Fiscal Policy in a Monetary Union: Gains from Changing Institutions

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Introduction

- Measure increase in welfare within a Monetary Union following the introduction of a coordinated fiscal policy.
- Whether fiscal policy should be decided at the country level or commonly, even being specific to each country.

- Welfare of the Union in two cases:
  - Fiscal policy is done by a common fiscal authority (Cooperative equilibrium);
  - Fiscal policy is done by each country’s fiscal authority (Nash equilibrium);
Methodology

- Meaning of coordination/ stabilization

- Decomposition:

\[ E \left( U^U \right) = \overline{U^U} + f(\text{volatility}) \]

- However, volatility of shocks can imply a change in the Union’s Utility mean.
Methodology

- Hence, we propose the following decomposition:

\[
E(U^U) = U^U_{\text{steady state}} + \underbrace{(U^U - U^U_{\text{steady state}})}_{\text{indirect}} + f(\text{volatility})
\]

\[
deterninistic + \underbrace{f(\text{volatility})}_{\text{stochastic}}
\]

\[
E(U^{U_{\text{Coop}}} - U^{U_{\text{Nash}}}) =
\]

\[
= E(U^{U_{\text{Coop}}}_{\text{steady state}} - U^{U_{\text{Nash}}}_{\text{steady state}}) + E(U^{U_{\text{Coop}}}_{\text{shock}} - U^{U_{\text{Nash}}}_{\text{shock}})
\]

\[
deterministic\text{ effect} + \underbrace{E(U^{U_{\text{Coop}}}_{\text{shock}} - U^{U_{\text{Nash}}}_{\text{shock}})}_{\text{stochastic effect}}
\]
Literature

- 3 groups according to the resolution approach:

1. **Log-normal distribution method**: Devereux and Engel, 1998; Obstfeld and Rogoff, 2002; Evers, 2007

\[
E \left( U^{U_{Coop}} - U^{U_{Nash}} \right) = \left( \frac{U^{U_{Coop}} - U^{U_{Nash}}}{\text{mean effect}} \right) + \left( \frac{\sigma^2_{U^{U_{Coop}}} - \sigma^2_{U^{U_{Nash}}}}{2} \right) \text{ stochastic effect}
\]
2. **Linear Quadratic Method:** Rotemberg and Woodford 1997; Benigno and Woodford 2005; Gali and Monacelli, 2007; Forlati 2007; Ferrero 2007; Beestma and Jensen, 2005.

\[
f(x; y) - f(\bar{x}; \bar{y}) \approx \alpha_1 (x - \bar{x}) + \alpha_2 (y - \bar{y}) + \beta_1 (x - \bar{x})^2 + \beta_2 (y - \bar{y})^2 \Rightarrow \\
\Rightarrow \mathcal{W} \approx \gamma_1 (x - \bar{x})^2 + \gamma_2 (y - \bar{y})^2
\]

\textit{stabilization}

\[
Loss = \alpha (\hat{y}_t - \tilde{y}_t)^2 + \beta \pi_t^2 + \gamma (\hat{p}_t - \tilde{p}_t)^2 + \text{t.i.p.}
\]

\[
E(U^U) \approx \overline{U^U} + \alpha \left( U^U - \overline{U^U} \right)
\]

\[
E(U^U) \approx \overline{U^U} + \alpha \left( U^U - \overline{U^U} \right) + \beta \left( U^U - \overline{U^U} \right)^2
\]

*stabilization effect*
The Model

- Two identical economies: H and F
  - same preferences;
  - same technology;
  - same parametrization;
  - …
  - but these assumptions do not close the channel that ensures coordination gains.
The Model - Households

- Utility of a representative household (same as in Gali and Monacelli):

\[ E_0 \sum_{t=0}^{\infty} \beta^t \left\{ (1 - \gamma) \ln C_t + \gamma \ln G_t - \frac{N_t^{1+\varphi}}{1 + \varphi} \right\} \]

- \( C_t \) composite consumption index (no bias):

\[ C_{Ht} = \left[ \int_0^1 C_{Ht}(i) \frac{\theta - 1}{\theta} \, di \right]^{\frac{\theta}{\theta - 1}} \]

\[ C_t = 2C_{Ht}^{\frac{1}{2}}C_{Ft}^{\frac{1}{2}} \]

\[ C_{Ft} = \left[ \int_0^1 C_{Ft}(j) \frac{\theta - 1}{\theta} \, dj \right]^{\frac{\theta}{\theta - 1}} \]

Note: variables with star represent country F.
The Model - Households

- Price indexes:

\[ P_{Ht} = \left[ \int_{0}^{1} P_{Ht}^i (1-\theta) \, di \right]^{\frac{1}{1-\theta}} \quad P_{Ft}^* = \left[ \int_{0}^{1} P_{Ft}^* (1-\theta) \, dj \right]^{\frac{1}{1-\theta}} \]

- Prices are the same in the Union:

\[
\begin{align*}
P_H &= P_H^* \\
P_F &= P_F^*
\end{align*}
\]

\[
P_t = P_t^* = P_{Ht}^{\frac{1}{2}} P_{Ft}^{\frac{1}{2}}
\]

- Terms of trade = \( \frac{P_{Ft}}{P_{Ht}} \)
The Model - Households

- Timing:

\[ M_t + B_{Ht} + B_{Ft} + E_t \{ Q_{t,t+1} B_{t+1} \} \leq \mathcal{W}_t \]

\[ P_t C_t \leq M_t \]

\[ \mathcal{W}_{t+1} = M_t + (B_{Ht} + B_{Ft}) R_t + B_{t+1} + \]

\[ + (1 - \tau_t) W_t N_t + Z_t + \int_0^1 \Gamma_t (i) d\tau - P_t C_t \]
The Model - Households

- Optimality:
  - Euler
    \[
    \frac{1}{P_t C_t} = \beta R_t E_t \frac{1}{P_{t+1} C_{t+1}}
    \]
  - Intertemporal condition for non-state contingent debt
    \[
    Q_{t,t+1} = \beta \frac{P_t C_t}{P_{t+1} C_{t+1}}
    \]
  - Intratemporal condition
    \[
    N_t^\varphi = (1 - \gamma) \left(1 - \frac{\tau_t}{R_t C_t} \frac{W_t}{P_t}\right)
    \]
The Model - Firms

- Prices set one period in advance:

\[
\max_{P_{Ht}(i)} E_{t-1} \left[ Q_{t-1,t} Q_{t,t+1} \left( P_{Ht}(i) Y_t(i) - W_t N_t(i) \right) \right]
\]

\[
P_{Ht} = P_{Ht}(i) = \frac{\theta}{\theta - 1} E_{t-1} \left[ \eta_t \begin{bmatrix} W_t \\ A_t \end{bmatrix} \right]
\]

\[
\eta_t = \frac{\frac{1}{R_t} \frac{Y_t}{C_{t+1}P_{t+1}}}{E_{t-1} \left[ \frac{1}{R_t} \frac{Y_t}{C_{t+1}P_{t+1}} \right]}
\]

- Flexible prices:

\[
P_{Ht} = P_{Ht}(i) = \frac{\theta}{\theta - 1} \frac{W_t}{A_t}
\]
The Model – authorities

- National fiscal authorities:

\[ \tau_t W_t N_t + B_{Ht+1} = P_{Ht} G_t + B_{Ht} R_t \]

- Government demand function:

\[ G_t(i) = \left( \frac{P_{Ht}(i)}{P_{Ht}} \right)^{-\theta} G_t \]

- Central monetary authority:
  - Issues money \((M^u)\);
  - Allocates seigniorage revenue \((Z^u)\);
  - Determines the interest rate.
Equilibrium Allocations

- Aggregate demand:

\[
Y_t = \frac{1}{2} \left( \frac{P_{Ft}}{P_{Ht}} \right)^{\frac{1}{2}} (C_t + C_t^*) + G_t
\]

\[
Y_t^* = \frac{1}{2} \left( \frac{P_{Ht}}{P_{Ft}} \right)^{\frac{1}{2}} (C_t + C_t^*) + G_t^*
\]

- Cash in advance:

\[
\frac{M_t^U}{P_t} \leq C_t + C_t^*
\]
Equilibrium Allocations

- Imposing:

\[ B_H = B_F + B_F^* = 0 \]

- By the structure of the model,

Balanced trade \( \Leftrightarrow \) Cons. risk sharing:

\[ C_t^* = C_t \]
Eq. Allocations - Flexible Price

\[ N = \left[ \frac{(1-\gamma)(\theta-1)(1-\tau)}{\theta-(\theta-1)\tau} \right]^{\frac{1}{\varphi+1}} \]

\[ N^*= \left[ \frac{(1-\gamma)(\theta-1)(1-\tau^*)}{\theta-(\theta-1)\tau^*} \right]^{\frac{1}{\varphi+1}} \]

\[ \frac{P_F}{P_H} = \frac{A}{A^*} \frac{N \theta-(\theta-1)\tau}{N^* \theta-(\theta-1)\tau^*} \]

\[ C = \frac{1}{\theta} \left[ ANA^*N^* (\theta-(\theta-1)\tau)(\theta-(\theta-1)\tau^*) \right]^{\frac{1}{2}} \]

\[ G = \frac{\theta-1}{\theta} \tau A \left[ \frac{(1-\gamma)(\theta-1)(1-\tau)}{\theta-(\theta-1)\tau} \right]^{\frac{1}{\varphi+1}} \]

\[ G^* = \frac{\theta-1}{\theta} \tau^* A^* \left[ \frac{(1-\gamma)(\theta-1)(1-\tau^*)}{\theta-(\theta-1)\tau^*} \right]^{\frac{1}{\varphi+1}} \]
Shocks

- Discrete distribution with 3 states:

<table>
<thead>
<tr>
<th>State</th>
<th>Probability</th>
<th>$H$</th>
<th>$F$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$s = 1$</td>
<td>$\pi_1$</td>
<td>$A_1$</td>
<td>$A_1^*$</td>
</tr>
<tr>
<td>$s = 2$</td>
<td>$\pi_2$</td>
<td>$A_2$</td>
<td>$A_2^*$</td>
</tr>
<tr>
<td>$s = 3$</td>
<td>$\pi_3$</td>
<td>$A_3$</td>
<td>$A_3^*$</td>
</tr>
</tbody>
</table>

Table 3: Distribution of shocks
Eq. Allocations – Sticky Prices

\[
\sum_{s=1}^{3} \pi_s \left[ \left( \frac{P_H}{P_F} \right)^{\frac{1}{2}} \frac{A_s N_s}{C_s} - \frac{\theta}{(\theta - 1)(1 - \gamma)} \frac{N_s^{\varphi + 1}}{1 - \tau_s} \right] = 0
\]

\[
\sum_{s=1}^{3} \pi_s \left[ \left( \frac{P_F}{P_H} \right)^{\frac{1}{2}} \frac{A^*_s N^*_s}{C^*_s} - \frac{\theta}{(\theta - 1)(1 - \gamma)} \frac{N^{*\varphi + 1}}{1 - \tau^*_s} \right] = 0
\]

\[
A_s N_s - \frac{1}{2} \left( \frac{P_F}{P_H} \right)^{\frac{1}{2}} \left[ C_s \left( 1 + \frac{2}{1 - \gamma} \frac{\tau_s}{1 - \tau_s} N_s^{\varphi + 1} \right) + C^*_s \right] = 0
\]

\[
A^*_s N^*_s - \frac{1}{2} \left( \frac{P_H}{P_F} \right)^{\frac{1}{2}} \left[ C^*_s \left( 1 + \frac{2}{1 - \gamma} \frac{\tau^*_s}{1 - \tau^*_s} N^{*\varphi + 1} \right) + C_s \right] = 0
\]

\[
C_s - C^*_s = 0,
\]

\[
\frac{M^U}{\frac{1}{2} P_H \frac{1}{2} P_F} - C_s - C^*_s = 0
\]

\[
\forall s = \{1, 2, 3\}
\]
The Cooperative Equilibrium

- Central Fiscal Authority:

\[
\max_{\tau_s, \tau^*_s} U^U = \frac{1}{2} E \left[ U \left( C_s, N_s, G_s \right) \right] + \frac{1}{2} E \left[ U^* \left( C^*_s, N^*_s, G^*_s \right) \right]
\]

s.t. \( \text{Equilibrium allocations} \)

Sticky prices:

\[
\{ \tau_s, \tau^*_s, P_H, P_F, C_s, C^*_s, N_s, N^*_s \}_{s=1, 2, 3}
\]
The Nash Equilibrium

- Fiscal Authority of country H:

$$\max_{\tau_s} E[U(C_s, N_s, G_s)]$$

s.t. Equilibrium allocations

- Fiscal Authority of country F:

$$\max_{\tau_s^*} E[U^*(C_s^*, N_s^*, G_s^*)]$$

s.t. Equilibrium allocations

Sticky prices:

$$\{\tau_s, P_H, P_F, C_s, C_s^*, N_s, N_s^*\}_{s=1,2,3}$$
Deterministic Gain

- Is the same for flexible prices or for prices set in advance (steady-state)

<table>
<thead>
<tr>
<th></th>
<th>Cooperative</th>
<th>Nash</th>
<th>Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\tau^C = \tau^*C$</td>
<td>$U/U^*$</td>
<td>$\tau^N = \tau^*N$</td>
<td>$U/U^*$</td>
</tr>
<tr>
<td>$A = A^* = e$</td>
<td>27.87%</td>
<td>1</td>
<td>46.53%</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>1</td>
<td>16.8%</td>
</tr>
</tbody>
</table>

$\varphi = 0.5$

$\theta = 6$

$\gamma = 0.25$
Stochastic Gain

- Computed by difference:

  \[ E \left( U^{UC} \right) - E \left( U^{UN} \right) \]

  Total Gain

  Deterministic gain

  \[ U^{UC}_{\text{steady state}} - U^{UN}_{\text{steady state}} \]

  Stochastic gain

  \[ E \left( U^{Ucoop}_{\text{shock}} - U^{U^{Nash}}_{\text{shock}} \right) \]
## Stochastic Gain

<table>
<thead>
<tr>
<th>Scenario 1</th>
<th>$A_1 = A_1^* = e$</th>
<th>$A_2 = A_2^* = e^{0.5}$</th>
<th>$A_3 = A_3^* = e^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario 4</td>
<td>$A_1 = A_1^* = e$</td>
<td>$A_2 = A_3^* = e^{0.5}$</td>
<td>$A_3 = A_2^* = e^2$</td>
</tr>
<tr>
<td>Scenario 5</td>
<td>$A_1 = A_1^* = e$</td>
<td>$A_2 = A_3^* = e^{0.5}$</td>
<td>$A_3 = A_3^* = e^2$</td>
</tr>
<tr>
<td>Scenario 2</td>
<td>$A_1 = A_1^* = e$</td>
<td>$A_2 = A_2^* = e^2$</td>
<td>$A_3 = A_3^* = e^2$</td>
</tr>
<tr>
<td>Scenario 3</td>
<td>$A_1 = A_1^* = e$</td>
<td>$A_2 = A_2^* = e^{0.5}$</td>
<td>$A_3 = A_3^* = e^2$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>State</th>
<th>Cooperative $\tau$</th>
<th>Nash $\tau$</th>
<th>Stochastic gain $%$ Total Gains</th>
</tr>
</thead>
<tbody>
<tr>
<td>$s_1$</td>
<td>27.87%</td>
<td>46.53%</td>
<td>0.0%</td>
</tr>
<tr>
<td>$s_2$</td>
<td>27.87%</td>
<td>46.53%</td>
<td>1.22%</td>
</tr>
<tr>
<td>$s_3$</td>
<td>27.87%</td>
<td>46.53%</td>
<td>0.82%</td>
</tr>
</tbody>
</table>

Note: The table represents the calculation of stochastic gain under different scenarios and states, with gains calculated as the difference between Nash and cooperative strategies.
Conclusions

• Question: Should fiscal instruments be used as means to stabilize shocks that have asymmetric transmissions throughout the Union?

• Cooperative gains decomposed by:
  • Large deterministic effect (often ignored)
  • Small stochastic effect.

• Conclusion: Stabilization fiscal policies should be conducted from a decentralized institutional environment (short-run), although the existence of a supranacional institution can be sustained in order to coordinate the deterministic component of those policies.
Research

- “Tax Competition versus Tax Cooperation”: Study in detail the functional forms and model conditions that allow for different relations between the Cooperative, the Nash and the First Best.

- “Coordination and Stabilization of Fiscal Policy in a Monetary Union”: I apply this method to more complex functional forms and Inflation persistency (Calvo price setting).

- Future research: Interactions with monetary policy.