Gains from Monetary Policy Cooperation under Dollar Pricing

Myunghyun Kim

Sungkyunkwan University

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Definitions

- **Producer currency pricing (PCP):** Firms set all prices in their own currency.

- **Local currency pricing (LCP):** Home (Foreign) firms set export prices in Foreign (Home) currency and domestic prices in their own currency.

- **Dollar pricing (DP):** Home firms set all prices in their own currency (PCP), while Foreign firms set export prices in Home currency and domestic prices in their own currency (LCP).

  - **Under DP,** every *international trade* transaction is priced in U.S. dollars (Home currency).
Motivation

- Almost every international trade transaction is priced in U.S. dollars
  - Gopinath and Rigobon 2008: 90% of U.S. imports and 97% of U.S. exports are priced in U.S. dollars for the period 1994-2005
- This suggests that open economy models with symmetric export pricing, i.e. PCP models or LCP models, do not seem to be plausible
  - In symmetric export pricing models, more than one currency are used in international trade transactions
Motivation

- **Dominant role of the U.S. dollar** in international trade can have significant **influences on the transmission of shocks** across countries, and hence **welfare**

- Nevertheless, most studies have not considered the dominant role of the U.S. dollar in international trade
  
  - Almost all researchers **still use two-country models with symmetric export pricing (either PCP or LCP)** to study optimal monetary policy in open economies
Introduction

**Aim**

- **Construct** a two-country model with asymmetric export pricing (i.e. DP model)

- Derive *quadratic loss functions* of cooperative and noncooperative policymakers

- **Compute welfare gains from monetary policy cooperation** in the DP model, and examine
  - whether welfare gains from cooperation exist
  - whether the gains are larger than those in the LCP and PCP models
  - whether Home (U.S.) gains are greater than Foreign (rest of the world) gains
Literature

- Related to the literature on optimal monetary policy in open economies and export price setting
  - PCP: Clarida, Galí, and Gertler (2002), Benigno and Benigno (2006), etc.
Introduction

The model

Linear-quadratic framework

Model analysis

Conclusion

Literature

- Few studies assume DP
  - Corsetti and Pesenti (2007), Devereux, Shi and Xu (2007), Goldberg and Tille (2009): consider one-period stochastic models with one-period ahead price setting (and thus fully sticky prices)
  - Mukhin (2018): Do not utilize the linear-quadratic framework, do not explicitly calculate the welfare gains, and focus only on cooperation
  - Egorov and Mukhin (2020): Do not utilize the linear-quadratic framework, do not explicitly calculate the welfare gains and assume the U.S. as a small open economy

⇒ This paper is complementary to Mukhin (2018) and Egorov and Mukhin (2020)
Illustration

- **PCP model**
  - Exist the *inefficiency arising from the internal relative price* $(P_F/P_H)$ misalignments
    - National CB can manipulate the internal relative price to improve its welfare through nominal exchange rate adjustment
    - Note that the internal relative price and the terms of trade are equalized under PCP since LOOP holds

$\Rightarrow$ **Small gains** from monetary policy cooperation
Illustration

- **LCP model**
  - Does not exist the inefficiency arising from the internal relative price misalignments
    - Import prices are set in local currencies → CB cannot control the price to improve welfare through nominal exchange rate adjustment
  - Do exist the inefficiency arising from currency misalignments (deviations from the LOOP)
    - LOOP does not hold → CB can engineer the currency misalignments to improve welfare through nominal exchange rate adjustment

⇒ Small gains from cooperation but larger than PCP model
Illustration

- **DP model**
  
  - Exist the *inefficiencies arising from both the internal relative price and currency misalignments*
    
    - **LOOP partially holds.** LOOP for Home goods holds but that for Foreign goods does not hold
    
    - **Home cannot control the internal relative price,** since its import prices are set in *Home currency* by Foreign firms
    
    - **But Foreign can control the internal relative price through nominal exchange rate adjustment,** because its import prices are set in *Home currency*
Illustration

- DP model

- Since LOOP for Foreign goods does not hold, Foreign can control currency misalignments by adjusting the nominal exchange rate.

- But Home cannot, because LOOP for Home products holds.
Illustration

- In the **DP model**, there is one more inefficiency compared to the PCP and LCP models

  ⇒ **Gains** from cooperation are greater than those in the PCP and LCP models

- **Only Foreign** can control both the *internal relative price* and *currency misalignments* through nominal exchange rate adjustment

  ⇒ **Rationalize** the fact that the **U.S. designates currency manipulators** to protect its welfare

  ⇒ **Home gains** are larger
Illustration

- Under log utility, unitary elasticity of substitution between Home and Foreign goods and no home bias, there are no gains from cooperation in the PCP and LCP models.

- In the PCP model with log utility and unitary elasticity of substitution, the internal relative price interdependence is absent $\rightarrow$ no gains from cooperation.

- In symmetric models such as the LCP and PCP models, the Home internal relative price and the inverse of the Foreign internal relative price are equal $\rightarrow$ combining this and no home bias generates constant real exchange rate $\rightarrow$ there are no deviations from the LOOP in the LCP model $\rightarrow$ no gains from cooperation.
Illustration

- In the DP model, the internal relative price interdependence disappears under the conditions.

- However, there are still currency misalignments.
  - Thanks to the asymmetry of the DP model, the LOOP still does not hold for Foreign products.

⇒ There are gains from monetary policy cooperation even under the conditions.
The model
The world economy consists of two countries: Home (U.S.) and Foreign (rest of the world).

Home and Foreign are symmetric with exception of export pricing.

- Firms in Home set all prices in their own currency, while those in Foreign set export prices in Home currency and domestic prices in their own currency.

- Hence, only Home currency (U.S. dollar) is used in international trade.

- The population size in each country is normalized to one and asset markets are complete.
The model

Households

- Utility:

\[
W_H = \mathbb{E}_{t_0} \sum_{t=t_0}^{\infty} \beta^{t-t_0} \left[ \frac{C_t^{1-\sigma}}{1-\sigma} - \chi \frac{h_t^{1+\omega}}{1+\omega} \right]
\]  

(1)

- Aggregate consumption:

\[
C_t = \left\{ (1-\gamma)^{\frac{1}{\eta}} C_{H,t}^{\frac{\eta-1}{\eta}} + \gamma^{\frac{1}{\eta}} C_{F,t}^{\frac{\eta-1}{\eta}} \right\}^{\frac{\eta}{\eta-1}}
\]

(2)

- LOOP partially holds

\[
P_{H,t} = E_t P_{H,t}^*, \quad P_{F,t} \neq E_t P_{F,t}^*
\]

(3)
Relative prices

- Home and Foreign currency misalignment (deviations from the LOOP):

\[ m_t = \frac{E_t P_{H,t}^*}{P_{H,t}} = 1, \quad m_t^* = \frac{E_t P_{F,t}^*}{P_{F,t}} \]  \hspace{1cm} (4)

- Home and Foreign internal relative prices, \( s_t \) and \( s_t^* \):

\[ s_t = \frac{P_{F,t}}{P_{H,t}}, \quad s_t^* = \frac{P_{H,t}^*}{P_{F,t}} \]  \hspace{1cm} (5)

- Home and Foreign terms of trade, \( \tau_t \) and \( \tau_t^* \), are

\[ \tau_t = \frac{P_{F,t}}{E_t P_{H,t}^*}, \quad \tau_t^* = \frac{E_t P_{H,t}^*}{P_{F,t}} \]  \hspace{1cm} (6)

Note that \( \tau_t = s_t \) but \( \tau_t^* \neq s_t^* \)
The model

Firms

- Production:
  \[ Y_t(j) = \exp(z_t) h_t(j) \]  (7)

- Firms’ resource constraints:
  \[ Y_t(j) = C_{H,t}(j) + C_{H,t}^*(j) \]  (8)
Price setting and aggregate resource constraints

- Home firm $j$ maximizes
  \[
  \mathbb{E}_{t_0} \sum_{t=t_0}^{\infty} \theta^{t-t_0} Q_{t_0,t} \left[ (1 + \mu) P_{H,t_0}(j) \{ C_{H,t}(j) + C^*_{H,t}(j) \} - MC_t Y_t(j) \right]
  \]
  \tag{9}

- Foreign firm $j^*$ maximizes
  \[
  \mathbb{E}_{t_0} \sum_{t=t_0}^{\infty} \theta^{t-t_0} Q^*_{t_0,t} \left[ (1 + \mu) \left\{ P^*_{F,t_0}(j^*) C^*_{F,t}(j^*) + \frac{P_{F,t_0}(j^*)}{E_t} C_{F,t}(j^*) \right\} - MC^*_{t} Y^*_t(j^*) \right]
  \]
  \tag{10}

- Aggregate resource constraints:
  \[
  Y_t = \Delta_t C_{H,t} + \Delta_t C^*_{H,t}, \quad Y^*_t = \Delta_{F,t} C_{F,t} + \Delta^*_{F,t} C^*_{F,t}
  \]
  \tag{11}
Linear-quadratic framework
Linear constraints

- **NKPCs:**

\[
\hat{\pi}_{H,t} = \beta E_t [\hat{\pi}_{H,t+1}] + \delta \left\{ (\sigma + \omega) \hat{Y}_t - (1 + \omega) z_t - \gamma (1 - \eta \sigma) (\hat{s}_t^* - \hat{e}_t) - \gamma (1 - \eta \sigma) \hat{m}_t^* \right\} \\
\hat{\pi}_{F,t}^* = \beta E_t [\hat{\pi}_{F,t+1}] + \delta \left\{ (\sigma + \omega) \hat{Y}_t^* - (1 + \omega) z_t^* + \gamma (1 - \eta \sigma) (\hat{s}_t^* - \hat{e}_t) - \gamma \eta \sigma \hat{m}_t^* \right\} \\
\hat{\pi}_F,t = \beta E_t [\hat{\pi}_F,t+1] + \delta \left\{ (\sigma + \omega) \hat{Y}_t^* - (1 + \omega) z_t^* + \gamma (1 - \eta \sigma) (\hat{s}_t^* - \hat{e}_t) + (1 - \gamma \eta \sigma) \hat{m}_t^* \right\}
\]
Linear constraints

\[ \hat{Y}_t - \hat{Y}^*_t + \eta(1 - \gamma)\hat{p}_{H,t} + \eta\gamma\hat{p}^*_{H,t} - \frac{1 - 2\gamma}{\sigma} \hat{e}_t - \eta(1 - \gamma)\hat{p}^*_{F,t} - \eta\gamma\hat{p}_{F,t} = 0 \] (15)

\[ \hat{\pi}_{H,t} = \hat{\pi}_t + \hat{p}_{H,t} - \hat{p}_{H,t-1} \] (16)

\[ \hat{\pi}^*_{H,t} = \hat{\pi}^*_t + \hat{p}^*_{H,t} - \hat{p}^*_{H,t-1} \] (17)

\[ \hat{\pi}^*_{F,t} = \hat{\pi}^*_t + \hat{p}^*_{F,t} - \hat{p}^*_{F,t-1} \] (18)

\[ \hat{\pi}_{F,t} = \hat{\pi}_t + \hat{p}_{F,t} - \hat{p}_{F,t-1} \] (19)

\[ (1 - \gamma)\hat{p}_{H,t} + \gamma\hat{p}_{F,t} = 0 \] (20)

\[ (1 - \gamma)\hat{p}^*_{F,t} + \gamma\hat{p}^*_{H,t} = 0 \] (21)

\[ \hat{p}_{H,t} = \hat{p}^*_{H,t} + \hat{e}_t \] (22)

\[ \hat{m}^*_{t} = \hat{p}^*_{F,t} + \hat{e}_t - \hat{p}_{F,t} \] (23)

\[ \hat{s}^*_{t} = \hat{p}^*_{H,t} - \hat{p}^*_{F,t} \] (24)
Quadratic loss functions

Under cooperation:

\[ L^W = \frac{1}{2} \mathbb{E}_{t_0} \sum_{t=t_0}^{\infty} \beta^{t-t_0} \left[ (1 + \omega) \left( \hat{Y}_t - z_t \right)^2 + (1 + \omega) \left( \hat{Y}_t^* - z_t^* \right)^2 + \Gamma \Sigma^2 \hat{\epsilon}_t^2 \right. \]
\[ + \frac{\varepsilon}{\delta} \left\{ \hat{\pi}^2_{H,t} + (1 - \gamma) \hat{\pi}^2_{F,t} + \gamma \hat{\pi}^2_{F,t} \right\} + \Gamma \left( \eta \hat{\rho}_{F,t} - \frac{\hat{e}_t}{\sigma} - \eta \hat{\rho}_{F,t}^* \right)^2 \]
\[ + (\sigma - 1) \left\{ \left( \hat{Y}_t + \gamma \Sigma \hat{e}_t + \eta \hat{\rho}_{H,t} \right)^2 + \left( \hat{Y}_t^* - \gamma \Sigma \hat{e}_t + \eta \gamma \hat{\pi}_t \right)^2 \right\} \]
\[ + \eta(1 - \eta) \left\{ (1 - \gamma) \hat{\rho}^2_{H,t} + \gamma \hat{\rho}^2_{F,t} + (1 - \gamma) \hat{\rho}_{F,t}^2 + \gamma \hat{\rho}_{H,t}^2 \right\} \]
\[ + t.i.p + O \left( \| \xi_t \|^3 \right), \quad (25) \]
Quadratic loss functions

- **Home loss function under noncooperation:**

\[
L = \frac{1}{2} \mathbb{E}_{t_0} \sum_{t=t_0}^{\infty} \beta^{t-t_0} \left[ \frac{1 - \Omega_1(1 + \omega)}{1 + \omega} \left( \hat{Y}_t - z_t \right)^2 + \frac{1 - \omega \Omega_1}{1 + \omega} \Gamma \Sigma^2 \hat{e}_t^2 \right. \\
\left. + \frac{\epsilon}{\delta} \left( 1 - (1 + \omega) \Omega_1 \right) \hat{n}_H^2 + \frac{\epsilon}{\delta} \left( (1 - \gamma) \omega \Omega_1 - \Omega_3 \right) \hat{n}_F^2 \right] \\
+ \gamma \frac{\epsilon}{\delta} \left( \omega \Omega_1 + \Omega_2 \right) \hat{n}_F^2 + \Gamma \omega \Omega_1 \left( \eta \hat{p}_F, t - \hat{e}_t - \eta \hat{p}_F^* \right) \right]
\]

\[
+ (1 - \eta) \left( \eta \left( 1 - \omega \Omega_1 \right) - \Omega_2 \right) \left\{ \left( 1 - \gamma \right) \hat{p}_F, t - \hat{e}_t - \eta \hat{p}_F^* \right\} \right]
\]

\[
+ (1 - \eta) \left( \eta \omega \Omega_1 + \frac{1}{\gamma} \omega \Omega_2 \right) \left\{ \left( 1 - \gamma \right) \hat{p}_H, t + \gamma \hat{p}_F^2 \right\} \right]
\]

\[
+ \Omega_1 \left\{ \left( 1 - \sigma \right) \hat{Y}_t - \sigma \gamma \Sigma \hat{e}_t + (1 - \sigma \eta) \hat{p}_H, t \right\} \right]
\]

\[
- \Omega_3 \left\{ (\omega + 1) \left( \hat{Y}_t^* - z_t^* \right) + \gamma \left( \eta \hat{p}_F, t - \hat{e}_t - \eta \hat{p}_F^* \right) \right\} \right]
\]

\[
+ \Omega_3 \left\{ \left( 1 - \sigma \right) \left( \hat{Y}_t^* - \gamma \Sigma \hat{e}_t + \eta \gamma \hat{t} \right) + (1 - \eta) \hat{p}_H^* \right\} \right]
\]

\[
+ \gamma \Omega_2 \left\{ (\omega + 1) \left( \hat{Y}_t^* - z_t^* \right) - \left( 1 - \gamma \right) \left( \eta \hat{p}_F, t - \hat{e}_t - \eta \hat{p}_F^* \right) \right\} \right]
\]

\[
- \gamma \Omega_2 \left\{ \left( 1 - \sigma \right) \left( \hat{Y}_t + \gamma \Sigma \hat{e}_t + \eta \hat{p}_H, t \right) + (1 - \eta) \hat{p}_F, t \right\} \right]
\]

\[
+ t.i.p + O (\|\xi_t\|^3),
\]

\[(26)\]
Quadratic loss functions

- **Foreign loss function under noncooperation:**

\[
L^* = \frac{1}{2} \mathbb{E}_{t_0} \sum_{t=t_0}^{\infty} \beta^{t-t_0} \left[ \begin{array}{c}
\Omega_1 \left\{ (\omega + 1)(\hat{Y}_t - z_t) \right\}^2 + (1 + \omega) \left( \hat{Y}_t^* - z_t^* \right)^2 + \omega \Omega_1 \Gamma \Sigma^2 \hat{e}_t^2 \\
+ \frac{\varepsilon}{\delta} (1 + \omega) \Omega_1 \hat{p}_{H,t}^2 + \frac{\varepsilon}{\delta} \left( \Omega_3 + (1 - \gamma) (1 - \omega \Omega_1) \right) \hat{p}_{F,t}^2 \\
+ \gamma \frac{\varepsilon}{\delta} ((1 - \omega \Omega_1) - \Omega_2) \hat{p}_{F,t}^2 \\
+ \Gamma (1 - \omega \Omega_1) \left( \eta \hat{p}_{F,t} - \frac{\hat{e}_t}{\sigma} - \eta \hat{p}_{F,t}^* \right)^2 \\
+ (\sigma - 1) \left\{ \hat{Y}_t^* - \gamma \Sigma \hat{e}_t + \eta \gamma \hat{r}_t \right\}^2 \\
+ (1 - \eta) (\Omega_2 + \eta \omega \Omega_1) \left\{ (1 - \gamma) \hat{p}_{F,t}^2 + \gamma \hat{p}_{H,t}^2 \right\} \\
+ (1 - \eta) (\eta (1 - \omega \Omega_1) - \Omega_2) \left\{ (1 - \gamma) \hat{p}_{H,t}^2 + \gamma \hat{p}_{F,t}^2 \right\} \\
- \Omega_1 \left\{ (1 - \sigma) \hat{Y}_t - \sigma \gamma \Sigma \hat{e}_t + (1 - \sigma \eta) \hat{p}_{H,t} \right\}^2 \\
+ \Omega_3 \left\{ (\omega + 1)(\hat{Y}_t^* - z_t^*) + \gamma \left( \eta \hat{p}_{F,t} - \frac{\hat{e}_t}{\sigma} - \eta \hat{p}_{F,t}^* \right) \right\}^2 \\
- \Omega_3 \left\{ (1 - \sigma) \left( \hat{Y}_t^* - \gamma \Sigma \hat{e}_t + \eta \gamma \hat{r}_t \right) + (1 - \eta) \hat{p}_{F,t}^* \right\}^2 \\
- \gamma \Omega_2 \left\{ (\omega + 1)(\hat{Y}_t^* - z_t^*) - (1 - \gamma) \left( \eta \hat{p}_{F,t} - \frac{\hat{e}_t}{\sigma} - \eta \hat{p}_{F,t}^* \right) \right\}^2 \\
+ \gamma \Omega_2 \left\{ (1 - \sigma) \left( \hat{Y}_t + \gamma \Sigma \hat{e}_t + \eta \hat{p}_{H,t} \right) + (1 - \eta) \hat{p}_{F,t} \right\}^2 \\
+ t.i.p + \mathcal{O} (\|\xi_t\|^3) \\
\end{array} \right],
\]

(27)
Special case

Quadratic loss functions in a special case with log utility, unitary elasticity of substitution (Cobb-Douglas aggregate consumption) and no home bias ($\sigma = \eta = 1$ and $\gamma = 0.5$)

\[
L = \frac{1}{2} \mathbb{E}_{t_0} \sum_{t=t_0}^{\infty} \beta^{t-t_0} \left[ \frac{1}{2} (1 + \omega) \left( \hat{Y}_t - z_t \right)^2 + \frac{1}{2} (1 + \omega) \left( \hat{Y}_t^* - z_t^* \right)^2 - \frac{\omega+1}{2} \left( \hat{Y}_t^* - z_t^* \right) \left( \hat{p}_F,t - \hat{e}_t - \hat{p}_F,t \right) + \frac{1}{8} \left( \hat{p}_F,t - \hat{e}_t - \hat{p}_F,t \right)^2 + \frac{\varepsilon}{2\delta} \hat{\pi}^2_{H,t} + \frac{\varepsilon}{2\delta} \hat{\pi}^2_{F,t} \right] + t.i.p + \mathcal{O} (||\xi_t||^3),
\]

\[
L^* = \frac{1}{2} \mathbb{E}_{t_0} \sum_{t=t_0}^{\infty} \beta^{t-t_0} \left[ \frac{1}{2} (1 + \omega) \left( \hat{Y}_t - z_t \right)^2 + \frac{1}{2} (1 + \omega) \left( \hat{Y}_t^* - z_t^* \right)^2 + \frac{\omega+1}{2} \left( \hat{Y}_t^* - z_t^* \right) \left( \hat{p}_F,t - \hat{e}_t - \hat{p}_F,t \right) + \frac{1}{8} \left( \hat{p}_F,t - \hat{e}_t - \hat{p}_F,t \right)^2 + \frac{\varepsilon}{2\delta} \hat{\pi}^2_{H,t} + \frac{\varepsilon}{2\delta} \hat{\pi}^2_{F,t} \right] + t.i.p + \mathcal{O} (||\xi_t||^3),
\]

\[
L^w = \frac{1}{2} \mathbb{E}_{t_0} \sum_{t=t_0}^{\infty} \beta^{t-t_0} \left[ (1 + \omega) \left( \hat{Y}_t - z_t \right)^2 + (1 + \omega) \left( \hat{Y}_t^* - z_t^* \right)^2 + \frac{1}{4} \left( \hat{p}_F,t - \hat{e}_t - \hat{p}_F,t \right)^2 + \frac{\varepsilon}{\delta} \hat{\pi}^2_{H,t} + \frac{\varepsilon}{2\delta} \hat{\pi}^2_{F,t} + \frac{\varepsilon}{2\delta} \hat{\pi}^2_{F,t} \right] + t.i.p + \mathcal{O} (||\xi_t||^3).
\]
Model analysis
Calibration

- Parameter values are standard

- Nonetheless, I also use various values of $\sigma$, $\gamma$ and $\eta$ in computing the gains from cooperation

**Table: Parameter values**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta$</td>
<td>0.99</td>
<td>Discount factor</td>
</tr>
<tr>
<td>$\chi$</td>
<td>1</td>
<td>Coefficient associated with labor disutility</td>
</tr>
<tr>
<td>$\omega$</td>
<td>4.71</td>
<td>Inverse elasticity of labor supply</td>
</tr>
<tr>
<td>$\sigma$</td>
<td>3</td>
<td>Degree of risk aversion</td>
</tr>
<tr>
<td>$\theta$</td>
<td>0.75</td>
<td>Probability that price cannot be adjusted</td>
</tr>
<tr>
<td>$\eta$</td>
<td>1.5</td>
<td>Elasticity of substitution between Home and Foreign goods</td>
</tr>
<tr>
<td>$\gamma$</td>
<td>0.5</td>
<td>Weight of imported goods in consumption basket</td>
</tr>
</tbody>
</table>
Impulse responses

- Responses of several variables in the DP model under cooperation and noncooperation to a positive one standard deviation productivity shock

- Under noncooperation, nominal exchange rate $E$ depreciates by less than under cooperation, and thus real exchange rate $e$ also depreciates by less

![Graphs showing impulse responses](image-url)
Hence, $P^*_H$ falls by less and $P_H$ falls by more $\rightarrow$ a smaller decline in $\pi^*_H$ and a larger fall in $\pi_H$.
Accordingly, $s^*$ decreases by less and $m^*$ rise by less.
From NKPCs, a **smaller decrease in** $\pi_F^*$ **and a slightly greater rise in** $\pi_F$

As a result, $\pi$ increases by less and $\pi^*$ drops by less
Impulse responses

- Smaller increase in $p_F^*$ $\rightarrow$ smaller fall in $Y^*$
- Smaller decrease in $p_H^*$ $\rightarrow$ $Y$ increases by less
Impulse responses

- Optimal monetary policy under noncooperation produces more stable Home CPI inflation $\pi$ but more volatile Home PPI inflation $\pi_H$ and import price inflation $\pi_F$.

- On the other hand, in Foreign, more stable CPI inflation $\pi^*$, PPI inflation $\pi_F^*$ and import price inflation $\pi_H^*$ are generated by optimal monetary policy under noncooperation.

- And, Home output $Y$ increases by less and Foreign output $Y^*$ falls by less compared to those under cooperation.
Impulse responses

Difference between impulse responses

- In the DP model, there are inefficiencies arising from both internal relative price and currency misalignments

  ⇒ Responses of internal relative price and currency misalignments under cooperation and noncooperation are different

- In the LCP model, there is no inefficiency stemming from internal relative price

  ⇒ Responses of currency misalignments under cooperation and noncooperation are different

- In the PCP model, there is no inefficiency stemming from currency misalignments

  ⇒ Responses of internal relative price under cooperation and noncooperation are different
Difference between impulse responses

### Foreign internal relative price

- **DP model**
- **LCP model**
- **PCP model**

### Foreign currency misalignments

- **DP model**
- **LCP model**
- **PCP model**
Welfare costs

- Consumption units by Lucas (1992) are used in computing the welfare costs.

- Welfare costs are aggregate consumption that a representative household has to give up to be as well off under cooperation as under noncooperation.

- Let $\lambda^C$ be the welfare cost from noncooperation of the Home representative household.

$$W^N_H = \mathbb{E}_t \sum_{t=t_0}^{\infty} \beta^{t-t_0} \left[ \left\{ \frac{(1 - \lambda^C) C_t^C}{1 - \sigma} \right\}^{1-\sigma} - \chi \frac{h_t^{C^{1+\omega}}}{1 + \omega} \right]$$
Welfare costs

Welfare gains
Welfare costs
Conclusion
This paper considers optimal monetary policy in a two-country model under DP.

In the DP model, there is one more inefficiency than in the LCP and PCP models.

- Internal relative price distortion compared to the LCP model, and distortion arising from deviations from the law of one price compared to the PCP model.

Accordingly, welfare gains from monetary policy cooperation in the DP model are substantially greater than in the LCP and PCP models.
Moreover, noncooperative Foreign policymaker in the DP model can manipulate not only internal relative price but also deviations from LOOP in favor of its own welfare through nominal exchange rate adjustment.

While noncooperative Home policymaker can control neither of the two.

Thus, gains from cooperation in Home are larger compared to Foreign.
This result also rationalizes the fact that the U.S. designates currency manipulators to protect its welfare.

Furthermore, I find that there are substantial gains from cooperation in the DP model even under the conditions that make gains from cooperation in the LCP and PCP models disappear.
Thank you