Secondary Markets in Turbulent Times:
Distortions, Disruptions and Bailouts

Fernando Broner*      Aitor Erce^     Alberto Martin*     Jaume Ventura*

*CREI, UPF and Barcelona GSE     ^Bank of Spain

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Motivation

- In 2006, Portugal, Ireland, Italy, Greece, and Spain looked very solid
  - growth: 3.7% (Germany and France 2.8%)
  - fiscal deficit/GDP: 1.8% (Germany and France 2.0%)
  - sovereign spreads: 0.15%
  - public debt/GDP: 77% (Germany and France 71%)
  - maturity: 6.4 years (Germany and France 6.6 years)

- By 2010, PIIGS were facing
  - major sovereign debt problems
  - deep recessions

- What happened?
Motivation

• Explanations
  – ignored problems: fiscal in Greece, low growth in Portugal and Italy, bubbles in Ireland and Spain
    * ex-post rationalization? why ignored for so long?
  – rollover/liquidity crises
    * but debts were long term and there is funding from official creditors
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- This paper
  - secondary markets and multiple equilibria
  - foreigners become pessimistic → sell bonds to domestics → crowds out investment →
    → lower growth → lower cost of default → default more likely → validates pessimism
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- Crucial assumptions
  - governments sometimes discriminate in favor of domestic residents
  - cost of default depends on size of economy
  - secondary markets
Related literature

- Self-fulfilling debt crises

- Secondary markets and sovereign risk

- Sovereign defaults and economic activity

- Gross capital flows during crises
Some facts

- Dynamics of Debt-GDP ratios
  - sources: OECD’s Economic Outlook Database, Eurostat
  - in PIIGS driven by high spreads, low growth, and high cyclical deficits, despite low structural deficits
  - in Germany driven bank recapitalization
Debts and Deficits: Germany vs. Spain

**Germany**

![Graph showing Germany's structural and cyclical primary deficits, interest payments, growth, and other adjustments over time, with public debt data on the right-hand side (RHS).]

**Spain**

![Graph showing Spain's structural and cyclical primary deficits, interest payments, growth, and other adjustments over time, with public debt data on the right-hand side (RHS).]
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- Domestic credit allocation
  - sources: National Central Banks’ Monetary Surveys and Financial Accounts, Datastream
  - in PIIGS credit to government increased while credit to corporations and households decreased
  - in Germany they have been flat
Sectorial credit: Germany vs. Spain
Public credit, private credit & sovereign spreads

Germany

Spain

- Public sector credit over private sector credit
- Spread (RHS)
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- **Patterns of public debt holdings**
  - sources: National Treasuries and Central Banks
  - in PIIGS sovereign debt holdings shifted from foreigners to domestic residents as spreads rose
  - in Germany they continued shifting to foreigners
Sovereign debt holders: Germany vs. Spain

Germany

Spain

bps

Residents
Non-residents

spread (RHS)
Italy

Greece

Portugal

Ireland

Residents

Non-residents

spread (RHS)
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- Sovereign debt maturity
  - sources: OECD’s Economic Outlook Database
  - in both PIIGS and Germany maturity has been stable at 6-7 years
Average term to maturity

France	Germany	Greece	Ireland
Italy	Portugal	Spain
Presentation of the model

- Sovereign debt, risk, and growth
  - multiple steady states and poverty traps

- Endogenous cost of default
  - multiple equilibria and rollover crises

- Role of maturity (preliminary)
Model

- OLG: young and old, measure one

- Preferences: \(1 - \mu\) consume when young and \(\mu\) maximizes expected consumption when old
  \[ U_t = E_t \{c_{t+1}\} \]

- Labor: young supplies one unit of labor inelastically

- Technology: Cobb-Douglas production function
  \[ f(k_t) = k_t^\alpha \]
  where \(\alpha \in (0, 1)\) and capital depreciates at rate \(\delta \in (0, 1)\)

- Factor markets: competitive
  \[ w_t = (1 - \alpha) \cdot k_t^\alpha \]
  \[ r_t = \alpha \cdot k_t^{\alpha-1} + 1 - \delta \]

- Young save fraction \(s \equiv \mu \cdot (1 - \alpha)\) of output
Model

- Small open economy
  - international financial market (IFM) willing to borrow and lend at expected rate $\rho$
  - domestic residents save in capital and borrow from or lend to IFM
- Financial markets: domestic residents can pledge fraction $\phi \in (0, \rho)$ of capital stock
  \[ f_t \leq \frac{\phi \cdot k_{t+1}}{\rho} \]
  where $f_t$ denotes financing (assume $\phi = 0$ in this presentation)
- Government follows these rules of behavior
  - (i) issues only one-period debt
  - (ii) taxes old enough to keep debt burden constant at $d_t = d$
  - (iii) never defaults on debt held by domestic residents
Model

- Government debt is traded in secondary markets
- Key question for evolution of economy: Who buys this debt?
  - depends on whether foreigners expect to be repaid or not
- Foreigners are repaid if secondary markets remain open when government debt matures
  - government might have incentives to impose capital controls
Equilibrium

- If foreigners are repaid with probability 1
  - foreigners buy all government debt
    \[ R_{t+1} = \rho \]
  - young invest solely in domestic capital
    \[ k_{t+1} = k^1_t(k_t) \equiv \min \left\{ s \cdot k_t^\alpha, \left( \frac{\alpha}{\rho + \delta - 1} \right)^{\frac{1}{1-\alpha}} \right\} \]
  - old receive return on capital, are taxed to pay government debt, and consume
Equilibrium

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  - old receive return on capital, are taxed to pay government debt, and consume

- If foreigners are repaid with probability 0
  - foreigners do not buy any government debt
  - young invest in both domestic capital and government debt
    \[ k_{t+1} = k^0(k_t) \equiv \min \left\{ s \cdot k_t^\alpha - d, \left( \frac{\alpha}{\rho + \delta - 1} \right)^{\frac{1}{1-\alpha}} \right\} \]
    \[ R_{t+1} = \max \left\{ \alpha \cdot k_{t+1}^{\alpha-1} + 1 - \delta, \rho \right\} \geq \rho \]
  - old receive return on capital and government debt, are taxed to pay government debt, and consume
The extreme laws of motion

$k_t$

$k_{t+1}$

No default

Certain default
Model with probabilistic default

- Foreigners are repaid with probability $\pi \in (0, 1)$
  - our interpretation: government can impose capital controls with probability $1 - \pi$
Model with probabilistic default

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- Contractual interest rate depends on identity of marginal buyer
  
  - foreigners hold government debt if compensated for risk of default
    
    $$R_t \geq \frac{\rho}{\pi}$$
  
  - domestic residents hold government debt if compensated for foregone investment
    
    $$R_t \geq \max \{ \alpha \cdot k_{t+1}^{\alpha-1} + 1 - \delta, \rho \}$$

- Identity of marginal buyer depends on capital stock

- Secondary markets ex-ante imply that government cannot choose who to borrow from
  
  - debt is purchased by agents that value it more
Model with probabilistic default

- Law of motion $k_t^{\pi}(k_t)$ characterized by three regions

- Region I: $k_t$ is low and its return high
  - domestic residents invest only in capital
  - all debt is purchased by IFM
  - $k_{t+1} = k_t^{1}(k_t)$

- Region II: $k_t$ and its return are intermediate
  - domestic residents invest in capital until return is equalized with (their) return on debt
  - some debt is purchased by IFM
  - $k_{t+1} = \left( \frac{\alpha \cdot \pi}{\rho - (1 - \delta) \cdot \pi} \right)^{\frac{1}{1-\alpha}}$

- Region III: $k_t$ is high and its return is low
  - domestic residents invest in capital and purchase all debt
  - no debt is purchased by IFM
  - $k_{t+1} = k_t^{0}(k_t)$
Law of motion with probabilistic default

\[ k_t \rightarrow k_{t+1} \]

- No default
- Default with probability \( 1 - \pi \)
**Model with probabilistic default**

- Government can discriminate ex post but not ex ante (can make it more symmetric)
  - ex-post discrimination means debt is more valuable if held by domestic residents
  - ex-ante non-discrimination means government cannot prevent crowding out

- Can have multiple steady states and poverty traps

- Changes in debt and risk of default can have unexpected consequences
An increase in debt

\[ k_t \rightarrow k_{t+1} \]

Low debt
High debt

\[ k_t \]

\[ k_{t+1} \]
An increase in default probability

\(k_t\) vs \(k_{t+1}\)

- Low default probability
- High default probability
Model with cost of default

- Until now there was no cost of default
  - in reality: loss of reputation, sanctions, disruption of financial markets
- We now introduce cost of default
  - if government defaults on foreigners, old generation suffers a loss
- Deadweight loss
  - increases with capital stock: disruptions are more costly in absolute terms in a larger economy
  - increases with size of default: more effort undertaken to impose penalty
- In particular, we assume
  \[
  \text{cost of default} = \lambda \cdot R_{t+1} \cdot d_{t+1}^F \cdot k_{t+1}
  \]
Model with cost of default

- Cost of default may sustain “optimistic equilibrium”
  \[ \lambda \cdot R_{t+1} \cdot d_{F_{t+1}} \cdot k_{t+1} \geq R_{t+1} \cdot d_{F_{t+1}} \iff k_{t+1} \geq 1/\lambda \] government repays foreigners

- If repayment is expected with probability 1
  \[ R_{t+1} = \rho \quad \text{and} \quad d_{F_{t+1}} = d \]
  \[ k_{t+1} = k^{1}(k_{t}) \]

and expectations are validated if

\[ k_{t} \geq k^{O} \equiv \min_{k} \\{ k : k^{1}(k) = 1/\lambda \} \quad \text{if } \lambda \geq 1/k^{*} \]
\[ = \infty \quad \text{if } \lambda < 1/k^{*} \]
where

\[ k^{*} = \left( \frac{\alpha}{\rho + \delta - 1} \right)^{\frac{1}{1-\alpha}} \]
Model with cost of default

- Cost of default may sustain “optimistic equilibrium”

\[ \text{if } \lambda \cdot R_{t+1} \cdot d_{t+1}^{F} \cdot k_{t+1} \geq R_{t+1} \cdot d_{t+1}^{F} \Leftrightarrow k_{t+1} \geq 1/\lambda \text{ government repays foreigners} \]

- If repayment is expected with probability 1

\[ R_{t+1} = \rho \text{ and } d_{t+1}^{F} = d \]
\[ k_{t+1} = k^{1}(k_{t}) \]

and expectations are validated if

\[ k_{t} \geq \bar{k}^{O} \equiv \begin{cases} \min_{k} \{k : k^{1}(k) = 1/\lambda\} & \text{if } \lambda \geq 1/k^{*} \\ \infty & \text{if } \lambda < 1/k^{*} \end{cases} \text{ where } k^{*} = \left(\frac{\alpha}{\rho + \delta - 1}\right)^{\frac{1}{1-\alpha}} \]

- In this equilibrium

\[ \to \text{ expect repayment } \rightarrow \text{ debt not attractive to domestic residents } \rightarrow \text{ high investment } \rightarrow \]
\[ \to \text{ high capital stock } \rightarrow \text{ repayment takes place} \]
Figure 13: Optimistic and pessimistic laws of motion

Optimistic law of motion

Pessimistic law of motion

$k_t$ vs. $k_{t+1}$
Model with cost of default

- Despite cost of default there may be a “pessimistic equilibrium”

\[- \text{ if } \lambda \cdot R_{t+1} \cdot d_{t+1}^F \cdot k_{t+1} \leq R_{t+1} \cdot d_{t+1}^F \iff k_{t+1} \leq 1/\lambda \text{ government defaults on foreigners}\]

- If repayment is expected with probability \( \pi \)

\[
R_{t+1} \in \left[ \rho, \frac{\rho}{\pi} \right] \quad \text{and} \quad d_{t+1}^F \in [0, d]
\]

\[
k_{t+1} = k^\pi (k_t)
\]

and expectations are validated if

\[
k_t \leq k^P \equiv \begin{cases} 
\max \{ k : k^\pi (k) = 1/\lambda \} & \text{if } \lambda \geq 1/k^* \\
\infty & \text{if } \lambda < 1/k^*
\end{cases}
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where \( k^* = \left( \frac{\alpha}{\rho + \delta - 1} \right)^{\frac{1}{1-\alpha}} \)
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  \infty & \text{if } \lambda < 1/k^*
  \end{array} \right. \]

  where \( k^* = \left( \frac{\alpha}{\rho + \delta - 1} \right)^{1/\alpha} \)

- In this equilibrium
  - expect default \( \rightarrow \) debt attractive to domestic residents \( \rightarrow \) low investment \( \rightarrow \)
    - low capital stock \( \rightarrow \) default takes place
Figure 13: Optimistic and pessimistic laws of motion
Model with cost of default

- Since \( k^\pi(k) \leq k^1(k) \) for all \( k \), it follows that
  \[ \bar{k}^P \geq \bar{k}^O \]

- Both optimistic and pessimistic equilibria exist if
  \[ k_t \in [\bar{k}^O, \bar{k}^P] \]

- A self-fulfilling crisis leads to
  - higher sovereign spreads
  - fraction of debt held domestically increases
  - domestic resources shift from investment to government debt
  - lower investment and growth
Maturity structure (preliminary discussion)

- Now government can issue debt of any maturity
- Assume
  - with probability $1 - \pi$ government can default on all outstanding debt held by foreigners
  - cost of default is proportional to market value of defaulted debt at end of previous period
- Conjecture: maturity structure makes no difference
  - optimistic and pessimistic equilibria exist for same values of $k_t$ as with one-period debt
  - laws of motion in both equilibria are the same as with one-period debt
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  - laws of motion in both equilibria are the same as with one-period debt
- Why?
  - with secondary markets foreigners can sell both maturing and non-maturing debt to domestic residents
  - size of “run” is independent of maturity structure
  - secondary markets make long-term debt effectively short-term with respect to rollover crises
Conclusions

- Facts of recent European crisis
  - higher spreads
  - sovereign debt holdings shifted from foreigners to domestic residents
  - bank credit shifted from corporate and consumers to government
  - debt dynamics driven by higher spreads and lower growth

- Portfolio reallocation
  - might seem puzzling and contrary to logic of optimal diversification
  - but is natural in models of sovereign risk with secondary markets

- In this paper, crisis triggered by
  - higher debt
  - higher probability of capital controls
  - multiple equilibria

- Secondary markets constrain governments. If they operate
  - at time of maturity: negative but ex-ante positive (reduce sovereign risk)
  - before maturity: negative (prevent market segmentation and lead to investment crowding out)

- Next,
  - formal analysis of maturity structure, contagion, and bailouts