Sovereign Default and Credit Swaps: The Role of Dealers’ Liquidity Provision

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The views expressed here are the authors and not necessarily those of the Federal Reserve Bank of Richmond or the Federal Reserve System
Introduction

What are Credit Default Swaps (CDS)?

- A contract involving a buyer, a seller and assets from a reference institution
- The buyer pays to the seller a price (negotiated) and quarterly coupons (standardized)
- The seller commits to compensate the buyer for the loss if the reference institution defaults

Research Questions:

- How is the sovereign bond’s market affected by the CDS market?
- What are the implications for sovereign debt management and default?
Why is the CDS market relevant? A story of two frictions

Trading frictions:

- Bonds and CDS are traded in over-the-counter (OTC) markets
- Complement markets: insurance availability make bonds more attractive
- Substitute markets: can substitute a bond for a combination of a risk-free asset and a CDS
- Quantitatively, do CDS complement or substitute bonds?

Regulation:

- Regulatory constraints modify the allocation of assets across investors
- Real world case: Ban on Naked CDS in European Union implemented in 2012
- Quantitatively, how strong are the consequences of such interventions?
What we do

Develop a sovereign default model where CDS are relevant

- we model OTC markets for bonds and CDS using search frictions
- whether CDS hurt or help bond’s market depends on the state of the economy and parameters

Discipline the model with transaction-level data of CDS to capture that

- CDS markets is dominated by large banks acting as dealers
- dealers provide net insurance to other investors
- dealers provide more insurance when default risk is larger
- source: Depository Trust and Clearinghouse Corporation (DTCC)

Quantify the effects on the bond market of alternative regulations in the CDS market
Literature review

**Sovereign Default:** Eaton and Gersovitz (1981), Arellano (2008), Salomao (2017), Passadore and Xu (2019), Chaumont (2020), plus everybody else in this Zoom


**Contributions**

- Propose a default model where CDS matter due to trading frictions
- Provide new evidence useful to quantify liquidity frictions
- Quantify the effect of regulatory changes that constraint risk allocation
Data and Empirical Findings
Data Description

Date range: January 2013 - July 2018 for 49 countries

- Transaction-level data on Sovereign CDS from the DTCC
- Compute CDS net position for each trader $j$, in country $i$, in month $t$
- Bond yields and CDS spreads
- (In Progress...) Bond holdings for large traders

**Dealers:** Top-10 traders in each country (results are robust to alternative definitions)
Top 10 dealers’ dominate CDS market

Top-10 dealers participate in 96% of transactions
Top-10 dealers play an important role providing insurance

Top-10 dealers are net sellers of insurance on average

Top 10 dealers sell more insurance when yields increase

<table>
<thead>
<tr>
<th></th>
<th>$\text{NetPos}_{jit}$</th>
<th>$\text{NetPos}_{jit}$</th>
<th>$\text{NetPos}_{jit}$</th>
<th>$\text{NetPos}_{jit}$</th>
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</thead>
<tbody>
<tr>
<td><strong>Yield</strong></td>
<td>-4.066</td>
<td>-5.303</td>
<td>-5.036</td>
<td>-4.201</td>
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<td></td>
<td>(0.224)</td>
<td>(0.220)</td>
<td>(0.216)</td>
<td>(0.252)</td>
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<tr>
<td><strong>Time FE</strong></td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Dealer FE</strong></td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td><strong>Country-Dealer FE</strong></td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Observations</strong></td>
<td>23,044</td>
<td>23,044</td>
<td>23,044</td>
<td>23,044</td>
</tr>
<tr>
<td><strong>Adjusted $R^2$</strong></td>
<td>0.014</td>
<td>0.072</td>
<td>0.156</td>
<td>0.831</td>
</tr>
</tbody>
</table>

Standard errors in parentheses

300+ Trades needed for inclusion. Positions in Millions of USD. Yield in Basis Points.
We want a model where:

1. CDS transactions are intermediated by dealers
2. Dealers are net sellers of CDS
3. Dealers provide more insurance when yields are higher
Model of over-the-counter Bond/CDS markets
Environment

Two periods, $t = t_1, t_2$

Two types of agents:

- Investors: measure one
- Dealers: free-entry

All agents have the same discount factor $\beta \in (0, 1)$
There are three assets: Bonds, CDS and Risk-free assets

Sovereign bond in fixed supply $B'$:

- Default risk: $\delta \in \{0, 1\}, \bar{\delta} \equiv Pr[\delta = 1]$, taken as given
- Each bond pays 1 good only if $\delta = 0$ in $t_2$

CDSs on the sovereign bond in zero net supply.

- If $\delta = 1$ in $t_2$ the seller pays 1 good to buyer per unit of CDS
- In all states buyer pays coupon $r \in [0, 1]$ at $t_2$ to the seller. For now $r = 0$, w.l.o.g.

Risk-free asset with a perfectly elastic supply at price $q_f = \beta$

Observation: We later endogenize $B'$ and $\delta$
Preferences are linear in period $t_1$ and concave in period $t_2$

Dealers

$$\Pi(x, a, b, c) = x + \beta \left[ (1 - \bar{\delta})u_d(a + b) + \bar{\delta}u_d(a + c) \right],$$

Investors

$$V(x, a, b, c) = x + \beta \left[ (1 - \bar{\delta})u_i(a + b + w) + \bar{\delta}u_i(a + c) \right],$$

where

- $w$ endowment correlated with bond’s return
- $u_i \neq u_d$ to allow for differences in risk aversion
- $x$ is consumption at $t_1$
- $a$ is risk-free asset holdings
- $b$ is sovereign bond holdings
- $c$ is CDS holdings
Markets

Period $t_1$: three different markets open sequentially

1. the decentralized (OTC) sovereign bond market (sub-period $s_1$)

2. the decentralized (OTC) CDS market and then (sub-period $s_2$)

3. the Walrasian risk-free asset market (sub-period $s_3$)
   - Dealers can access a Walrasian inter-dealer market where bonds trade at price $q$ and CDS trade at price $p$ any time.

Period $t_2$: default realization, $\delta \in \{0, 1\}$, is observed and agents consume
Search is directed with infinitely many sub-markets defined by transaction fees, $f_j \in \mathbb{R}_+, j \in \{b, c\}$

Trading probabilities in each sub-market, $f_j$ are

- Investor: $\alpha(f_j)$, increasing (result) and concave (assumption)
- Dealer: $\rho(f_j)$, decreasing (result)

To be active in bonds and/or CDS market dealers pay $\gamma_b$ and/or $\gamma_c$ and choose $f_j$

Investors choose where to trade bonds and CDS, $f_b$ and $f_c$
The dealer’s problem

The incumbent dealer’s problem is

$$\pi \equiv \max_{a,b \geq 0, c \in [c, \bar{c}(b)]} \beta \left[ (1 - \delta)u_d(a + b) + \delta u_d(a + c) \right] - qb - pc - q_f a,$$

where bounds to $c$ could be $\pm \infty$ (determined by regulation).

Entry decision: free-entry condition implies

$$\tilde{\gamma}_b \equiv \gamma_b - \pi = \rho(f_b)f_b$$

$$\tilde{\gamma}_c \equiv \gamma_c - \pi = \rho(f_c)f_c$$
The investor’s problem: We solve by backward induction

In sub-period $s_3$ we have

$$V(b, c; s_3) \equiv \max_a \beta \left[ (1 - \bar{\delta}) u_i(a + b + w) + \bar{\delta} u_i(a + c) \right] - q_f a$$

In sub-period $s_2$ we have

$$V(b; s_2) \equiv V(b, 0; s_3) + \max_{f_c \geq 0, c \in [c, \bar{c}(b)]} \alpha(f_c) \left[ V(b, c; s_3) - V(b, 0; s_3) - pc - f_c \right]$$

In sub-period $s_1$ we have

$$V(s_1) \equiv V(0; s_2) + \max_{f_b \geq 0, b \geq 0} \alpha(f_b) \left[ V(b; s_2) - V(0; s_2) - qb - f_b \right]$$
Market clearing (inter-dealer market)

The market clearing conditions are

\[ [q] : B' = \alpha(f_b)b_i + Db_d \]

\[ [p] : 0 = M(\alpha(f_b), d_c(b_i))c_i(b_i) + M(1 - \alpha(f_b), d_c(0))c_i(0) + Dc_d \]

where \( D \) is total mass of dealers counting bonds and CDS markets.
In equilibrium

(i) dealers enter either the bond or the CDS market, not both

(ii) if constraints do not bind, the CDS-bond basis holds for inter-dealer prices, \( p + q = q_f \)

(iii) if constraints do not bind, investors who trade bonds do not trade CDS

(iv) investors who trade in CDS market choose \( c_i(0) = -b_i \)

- pure substitution in (iii) and (iv) is a consequence of one period assets
- we then add an exposure shock (\( w \)) to capture complementarity

(v) If \( \gamma_b, \gamma_c > 0 \), then \( p \neq \beta \bar{\delta} \) and \( q \neq \beta(1 - \bar{\delta}) \)

(vi) As \( \gamma_b, \gamma_c \to 0 \) then \( p \to \beta \bar{\delta} \) and \( q \to \beta(1 - \bar{\delta}) \)
Sovereign-Default Model
Quantitative Model of Sovereign Default

We embed the Bond/CDS model into a canonical sovereign-default model

Government’s option value of default is

\[
W(Y, B) = \max_{\delta \in \{0,1\}} (1 - \delta)W^r(Y, B) + \delta W^d(Y),
\]

\[
W^d(Y) = U(h(Y)) + \beta_g \mathbb{E}_{Y'|Y} [\phi W(Y', 0) + (1 - \phi)W^d(Y')],
\]

\[
W^r(Y, B) = \max_{B'} U(Y + q(Y, B')B' - B) + \beta_g \mathbb{E}_{Y'|Y} W(Y', B').
\]

where

- \( h(Y) = Y - \max\{0, d_0 Y + d_1 Y^2\} \) is the endowment under default
- \( q(Y, B') \) is an outcome of the OTC market equilibrium.
Quantitative Analysis: Argentina
Calibration

- Standard parameters calibrated as usual
- New parameters:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Target</th>
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</thead>
<tbody>
<tr>
<td>$\gamma_b$</td>
<td>Entry costs bond market</td>
<td>Average bid-ask spread of bonds $f_b/</td>
</tr>
<tr>
<td>$\gamma_c$</td>
<td>Entry costs CDS market</td>
<td>Average bid-ask spread of CDS $f_c/</td>
</tr>
<tr>
<td>$\lambda_i$</td>
<td>Investor risk aversion</td>
<td>Normalized to 2</td>
</tr>
<tr>
<td>$\lambda_d$</td>
<td>Dealer risk aversion</td>
<td>indirect inference</td>
</tr>
<tr>
<td>$\omega$</td>
<td>Investor exposure</td>
<td>indirect inference</td>
</tr>
<tr>
<td>$\xi$</td>
<td>Matching function parameter</td>
<td>indirect inference</td>
</tr>
</tbody>
</table>
Argentina: Dealer’s net position of CDS decreases with Yields

\[
NetPos_t = \beta_0 + \beta_1 Yield_t + \epsilon_t
\]

- \( \beta_0 \) identifies net investor’s exposure \([w]\)
- \( \beta_1 \) identifies dealer’s risk aversion \([\lambda_d]\)
Argentina: Bid-Ask spread increases with Yields

Spread as Yield Changes in Argentina
Correlation = 0.6875

\[
\frac{f_b}{|b|} = \epsilon_{\alpha, \theta}(\theta_b) \left( V(b; s_2) - qb - V(0; s_2) \right) \frac{1}{|b|}
\]
Default Events: Aggregate dynamics and insurance

Default episodes
Deviations from mean with +/- std. confidence intervals

- Log GDP
- Debt service-output ratio (%)
- Sovereign spread
- Agg. CDS position of dealers / mean GDP x 1000
Default Events: Liquidity and dealers’ positions

Default episodes
Deviations from mean with +/-1 std. confidence intervals

Bid/ask spread for bonds (%)

Bid/ask spread for CDS (%)

CDS-bond basis deviation (%)
Policy Analysis
We consider the following regulatory changes:

- banning naked CDS ($\bar{c}(b) = b$)
- completely banning CDS trading $c = \bar{c}(b) = 0$
- allowing for short-sales in bonds
Results: Effects of alternative regulatory changes

- CDS bans: without exposure shocks small effects; with shocks $\tilde{w} \sim N(w, \sigma_w^2)$ larger effects
- Bond short sells: have a strong positive effect on bond price
  - intensive margin: investors sell bonds and supply increases (pay higher fees too)
  - extensive margin: more dealers enter and each extra dealer increases demand (dominates)
Conclusions
Conclusions

We argue that CDS are relevant for bond markets:

- Trading frictions
- Regulation

We develop a model where bonds and CDS markets interact because of those frictions.

We calibrate the model to replicate that

- Dealers provide net insurance to other investors
- They provide more insurance when default risk is larger

We quantify the effects of regulatory changes and find that

- restrictions to CDS market affect bond prices only when we include exposure shocks
- allowing for short sales of bonds significantly affect bond prices
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