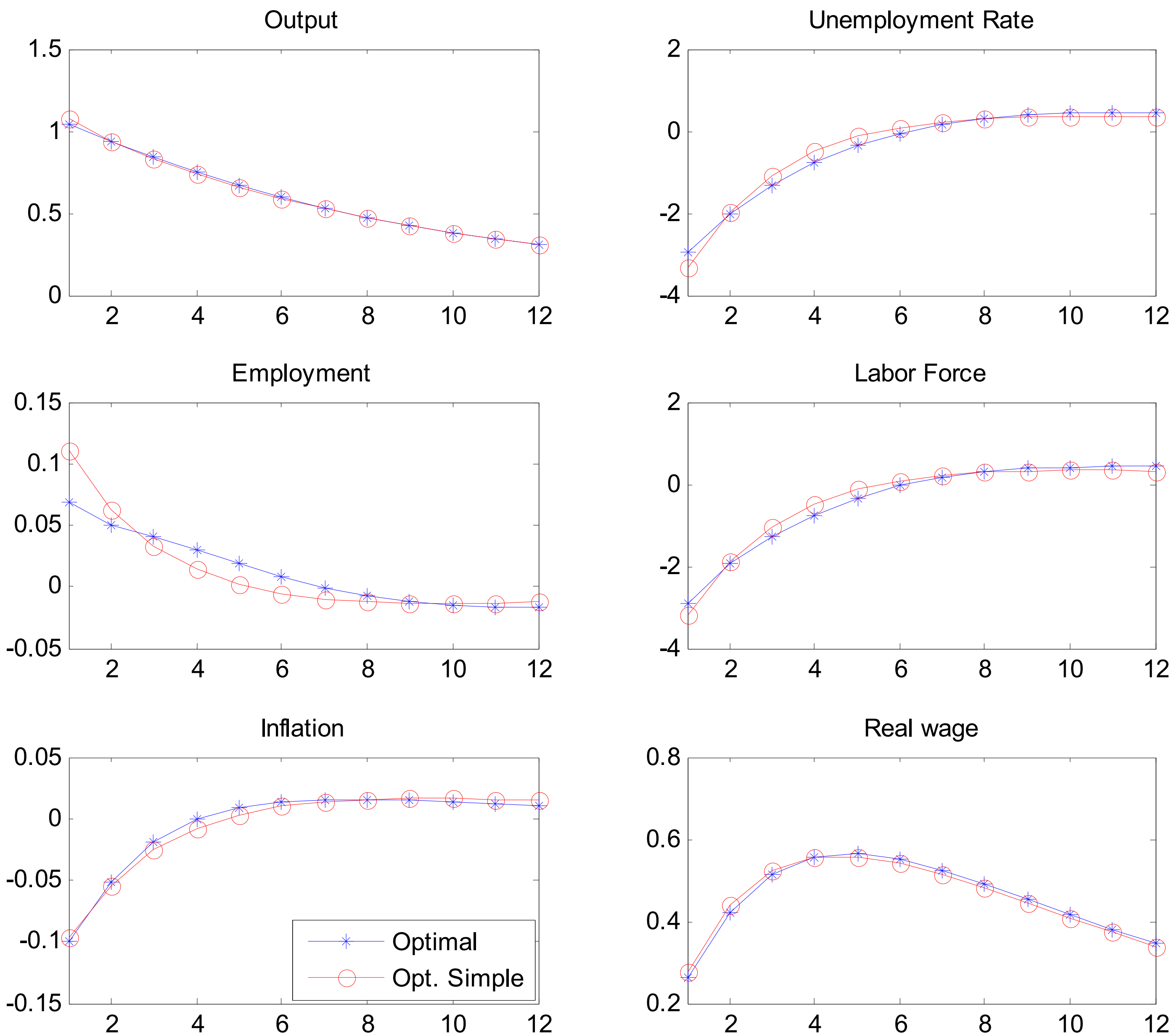


Figure 8. Monetary Policy Design: Optimal vs. Optimal Simple

Sticky Prices and Wages, Technology Shock



Possible Extensions

- Real wage rigidities (via partial indexation to price inflation)
- Differential wage flexibility for new hires (Bodart et al.)
- Preferences with smaller short-run wealth effects (Jaimovich-Rebelo)
- Other demand shocks

Table 2. Cyclical Properties

	Unconditional		*Demand*		*Technology*	
	$\frac{\sigma(x)}{\sigma(y)}$	$\rho(x,y)$	$\frac{\sigma(x)}{\sigma(y)}$	$\rho(x,y)$	$\frac{\sigma(x)}{\sigma(y)}$	$\rho(x,y)$
Employment	$0,60$	0.83	0.59	0.92	0.90	0.51
Labor force	0.20	0.30	0.20	0.31	0.39	0.02
Unemployment rate	0.49	-0.90	0.50	-0.93	0.62	-0.76
Real Wage	0.44	0.07	0.32	-0.78	0.27	0.27
Price Inflation	0.19	0.27	0.18	0.37	0.27	0.60

Figure 1. Estimated Effects of Technology Shocks

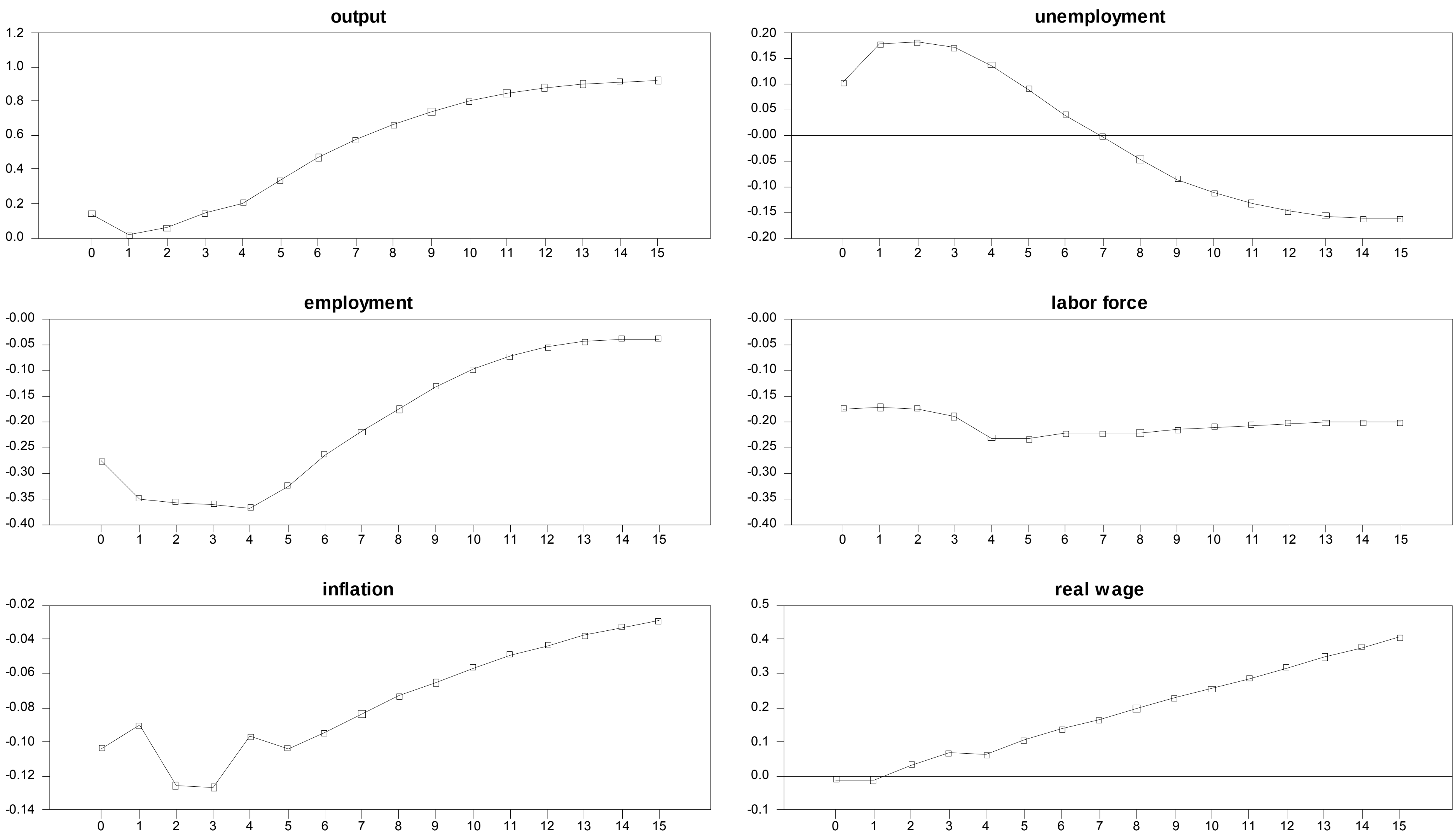


Figure 2b. The Effects of Technology Shocks: Sticky Wages (ξ=0.5)

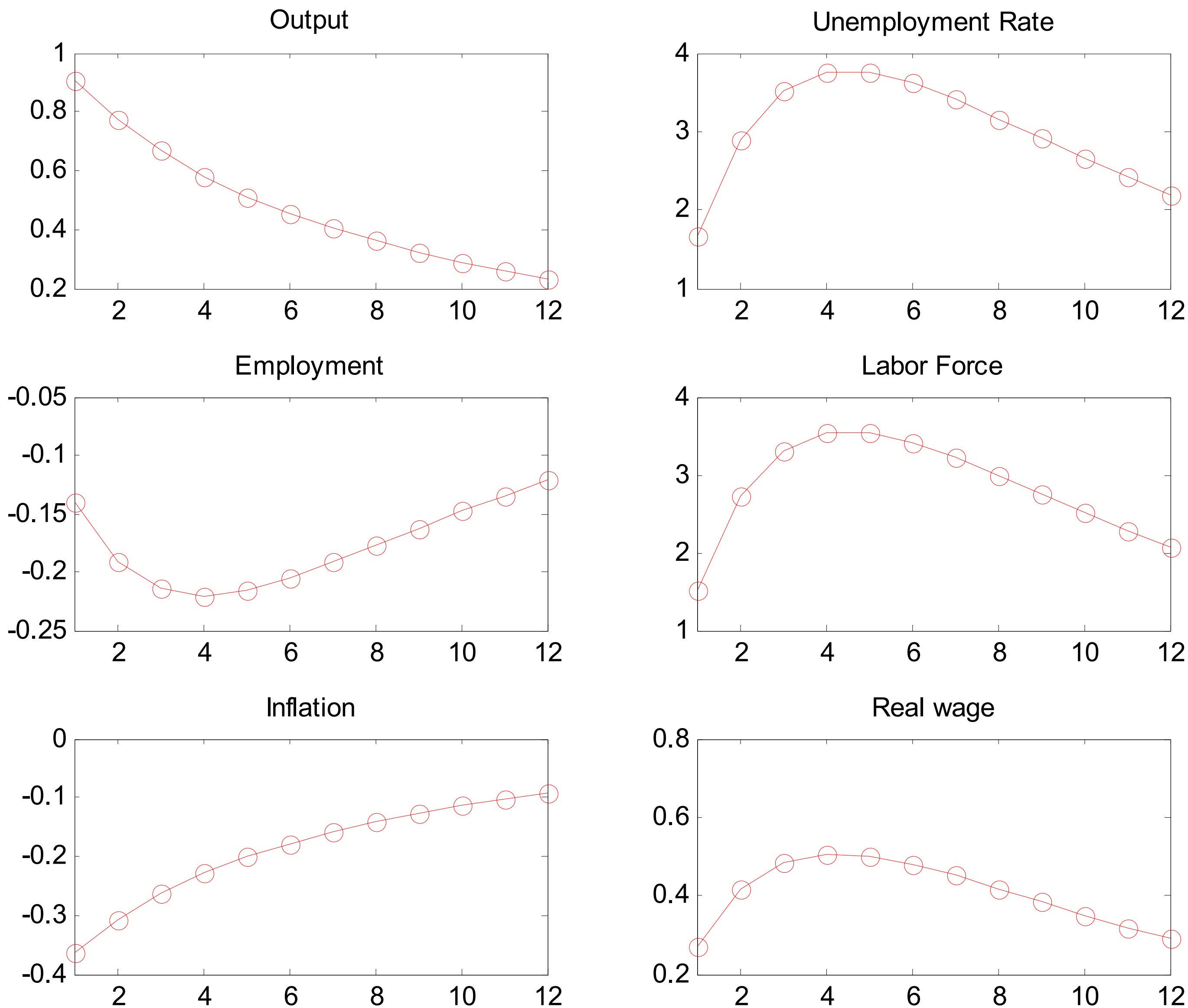
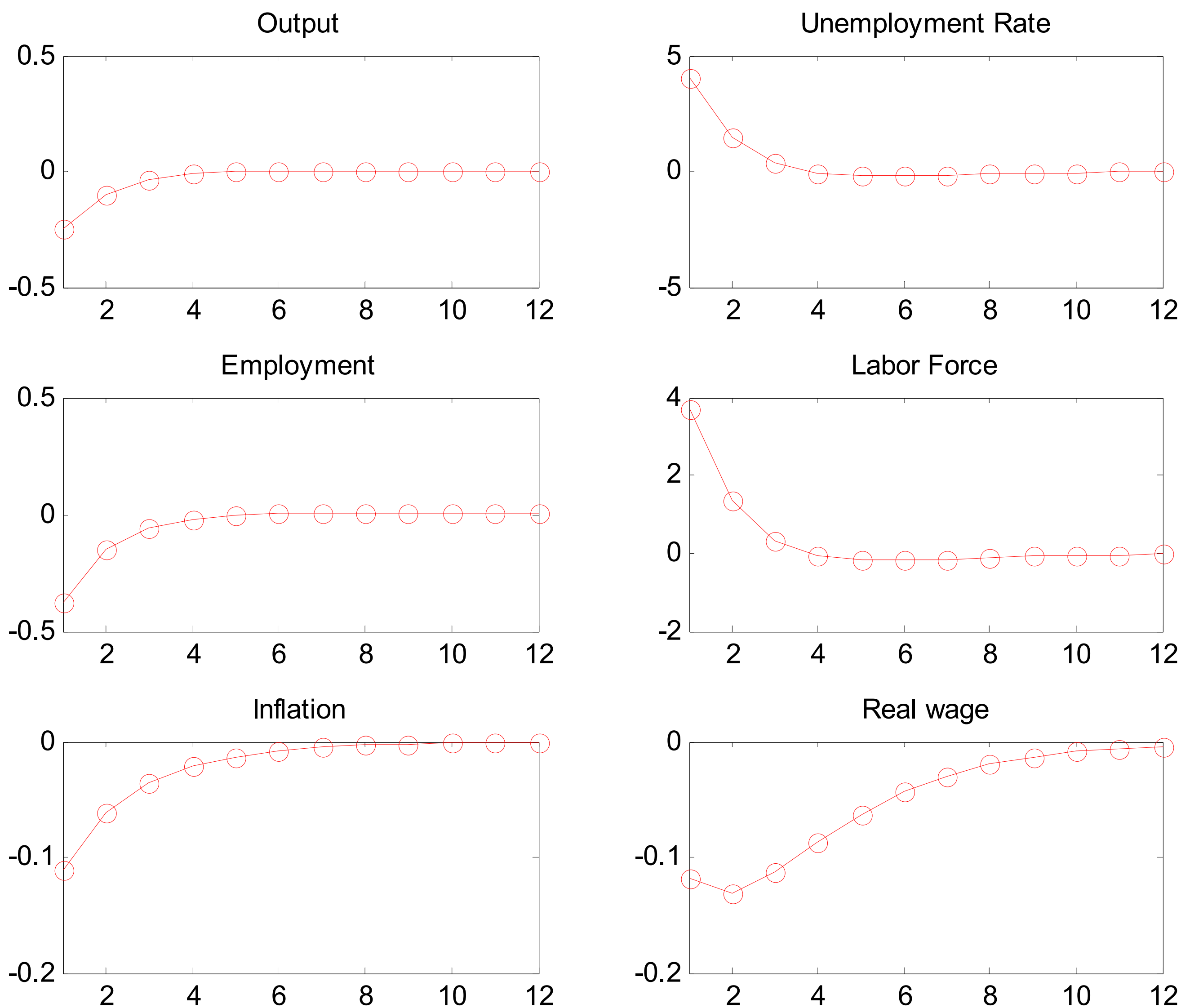


Figure 2a. The Effects of Monetary Policy Shocks: Sticky Wages (ξ=0.5)



A Model with Labor Market Frictions and Nominal Rigidities

Households

$$\max E_0 \sum_{t=0}^{\infty} \beta^t \left(\log C_t - \frac{\chi}{1+\varphi} L_t^{1+\varphi} \right)$$

subject to

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

$$L_t = N_t + \psi U_t$$

$$N_t = (1-\delta) N_{t-1} + x_t U_t^0$$

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

Some identities and definitions

$$U_t \equiv (1 - x_t) U_t^0$$

$$u_t = \frac{U_t}{U_t + N_t}$$

Firms: Final Goods

Technology

$$Y_t(i) = X_t(i)$$

Calvo price setting

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

Optimal price setting rule

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

Price inflation equation

$$\pi_t^p = \beta \ E_t\{\pi_{t+1}^p\} - \lambda_p \ \widehat{\mu}_t^p$$

where $\widehat{\mu}_t^p \equiv p_t - (p_t^I - \tau) - \mu^p$

Firms: Intermediate Goods

Technology

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

where

$$N_t(j) = (1-\delta) N_{t-1}(j) + H_t(j) \tag{2}$$

Hiring cost

$$G_t = \Gamma x_t^{\gamma}$$

where $x_t \equiv H_t / U_t^0$

Aside: Relation to matching function approach (with posting cost Γ).

$$M(V_t, U_t) = V_t^{\varsigma} U_t^{1-\varsigma} \implies G_t = \Gamma \, x_t^{\frac{1-\varsigma}{\varsigma}}$$

Optimal Hiring Policy

$$MRPN_t(j) = \frac{W_t(j)}{P_t} + G_t - (1-\delta)\ E_t\left\{\Lambda_{t,t+1}\ G_{t+1}\right\}$$
$$\equiv \frac{W_t(j)}{P_t} + B_t$$

where $MRPN_t(j) \equiv (P_t^I / P_t)\ (1-\alpha) A_t N_t(j)^{-\alpha}$

Labor Market Frictions, Price Markups, and Inflation Dynamics

$$\widehat{\mu}_t^p = -s_t^n - \Phi\ (\widehat{b}_t - \widehat{\omega}_t)$$

where $\Phi \equiv \frac{B}{(W/P)+B}$ and

$$\widehat{b}_t = \frac{\gamma}{1-\beta(1-\delta)}\ \widehat{x}_t - \frac{\beta(1-\delta)}{1-\beta(1-\delta)}\ (\gamma E_t\{\widehat{x}_{t+1}\} - \widehat{r}_t)$$

Calibration: $\Phi \simeq 0.006$ $\Rightarrow$ negligible effect of labor market frictions on inflation dynamics (Krause et al.)

Monetary Policy

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

The Case of Flexible Wages

Households

$$\mathcal{V}_t^N(j) = \frac{W_t(j)}{P_t} - MRS_t + E_t\left\{\Lambda_{t,t+1}\left[(1-\delta)\mathcal{V}_{t+1}^N(j) + \delta\mathcal{V}_{t+1}^U\right]\right\}$$

where $MRS_t \equiv \chi C_t L_t^{\varphi}$

$$\mathcal{V}_t^U = x_t \int_0^1 \frac{H_t(z)}{H_t}\,\mathcal{V}_t^N(z)dz \;+ (1-x_t)\;\left(-\psi MRS_t + E_t\left\{\Lambda_{t,t+1}\mathcal{V}_{t+1}^U\right\}\right)$$

Optimal participation condition: $\mathcal{V}_t^U = 0$ for all $t \Longrightarrow$

$$\psi\; MRS_t = \frac{x_t}{1-x_t}\int_0^1 \frac{H_t(z)}{H_t}\;\mathcal{S}_t^H(z)\;dz$$

$$\mathcal{S}_t^H(j) = \frac{W_t(j)}{P_t} - MRS_t + (1-\delta)\;E_t\left\{\Lambda_{t,t+1}\;\mathcal{S}_{t+1}^H(j)\right\}$$

Firms

$$\begin{aligned} \mathcal{S}_t^F(j) &= MRPN_t(j) - \frac{W_t(j)}{P_t} + (1-\delta)\ E_t\left\{\Lambda_{t,t+1}\ \mathcal{S}_{t+1}^F(j)\right\} \\ &= G_t \end{aligned}$$

Reservation wages:

$$\Omega_t^H(j) = MRS_t - (1-\delta)\ E_t\left\{\Lambda_{t,t+1}\ \mathcal{S}_{t+1}^H(j)\right\}$$

$$\Omega_t^F(j) = MRPN_t(j) + (1-\delta)\ E_t\left\{\Lambda_{t,t+1}\ \mathcal{S}_{t+1}^F(j)\right\}$$

Bargaining set

$$\begin{aligned} \Omega_t^F(j) - \Omega_t^H(j) &= \mathcal{S}_t^F(j) + \mathcal{S}_t^H(j) \\ &\geq G_t \end{aligned}$$

Nash bargaining

$$\xi \, \mathcal{S}_t^H(j) = (1-\xi) \, \mathcal{S}_t^F(j)$$

$$\begin{aligned} \frac{W_t(j)}{P_t} &= \xi \, \Omega_t^H(j) + (1-\xi) \, \Omega_t^F(j) \\ &= \xi \, MRS_t + (1-\xi) \, MRPN_t(j) \end{aligned}$$

Symmetric equilibrium

$$\frac{W_t}{P_t} = \xi \, MRS_t + (1-\xi) \, MRPN_t$$

implied participation condition

$$\xi\psi \, MRS_t = (1-\xi) \, \frac{x_t}{1-x_t} \, G_t$$

The Case of Sticky Wages

Households

$$\mathcal{V}^N_{t+k|t} = \frac{W_t^*}{P_{t+k}} - MRS_{t+k} + E_{t+k}\left\{\Lambda_{t+k,t+k+1} \left[(1-\delta)(\theta_w \mathcal{V}^N_{t+k+1|t} + (1-\theta_w)\mathcal{V}^N_{t+k+1|t+k+1}\right.\right.$$

$$\mathcal{V}^U_t = x_t \int_0^1 \frac{H_t(z)}{H_t} \mathcal{V}^N_t(z) dz + (1-x_t) \left(-\psi MRS_t + E_t\left\{\Lambda_{t,t+1}\mathcal{V}^U_{t+1}\right\}\right)$$

Optimal participation: $\mathcal{V}^U_t = 0$ for all $t \Longrightarrow$

$$\mathcal{S}^H_{t+k|t} = \frac{W_t^*}{P_{t+k}} - MRS_{t+k} + (1-\delta)\ E_{t+k}\left\{\Lambda_{t+k,t+k+1}\ (\theta_w \mathcal{S}^H_{t+k+1|t} + (1-\theta_w)\mathcal{S}^H_{t+k+1|t+k+1})\right.$$

$$\psi\ MRS_t = \frac{x_t}{1-x_t}\int_0^1 \left(\frac{H_t(z)}{H_t}\right)\ \mathcal{S}^H_t(z)\ dz$$

Firms

$$\begin{aligned}
\mathcal{S}^F_{t+k|t} &\equiv MRPN_{t+k|t} - \frac{W_t^*}{P_{t+k}} \\
&\quad + (1-\delta)\ E_{t+k}\left\{\Lambda_{t+k,t+k+1}\ (\theta_w \mathcal{S}^F_{t+k+1|t} + (1-\theta_w)\mathcal{S}^F_{t+k+1|t+k+1})\right\} \\
&= G_{t+k}
\end{aligned}$$

where $MRPN_{t+k|t} \equiv \frac{P^I_{t+k}}{P_{t+k}}(1-\alpha)A_{t+k}N^{-\alpha}_{t+k|t}$

Nash bargaining

$$\xi \ \mathcal{S}^{H}_{t|t} = (1-\xi) \ \mathcal{S}^{F}_{t|t} \tag{3}$$

which implies

$$E_t \left\{ \sum_{k=0}^{\infty} ((1-\delta)\theta_w)^k \Lambda_{t,t+k} \ \left(\frac{W_t^*}{P_{t+k}} - \Omega^{tar}_{t+k|t} \right) \right\} = 0$$

where

$$\Omega^{tar}_{t+k|t} \equiv \xi \ MRS_{t+k} + (1-\xi) \ MRPN_{t+k|t}$$

Sustainability of the fixed wage

$$W_t^* \in [\underline{W}_{t+k|t}, \overline{W}_{t+k|t}]$$

where

$$\underline{W}_{t+k|t} \equiv P_{t+k} \ \Big(MRS_{t+k} - (1-\delta) \ E_{t+k} \Big\{ \Lambda_{t+k,t+k+1} \ (\theta_w \mathcal{S}^{H}_{t+k+1|t} + (1-\theta_w)\mathcal{S}$$

$$\overline{W}_{t+k|t} \equiv P_{t+k} \ \Big(MRPN_{t+k|t} + (1-\delta) \ E_{t+k} \left\{ \Lambda_{t+k,t+k+1} \ G_{t+k+1} \right\} \Big)$$

Log-linearized wage inflation equation

$$\pi_t^w = \beta(1-\delta)\ E_t\{\pi_{t+1}^w\} - \lambda_w\ (\widehat{\omega}_t - \widehat{\omega}_t^{tar})$$

where

$$\widehat{\omega}_t^{tar} = (1-\Upsilon)\ (\widehat{c}_t + \varphi \widehat{l}_t) + \Upsilon\ (-\widehat{\mu}_t^p + a_t - \alpha\ \widehat{n}_t)$$

$\Upsilon \equiv \Upsilon \equiv \frac{(1-\xi)MRPN}{W/P}$ and $\lambda_w \equiv \frac{(1-\beta(1-\delta)\theta_w)(1-\theta_w)}{\theta_w\ (1-\Upsilon(1-\Phi))}$.

Relation to New Keynesian wage inflation equation

$$\pi_t^w = \beta\ E_t\{\pi_{t+1}^w\} - \lambda_{ehl}\ (\widehat{\omega}_t - \widehat{mrs}_t)$$

where $\widehat{mrs}_t = \widehat{c}_t + \varphi \widehat{n}_t$

Aggregate Demand and Output

$$Y_t = C_t + G_t H_t$$

$$Y_t = \frac{1}{D_t^p D_t^w} A_t N_t^{1-\alpha}$$

where

$$D_t^p \equiv \int_0^1 \left(\frac{P_t(i)}{P_t} \right)^{-\epsilon} di \geq 1$$

$$D_t^w \equiv \left[\int_0^1 \left(\frac{N_t(j)}{N_t} \right)^{1-\alpha} dj \right]^{-1} \geq 1$$

Optimal Monetary Policy Design

Welfare losses around efficient steady state

$$\frac{1}{2}\ E_0 \sum_{t=0}^{\infty} \beta^t\ L_t$$

where

$$L_t = \frac{\epsilon}{\lambda_p}\ (\pi_t^p)^2 + \frac{(1-\Phi)^2(1-\alpha)}{\alpha\lambda_w^*}\ (\pi_t^w)^2 + \frac{(1+\varphi)(1-\Omega)N}{(1-\alpha)L}\ \left(\widetilde{y}_t + \frac{(1-\alpha)\psi U}{N}\widetilde{u}_t\right.$$

Optimal policy

Optimized simple rule

$$i_t = 1.51\ \pi_t^p - 0.10\ y_t + 0.01\ \pi_t^w - 0.025\ u_t$$

Calibration

- $N = 0.59$, $L = 0.62$ $\Rightarrow$ $u = 0.05$
- $x = 0.7$ $\Rightarrow$ $\delta \simeq 0.12$ (BG)
- $\alpha = 1/3$
- $\beta = 0.99, .\varphi = 5$
- $\theta_p = 0.75$, $\theta_w = 0.75$
- $\phi_p = 1.5$, $\phi_y = 0.5/4$ (Taylor)
- $G = 0.045\ (W/P)$ (HM and Shimer, based on Silva and Toledo)
- $\gamma = 1$ (BG)
- $\xi = 0.5 \Rightarrow \psi = 0.041$ or $\xi = 0.05 \Rightarrow \psi = 0.82$

Possible Extensions

- Real wage rigidities (via partial indexation to price inflation)
- Differential wage flexibility for new hires (Bodart et al.)
- Preferences with smaller short-run wealth effects (Jaimovich-Rebelo)
- Other demand shocks