Sticky Wages and Monetary Policy

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Alternative Labor Market Specifications

- Competitive labor markets

$$w_t - p_t = mrs_t$$

where $mrs_t = \sigma c_t + \varphi n_t$.

- General labor market imperfections

$$w_t - p_t = \mu_t^w + mrs_t$$

where μ_t^w: (log) wage markup.

- *Example*: monopoly union, flexible wages and isoelastic labor demand

$$\mu_t^w = \log\left(\frac{\epsilon_w}{\epsilon_w - 1}\right) \equiv \mu^w$$

Implications for Inflation Dynamics

Recall

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

Now

$$\begin{aligned} \mu_t^p &= p_t - (w_t - a_t) \\ &= a_t - (\mu_t^w + mrs_t) \\ &= -\mu_t^w - (\sigma + \varphi) y_t + (1 + \varphi) a_t \end{aligned}$$

Thus,

$$\widehat{\mu}_t^p = -(\sigma + \varphi)\widetilde{y}_t - \widehat{\mu}_t^w$$

Implied inflation equation:

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

$\Longrightarrow$ tradeoff between inflation and output gap stabilization

The Erceg-Henderson-Levin Model

- Fraction of households/trade unions adjusting nominal wage: $1 - \theta_w$
- Constant elasticity of labor demand ϵ_w
- Aggregate wage dynamics

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

- Optimal wage setting rule:

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

- Implied wage inflation equation

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

where $\lambda_w \equiv \frac{(1-\beta\theta_w)(1-\theta_w)}{\theta_w \ (1+\varphi\epsilon_w)}$

Equilibrium

- The *real wage gap:*

$$\widetilde{\omega}_t \equiv \omega_t - \omega_t^n$$
$$= \omega_t - (a_t - \mu^p)$$

- Average Price Markup

$$\widehat{\mu}_t^p = p_t - (w_t - a_t) - \mu^p$$
$$= -\widetilde{\omega}_t$$

- Price Inflation

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

- Average Wage Markup

$$\begin{aligned} \widehat{\mu}_t^w &= \omega_t - mrs_t - \mu^w \\ &= \widetilde{\omega}_t - (\sigma \widetilde{y}_t + \varphi \widetilde{n}_t) \\ &= \widetilde{\omega}_t - (\sigma + \varphi)\, \widetilde{y}_t \end{aligned}$$

- Wage Inflation

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

where $\kappa_w \equiv \lambda_w \,(\sigma + \varphi)$

- Wage gap identity:

$$\widetilde{\omega}_{t-1} \equiv \widetilde{\omega}_t - \pi_t^w + \pi_t^p + \Delta a_t$$

- Dynamic IS equation

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

- Interest Rate Rule:

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

- *Dynamical system*:

$$\mathbf{x}_t = \mathbf{A}_w E_t\{\mathbf{x}_{t+1}\} + \mathbf{B}_w \mathbf{z}_t$$

where

$$\mathbf{x}_t \equiv [\widetilde{y}_t, \pi_t^p, \pi_t^w, \widetilde{\omega}_{t-1}]'$$

$$\mathbf{z}_t \equiv [\widehat{r}_t^n - v_t, \ \Delta a_t]'$$

- *Conditions for uniqueness of the equilibrium*

Particular case ($\phi_y = 0$):

$$\phi_p + \phi_w > 1$$

Dynamic Responses to a Monetary Policy Shock

- Driving process

$$v_t = \rho_v v_{t-1} + \varepsilon_t^m$$

- Calibration of price and wage rigidities

Baseline: $\theta_p = 2/3,\ \theta_w = 3/4$

Flexible wage: $\theta_p = 2/3,\ \theta_w = 0$

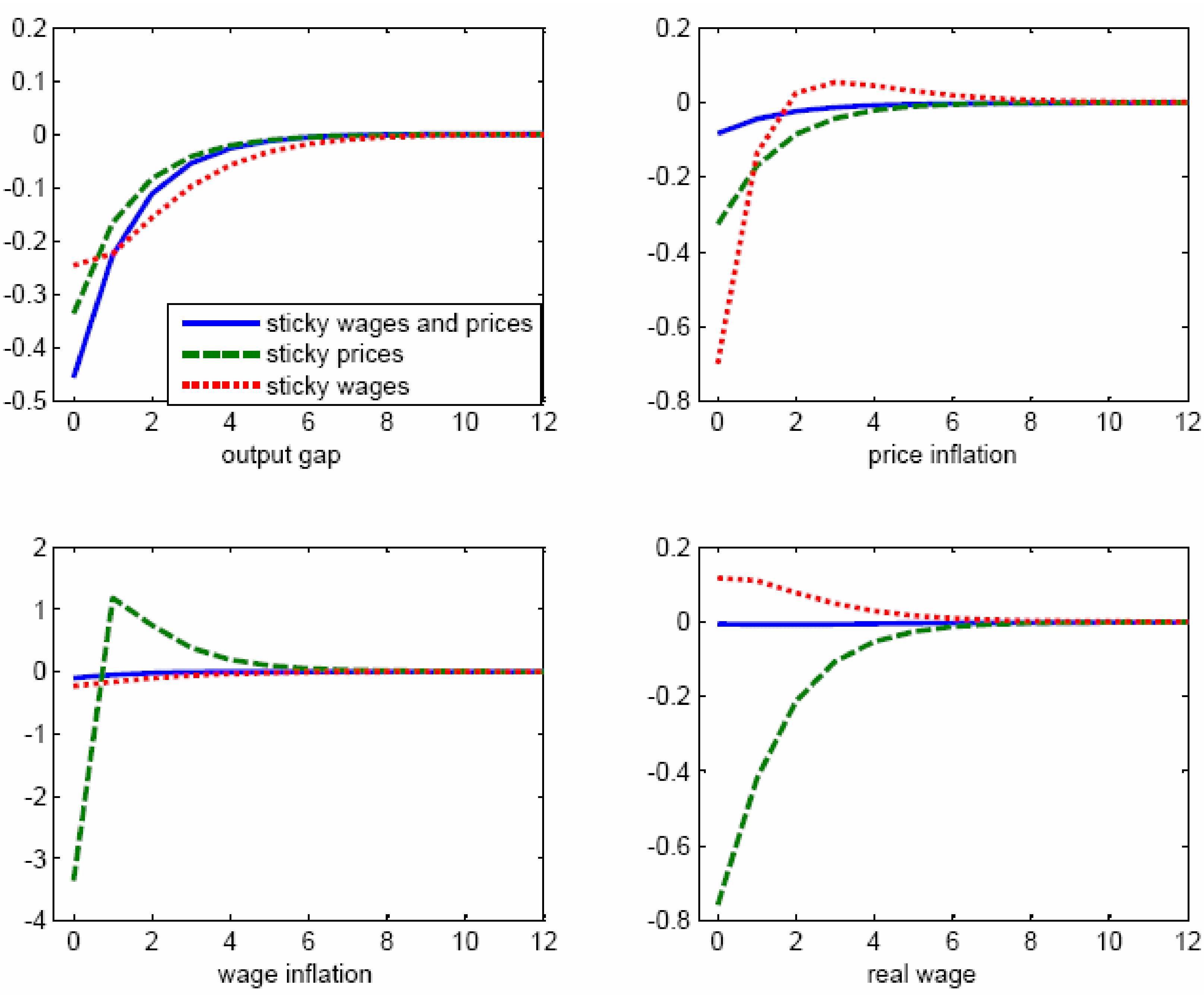
Flexible price: $\theta_p = 0,\ \theta_w = 3/4$

- Other parameters

$\sigma = \varphi = 1$
$\phi_p = 1.5,\ \phi_w = \phi_p = 0$
$\rho_v = 0.5$

- Evidence

Figure 6.3: Sticky Wages and the Effects of a Monetary Policy Shock



Monetary Policy Design

- Emergence of a tradeoff between output gap and inflation stabilization
- Frictionless equilibrium allocation is no longer feasible (as long as it requires real wage changes)
- Welfare losses (second order approximation)

$$\mathbb{L} = (\sigma + \varphi)\, var(\widetilde{y}_t) + \frac{\epsilon_p}{\lambda_p} var(\pi_t^p) + \frac{\epsilon_w}{\lambda_w} var(\pi_t^w)$$

$\Longrightarrow$ strict price inflation targeting is no longer optimal

Optimal Monetary Policy

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

subject to

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

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

$$\widetilde{\omega}_{t-1} \equiv \widetilde{\omega}_t - \pi_t^w + \pi_t^p + \Delta a_t$$

- *Optimality conditions*:

$$(\sigma + \varphi)\,\widetilde{y}_t + \kappa_w \xi_{2,t} = 0 \tag{1}$$

$$\frac{\epsilon_p}{\lambda_p}\pi_t^p - \Delta\xi_{1,t} + \xi_{3,t} = 0 \tag{2}$$

$$\frac{\epsilon_w}{\lambda_w}\pi_t^w - \Delta\xi_{2,t} - \xi_{3,t} = 0 \tag{3}$$

$$\lambda_p \xi_{1,t} - \lambda_w \xi_{2,t} + \xi_{3,t} - \beta E_t\{\xi_{3,t+1}\} = 0 \tag{4}$$

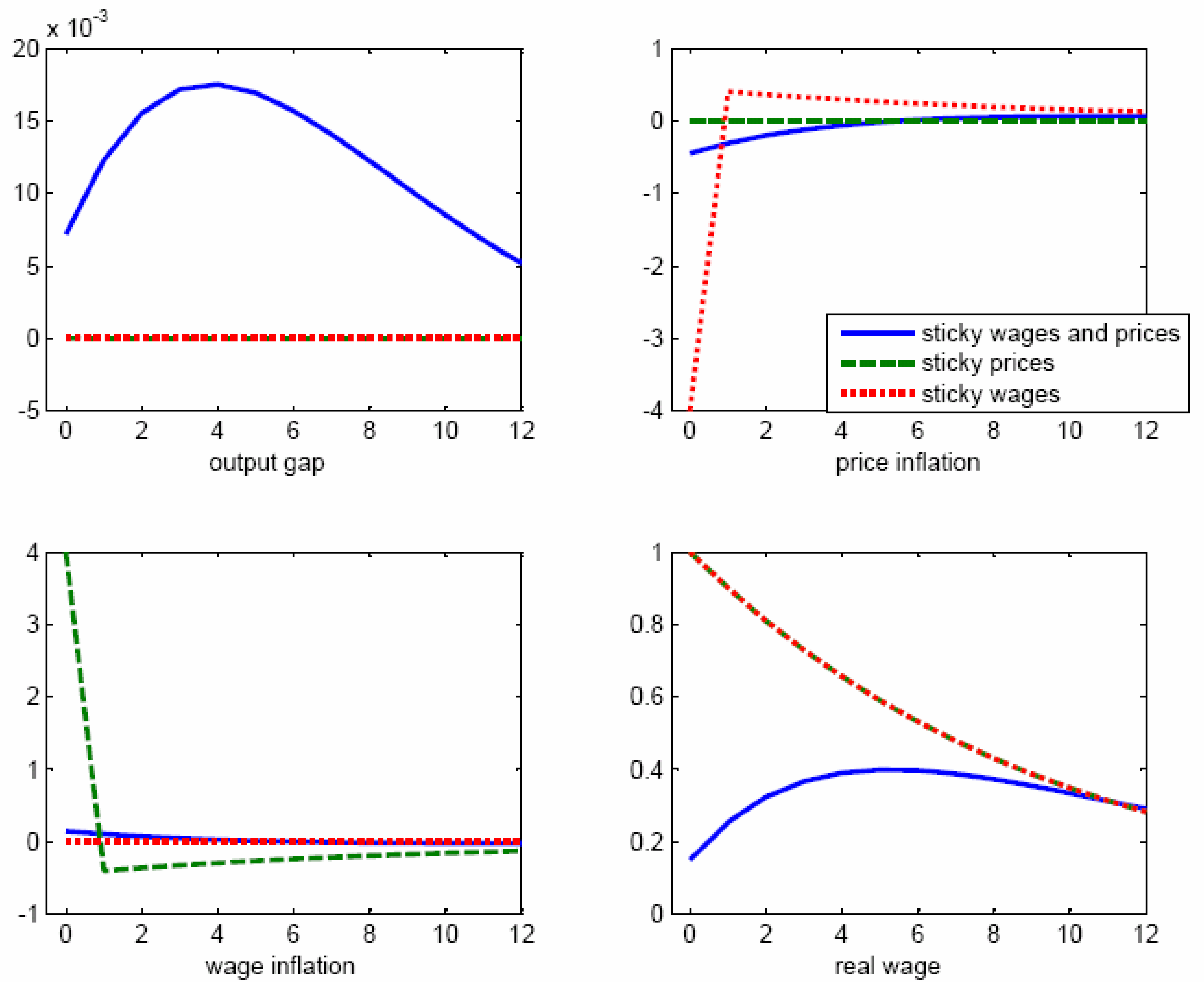
- Dynamical system

$$\mathbf{A}_0^* \mathbf{x}_t = \mathbf{A}_1^* E_t\{\mathbf{x}_{t+1}\} + \mathbf{B}^* \Delta a_t$$

where $\mathbf{x}_t \equiv [\widetilde{y}_t, \pi_t^p, \pi_t^w, \widetilde{\omega}_{t-1}, \xi_{1,t-1}, \xi_{2,t-1}, \xi_{3,t}]'$

- *Dynamic Responses to a Technology Shock under the Optimal Policy*

Figure 6.4: The Effects of a Technology Shock under the Optimal Policy



Approximately Optimal Monetary Policy

- A New Keynesian Phillips Curve for Composite Inflation

$$\pi_t = \beta E_t\{\pi_{t+1}\} + \kappa \widetilde{y}_t$$

where

$$\pi_t \equiv (1 - \vartheta)\pi_t^p + \vartheta \pi_t^w$$

with $\vartheta \equiv \frac{\lambda_p}{\lambda_p + \lambda_w} \in [0, 1]$ and $\kappa \equiv \frac{\lambda_p \lambda_w}{\lambda_p + \lambda_w}(\sigma + \varphi)$

- Findings

$\Longrightarrow$ no policy tradeoff

$\Longrightarrow$ nearly optimal for plausible calibrations (Woodford figure)

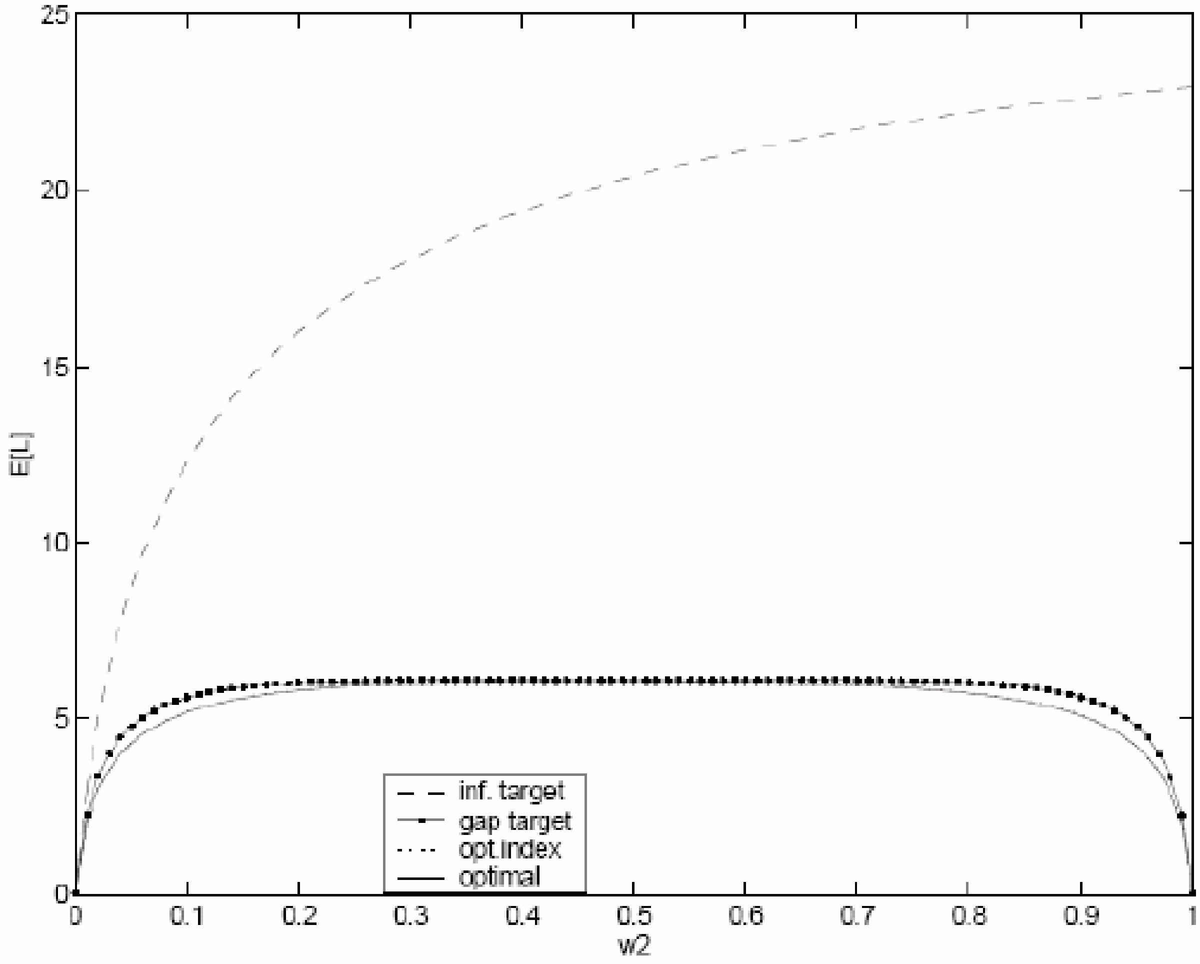


Figure 6.4: Welfare losses under alternative policies with sticky wages and prices.

Woodford (2003)