Sovereign Risk and Economic Activity: The Role of Firm Entry and Exit

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The views expressed here are the authors and not necessarily those of the Federal Reserve Bank of St. Louis or the Federal Reserve System.
Motivation

European Sovereign Debt Crisis

- Increased sovereign default risk
- Significant and persistent decline in economic activity

**Sovereign spreads**

**GDP**
Motivation


• Potentially a relevant margin during sovereign debt crises:

This paper

Research Questions:

• What is the output and employment costs of a sovereign debt crisis?

• How large is the contribution of firms’ entry and exit?

Our approach:

• We develop a heterogeneous firm dynamics model with endogenous entry and exit, sovereign default risk and financial frictions

• The calibrated model can reproduce firms’ life-cycle dynamics and salient features of the sovereign-bank-firm relationships in Portugal

• We use the model to quantify how much of the output costs of sovereign debt crises is due to changes in firms’ entry and exit decisions
Our findings

Empirical regularities:

- The higher sovereign risk during the European deb crisis (2010-2012) is associated with a decline in firm entry and a rise in exit
- Those sectors that rely more heavily on external finance were affected more during the debt crisis, consistent with the bank lending channel
- Cohorts of firms exposed to high sovereign default risk consists of fewer firms and employ persistently fewer workers over the life cycle
- The cumulative drop in employment across exposed cohorts is significant and has a long-lasting negative effect on the dynamics of the economic aggregates

Quantitative model:

- Endogenous fall in entry amplifies the fall in employment at impact
- Endogenous fall in entry significantly increases the persistence of recessions
Firms entry and exit during the European debt crisis
Default risk, entry and exit in Europe

$log(Y_{s,j,t}) = \beta_0 + \beta_1 spread_{j,t} + \alpha_s + \gamma_j + \phi_{s,j} + \eta_t + \psi_{s,t} + X_{s,j,t} + \varepsilon_{s,j,t},$

Table 1: Sovereign Risk, Entry and Exit

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sovereign spread</td>
<td>-0.018***</td>
<td>-0.025***</td>
<td>-0.025***</td>
<td>0.025***</td>
<td>0.025***</td>
<td>0.023***</td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td>(0.006)</td>
<td>(0.006)</td>
<td>(0.005)</td>
<td>(0.006)</td>
<td>(0.005)</td>
</tr>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Country×Industry FE</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Year FE</td>
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<td>✓</td>
<td>✓</td>
<td>—</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Industry×Year FE</td>
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<td>—</td>
<td>✓</td>
<td>—</td>
<td>—</td>
<td>✓</td>
</tr>
<tr>
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<tr>
<td>Observations</td>
<td>5,436</td>
<td>5,107</td>
<td>5,107</td>
<td>4,549</td>
<td>4,306</td>
<td>4,259</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.9761</td>
<td>0.979</td>
<td>0.9843</td>
<td>0.9761</td>
<td>0.9811</td>
<td>0.9844</td>
</tr>
</tbody>
</table>
\[
\log(Y_{s,j,t}) = \beta_0 + \beta_1 \text{spread}_{j,t} + \beta_2 \text{spread}_{j,t} \times \text{high-EFD}_s + \beta_3 \text{spread}_{j,t} \times \text{high-EFD}_s \times \text{periphery}_j \\
+ \alpha_s + \gamma_j + \phi_{s,j} + \eta_t + \eta_{j,t} + \psi_{s,t} + \theta_{j,t} + X_{s,j,t} + \varepsilon_{s,j,t},
\]

**Table 2: External Finance Dependence, Entry, and Exit**

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>(a) Entry</th>
<th>(b) Exit</th>
<th>(c) Net Entry</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sovereign spread</strong></td>
<td>-0.017*** (0.006)</td>
<td>0.023*** (0.005)</td>
<td>-0.027*** (0.008)</td>
</tr>
<tr>
<td><strong>Sovereign spread \times \text{high-EFD}</strong></td>
<td>0.016 (0.018)</td>
<td>0.009 (0.020)</td>
<td>-0.008 (0.012)</td>
</tr>
<tr>
<td><strong>Sovereign spread \times \text{high-EFD} \times \text{periphery}</strong></td>
<td>-0.047*** (0.016)</td>
<td>-0.034* (0.020)</td>
<td>0.002 (0.011)</td>
</tr>
<tr>
<td><strong>Country FE</strong></td>
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<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Industry FE</strong></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Country \times Industry FE</strong></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Year FE</strong></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Industry \times Year FE</strong></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Country \times Year FE</strong></td>
<td>–</td>
<td>✓</td>
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</tr>
<tr>
<td><strong>Controls</strong></td>
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<td>✓</td>
<td>✓</td>
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<tr>
<td><strong>Observations</strong></td>
<td>5107 5436</td>
<td>4259 4306</td>
<td>4339 4386</td>
</tr>
<tr>
<td><strong>R^2</strong></td>
<td>0.984 0.986</td>
<td>0.986 0.992</td>
<td>0.567 0.696</td>
</tr>
</tbody>
</table>
The credit channel, entry and exit

\[ Y_{s,j,t} = \beta_0 + \beta_1 \text{sovcrisis}_t \times \text{high-EFD}_s \times \text{periphery}_j + \alpha_s + \gamma_j + \phi_{s,j} + \eta_t + \eta_{j,t} + \psi_{s,t} + \theta_{j,t} + \varepsilon_{s,j,t}, \]

Table 3: Sovereign crisis, credit channel, and entry and Exit

<table>
<thead>
<tr>
<th>Panel A</th>
<th>Panel B</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent Variable</strong></td>
<td><strong>Entry</strong></td>
</tr>
<tr>
<td>Crisis × high-EFD × periphery</td>
<td>-0.077*</td>
</tr>
<tr>
<td></td>
<td>(0.044)</td>
</tr>
<tr>
<td>Crisis × high-EFD × periphery × spread</td>
<td></td>
</tr>
<tr>
<td>Country FE</td>
<td>✓</td>
</tr>
<tr>
<td>Industry FE</td>
<td>✓</td>
</tr>
<tr>
<td>Country × Industry FE</td>
<td>✓</td>
</tr>
<tr>
<td>Year FE</td>
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<tr>
<td>Industry × Year FE</td>
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</tr>
<tr>
<td>Country × Year FE</td>
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</tr>
<tr>
<td>Controls</td>
<td>✓</td>
</tr>
<tr>
<td>Observations</td>
<td>5,902</td>
</tr>
<tr>
<td>R²</td>
<td>0.987</td>
</tr>
</tbody>
</table>
Firms entry and exit in Portugal
Higher sovereign spreads, lower entry and higher exit rates

Figure 1: Interest rate spreads, GDP, employment and firm dynamics in Portugal
Even more so in sectors with higher external finance dependence

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Panel A. <strong>Entry</strong></th>
<th>Panel B. <strong>Exit</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>Sovereign spread</td>
<td>-.022***</td>
<td>(.008)</td>
</tr>
<tr>
<td>Sovereign spread × high-EFD</td>
<td>-.029***</td>
<td>(.006)</td>
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<tr>
<td>Controls</td>
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<tr>
<td>Sector FE</td>
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<tr>
<td>Time FE</td>
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<tr>
<td>N</td>
<td>658</td>
<td>611</td>
</tr>
<tr>
<td>R²</td>
<td>0.988</td>
<td>0.979</td>
</tr>
</tbody>
</table>
Cohorts exposed to high spreads have less firms and employ less workers

Figure 2: Cohorts’ Post-Entry Dynamics

(a) Cohort-level employment
(b) Number of firms
(c) Average size
(d) Survival
High spreads have large and long-lasting effects on employment

- Cohorts exposed to the high spreads accounted for 16% of jobs lost by 2013, and their persistent contribution explains 33% of jobs lost by 2016.

Figure 3: The Changes in the Total Employment Accounted by Cohorts Born over 2010-2012.

(a) Relative to 2010  (b) Relative to 2013  (c) Relative to 2005
The Model
Follows Arellano, Bai, Bcola (2021). We incorporate endogenous entry and exit.

- **Households**
  - Choose consumption and labor supply.

- **Firms**
  - Incumbents
    - Choose production and exit
    - Borrow money to finance *working capital*
  - Entrants
    - Make entry decisions
    - Borrow money to finance *entry cost and initial working capital*

- **Government**
  - Default risk is governed by an exogenous process

- **Banks**
  - Price government bonds according to a standard no-arbitrage condition
  - Supply loans to firms passing-through default risk to corporate loans interest rates
Sovereign Default Risk

Sovereign default risk evolves exogenously as in Bocola (2016)

In every period the economy is hit by a shock $\varepsilon_{d,t}$ drawn from a standard logistic distribution.

$$D_{t+1} = \begin{cases} 
1 & \text{if } \varepsilon_{d,t+1} - d_t \geq 0 \\ 
0 & \text{otherwise}
\end{cases}$$

where $d_t$ is an AR(1) process

$$d_{t+1} = (1 - \rho_d)\bar{d} + \rho_d d_t + \sigma_d \varepsilon_{d,t+1}, \quad \varepsilon_{d,t+1} \sim \mathcal{N}(0, 1)$$

The probability of default

$$\pi^d \equiv \text{Prob}(D_{t+1} = 1) = \frac{e^{d_t}}{1 + e^{d_t}}$$
Sovereign Bond Pricing and Bank Lending Rates

Sovereign bond’s price is determined by a standard no-arbitrage condition

\[ q_t = \mathbb{E}_t [\beta (1 - D_{t+1})(\vartheta + q_{t+1}(1 - \vartheta))] \]

Bank lending rate is a (reduced form) function of sovereign bond rates:

\[ R_t = \chi_1 R_{g,t}^{\chi_2} \tag{1} \]

where \( \chi_1 \) and \( \chi_2 \) are parameters capturing the pass-through of sovereign bond’s rates to the interest rate of corporate loans

\[ R_{g,t} = 1 + \frac{\vartheta}{q_t} - \vartheta \]
**Lending Rate ⇔ Entry and Exit**

**Higher lending rates ⇒ higher exit:** Need to finance working capital

Incumbent firms problem

\[
V^l(z, k; s) = \max_{l, i, k'} (1 - \tau) z_t (k_t^{\alpha} l_t^{1-\alpha})^\theta - (1 - \phi) [wl + i + g(k, k')] - \phi R(s)b \\
+ \int \max \{ V_x(k), \beta(1 - \gamma) \mathbb{E}[V^l(z', k'; s') | z, s] - c_f \} dF_{c_f}(c_f)
\]

\[
k' = (1 - \delta) k + i
\]

and the working capital constraint

\[
b = \phi [wl + i + g(k, k')] 
\]

The Higher \( R, \) the higher the cost of investment and labor, the lower capital, the lower continuation value, the higher exit probability.
Lending Rate ⇔ Entry and Exit

**Higher lending rates ⇒ lower entry:** Need to borrow to finance entry cost and working capital

The value function after entry decision is made reads

\[
\tilde{V}^E(p, s) = \max_{i^e} \left\{ -(1 - \phi)(i^e + g^e(i, k_0)) - Rb_i^e + \beta \mathbb{E}[V^I(z', k', s')|p, s] \right\}
\]

subject to

\[
k'^e = k_0 + i^e
\]

\[
b_i^e = \phi [i^e + g^e(i, k_0)]
\]

The value of waiting to enter is

\[
V^w(p, s) = \beta \int_{s'} V^E(p, s')dF(s'|s)
\]
Lending Rate ⇔ Entry and Exit

A potential entrant with signal $p$ makes entry decision according to the following rule,

$$V^E(p, s) = \max \left\{ V^w(p, s), \; \tilde{V}^E(p, s) - (1 - \phi) c_e - R b^e_{c_e} \right\}$$

with

$$b^e_{c_e} = \phi c_e$$

The higher $R$, the higher the cost of entry, the lower the entry.
Quantitative Analysis
Figure 1: Cohorts Average Life Cycle Characteristics

(a) Average survival rate

(b) Exit rate by age

(c) Average Size

(d) Share
What is the role of entry on employment dynamics?

**Figure 2**: The role of the observed dynamics of entry over 2011-2018.

(a) Number of entrants  
(b) Number of firms  
(c) Employment
The response of the economy to an increase in bank lending rates

Figure 3: Impulse response to a shock process that matches the dynamics of the firm spread to the one observed in Portugal over the period 2010-2017.

- (a) Interest rate
- (b) Number of entrants
- (c) Number of firms
- (d) Investment
- (e) Employment
- (f) Output
Concluding Remarks
Conclusions

This paper:

- We study how firm dynamics shape the economic costs of a debt crisis

Empirical regularities:

- During the European debt crisis there was less entry and more exit
- Sectors with higher EFD were affected more, consistent with the bank lending channel
- Cohorts affected by the crisis are smaller and employ persistently less workers
- The cumulative drop in employment has a long-lasting negative effect on employment and output

Quantitative Analysis:

- Endogenous fall in entry amplifies the fall in employment at impact
- Endogenous fall in entry significantly increases the persistence of recessions
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