Monetary Conservatism and Sovereign Default

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Fiscal Sustainability, XXI Century

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Overview

1. **Introduction**
2. Model
3. Quantitative Analysis
4. Summary

Motivation

Monetary policy and lack of commitment

- Nominal public debt:
  - A government faces temptation to relax its budget via surprise inflation.
- Discretionary policy:
  - Inflation bias relative to optimal policy under commitment.
- Solution proposed by *Rogoff (1985)*:
  - Delegate monetary policy to a monetary conservative central banker.

Motivation

Monetary policy in practice

- Most developed economies have delegated monetary policy to independent central banks with a focus on price stability.
- Many emerging economies have also recently introduced independent central banks (see e.g. *Carstens and Jácome, 2005*).
- However, these countries often face frictions that might undermine the success of such reforms.

Topic of this paper

Evaluate monetary conservatism when an economy is subject to three particular frictions:

- Incomplete financial markets
- Lack of commitment to debt repayment
- Political economy distortions

Model environment

- Small open economy as in *Arellano (2008)*
- The economy's government consists of
  - a present-biased fiscal authority
  - an inflation-averse monetary authority
- No commitment to future policies
- Quantitative exercise:
  - Vary the degree of monetary conservatism

Preview of results

- Increasing the degree of monetary conservatism leads to
  - less inflation, higher average debt and more defaults,
  - more volatile public spending but more stable inflation,
  - sign and size of welfare gains depends on details of the economy.
- Monetary conservatism is successful in reducing inflation and can be desirable despite considerable negative side effects.

Related literature

- Time-consistent monetary policy and central bank independence:
  - *Rogoff (1985), Adam and Billi (2008), Niemann (2011), Martin (2015)*
- Monetary policy and sovereign default:
  - *Aguiar et al. (2013, 2015)*, *Hur et al. (2014)*, *Du and Schreger (2015)*, *Nuño and Thomas (2015), Röttger (2015)*
- Quantitative sovereign default models with incomplete markets:
  - *Aguiar and Gopinath (2006)*, *Arellano (2008)*, *Cuadra and Sapriza (2008)*

Overview

Setting

Arellano-Eaton-Gersovitz-type small open economy model:

- Households
- Government

  $\Rightarrow$ Two separate authorities that optimize without commitment:

  1. Fiscal authority
     - chooses fiscal policy
     - is subject to political economy comstraints.
  2. Monetary authority
     - controls the inflation rate
     - might be inflation averse
- Risk-neutral foreign investors

Households

- The economy is populated by a representative household with preferences

$$\mathcal{U} = \mathbb{E}_0 \left[\sum_{t=0}^{\infty} \beta^t U(g_t, \pi_t) \right], \; 0 < \beta < 1,$$

with

$$U(g_t, \pi_t) = u(g_t) - \psi(\pi_t).$$

- Interpretation of (convex) inflation cost function $\psi(\pi_t)$:
  - Direct utility loss of inflation (Aguiar et al., 2013, 2015).
  - Resource losses of inflation and household utility that is linear in private consumption.

Fiscal authority

- Inspired by *Cuadra and Sapriza (2008) and Aguiar and Amador (2011)*, there are two political parties $i \in \mathbb{I} \equiv \{1, 2\}$ with preferences

$$\mathcal{F}_i = \mathbb{E}_0 \left[\sum_{t=0}^{\infty} \beta^t U_i^{\mathcal{F}} \left(g_t, \pi_t \right) \right],$$

where

$$U_i^{\mathcal{F}} \left(g_t, \pi_t \right) = \tilde{\theta}_{it} u \left(g_t \right) - \psi \left(\pi_t \right),$$

with

$$\tilde{\theta}_{it} = \begin{cases} \theta > 1, & \text{if } i \text{ is in office} \\ 1, & \text{if } i \text{ is not in office} \end{cases}$$

Fiscal authority (cont'd)

- Given random tax revenue τ_t, the incumbent party chooses fiscal policy without commitment:
  - default $d_t \in \{0, 1\}$, public good g_t, debt issuance b_{t+1}.
- Incumbent party remains in office with probability μ and is replaced with probability $1 - \mu$.
- Political disagreement ($\theta > 1$) and turnover risk ($\mu < 1$):

  $\Rightarrow$ Deficit bias (*Persson and Svensson, 1989, Alesina and Tabellini, 1990*) and suboptimal policies relative to $\theta = 1$ (and $\mu = 1$).
- Closely related to the present bias in models with quasi-geometric discounting (see e.g. Aguiar *and* Amador, 2011).

Monetary authority

- The monetary authority (or central bank) has preferences

$$\mathcal{M} = \mathbb{E}_0 \left[\sum_{t=0}^{\infty} \beta^t U^{\mathcal{M}} (g_t, \pi_t) \right],$$

  where

$$U^{\mathcal{M}} (g_t, \pi_t) = u(g_t) - \alpha \psi (\pi_t),$$

  with $\alpha \geq 0$.
- central bank sets the inflation rate π_t without commitment.
- Parameter α reflects degree of monetary conservatism (*Rogoff, 1985*, *Niemann, 2011*)
- For $\alpha \neq 1$ ($\alpha \neq \alpha_\theta \equiv 1/\theta$), the relative weight on the inflation cost deviates from that for the households (fiscal authority).

Government budget constraint

Repayment case

- Fixed debt structure (see *Chatterjee and Eyigungor, 2012*):
  - Constant nominal debt share λ:

$$
\begin{aligned}
b_{Nt+1} &= \frac{B_{Nt+1}}{P_t} = \lambda b_{t+1}, \\
b_{Rt+1} &= (1-\lambda) b_{t+1},
\end{aligned}
$$

  with

$$
b_{t+1} = b_{Nt+1} + b_{Rt+1}.
$$

- Government budget if debt is honored:

$$
\tau_t + \left(\lambda q_{Nt} + (1-\lambda)\, q_{Rt}\right) b_{t+1} = g_t + \left(\lambda \pi_t^{-1} + 1 - \lambda\right) b_t,
$$

with random tax revenues τ_t.

Government budget constraint

Default case

- Following *Arellano (2008)*, there are two types of default costs:
  - Resource losses $\phi(\tau_t) \geq 0$.
  - Temporary exclusion from financial markets.
- Government budget in default case:

$$\tau_t - \phi(\tau_t) = g_t.$$

International investors

- Homogeneous risk-neutral foreign investors can borrow at the risk-free rate r_f and maximize expected profits.
- The price of a real bond is given as

$$q_R\left(b_{t+1}, \tau_t\right) = \frac{1}{1+r_f}\mathbb{E}_t\left[1 - \mathcal{D}(b_{t+1}, \tau_{t+1})\right],$$

while a nominal bond is priced according to

$$q_N\left(b_{t+1}, \tau_t\right) = \frac{1}{1+r_f}\mathbb{E}_t\left[\frac{1 - \mathcal{D}(b_{t+1}, \tau_{t+1})}{\Pi^r(b_{t+1}, \tau_{t+1})}\right],$$

where $\mathcal{D}(\cdot)$ and $\Pi(\cdot)$ determine the default and inflation decisions d_{t+1} and π_{t+1}.

Policy interaction

- Interaction between periods:
  - Markov-perfect policy game with state (b, τ)
  - Authorities take as given future policies but can affect them via b'.
- Interaction within periods:
  - Timing after tax revenues τ are realized:
    1. Fiscal authority chooses $d \in \{0, 1\}$.
    2. Central bank chooses π.
    3. Fiscal authority chooses g and b'.

Public policy problems

Step 1: Fiscal policy problem

- After tax revenues τ are realized, the fiscal authority solves

$$\mathcal{F}(b,\tau) = \max_{d\in\{0,1\}} \left\{(1-d)\mathcal{F}^r(b,\tau) + d\mathcal{F}^d(\tau)\right\}$$

- The beginning-of-period values of the central bank and the party not in office satisfy

$$\begin{aligned}
\mathcal{M}(b,\tau) &= (1-\mathcal{D}(b,\tau))\,\mathcal{M}^r(b,\tau) + \mathcal{D}(b,\tau)\mathcal{M}^d(\tau), \\
\mathcal{F}^*(b,\tau) &= (1-\mathcal{D}(b,\tau))\,\mathcal{F}^{*r}(b,\tau) + \mathcal{D}(b,\tau)\mathcal{F}^{*d}(\tau),
\end{aligned}$$

with $\mathcal{D}(\cdot)$ denoting the policy function for the fiscal authority's default decision.

Public policy problems

Step 2: Monetary policy problem

The central bank solves

$$\mathcal{M}^r(b,\tau) = \max_{\pi} \left\{ \begin{array}{c} u(\hat{\mathcal{G}}^r(\pi,b,\tau)) - \alpha\psi(\pi) \\ +\beta\mathbb{E}_{\tau'|\tau}\left[\mathcal{M}(\hat{\mathcal{B}}^r(\pi,b,\tau),\tau')\right] \end{array} \right\},$$

if the fiscal authority repays and

$$\mathcal{M}^d(\tau) = \max_{\pi} \left\{ \begin{array}{c} u(\hat{\mathcal{G}}^d(\pi,\tau)) - \alpha\psi(\pi) \\ +\beta\mathbb{E}_{\tau'|\tau}\left[\begin{array}{c} \delta\mathcal{M}(0,\tau') \\ +(1-\delta)\,\mathcal{M}^d(\tau') \end{array} \right] \end{array} \right\},$$

if it defaults.

Public policy problems

Step 3: Fiscal policy problem

In the repayment case, the fiscal authority solves

$$\hat{\mathcal{F}}^r(\pi, b, \tau) = \max_{g, b'} \left\{ \begin{array}{c} \theta u(g) - \psi(\pi) \\ +\beta \mathbb{E}_{\tau'|\tau} \left[\begin{array}{c} \mu \mathcal{F}(b', \tau') \\ +(1-\mu)\mathcal{F}^*(b', \tau') \end{array} \right] \end{array} \right\}$$

$$\text{subject to } 0 \leq \tau - g - \left(\lambda \pi^{-1} + 1 - \lambda\right) b + \left[\lambda q_N\left(b', \tau\right) + (1-\lambda) q_R\left(b', \tau\right)\right] b'$$

Public policy problems

Step 3: Fiscal policy problem (cont'd)

In the default case, the fiscal authority solves

$$\hat{\mathcal{F}}^d(\pi,\tau) \quad = \quad \max_g \left\{ \begin{array}{c} \theta u(g) - \psi(\pi) \\ +\delta\beta\mathbb{E}_{\tau'|\tau}\left[\begin{array}{c} \mu\mathcal{F}(0,\tau') \\ +(1-\mu)\,\mathcal{F}^*(0,\tau') \end{array} \right] \\ +(1-\delta)\,\beta\mathbb{E}_{\tau'|\tau}\left[\begin{array}{c} \mu\mathcal{F}^d(\tau') \\ +(1-\mu)\,\mathcal{F}^{*d}(\tau') \end{array} \right] \end{array} \right\}$$

subject to $0 \quad \leq \quad \tau - g - \phi(\tau)$

Public policy problems

Step 3: Political party not in office

The value functions for the party not in office satisfy

$$\hat{\mathcal{F}}^{*r}(\pi, b, \tau) = \left\{ \begin{array}{c} u(\hat{\mathcal{G}}^r(\pi, b, \tau)) - \psi(\pi) \\ +\beta \mathbb{E}_{\tau'|\tau} \left[\begin{array}{c} \mu \mathcal{F}(\hat{\mathcal{B}}^r(\pi, b, \tau), \tau') \\ + (1-\mu)\, \mathcal{F}^*(\hat{\mathcal{B}}^r(\pi, b, \tau), \tau') \end{array} \right] \end{array} \right\},$$

$$\hat{\mathcal{F}}^{*d}(\pi, \tau) = \left\{ \begin{array}{c} u(\hat{\mathcal{G}}^d(\pi, b, \tau)) - \psi(\pi) \\ +\delta\beta \mathbb{E}_{\tau'|\tau} \left[\begin{array}{c} \mu \mathcal{F}(0, \tau') \\ + (1-\mu)\, \mathcal{F}^*(0, \tau') \end{array} \right] \\ + (1-\delta)\, \beta \mathbb{E}_{\tau'|\tau} \left[\begin{array}{c} \mu \mathcal{F}^d(\tau') \\ + (1-\mu)\, \mathcal{F}^{*d}(\tau') \end{array} \right] \end{array} \right\}.$$

Public policy problems

Step 3: Monetary authority

The value functions for the central bank satisfy

$$\begin{aligned}
\hat{\mathcal{M}}^r(\pi, b, \tau) &= \left\{ \begin{array}{c} u(\hat{\mathcal{G}}^r(\pi, b, \tau)) - \alpha\psi(\pi) \\ +\beta\mathbb{E}_{\tau'|\tau}\left[\mathcal{M}(\hat{\mathcal{B}}^r(\pi, b, \tau), \tau')\right] \end{array} \right\}, \\
\hat{\mathcal{M}}^d(\pi, \tau) &= \left\{ \begin{array}{c} u(\hat{\mathcal{G}}^d(\pi, b, \tau)) - \alpha\psi(\pi) \\ +\delta\beta\mathbb{E}_{\tau'|\tau}\left[\mathcal{M}(0, \tau')\right] \\ +\left(1-\delta\right)\beta\mathbb{E}_{\tau'|\tau}\left[\mathcal{M}^d(\tau')\right] \end{array} \right\}.
\end{aligned}$$

Equilibrium policies

In equilibrium, all values and policies will only be functions of the beginning-of-period state variables:

$$\begin{aligned} \mathcal{X}^r(b,\tau) &= \hat{\mathcal{X}}^r(\Pi^r(b,\tau),b,\tau), \\ \mathcal{X}^d(\tau) &= \hat{\mathcal{X}}^d(\Pi^d(\tau),\tau), \end{aligned}$$

for $\mathcal{X} \in \{\mathcal{B},\mathcal{F},\mathcal{F}^*,\mathcal{G}\}$, and

$$\mathcal{X}(b,\tau) = (1-\mathcal{D}(b,\tau))\,\mathcal{X}^r(b,\tau) + \mathcal{D}(b,\tau)\mathcal{X}^d(\tau),$$

for $\mathcal{X} \in \{\mathcal{B},\mathcal{F},\mathcal{F}^*,\mathcal{G},\mathcal{M},\Pi\}$.

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Functional forms

- CRRA utility:

$$u(g) = \begin{cases} \frac{g^{1-\gamma}}{1-\gamma} & \text{if } \gamma \neq 1 \\ \ln g & \text{if } \gamma = 1 \end{cases}$$

- Quadratic inflation costs as in *Calvo and Guidotti (1992)*:

$$\psi(\pi) = \frac{\chi}{2} (\pi - 1)^2, \chi > 0,$$

- Asymmetric default costs as in *Arellano (2008)*:

$$\phi(\tau) = \max \{0, \tau - \bar{\tau}\},$$

- Tax revenues follow a log-normal AR(1)-process:

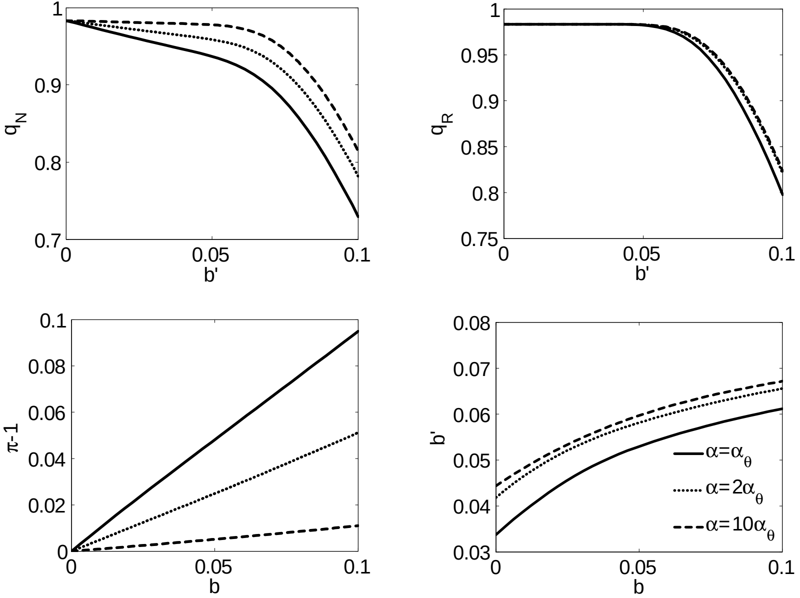
$$\tau_t = \tau_{t-1}^{\rho} \exp(\sigma \varepsilon_t), \varepsilon_t \overset{i.i.d.}{\sim} N(0,1), 0 < \rho < 1.$$

Calibration

Model calibration (no CBI, one model period is one quarter):

Parameter	Description	Value	Target
r_f	Risk-free rate	0.017	Arellano (2008)
β	Discount factor	$1/(1+r_f)$	-
γ	CRRA	2	Standard value
δ	Probability of reentry	0.1	Aguiar/Gopinath (2006)
λ	Share of nominal debt	0.58	Du/Schreger (2015)
μ	Probability of reelection	0.9	Cuadra/Sapriza (2008)
ρ	Persistence revenue process	0.9	Standard value
σ	Std. dev. revenue process	0.022	Std. of g in Mexico
μ	Probability of reelection	0.9	Cuadra/Sapriza (2008)
$\bar{\tau}$	Default cost parameter	0.982	1% default prob.
θ	Weight on public good	2.75	20.68% avg. inflation
χ	Inflation cost parameter	1.53	$\text{Mean}(b/\tau) = 0.05$

Bond price schedules and policy functions at $\tau = \mathbb{E}[\tau]$



Simulation results

- Quantitative model analysis compares model statisics for different monetary policy regimes
- Values for α relative to $\alpha_\theta \equiv 1/\theta$

	No CBI	$\alpha = \alpha_\theta$	$\alpha = 2\alpha_\theta$	$\alpha = 10\alpha_\theta$
Avg. default prob. (annual)	0.0087	0.0085	0.0155	0.0192
Mean(b/τ)	0.0531	0.0519	0.0654	0.0708
Mean($\pi - 1$) (annual)	0.2095	0.2116	0.1322	0.0291
Std(g)/Std(τ)	1.1041	1.0957	1.1956	1.2614
Std(π)/Std(τ)	1.3399	1.3118	1.2152	0.3263
Welfare measure ω (in %)	-	0.0005	0.0523	0.1051

Role of political frictions

- Consider model versions with $\beta < 1/(1 + r_f)$:
  - No political frictions: $\theta = 1$, $\mu = 1$
  - No turnover risk: $\theta > 1$, $\mu = 1$
- Parameters $\bar{\tau}$, β and χ re-calibrated to match long-run targets

	$\alpha = \alpha_\theta$	$\alpha = 2\alpha_\theta$	$\alpha = 3\alpha_\theta$	$\alpha = 10\alpha_\theta$
$\theta = 1$, $\mu = 1$	0	-0.0227	-0.0244	-0.0272
$\theta > 1$, $\mu = 1$	0	0.0458	0.0729	0.0973
$\theta > 1$, $\mu < 1$	0.0005	0.0523	0.0789	0.1051

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Summary

- The role of monetary conservatism has been revisited in a quantitative sovereign default model with
  - incomplete financial markets,
  - lack of commitment to debt repayment,
  - political economy distortions.
- Increasing a central bank's degree of monetary conservatism leads to
  - higher average debt, more defaults and less inflation,
  - more volatile public spending but more stable inflation,
  - welfare gains or costs depending on political frictions.

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