Optimal Macroprudential and Monetary Policy in a Currency Union

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Macroeconomic Stabilization Tools

Closed Economy

- Monetary policy (before the crisis)
- Macroprudential policy (after the crisis)
Macroeconomic Stabilization Tools

Closed Economy

- Monetary policy (before the crisis)
- Macroprudential policy (after the crisis)

Monetary Union

- Monetary policy *cannot* stabilize asymmetric shocks
- Macroprudential policy *can* be used to stabilize economy
**Today**

**Key elements of the model**

1. Nominal rigidities
2. Financial sector
3. Monetary union

**Main results**

1. Optimal regional macroprudential policy
   - 2 AD and 2 pecuniary externalities
2. Optimal global (coordinated) macroprudential policy
   - Two international spillovers
   - Local PM overregulates due to pecuniary externality
   - Local PM overregulates if many countries in recession
Contribution to the Literature

Pecuniary externality in international models

- Jeanne-Korinek (2010), Bianchi (2011), Benigno et al. (2013)
- This paper: pecuniary externality in the financial sector

Macroprudential policy due to nominal rigidities and ZLB

- Farhi-Werning (2016), Korinek-Simsek (2016)
- This paper: macroprudential regulation of the financial sectors in a currency union

Financial regulation in monetary union

- This paper: optimal policy
A Model with Nominal Rigidities

Households \( \max_{\{c_t,n_t\},D_1^c} \left[ u(c_0) - v(n_0) + \beta \left[ u(c_1) - v(n_1) \right] \right] \)

\[ s.t. : \quad P_0 c_0 + \frac{D_1^c}{1 + i_0} \leq W_0 n_0 + \Pi_0 \]
\[ P_1 c_1 \leq D_1^c + W_1 n_1 + \Pi_1 \]

Firms produce \( y_t = A_t n_t \)

Solution

\[ u'(y_1) = \frac{1}{A_1} v' \left( \frac{y_1}{A_1} \right) \quad \Rightarrow \quad y_1^* = y_1(A_1) \]

\[ u'(y_0) = \beta \frac{1 + i_0}{P_1/P_0} u'(y_1^*) \quad \Rightarrow \quad y_0 = y_0 \left( \frac{1 + i_0}{P_1/P_0}, y_1^* \right) \]

Welfare

\[ u'(y_0) \neq \frac{1}{A_0} v' \left( \frac{y_0}{A_0} \right) \quad \Rightarrow \quad \tau_0 \equiv 1 - \frac{v'(y_0/A_0)/A_0}{u'(y_0)} \neq 0 \]
A Model with Banks: Preferences

\[ U = u(c_0) - v(n_0) + \beta [u(c_1 + c_1) - v(n_1)] \]

- \( c_1 + c_1 \) – total consumption in period 1
A Model with Banks: Preferences

\[ U = u(c_0) - v(n_0) + \beta \left[ u(c_1 + c_1) - v(n_1) \right] + \beta \nu u(c_1) \]

- \( c_1 + c_1 \) – total consumption in period 1
- \( c_1 \) – must be bought with safe securities \( D_1^c \): \( P_1c_1 \leq D_1^c \)
A Model with Banks: Preferences

\[ U = u(c_0) - v(n_0) + \beta \left[ u(c_1 + c_1) - v(n_1) \right] + \beta \left[ \nu u(c_1) + X_1 g(h_1) \right] \]

- \( c_1 + c_1 \) – total consumption in period 1
- \( c_1 \) – must be bought with safe securities \( D_1^c \): \( P_1 c_1 \leq D_1^c \)
- \( h_1 \) – consumption of durable goods
A Model with Banks: Preferences

\[ U = u(c_0) - v(n_0) + \beta \left[ u(c_1 + c_1) - v(n_1) \right] + \beta \left[ \nu u(c_1) + X_1 g(h_1) \right] \]

- \( c_1 + c_1 \) – total consumption in period 1

- \( c_1 \) – must be bought with safe securities \( D_1^c \): \( P_1 c_1 \leq D_1^c \)

- \( h_1 \) – consumption of durable goods

- \( X_1 = \begin{cases} 1, & \text{with prob } \mu \\ \theta, & \text{with prob } 1 - \mu \end{cases} \) – shock to preferences
Durable goods production

\[ h_1 = G(k_0) \]
A Model with Banks: Financial Sector

Durable goods production

\[ h_1 = G(k_0) \]

Banks

\[
\max_{k_0, D_1^b, B(s_1)} \mathbb{E} \left\{ Q(s_1) \left[ \Gamma_1(s_1) G(k_0) - D_1^b - B(s_1) \right] \right\}
\]

s.t. \[ D_1^b \leq \min_{s_1} \{ \Gamma_1(s_1) \} G(k_0) \]

\[ P_0 k_0 \leq \frac{D_1^b}{1 + i_0} + \mathbb{E} [B(s_1) Q(s_1)] \]
**A Model with Banks: Financial Sector**

Durable goods production

\[ h_1 = G(k_0) \]

Banks

\[
\max_{k_0, D_1^b, B(s_1)} \mathbb{E}[Q(s_1)\Gamma_1(s_1)] G(k_0) - P_0 k_0 + \frac{\tau_A}{1 + \tau_A} \cdot \frac{D_1^b}{1 + i_0}
\]

s.t.

\[ D_1^b \leq \min_{s_1} \{\Gamma_1(s_1)\} G(k_0) \]
A Model with Banks: Financial Sector

Durable goods production

\[ h_1 = G(k_0) \]

Banks

\[
\max_{k_0, D^b_1, B(s_1)} \mathbb{E} [Q(s_1) \Gamma_1(s_1)] G(k_0) - P_0 k_0 + \frac{\tau_A}{1 + \tau_A} \cdot \frac{D^b_1}{1 + i_0} \\
\text{s.t. } D^b_1 \leq \min_{s_1} \{ \Gamma_1(s_1) \} G(k_0)
\]

With non-pecuniary safety preferences: \( \mathbb{E} Q(s_1) \neq 1/(1 + i_0) \)

\[ \tau_A \equiv \frac{1/\mathbb{E} Q(s_1) - (1 + i_0)}{1 + i_0} \]
A Model with Banks: Equilibrium

Equilibrium with flexible prices

\[ u'(c_0) = v'(y_0/A_0)/A_0, \quad u'(y_1) = v'(y_1/A_1)/A_1 \]
A Model with Banks: Equilibrium

Equilibrium with flexible prices

\[ u'(c_0) = v'(y_0/A_0)/A_0, \quad u'(y_1) = v'(y_1/A_1)/A_1 \]

\[ \beta \frac{u'(y_1)}{u'(c_0)} \left[ (\mu + (1 - \mu)\theta) \frac{g'[G(k_0)]}{u'(y_1)} G'(k_0) \right] = 1 \]
A Model with Banks: Equilibrium

Equilibrium with flexible prices

\[ u'(c_0) = v'(y_0/A_0)/A_0, \quad u'(y_1) = v'(y_1/A_1)/A_1 \]

\[
\beta \frac{u'(y_1)}{u'(c_0)} \left[ (\mu + (1 - \mu)\theta) \frac{g'[G(k_0)]}{u'(y_1)} G'(k_0) + \tau_A \theta \frac{g'[G(k_0)]}{u'(y_1)} G'(k_0) \right] = 1
\]

\[
\tau_A = \frac{\nu u'(d_1^b)}{u'(y_1)}, \quad d_1^b = \frac{\theta g'[G(k_0)]}{u'(y_1)} G(k_0)
\]
A Model with Banks: Equilibrium

Equilibrium with flexible prices

\[ u'(c_0) = v'(y_0/A_0)/A_0, \quad u'(y_1) = v'(y_1/A_1)/A_1 \]

\[ \beta \frac{u'(y_1)}{u'(c_0)} \left[ (\mu + (1 - \mu)\theta) \frac{g'[G'(k_0)]}{u'(y_1)} G'(k_0) + \tau_A \theta \frac{g'[G(k_0)]}{u'(y_1)} G'(k_0) \right] = 1 \]

\[ \tau_A = \frac{\nu u'(d_1^b)}{u'(y_1)}, \quad d_1^b = \frac{\theta g'[G(k_0)]}{u'(y_1)} G(k_0) \]

First best
A Model with Banks: Equilibrium

Equilibrium with flexible prices

\[ u'(c_0) = v'(y_0/A_0)/A_0, \quad u'(y_1) = v'(y_1/A_1)/A_1 \]

\[ \beta \frac{u'(y_1)}{u'(c_0)} \left[ (\mu + (1 - \mu)\theta) \frac{g'[G(k_0)]}{u'(y_1)} G'(k_0) + \tau_A \theta \frac{g'[G(k_0)]}{u'(y_1)} G'(k_0) \right] = 1 \]

\[ \tau_A = \frac{\nu u'(d^b_1)}{u'(y_1)}, \quad d^b_1 = \frac{\theta g'[G(k_0)]}{u'(y_1)} G(k_0) \]

First best

\[ \tau_A = 0 \]

\[ \text{Policy: issue lots of government safe bonds} \]

(Friedman rule for safe assets)
Assumption: fiscal policy cannot achieve first best
A Model with Banks: Second Best

Assumption: fiscal policy cannot achieve first best

Available tools: regulator varies the amount of private safe debt (Pigouvian taxes on safe debt issuance)
A Model with Banks: Second Best

Assumption: fiscal policy cannot achieve first best

Available tools: regulator varies the amount of private safe debt (Pigouvian taxes on safe debt issuance)

Private allocation isn’t 2nd best efficient: pecuniary externality

\[ d_1^b = \frac{\theta g'[G(k_0)]}{u'(y_1^*)} G(k_0) \]

too much safe debt; durable price – too low; too many durables
A Model with Banks: Second Best

Assumption: fiscal policy cannot achieve first best

Available tools: regulator varies the amount of private safe debt (Pigouvian taxes on safe debt issuance)

Private allocation isn’t 2nd best efficient: pecuniary externality

\[ d_{1}^{b} = \frac{\theta g'[G(k_{0})]}{w'(y_{1}^{*})} G(k_{0}) \]

too much safe debt; durable price – too low; too many durables

Optimal macroprudential tax mitigates pecuniary externality

\[ \tau_{0}^{b} = \frac{\tau_{A}}{1 + \tau_{A} \epsilon_{\Gamma}} \]

\[ [\epsilon_{\Gamma} - \text{elasticity of durables demand}] \]
Model of Monetary Union: Assumptions

- Continuum of countries $i \in [0, 1]$

- Goods
  - $c_{NT,i}^t$: non-traded produced goods [sticky price in $t = 0$]
  - $c_{T,i}^t$: homogenous traded goods [endowment $e_{i0}^i, e_{i1}^i$]
  - $h_i^i$: non-traded durable goods
  - Cole-Obstfeld (log) utility

- No labor mobility

- International markets
  - traded goods
  - safe debt

- Government
  - union-wide monetary authority
  - regional financial regulators who rebate locally

- Safe-assets-in-advance constraint (more general in the paper):
  \[ P_{T,1} c_{T,1}^i \leq D_1^{c,i} \]
Optimal Regional Policy

Objective: max $U_i$

Constraints

- All regional equilibrium conditions
- International prices ($P_{T,0}, P_{T,1}, i_0$) are exogenous

Macroprudential tool

- Country-specific tax on safe debt issuance $\tau_{b,i_0}$

Proposition 1.

$$\tau_{b,i_0} = 1 - \tau_{i_0} (\tau_{i_A \epsilon_i \Gamma_1 + \tau_{i_A} - \tau_{i_0} Z_i \sum_{i} d_{b,i} - a_{1 - \tau_{i_0} Z_i 4}) > 0$$
Optimal Regional Policy

Objective: $\max \mathcal{U}^i$

Constraints

- all regional equilibrium conditions
- international prices $(P_{T,0}, P_{T,1}, i_0)$ are exogenous

Macroprudential tool

- country-specific tax on safe debt issuance $\tau_{0,b,i}$
Optimal Regional Policy

Objective: \( \max U^i \)

Constraints

- all regional equilibrium conditions
- international prices \((P_{T,0}, P_{T,1}, i_0)\) are exogenous

Macroprudential tool

- country-specific tax on safe debt issuance \(\tau_{0,b,i}^i\)

Proposition 1.

\[
\tau_{0,b,i}^i = \frac{1}{1 - \tau_0^i} \left( \frac{\tau_A^i \epsilon_A^i}{1 + \tau_A^i} - \tau_0^i Z_2^i + Z_3^i a_{1,b,i} - \frac{a}{1 - a} \tau_0^i Z_4^i \right)
\]

\(Z_2^i, Z_3^i, Z_4^i > 0\)
Optimal Regional Policy

Intuition

\[
\tau_{0}^{b,i} = \frac{1}{1 - \tau_{0}^{i}} \left( \frac{\tau_{A}^{i} \epsilon_{i}^{i}}{1 + \tau_{A}^{i}} - \tau_{0}^{i} Z_{2}^{i} + d_{1}^{b,i} Z_{3}^{i} - \frac{a}{1 - a} \tau_{0}^{i} Z_{4}^{i} \right)
\]
Optimal Regional Policy

Intuition

\[ \tau_{b,i}^0 = \frac{1}{1 - \tau_0^i} \left( \frac{\tau_A^i e_G^i}{1 + \tau_A^i} - \tau_0^i Z_2^i + d_1^{b,i} Z_3^i - \frac{a}{1 - a} \tau_0^i Z_4^i \right) \]

2) \( d_1^{b,i} \uparrow \Rightarrow k_0^i \uparrow \Rightarrow y_{NT,0}^i \uparrow \) (AD externality)
Optimal Regional Policy

Intuition

\[ \tau_{0}^{b,i} = \frac{1}{1 - \tau_{0}^{i}} \left( \frac{\tau_{A}^{i} \epsilon_{i}^{i}}{1 + \tau_{A}^{i}} - \tau_{0}^{i} Z_{2}^{i} + d_{1}^{b,i} Z_{3}^{i} - \frac{a}{1 - a} \tau_{0}^{i} Z_{4}^{i} \right) \]

2) \( d_{1}^{b,i} \uparrow \Rightarrow k_{0}^{i} \uparrow \Rightarrow y_{NT,0}^{i} \uparrow \) (AD externality)

3) \( d_{1}^{b,i} \uparrow \Rightarrow c_{T,0}^{i} \uparrow, c_{T,1}^{i} \downarrow \Rightarrow d_{1}^{b,i} \leq \theta^{i} \frac{g'[G(k_{0}^{i})]}{(1-a)/c_{T,1}^{i}} G(k_{0}^{i}) - \text{tighter} \)

Plot (International pecuniary externality)
**Optimal Regional Policy**

**Intuition**

\[
\tau_{0}^{b,i} = \frac{1}{1 - \tau_{0}^{i}} \left( \frac{\tau_{A}^{i} e_{i}^{\Gamma}}{1 + \tau_{A}^{i} Z_{2}^{i}} - \tau_{0}^{i} Z_{2}^{i} + d_{1}^{b,i} Z_{3}^{i} - \frac{a}{1 - a} \tau_{0}^{i} Z_{4}^{i} \right)
\]

2) \(d_{1}^{b,i} \uparrow \Rightarrow k_{0}^{i} \uparrow \Rightarrow y_{NT,0}^{i} \uparrow\) (AD externality)

3) \(d_{1}^{b,i} \uparrow \Rightarrow c_{T,0}^{i} \uparrow, c_{T,1}^{i} \downarrow \Rightarrow d_{1}^{b,i} \leq \theta^{i} \frac{g'[G(k_{0}^{i})]}{(1-a)/c_{T,1}^{i}} G(k_{0}^{i}) - 	ext{tighter}\) (International pecuniary externality)

4) \(d_{1}^{b,i} \uparrow \Rightarrow c_{T,0}^{i} \uparrow \Rightarrow c_{NT,0}^{i} = \frac{a}{1-a} \frac{P_{T,0}^{i}}{P_{NT,0}^{i}} c_{T,0}^{i} \Rightarrow y_{NT,0}^{i} \uparrow\) (Monetary union AD externality)
Optimal Coordinated Policy

Objective: $\int \omega^i U^i di$

Constraints: all local equilibrium conditions and international market clearing

Tools: $\{\tau_{0,i}^b\}$ and $i_0$
Optimal Coordinated Policy

Objective: $\int \omega^i U^i di$

Constraints: all local equilibrium conditions and international market clearing

Tools: $\{\tau^{b,i}_0\}$ and $i_0$

Proposition 2.

- Monetary policy: $\int \omega^i \tau^i_0 di = 0$
Optimal Coordinated Policy

Objective: $\int \omega^i U^i \, di$

Constraints: all local equilibrium conditions and international market clearing

Tools: $\{\tau_0^{b,i}\}$ and $i_0$

Proposition 2.

- Monetary policy: $\int \omega^i \tau_0^i \, di = 0$
- Macroprudential policy

$$\tau_0^{b,i} = \frac{1}{1 - \tau_0^i} \left( \frac{\tau_A^i e_i^i}{1 + \tau_A^i} - \tau_0^i Z_2^i + Z_3^i d_1^{b,i} - \frac{a}{1 - a} \tau_0^i Z_4^i + Z_5^i \tilde{\psi}_0 \right)$$
International Spillovers

Intuition
1) $\tau_{0}^{b,i} \uparrow \Rightarrow d_{1}^{b,i} \downarrow \Rightarrow c_{T,1}^{i} \uparrow \Rightarrow c_{T,1}^{j} \downarrow$
International Spillovers

Intuition

1) \[ \tau_{0,\cdot}^{b,i} \uparrow \Rightarrow d_1^{b,i} \downarrow \Rightarrow c_{T,1}^{\cdot} \uparrow \Rightarrow c_{T,1}^{\cdot} \downarrow \]

- collateral constraint in country \( j \) gets tighter:

\[
d_1^{b,j} \leq \theta^j \frac{g'[G(k_0^j)]}{(1-a)c_{T,1}^j} G(k_0^j)
\]

(International spillover)
International Spillovers

Intuition

1) \( \tau_0^{b,i} \uparrow \Rightarrow d_1^{b,i} \downarrow \Rightarrow c_{T,1}^{j} \uparrow \Rightarrow c_{T,1}^{j} \downarrow \)

- collateral constraint in country \( j \) gets tighter:

\[
d_1^{b,j} \leq \theta_j \frac{g'[G(k_0^j)]}{(1-a)/c_{T,1}^{j}} G(k_0^j)
\]

(International spillover)

2) \( \tau_0^{b,i} \uparrow \Rightarrow d_1^{b,i} \downarrow \Rightarrow r_0 \downarrow \Rightarrow y_{NT,0}^{j} \downarrow \)

\[
\begin{bmatrix}
\downarrow P_{T,0} = \frac{1+r_0}{1+i_0} P_{T,1} \Rightarrow \downarrow c_{NT,0}^{j} \sim \frac{P_{T,0}}{P_{NT,0}} c_T^{j} \Rightarrow \frac{P_{T,1}}{(1+i_0)P_{NT,0}} \frac{c_T^{j}}{\beta(1+\tau_A)}
\end{bmatrix}
\]

(Monetary union spillover)
CONCLUSION

1. Optimal macroprudential and monetary policy in MU

2. Regional macroprudential policy
   - takes into account 2 AD and 2 pecuniary externalities

3. Spillovers
   - negative due to international pecuniary externality
   - negative (positive) on neighbours in recessions (booms) due to monetary union AD externality
MODEL WITH BANKS AND NOM. REGIDITIES

Proposition

1. Optimal monetary and macroprudential policy

\[ \tau_0 = 0 \]
\[ \tau^b_0 = \frac{\tau_A}{1 + \tau_A} \epsilon \Gamma \]

2. If monetary policy is suboptimal (\(\tau_0 \neq 0\)), then

\[ \tau^b_0 = \frac{1}{1 - \tau_0} \left( \frac{\tau_A}{1 + \tau_A} \epsilon \Gamma - \tau_0 Z_2 \right), Z_2 > 1 \]

Farhi-Werning (2016), Korinek-Simsek (2016)
Household Problem
with Reserve Requirements

\[ \mathbb{E}\left\{ u(c_0) - v(n_0) + \beta \left[ u(c_1 + c_1) - v(n_1) + u(c_1) + X_1 g(h_1) \right] \right\} \]

s.t. :

\[ T_0 + P_0 c_0 + \frac{D_1^c}{1 + i_0} + \frac{R_1^b}{1 + i_0^r} + P_0 k_0 \leq \frac{D_1^b}{1 + i_0} + W_0 n_0 + \Pi_0^j \]

\[ P_1 (c_1 + c_1) + T_1 + \Gamma_1 h_1 + D_1^b \leq D_1^c + R_1^b + W_1 n_1 + \Gamma_1 G(k_0) + \Pi_1^j \]

\[ P_1 c_1 \leq D_1^c \quad \text{[Safe-assets-in-advance constraint]} \]

\[ D_1^b \leq \min\{\Gamma_1\} G(k_0) + R_1^b \quad \text{[Collateral constraint]} \]

\[ z_0 D_1^b \leq R_1^b \quad \text{[Universal reserve requirement]} \]
Household Problem

with Pigouvian Taxes

\[
\mathbb{E}\left\{ u(c_0) - v(n_0) + \beta \left[ u(c_1 + c_1) - v(n_1) + u(c_1) + X_1 g(h_1) \right] \right\}
\]

s.t. :

\[
T_0 + P_0 c_0 + \frac{D_1^c}{1 + i_0} + P_0 k_0 \leq \frac{\tilde{D}_1^b}{1 + i_0} \left( 1 - \tau_0^b \right) + W_0 n_0 + \Pi_0^j
\]

\[
P_1 (c_1 + c_1) + T_1 + \Gamma_1 h_1 + \tilde{D}_1^b \leq D_1^c + W_1 n_1 + \Gamma_1 G(k_0) + \Pi_1^j
\]

\[
P_1 c_1 \leq D_1^c
\]

\[
\tilde{D}_1^b \leq \min\{\Gamma_1\} G(k_0)
\]
Equilibrium

Euler equation

\[ u'(c_0) = \beta \frac{1 + i_0}{\Pi^*} u'(y_1^*) (1 + \tau_A), \quad \tau_A = \frac{\nu u'(d^b_1)}{u'(y_1^*)} \]

Investment in durable goods

\[ \beta \frac{u'(y_1^*)}{u'(c_0)} G'(k_0) \left[ (\mu + (1 - \mu)\theta) \frac{g'[G(k_0)]}{u'(y_1^*)} + \zeta_0(\tau^b_0)\theta \frac{g'[G(k_0)]}{u'(y_1^*)} \right] = 1 \]

Collateral constraint

\[ d^b_1 \leq \theta \frac{g'[G(k_0)]}{u'(y_1^*)} G(k_0) \]
**Ramsey Problem**

\[
\max_{c_0, k_0, \tilde{d}_1} \quad u(c_0) - v \left( \frac{c_0 + k_0}{A_0} \right) + \beta \left[ u(y_1^*) - v(y_1^*/A_1) \right] \\
+ \beta \left[ (\mu + (1 - \mu)\theta) g(G(k_0)) + \nu u(d_1^b + d_1^g) \right]
\]

s.t. : \quad d_1^b \leq \theta \frac{g'[G(k_0)]}{u'(y_1^*)} G(k_0)
Model of Monetary Union: Preferences

\[ U = u(c_0) - v(n_0) + \beta \left[ u(c_1 + c_1) - v(n_1) \right] \]
\[ + \beta \left[ \nu u(c_1) + X_1 g(h_1) \right] \]

\[ \Downarrow \]

\[ U^i = U(c^i_{NT,0}, c^i_{T,0}) - v(n^i_0) + \beta U(c^i_{NT,1} + c^i_{NT,1}, c^i_{T,1} + c^i_{T,1}) \]
\[ + \beta \left[ \nu^i U(c^i_{NT,1}, c^i_{T,1}) + X^i_1 g(h^i_1) - v(n^i_1) \right] \]

- \( i \) – country index
- \( T \) – traded goods index
- \( NT \) – non-traded goods index
- \( P^i_{NT,1} c^i_{NT,1} + P_T c^i_{T,1} \leq D^i_{c,i} \)

Assumption \( U(c_{NT}, c_T) = \log (c^a_{NT} c_T^{1-a}) \)
SMALL OPEN ECONOMY
Small Open Economy
SMALL OPEN ECONOMY