Coordination and Crisis in Monetary Unions

Aguiar, Amador, Farhi, and Gopinath (WP, 2015)

Sargent Reading Group
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Monetary Unions

- Large literature on shock stabilization
- Euro crisis uncovered other types of tensions
- Policy games

This paper

- Inflation, nominal debt dynamics and self-fulfilling debt crises
- (lack of) Policy coordination and commitment
- Debt ceilings, optimal currency areas
Roadmap

1. Set-up, deterministic model

2. Fiscal externalities

3. Rollover crises

4. Optimal composition of a currency union
Environment

- Time is continuous and infinite, \( t \in [0, \infty) \)
- Continuum of SOE’s form a monetary union
- Single consumption good, domestic price

\[
P(t) = P(0) \exp \left[ \int_0^t \pi(t) \, dt \right]
\]

- Each economy endowed with \( y \) units of good each period
- Preferences
  1. Continuum of small open economies, \( i \in [0, 1] \)

\[
U^f = \int_0^\infty e^{-\rho t} \left[u(c_i(t)) - \psi(\pi(t))\right] \, dt
\]

  2. Monetary authority

\[
U^m = \int_0^\infty e^{-\rho t} \left( \int [u(c_i(t)) - \psi(\pi(t))] \, di \right) \, dt
\]

  3. Continuum of risk-neutral lenders with outside option \( \rho \)
Bond Markets and Default

▶ Each SOE issues a non-contingent nominal bond that is continuously rolled over

\[
\dot{b}_i(t) = c_i(t) - y + [r_i(t) - \pi(t)]b_i(t)
\]

▶ Fiscal authority lacks commitment to repay debt

▶ Value of default at \(T\)

\[
V(T) = \frac{u[(1 - \chi)y]}{\rho} - \int_T^\infty e^{-\rho(t-T)}\psi(\pi(t))dt
\]
Symmetric MPE

- Focus on union with high debt and low debt members

\[
b_H(t) \equiv \frac{1}{\eta} \int_{i \in H} b_i(t) \, di
\]

\[
b_L(t) \equiv \frac{1}{1 - \eta} \int_{i \in L} b_i(t) \, di
\]

\[b(t) = (b_H(t), b_L(t))\] is the aggregate state.

- Perfect foresight equilibrium with no rollover crises.
Problems

Fiscal authority

\[ V(b, b) = \max \int_{c(t)}^{\infty} e^{-\rho t} [u(c(t)) - \psi_0 \Pi(b(t))] dt \]

subject to

\[ \dot{b}(t) = c(t) - y + [r(b(t), b(t)) - \Pi(b(t))]b(t) \]

\[ \dot{b}_j(t) = \tilde{C}(b_j(t), b(t)) - y + [r(b_j(t), b(t)) - \Pi(b(t))]b_j(t), j = H, L \]

\[ b(t) \in \bar{\Omega}, t \geq 0 \]

Monetary authority

\[ J(b) = \max \int_{\pi(t) \in [0, \bar{\pi}]} \int_{0}^{\infty} [\eta u(C(b_H(t))) + (1 - \eta)u(C(b_L(t))) - \psi_0 \pi(t)] dt \]

subject to

\[ \dot{b}_j(t) = C(b_j(t)) + [r(b_j(t), b(t)) - \pi(t)]b_j(t) - y \]
Recursive Competitive Equilibrium

Interest rate schedule $r$, value functions $V, J$, policy functions $C, \Pi$ such that

1. $V$ solves the fiscal authority’s problem and $C$ is the associated policy function

2. $J$ solves the monetary authority’s problem and $\Pi$ is the associated policy function

3. Bond holders break even

$$r(b, b) = \rho + \Pi(b)$$

4. $V(b, b) \geq \underline{V}(b)$
Monotone Equilibrium

Define $b_\pi(b_L)$ as

$$\eta u'(y - \rho b_\pi)b_\pi + (1 - \eta)u'(y - \rho b_L)b_L = \psi_0$$

Best monotone equilibrium

1. Consumption,

$$C(b) = y - \rho b$$

2. Inflation,

$$\Pi(b) = \begin{cases} 0 & \text{if } b_H \leq b_\pi(b_L) \\ \bar{\pi} & \text{if } b_H > b_\pi(b_L) \end{cases}$$

3. Interest rate schedule,

$$r(b, b) = \begin{cases} \rho & \text{if } b_H \leq b_\pi(b_L) \\ \rho + \bar{\pi} & \text{if } b_H > b_\pi(b_L) \end{cases}$$

4. Value functions

$$V(b, b) = \begin{cases} \frac{u(y - \rho b)}{\rho} & \text{if } b_H \leq b_\pi(b_L) \\ \frac{u(y - \rho b)}{\rho} - \frac{\psi_0 \bar{\pi}}{\rho} & \text{if } b_H > b_\pi(b_L) \end{cases}$$
Best Monotone Equilibrium

(a) Value Function

(b) Interest Rates

(c) Consumption Policy

(d) Inflation Policy
Fiscal Externalities

- Small decrease in debt around $b_\pi$ leads to discrete jump in welfare.
- Opportunity not exploited due to lack of coordination between fiscal and monetary authorities.
Rollover Crises

- Coordination problem for creditors (Cole and Kehoe, 2000)
- If no rollover, repay during a grace period of length $\delta$ at fixed interest rate $\tilde{r}$
- May default at any point during the grace period if
  \[
  \hat{V}^G(b, \tilde{r}; \tilde{\Pi}) \leq \hat{V} \equiv \frac{u[(1 - \chi)y]}{\rho}
  \]
- Define “crisis” and “safe” zones à la Cole and Kehoe
  \[
  \mathcal{C} = \{ b \in \bar{\Omega} | b > b_\lambda \}
  \]
- Sunspot: if $b \in \mathcal{C}$ creditors refuse to roll over maturing debt with Poisson arrival $\lambda$
  Only source of uncertainty in the model.
Fiscal Authorities

Interest rate must compensate lenders for inflation and default risk,

\[ r(b, b) = \rho + \Pi(b) + \lambda \Pi_C(b) \]

Fiscal authority solves

\[ \hat{V}(b) = \max_{c(t)} \int_0^\infty e^{-\rho t - \lambda \int_0^t \Pi_C[b(s)]ds} \left[ u(c(t)) + \lambda \hat{V} \right] dt \]

subject to

\[ \dot{b}(t) = c(t) - y + [r(b(t), b(t)) - \Pi(b)]b(t) \]

\[ b(0) = b, \quad \text{and} \quad b(t) \in \tilde{\Omega} \]

Interest rate now depends on \( b(t) \)

- Fiscal authority can save its way out of the crisis zone.
Monetary Authority

\[ J(b) = \max_{\pi(t) \in [0, \bar{\pi}]} \int_0^\infty \eta e^{-\rho t - \lambda} \int_0^t \mathbb{I}_C[b(s)] ds \left[ u(C(b(t))) + \lambda \hat{V} \right] dt \]

\[ + \int_0^\infty (1 - \eta) \int_0^\infty \eta e^{-\rho t - \lambda} \int_0^t \mathbb{I}_C[b(s)] ds \pi(t) dt \]

subject to

\[ \dot{b}(t) = C(b(t)) - y + [\rho + \Pi(b(t)) + \lambda \mathbb{I}_C(b(t)) - \pi(t)] b(t) \]

\[ b(0) = b \]

- Incentive to inflate away debt so as to help fiscal authority to exit the crisis zone.
RCE with Crises

Interest rate schedule $r$, value functions $(\hat{V}, \hat{V}^G, J)$, policy functions $(C, C^G, \Pi)$, and threshold $b_\lambda$ such that

1. $\hat{V}$ solves the fiscal authority’s problem and $C$ is its policy function

2. $\hat{V}^G$ solves the fiscal authority’s grace period problem and $C^G$ is the policy function

3. $J$ solves the monetary authority’s problem and $\Pi$ is its policy function

4. Bond holders break even

$$r(b, b) = \rho + \Pi(b) + \lambda \mathbb{I}_C(b)$$

5. $\hat{V}(b) \geq \hat{V}$

6. $\hat{V}^G[b, r(b, b); \tilde{\Pi}^e(., b)] < \hat{V}$ for $b > b_\lambda$ and all $b \in \tilde{\Omega}$. 
Equilibrium Policies

- Fiscal policy

\[ C(b) = \begin{cases} 
  y - \rho b & \text{if } b \leq b_\lambda \\
  c_\lambda & \text{if } b_\lambda < b \leq b^* \\
  y - (\rho + \lambda)b & \text{if } b^* < b 
\end{cases} \]

and

\[ \dot{b} = \begin{cases} 
  -(\rho + \lambda)(b^* - b) & \text{if } b \in (b_\lambda, b^*) \\
  0 & \text{otherwise} 
\end{cases} \]

where \( c_\lambda(b_\lambda) \) and \( b^* = (y - c_\lambda)/(\rho + \lambda) \)

- Monetary policy

\[ \Pi(b) = \begin{cases} 
  0 & \text{if } b \leq b_\pi \\
  \bar{\pi} & \text{if } b_\pi < b 
\end{cases} \]

where

\[ b_\pi = \sup_b \left\{ b \in \bar{\Omega} \mid u'(C(b))b \leq \frac{\psi_0}{\eta} \right\} \]
Equilibrium Crisis Zone

- Multiple equilibria corresponding to different thresholds $b_\lambda$

- Restrict $\hat{V}^G - \hat{V}$ in the safe zone via off-equilibrium beliefs

Equilibrium selection

- Suppose crisis occurs in the safe zone, debtors enter grace period

- Monetary authority sets inflation assuming debtors will repay

- Maximal inflationary support that is consistent with monetary authority’s objective function

- No fiscal externality during the grace period, objectives are aligned
Debt Distribution

How does $b_\lambda$ vary with $\eta$?
Optimal Composition of a Currency Union

Without crises:

- High debt country is strictly better off when other members have low debt.
- This endogenously lowers the benefit of inflation for the monetary authority, allowing it to deliver the commitment outcome.

With rollover crises:

- High debt countries may be better off when there are other high debt countries.
- Crisis region is minimized at an interior $\eta > 0$
- High number of debtors makes it credible for the monetary authority to stand ready and inflate/assist in case of a rollover crisis.