THE PASS-THROUGH OF SOVEREIGN RISK

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MFM and Macroeconomic Fragility

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INTRODUCTION

• Banks in southern Europe exposed to domestic government debt and main provider of external finance to firms.
  • In 2010, holdings of government bonds accounted for 83% of their equity.
  • In 2010, 75% of external financing of firms from domestic banks.

• Evidence that sovereign credit risk increased corporate funding costs.

• Questions:
  1. How does sovereign risk pass on to credit markets and real economic activity?
  2. Were unconventional credit policies effective in limiting its transmission?

• This paper
  1. Quantitative model of the transmission of sovereign credit risk on corporate funding costs and real economic activity.
     • Leverage constraint channel.
     • Risk channel.
  2. Model estimated with Italian data
     • Measurement.
     • Policy Evaluation (refinancing operations).
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ROADMAP

1 The Model

2 Estimation

3 The Mechanisms

4 Measurement and Policy Evaluation
Model Overview

Quantitative business cycle model with banks, households, firms and a government

- **Key Ingredients:**
  - **Market segmentation:** Banks hold government and corporate securities.
  - **Leverage constraints:** Ability to attract deposits depends on net worth.
  - **Risk of sovereign default:** Exogenous risk of a “haircut” on gov. bonds.

- **Key Relation:** ↑ Probability of a sovereign default ↑ Expected Excess Returns
  - **Leverage constraint channel:** Sovereign risk tightens the leverage constraints of banks.
  - **Risk channel:** Sovereign risk priced factor for corporate assets.

Nonlinear analysis crucial to capture time-variation in risk premia.

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THE MODEL
THE ECONOMY

Households
Bankers
Government
Final Good Producers
Capital Good Producers
THE MODEL
THE ECONOMY

Households

Final Good Producers

Bankers

Government

Capital Good Producers

Final Good Producers

Households
THE MODEL
THE ECONOMY

Households $\rightarrow$ Final Good Producers

Households $\rightarrow$ Government $\rightarrow$ Banks

Government $\rightarrow$ Banks

Banks $\rightarrow$ Final Good Producers

Banks $\rightarrow$ Capital Good Producers

Households $\rightarrow$ Wages $\rightarrow$ Labor $\rightarrow$ Final Good Producers

Households $\rightarrow$ Taxes $\rightarrow$ Government

Government $\rightarrow$ Banks $\rightarrow$ Final Good Producers

Banks $\rightarrow$ Deposits $\rightarrow$ Final Good Producers

Banks $\rightarrow$ Capital Good Producers $\rightarrow$ Final Good Producers

Banks $\rightarrow$ R(S) $\rightarrow$ Final Good Producers

Banks $\rightarrow$ R_b(S') $\rightarrow$ Final Good Producers

Banks $\rightarrow$ Capital Good Producers $\rightarrow$ Final Good Producers

Households $\rightarrow$ Bankers $\rightarrow$ Government $\rightarrow$ Final Good Producers $\rightarrow$ Capital Good Producers
THE MODEL
THE ECONOMY

Households ---- wages ---- Final Good Producers

R(S) ---- deposits ---- a_k

Government ---- taxes ---- Banks

R_b(S') ---- a_b ---- Capital Good Producers

Final Good Producers ---- labor ---- Households

Bankers

Government

Final Good Producers

Capital Good Producers
THE MODEL

THE ECONOMY

Households  Bankers  Government  Final Good Producers  Capital Good Producers

Households

Final Good Producers

Government

Capital Good Producers

Banks

R(S)

deposits

taxes

wages

labor

price of capital

capital

R_k(S')

R_b(S')

a_k

a_b
The government issues long term securities \((\pi, \nu)\).

In default states \((d = 1)\), "haircut" \(\Delta\) on bondholders.

Realized returns on government securities is:

\[
R_b(S', S) = \left[1 - d'\Delta\right] \left\{ \frac{\pi + (1 - \pi)[\nu + Q_b(S')]}{Q_b(S)} \right\}.
\]

Default can occur in every period as follows

\[
d' = \begin{cases} 
1 & \text{with probability} \quad \pi(s) = \frac{e^s}{1 + e^s} \\
0 & \text{otherwise}
\end{cases}
\]

\(s\) is an AR(1).
THE MODEL

**Bankers**

- They collect deposits and invest in assets

\[ Q_b(S)a_b + Q_k(S)a_k = n + d_d. \]

- Net worth evolves via retained earnings

\[ n' = \sum_{j=\{b,k\}} R_j(S', S)Q_j(S)a_j - R(S)d_d. \]

- Limited Enforcement → Constraints on bankers’ leverage.

\[ \frac{\sum_j Q_j(S)a_j}{n} \leq \frac{\alpha(S)}{\lambda} \quad \text{with multiplier} \quad \mu(S) > 0. \]

- Objective: maximize present discounted value of wealth subject to leverage constraint.

- Bankers’ Euler equation for asset \( j \)

\[ \mathbb{E}_S \{ \hat{A}(S', S)R_j(S', S) \} = \mathbb{E}_S\{\hat{A}(S', S)R(S)\} + \lambda \mu(S). \]
ESTIMATION

SUMMARY

State variables: 3 exogenous shocks (TFP, government spending, $s$), 4 endogenous.

Numerical Solution: global (projection with sparse collocation).


I estimate the model’s parameters in two steps.

   - Likelihood: i) Multiplier on leverage constraints and ii) GDP growth.
   - Additional information (banks’ bondholdings data, long run averages).

2. Sovereign risk process estimated using physical probabilities of sovereign default
   - CDS spreads on Italian 5yrs. contracts.
   - Empirical counterpart of model’s pricing kernel.
Bankers’ Euler equation is

$$\mathbb{E}_S \left\{ \hat{A}(S', S)R_k(S', S) \right\} = \mathbb{E}_S \{\hat{A}(S', S)R(S)\} + \lambda \mu(S).$$

Rearranging it

$$\frac{\mathbb{E}_S[R_k(S', S) - R(S)]}{R(S)} = \frac{\lambda \mu(S) - \text{cov}_S[\hat{A}(S', S), R_k(S', S)]}{\mathbb{E}_S[\hat{A}(S', S)]}.$$

**Expected excess returns driven by two components**

- **Multiplier component**: captures the effects of binding leverage constraints.
- **Covariance component**: represents firms’ specific risk.

Both components sensitive to a sovereign risk shock.
**The Mechanisms**

**The Leverage Constraint Channel**

**Impulse:** Sovereign default probabilities increase from 0.17% to 5%

- $s$-shock tightens leverage constraints of banks $\rightarrow$ increase the financing costs of firms.
- $s$-shock raises risk premia for holding corporate assets.
Why is sovereign risk a priced-factor for corporate securities?

- In a sovereign default, large balance sheet losses for banks.
- Tight leverage constraints → Fire sales of corporate assets.
- Tight leverage constraints → High pricing kernel.
Counterfactual: **What would have happened in absence of sovereign risk?**

- Generate filtered and counterfactual trajectories using standard filtering techniques
- Report statistics on the differences between these two paths (2010:Q1-2011:Q4)

**Measuring the effects of Sovereign risk Expected Excess Returns and Output: 2010:Q1-2011:Q4**

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Posterior Mean</th>
<th>90% Credible Set</th>
</tr>
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<tbody>
<tr>
<td>Average Expected Excess Returns</td>
<td>0.47</td>
<td>[0.16,1.07]</td>
</tr>
<tr>
<td>Covariance Component (%)</td>
<td>0.26</td>
<td>[0.19,0.51]</td>
</tr>
<tr>
<td>Cumulative Output Losses</td>
<td>4.75</td>
<td>[2.10,8.03]</td>
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- Expected excess returns 47bp higher on average, 26\% due to covariance component
- Cumulative output losses 4.75\%
- In 2011:Q4, expected excess returns 100bp, 47\% due to covariance component
POLICY EVALUATION
LONGER TERM REFINANCING OPERATIONS

- Government lends \( \bar{m} \) to banks at \( t = 1 \). Banks repay \( R_m m \) at \( T \).

- Policy calibrated to actual ECB intervention.

- State vector: \( p(S_{t=2011:Q4} | Y^T, \theta^m) \).

- Policy has weak direct effects on expected excess return and output

### Average Effects of LTROs on Output and Expected Excess Returns: 2012:Q1-2014:Q4

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- **Why?** In 2011:Q4, corporate risk is estimated to be high, this dampens effects of LTROs
  - High corporate risk \( \Rightarrow \) Low incentives to invest in firms
  - Tight leverage constraints \( \Rightarrow \) Profitable investment opportunities
**Policy Evaluation**

**Longer Term Refinancing Operations**

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| Expected Excess Returns                       | -0.0813         | [-0.4088, 0.5870]           |

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CONCLUSIONS

• Equilibrium model to study the sovereign risk “pass-through".

• Sovereign risk affects corporate funding costs because of two mechanisms:
  
  • **Leverage constraint channel**: impairs access to financial markets of banks.
  
  • **Risk channel**: It makes firms riskier from banks’ point of view.

• Model estimated on Italian data:

  1. Sovereign risk had severe effects on corporate funding costs and output.
  2. Both channels empirically relevant.
  3. Measuring these two transmission mechanisms provides key information for the evaluation of credit policies.