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

Gaston Chaumont — University of Rochester
Grey Gordon — Richmond Fed
Bruno Sultanum — Richmond Fed
Elliot Tobin — Richmond Fed

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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 instituion
- 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

OTC markets and assets liquidity: Duffie, Garleanu, Pedersen (2005), Lagos and Rocheteau (2009), Lester, Rocheteau, Weill (2015), Oehmke and Zawandowski (2015) Sambalaibat(2014, 2018)...

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

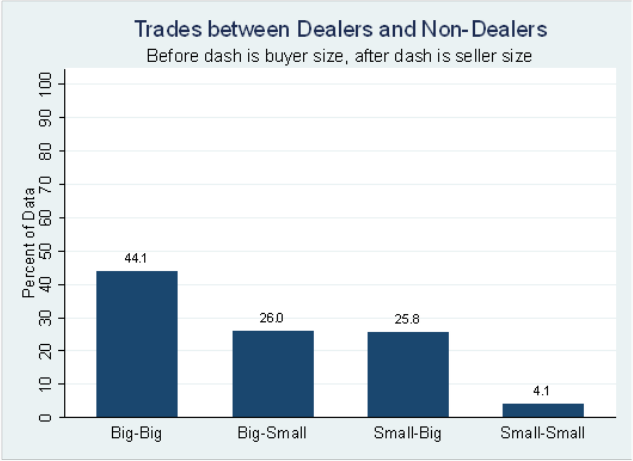
Date range: January 2013 - July 2018 for 49 countries

- 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

	$NetPos_{jit}$	$NetPos_{jit}$	$NetPos_{jit}$	$NetPos_{jit}$
Yield	-4.066	-5.303	-5.036	-4.201
	(0.224)	(0.220)	(0.216)	(0.252)
Time FE	No	Yes	Yes	Yes
Dealer FE	No	No	Yes	No
Country-Dealer FE	No	No	No	Yes
Observations	23,044	23,044	23,044	23,044
Adjusted R^2	0.014	0.072	0.156	0.831

Standard errors in parentheses

300+ Trades needed for inclusion. Positions in Millions of USD. Yield in Basis Points.

Summarizing

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 δ

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

Bond and CDS Over-the-Counter Markets

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 γ_b and/or γ_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

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

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

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

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

Results

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

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

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

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

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 equilibirum.

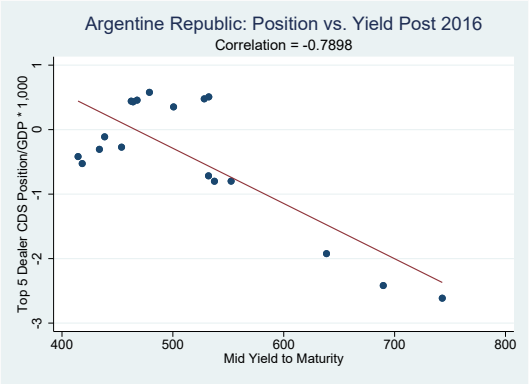
Quantitative Analysis: Argentina

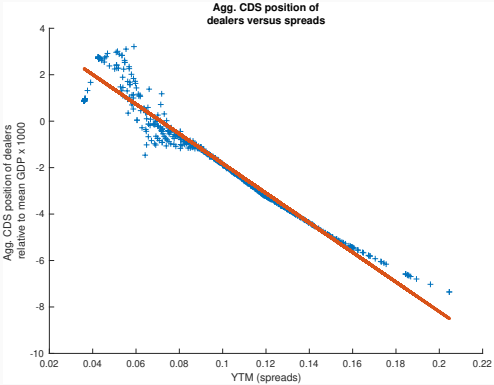
Calibration

- Standard parameters calibrated as usual
- New parameters:

Parameter values		
Parameter	Description	Target
γ_b	Entry costs bond market	Average bid-ask spread of bonds $f_b/\lvert b_i \rvert$
γ_c	Entry costs CDS market	Average bid-ask spread of CDS $f_c/\lvert c_i(0) \rvert$
λ_i	Investor risk aversion	Normalized to 2
λ_d	Dealer risk aversion	indirect inference
w	Investor exposure	indirect inference
ξ	Matching function parameter	indirect inference

Argentina: Dealer's net position of CDS decreases with Yields

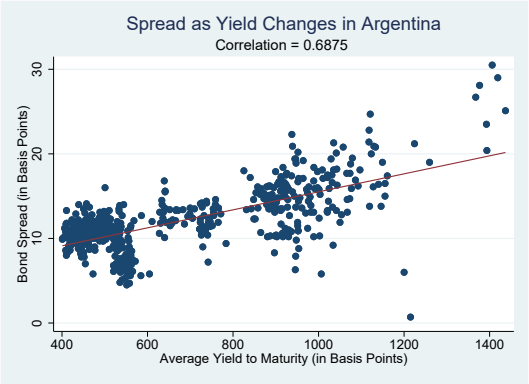


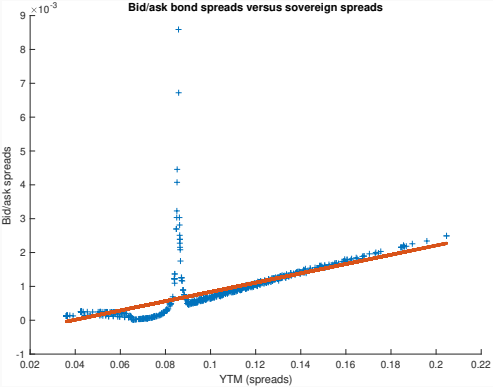


$$NetPos_t = \beta_0 + \beta_1 Yield_t + \epsilon_t$$

- β_0 identifies net investor's exposure $[w]$
- β_1 identifies dealer's risk aversion $[\lambda_d]$

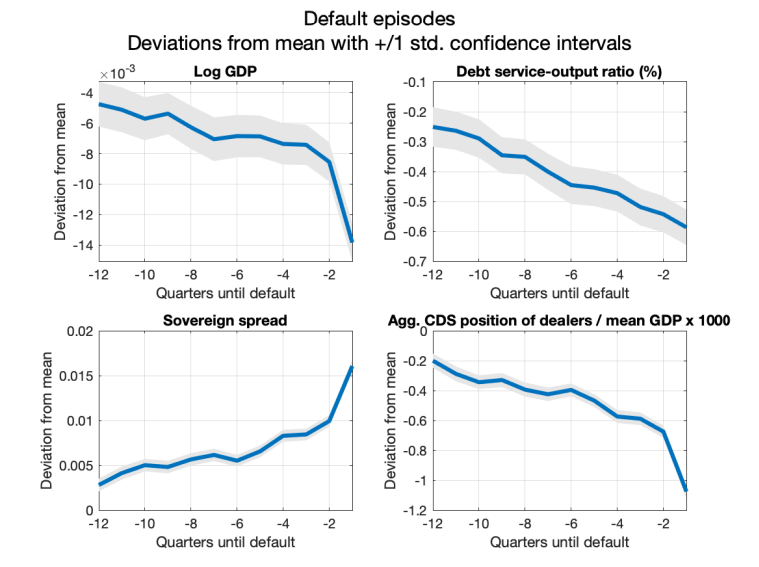
Argentina: Bid-Ask spread increases with Yields



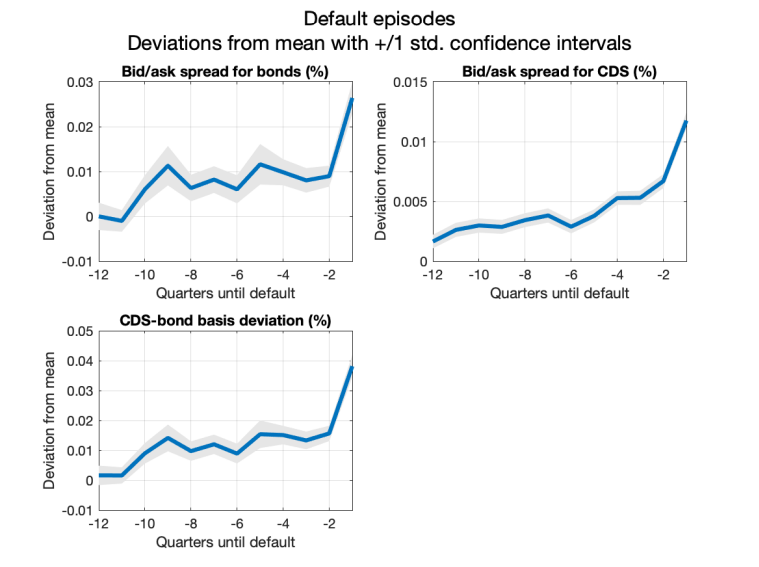


$$\frac{f_b}{|b|} = \epsilon_{\alpha,\theta}(\theta_b)\frac{(V(b;s_2) - qb - V(0;s_2))}{|b|}$$

Default Events: Aggregate dynamics and insurance



Default Events: Liquidity and dealers' positions



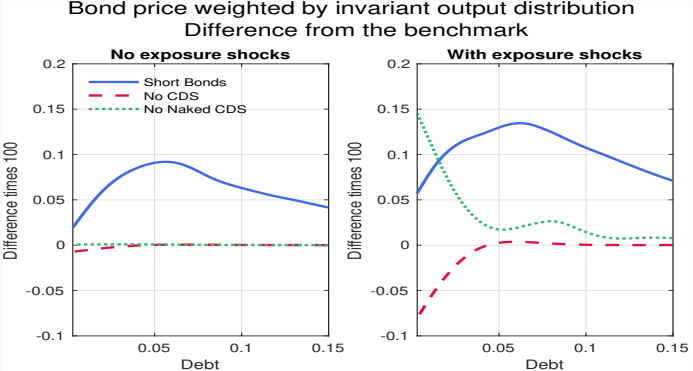
Policy Analysis

Policy analysis: Alternative regulatory changes

We consider the following regulatory changes:

- banning naked CDS ($\overline{c}(b) = b$)
- completely banning CDS trading $\underline{c} = \overline{c}(b) = 0$
- 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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