On a Lender of Last Resort with a Central Bank and a Stability Fund

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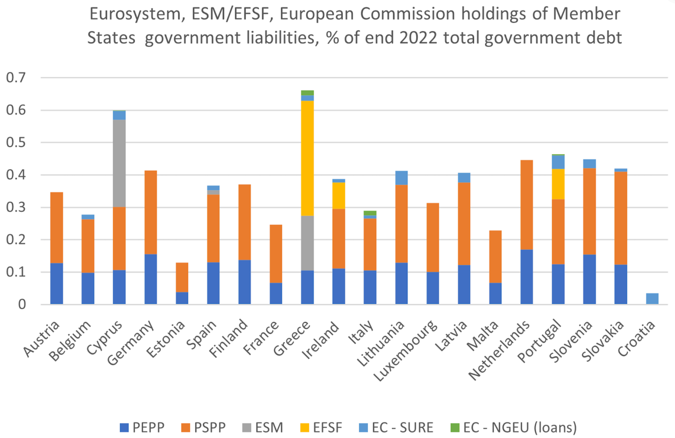
Motivation

Last two decades characterized by several crises:

- Multiple programs $\rightarrow$ Large fraction of debt in euro area institutions.
- No leading sovereign debt policy but heavy intervention of the ECB
  - Direct: PSPP, PEPP
  - Announced: MTO, TPI

Motivation

Details



Motivation

Last two decades characterized by several crises:

- Multiple programs → Large fraction of debt in euro area institutions.
- No leading sovereign debt policy but heavy intervention of the ECB
  - Direct: PSPP, PEPP
  - Indirect: MTO, TPI
- TPI is conditional on debt being sustainable:

  ...in ascertaining that the trajectory of public debt is sustainable, the Governing Council will take into account, where available, the debt sustainability analyses of the European Commission, ESM [...]

⇒ What is to complement the ECB in its role of lender of last resort?

This Paper

- Role and design of Financial Stability Fund:
  - Roch and Uhlig (2018), **Liu et al. (2020)**, **Ábrahám et al. (2019)**, Dovis and Kirpalani (2023).
- Sovereign debt crises:
  - Fundamental-driven à la Eaton and Gersovitz (1981).
  - Belief-driven à la Cole and Kehoe (2000).
- Effective lender of last resort:
  - Sovereign debt stabilization.
  - Interaction between Financial Stability Fund and Central Bank.

Main Results

- Fund prevents both fundamental and belief-driven debt crises:
  - Provides securities contingent on state and non-default unlike private lenders.
  - Fills the gap in case of failed debt auction.

  } Fund is essential

- Perfect complementarity between Fund and Central Bank:
  - Fund can stabilize sovereign debt (i.e. makes it safe), but may lack absorption capacity.
  - Central Bank has absorption capacity, but needs instruments to prevent fundamental risk.
- Optimal maturity structure as outcome of institutional design:
  - Longer maturities avert self-fulfilling debt crises.
  - Shorter maturities ease the Fund's intervention.

Outline

Economy

- Benevolent government with no committment acting as a representative agent
- Continuum of private competitive lenders:
  - Non-contingent long-term debt, $b' \leq 0$, maturity δ and coupon κ.
  - Coordination on sunspot $\rho \in \{0, 1\}$
- Financial Stability Fund:
  - Full set of Arrow securities, $\hat{a}'(\theta)$.
  - Complements private lenders (*Minimum intervention*)

Fund Contract I

- Two sided limited enforcement constraints
  - Fund should make no permanent losses ex-ante or ex-post:

    No-Excessive-Lending (or DSA)

$$\mathbb{E}\left[\sum_{j=t}^{\infty}\left(\frac{1}{1+r}\right)^{j-t}\tau^{f}(s^{j})\Big|s^{t}\right] \geq \underbrace{\theta_{t-1}Z}_{\text{No permanent loss if } Z=0}. \tag{NEL}$$

  - Government should not default

    No-default

$$\mathbb{E}\left[\sum_{j=t}^{\infty}\beta^{j-t}U(c(s^{j}),n(s^{j}))\Big|s^{t}\right] \geq \underbrace{V^{D}(s^{t})}_{\text{Value under default}}. \tag{ND}$$

Fund Contract II

$\{c(s^t), n(s^t)\}_{t=0}^{\infty}$ is a solution to the Fund's contract, given $b_{l,0}$, if there exist sequences of transfers $\{\tau_p(s^t), \tau_f(s^t)\}_{t=0}^{\infty}$ with associate $\{b_{l,t}\}_{t=0}^{\infty}$, such that:

$$\max_{\{c(s^t),n(s^t)\}_{t=0}^{\infty}} \mathbb{E}\Big[\mu_{b,0} \overbrace{\sum_{t=0}^{\infty} \beta^t U(c(s^t), n(s^t))}^{\text{Value of sovereign}} + \mu_{l,0} \overbrace{\sum_{t=0}^{\infty} \Big(\frac{1}{1+r}\Big)^t \tau(s^t)}^{\text{Value of lenders}} \Big| s_0 \Big]$$

$$\text{s.t. (NEL), (ND)}$$

$\Rightarrow$ Existence and uniqueness: interiority condition and appropriate $b_{l,0}$.

$\Rightarrow$ Initial $\mu_{b,0}$ and $\mu_{l,0}$ obtained by setting (NEL) to 0 at $t = 0$.

Two Types of Sudden Stops

Details

1. Fundamental-driven (excessive lending externality):
   - When (NEL) binds at θ', negative spread at θ: $r_f(s, \omega, \bar{\omega}') = r_p(s, \omega, \bar{\omega}') < r$
   - Negative spread restricts provision of Fund's insurance and sustains no-trade in private bond markets
   - Private lenders would like to liquidate their holdings to the fund and invest at r

   $\Rightarrow$ Fund must be ready to absorb long-term private debt position δb_l.

2. Belief-driven:
   - Borrower is in crisis zone and $\rho = 1$.
   - Fund must be able to absorb the Gross Financial Needs (GFN) if needed, i.e. $\bar{a}_l' \geq \bar{\omega}_l - \delta b_l$.

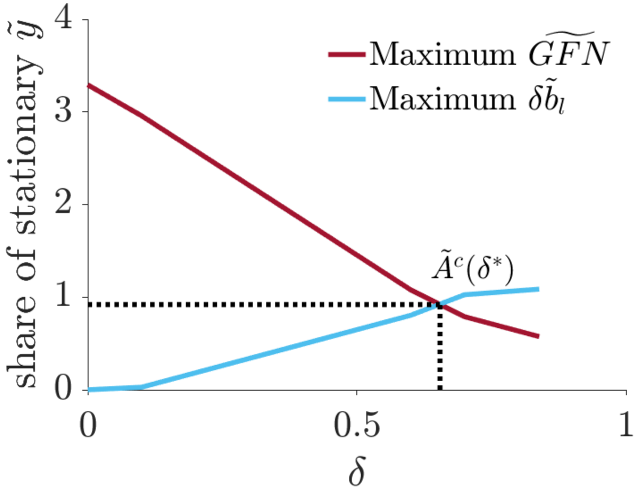
Optimal Maturity

- Recall, two types of sudden stops to take care of:
  - Fundamental-driven: δb_l increasing in δ.
  - Belief-driven: $GFN(\delta) = q_f(s, \omega, \bar{\omega}')(\bar{\omega}_l' - \delta\omega_l)$ decreasing in δ
- The minimal capacity absorption for a Fund contract with maturity δ is:

$$A^c(\delta) = \max\{GFN(\delta), \delta b_l\}.$$

- The optimal maturity structure: $\delta^* = \arg\min_{\delta \in [0,1]} \mathrm{A^c}(\delta)$.
- The Required Fiscal Capacity (RFC) is $A^c(\delta^*)$.

Optimal Maturity



Fund's Intervention

- Minimal Intervention Policy: For a given state (θ, b_l), we say that the the Fund implements a Minimal Intervention Policy if $\bar{a}'_l = \underline{a}(\theta, b_l)$ where

  1. If (NEL) binds, $\underline{a}(\theta, b_l) \in [\check{a}, \check{a} + \delta b_l]$.
  2. If (NEL) does not bind, $(s, \omega) \in \underbrace{\mathcal{C}(\varrho)}_{\text{Crisis zone}}$ and $\rho = 1$, then $\underline{a}(\theta, b_l) \in [\bar{\omega}_l - \delta b_l, \bar{\omega}_l]$.
  3. Otherwise, $\underline{a}(\theta, b_l) = 0$.

- Implications:
  - No Default: With the Fund's intervention, the sovereign does not default.
  - Safe Zone: With the Fund's intervention, the sovereign remains in the safe zone.
  - Safe assets: With the Fund's intervention, all sovereign debt liabilities become safe assets.

- The First and Second Welfare Theorems are satisfied.

Central Bank

- Problem: Fund may not have the necessary absorption capacity $\rightarrow$ e.g. ESM.
- Solution: Central Bank (CB) may complement the absorbing capacity of the Fund.
- CB unpleasant arithmetic:
  - Reserves must be safe and transfers cannot be permanent.
  - CB intervention conditional on sovereign debt free from fundamental defaults $\rightarrow$ ECB's TPI/OMT.
- Fund allows CB to intervene and CB guarantees the success of Fund intervention.

Outline

Calibration

Calibration to Italy 1992 to 2019

Calibration Outcome

Details

Variable	Data	SFC		No SFC	
		Without Fund	With Fund	Without Fund	With Fund
A. Targeted Moments					
$b'/y\%$	117.64	118.00	123.70	119.10	176.8
$n\%$	38.64	38.87	39.09	38.80	39.51
spread%	2.50	0.48	-0.04	0.13	-0.03
$\sigma(\tau/y)/\sigma(y)$	1.09	1.38	0.91	0.96	0.91
$\sigma(n)/\sigma(y)$	0.75	0.75	0.74	0.74	0.75
corr(spread, y)	-0.16	-0.29	-0.71	-0.37	-0.66
corr($\tau/y, y$)	0.29	0.42	0.97	0.54	0.98
B. Non-Targeted Moments					
σ(spread)	0.96	0.66	0.01	0.08	0.01
$\sigma(c)/\sigma(y)$	1.27	0.88	0.25	0.91	0.20
corr(c, y)	0.53	0.61	0.77	0.64	0.85
corr(n, y)	0.68	0.56	0.98	0.51	0.99

Welfare

State		Welfare Gains (%)		Maximal Debt Absoption (% of GDP)			
		With Fund		With Fund		Without Fund	
		SFC	No SFC	SFC	No SFC	SFC	No SFC
$\rho = 0$	$\gamma = \gamma_{min}$	0.50	0.80	180	250	159	171
$\rho = 0$	$\gamma = \gamma_{med}$	0.16	0.42	144	194	136	141
$\rho = 0$	$\gamma = \gamma_{max}$	0.01	0.38	126	168	112	113
$\rho = 1$	$\gamma = \gamma_{min}$	0.50	-	180	-	158	-
$\rho = 1$	$\gamma = \gamma_{med}$	0.16	-	144	-	136	-
$\rho = 1$	$\gamma = \gamma_{max}$	0.01	-	126	-	112	-
Average		0.11	0.41				

Optimal Maturity

Details

- Average Italian debt maturity: 6.2 years.
- Optimal debt maturity: 2.9 years.
- Current needed capacity absorption: 105% of GDP.
- Capacity absorption under optimal maturity: 90% of GDP.

Outline

Conclusion

- Optimal design of a lender of last resort.
- Fund is essential as it provides insurance and prevents excess lending.
- Fund averts debt crises but might lack the required absorption capacity.
- Central Bank can complement the Fund intervention.
- Optimal maturity to minimize the required absorption.

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Appendix

Euro Area sovereign debt by country and holder I

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- Price is determined by the agent whose constraint is not binding (Krueger et al., 2008)

$$q_f(\theta', \omega'(\theta')|s, \omega) = \frac{\pi(\theta'|\theta)}{1+r}\left[(1-\delta+\delta\kappa) + \delta \sum_{\theta''|\theta'} q_f(\theta'', \omega''(\theta'')|s', \omega')\right] \max\left\{\frac{u_c(c')}{u_c(c)}\eta, 1\right\}.$$

- If (NEL) binds in θ', then $q_f(\theta', \omega'(\theta')|s, \omega) > \frac{1-\delta+\delta\kappa}{1+r-\delta}$.

- As private lenders have access to the Fund, no arbitrage is possible so

$$q_p(s, \omega, \bar{\omega}') = \sum_{\theta'|\theta} q_f(\theta', \omega'(\theta')|s, \omega).$$

$\Rightarrow$ negative spread passes through private bond market.

Appendix

IRF I

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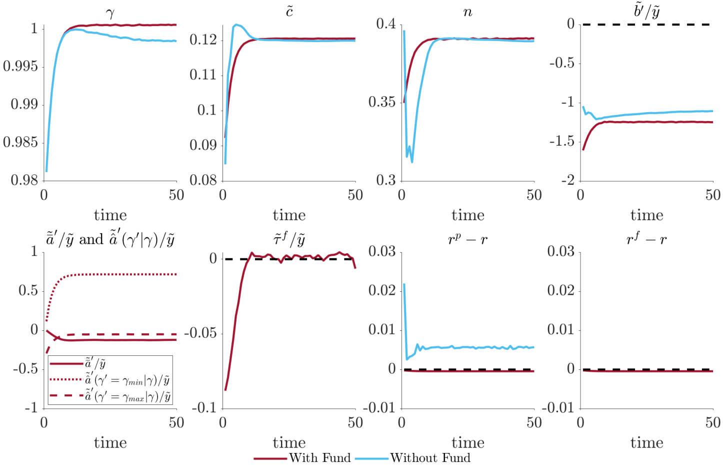

Figure: Impulse Response Functions to a Negative γ Shock Without SFC

Appendix

IRF II

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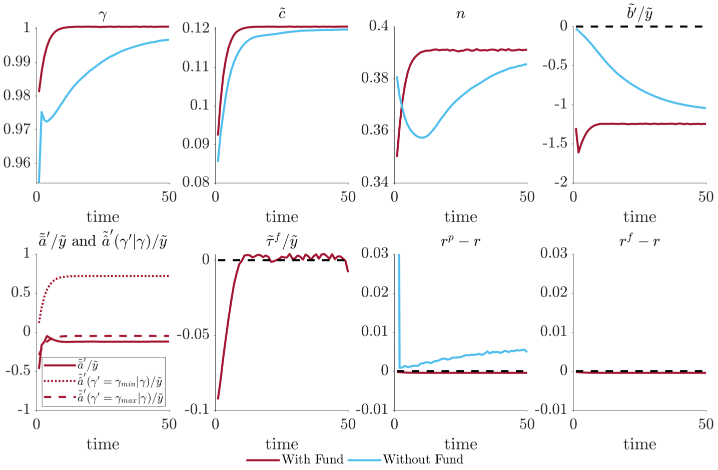

Figure: Impulse Response Functions to a Negative γ Shock With SFC and LOLR Absorption

Simulation I

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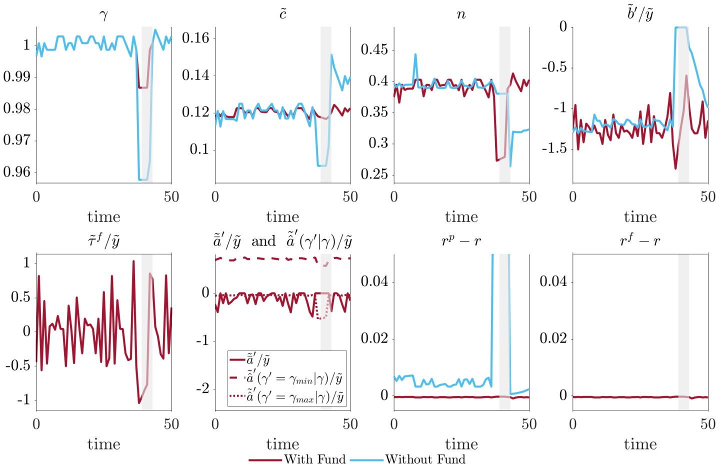

Figure: Simulation of a Steady State Path Without SFC

Appendix

Simulation II

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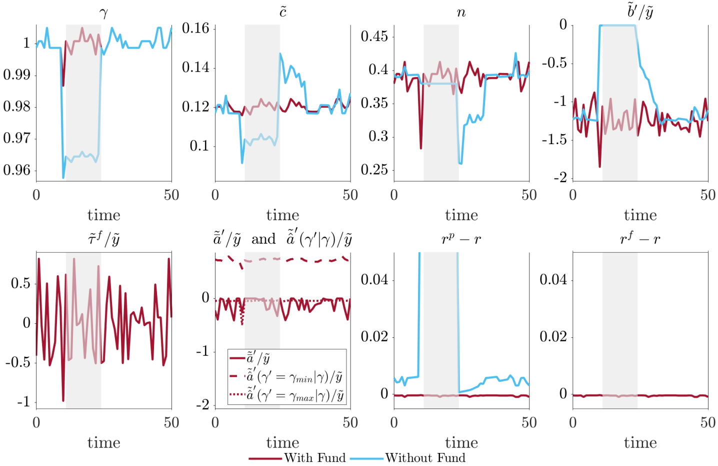

Figure: Simulation of a Steady State Path With SFC and LOLR Absorption

Fund absorption I

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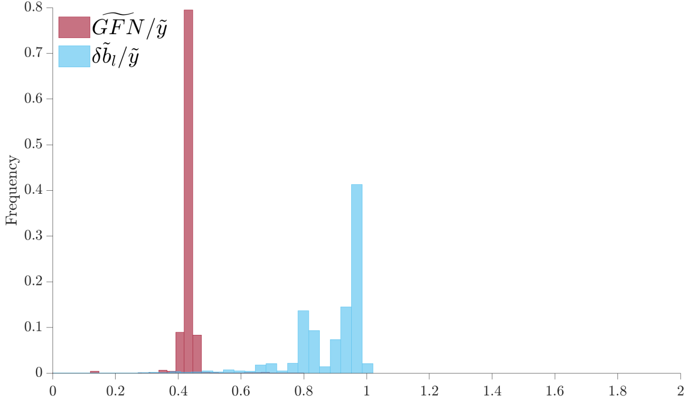

Figure: Absorption at Italian δ

Fund absorption II

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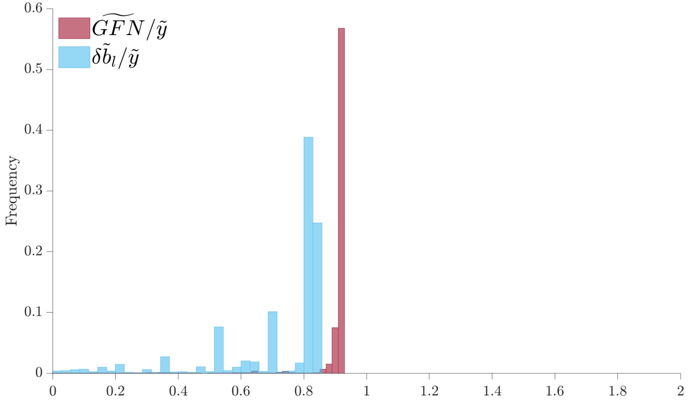

Figure: Absorption at optimal δ

- Discrete choice with $s \equiv (\theta, \rho)$:

$$V(s,b) = \max_{b'} \mathbb{E}\Big\{ \underbrace{V^P(s,b,b')}_{\text{Value under repayment}}, \overbrace{V^D(s)}^{\text{Value under default}} \Big\}.$$

- Value under repayment:

$$V^P(s,b,b') = \max_{c,n} U(c,n) + \beta \mathbb{E}\Big[V(s',b') \Big| s \Big]$$

$$\text{s.t.} \quad c + \underbrace{q_p(s,b,b')(b' - \delta b)}_{\text{New private debt issuance}} \leq \theta f(n) + \underbrace{(1 - \delta + \delta\kappa)b}_{\text{Maturing debt and coupon payment}}.$$

- Value under default:

$$V^D(s) = \max_{n} U(\theta^D f(n), n) + \beta \mathbb{E}\Big[(1-\lambda) V^D(s') + \underbrace{\lambda}_{\text{Market re-access probability}} V(s',0) \Big| s \Big].$$

Appendix

Self-Fulfilling Debt Crises

- Private bond price:

$$q_p(s,b,b') = \frac{1 - \overbrace{d(s,b,b')}^{\text{Default policy today}}}{1+r}\left[1 - \delta + \delta\kappa + \delta\mathbb{E}\left[(1 - \overbrace{d(s',b',b'')}^{\text{Default policy tomorrow}})q_p(s',b',b'')\middle|s\right]\right].$$

$\Rightarrow$ Multiple equilibria: in Eaton and Gersovitz, $d(s,b,b') = 0\ \forall(s,b,b')$ and $\mathbb{E}d(s',b',b'') \geq 0$.

- In Eaton and Gersovitz, $d(s,b,b') = 0$ for all (s,b,b') and $\mathbb{E}d(s',b',b'') \geq 0$.
- Three zones:

1. The safe zone: $D(s,b) = 0$ and ρ is irrelevant.
2. The default zone: $D(s,b) = 1$ and ρ is irrelevant.
3. The crisis zone: $D(s,b) = 1$ if $\rho = 1$ and $D(s,b) = 0$ if $\rho = 0$.

$\Rightarrow$ $D(s,b) = d(s,b,B(s,b))$ where $b' = B(s,b)$.