The Components of the CDS Bid-Ask Spreads: A Reduced-form Approach

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Outline

Motivations

Understanding and estimating various components of the bid-ask spreads have been one of the key topics in the market microstructure literature.

The bid-ask spread is not only important in the equity market, it is also key understanding the CDS market.

Unlike conventional securities such as stocks and corporate bonds, each CDS tract has two legs. Dealers in the CDS market have different considerations fo two legs when quoting bid and ask CDS premiums.

This unique security design allows a natural identi cation scheme for modeli various components in the CDS bid and ask quote spreads.

Contributions

We provide an empirical study of the CDS market structure through the lens c model that quanti es the components in the CDS bid-ask spreads;

We nd that the recovery-related liquidity component accounts for a big portion the bid-ask spreads, around about 60% on average across different maturities. component is highly correlated with the market-wide liquidity factor, NOISE (Hu Pan, and Wang 2013 JF).

The next largest components (around 35%) are adverse selection related with side adverse selection much larger than the buy side;

Contributions (cont.)

The monopolist pro ts is a sizeable component in the bid-ask spread, accoun
for around 5% on average and concentrating on 5-year maturity;

Consistent with classic market microstructure theories, the identi ed adverse se
tion components predict future changes in the CDS premiums and explain cr
sectional distribution of the CDS returns;

During the pandemic, the CDS market has become less competitive, re ecte
the higher monopolist pro ts, and less ef cient (more informational frictions), re
 ected in more concerns for the adverse selection and the counterparty risk fr
the sell side.

Benchmark quote

- Constant risk-neutral default intensity λ.
  - Exponentially distributed default time with survival probability $e^{-\lambda t}$ and density $\lambda e^{-\lambda t}$.

- For time to maturity Δt, the premium leg $Q_{\Delta t}$ and protection leg $P_{\Delta t}$ are given as:

$$Q_{\Delta t} = s_{\Delta t} \int_0^{\Delta t} e^{-\lambda t}\, dt\,;$$

$$P_{\Delta t} = w\lambda \int_0^{\Delta t} e^{-\lambda t}\, dt\,.$$

Benchmark quote (cont.)

The CDS spread is the s_{Dt} equalising Q_{Dt} and P_{Dt}, i.e.,

$$s_{Dt} = \frac{wl \int_0^{Dt} e^{\ tl}\, dt}{\int_0^{Dt} e^{\ tl}\, dt} = wl\ :$$

where w is the LGD and is the default intensity.

Adding liquidity premium to LGD

We capture this by using a liquidity convenience yield h to discount recovery given default $(1-w)$.

That is, the protection leg is now given as

$$P_{Dt} = \lambda \int_0^{Dt} \left[1 - (1-w)e^{-th}\right] e^{-t\lambda}\, dt\,;$$

and CDS premium is:

$$s_{Dt} = \frac{\lambda \int_0^{Dt} [1 - (1-w)e^{-th}]\, e^{-t\lambda}\, dt}{\int_0^{Dt} e^{-t\lambda}\, dt} = \lambda \left(1 - \frac{g(\lambda + h; Dt)}{g(\lambda; Dt)}(1-w)\right);$$

where $g(x;t) = \frac{1-e^{-xt}}{x}$:

Ask quote

Selling dealer adjusts the default intensity upward for adverse selection of buy

$$\lambda \rightarrow \lambda_A = \lambda + \lambda_A.$$

Selling dealer's market power is reflected in further discount of buyer's premiu payments at rate γ_A:

$$Q_{A,Dt} = s_{A,Dt} \int_0^{Dt} e^{-t(\lambda_A+\gamma_A)}\, dt,$$

$$P_{A,Dt} = \lambda_A \int_0^{Dt} \left[1 - (1-w)\, e^{-th}\right] e^{-t\lambda_A}\, dt,$$

Ask quote (cont.)

and the CDS premium ask quote is

$$s_{A;\Delta t} = \lambda_A \left[\frac{g(\lambda_A;\Delta t)}{g(\lambda_A+\gamma_A;\Delta t)} - 1 - \frac{g(\lambda_A+\eta;\Delta t)}{g(\lambda_A;\Delta t)}(1-w) \right].$$

Bid quote

Buying dealer adjusts the default intensity downward for adverse selection of s
ers:

$$l \;\; ! \;\; l_B = l \quad l_B:$$

The sellers' counterparty risk is priced in the bid quote through additional discou
ing of protection payment at rate g_B:

$$Q_{B;Dt} = s_{B;Dt} \int_0^{Dt} e^{\,tl_B} dt \, ;$$

$$P_{B;Dt} = l_B \int_0^{Dt} 1 \quad (1 \quad w)\, e^{\,th} \quad e^{\,t(l_B + g_B)} dt \, ;$$

Bid quote (cont.)

and the CDS premium ask quote is

$$s_{B;\Delta t} = \lambda_B \frac{g(\lambda_B + \gamma_B; \Delta t)}{g(\lambda_B; \Delta t)} - 1 - \frac{g(\lambda_B + \gamma_B + \eta; \Delta t)}{g(\lambda_B + \gamma_B; \Delta t)} (1 - w) :$$

Adverse selection induced inventory cost

When dealers raise the ask quote to compensate for selling to informed clients, also raise the bid quote to increase the likelihood of unloading the short positio

When dealers reduce the bid quote to compensate for buying from informed clie they also reduce the ask quote to increase the likelihood of unloading the l position.

$$I_A = I_A^0 \quad b I_B^0;$$
$$I_B = I_B^0 \quad a I_A^0:$$

$a I_A^0$ and $b I_B^0$ represent adverse selection induced inventory costs.

General properties

Proposition

Given positive λ, λ_A, η, γ_A, γ_B, and $0 < w \leq 1$ and $0 < \lambda_B < \lambda$, for any $\Delta t > 0$ the following are true:

1. $\frac{\partial s_{\Delta t}}{\partial \lambda} > w$; $\frac{\partial s_{A;\Delta t}}{\partial \lambda_A} > w$; and $\frac{\partial s_{B;\Delta t}}{\partial \lambda_B} > 0$;
2. $BA_{\Delta t} = s_{A;\Delta t} - s_{B;\Delta t}$ is positive;
3. $\frac{\partial BA_{\Delta t}}{\partial \gamma_A} > 0$; $\frac{\partial BA_{\Delta t}}{\partial \gamma_B} > 0$; $\frac{\partial BA_{\Delta t}}{\partial \lambda_A} > 0$; and $\frac{\partial BA_{\Delta t}}{\partial \lambda_B} > 0$;
4. $\frac{\partial BA_{\Delta t}}{\partial w} > 0$ if $\gamma_A > \eta$, and $\frac{\partial BA_{\Delta t}}{\partial \eta} > 0$ if $\lambda_A + \lambda_B > \gamma_B$.

Market size and activities

CDS premiums and bid-ask spreads

Fitting model to data

- 8 tenors are observed each day, with 8 bid and ask quotes.
- l , w, h do not depend on CDS tenor.
  - In this version we assume $w = 1 \quad e^{l}$ reduce dimensionality by 1 while allowing LGD and PD to be positively correlated.
  - More empirically driven parametrization can be easily accommodated.
- l_A, l_B, g_A, and g_B are tenor-speci c.
  - Each is interpolated using splines with exact values at 6 months, 5 years, and 10 years.
- Thus, 14 parameters are tted to 16 observed values each day by minimizing RMSE.
- We will use this model like how we use Black-Scholes: constant volatility parameter is backed out and used to forecast future realized volatility.

Fitting T-Mobile's time-series averages

a) CDS premium

b) Bid-Ask Spreads

T-Mobile's bid-ask spread components across maturities

T-Mobile's bid-ask spread components over time

Distribution of bid-ask spread components across maturities

Cross-sectional distribution of bid-ask spread components over time

Relation with market-wide liquidity

Table: Regressing the components to the market-wide liquidity

RHS \ LHS	DBAS(5yr)	$D\overline{l}_A$	$D\overline{l}_B$	Dh	$D\overline{g}_A$	$D\overline{g}_B$	Dl
D NOISE	0.670***	-0.020	0.042	11.412**	-0.009	-0.003	0.569
lagged D NOISE	0.706***	-0.027**	0.039	10.646**	-0.001	0.000	1.526**
lagged LHS	0.057***	-0.214***	-0.205***	-0.185***	-0.269***	-0.196***	-0.128***

Predicting future CDS premiums

Predicting future CDS premiums (cont.)

High minus low portfolio returns

Table: Double sorting average high-minus-low portfolio returns

Variables	Full sample	Low premium sample	Mid premium sample	High premium sample
$\overline{BAS}$	-0.52	-0.15	-0.68	-0.05
$\overline{l_A}$	0.57*	0.66	0.71	0.41
$\overline{l_B}$	-0.96*	-0.95**	-0.44	-0.64
$\overline{l_A}$ $\overline{l_B}$	1.16**	0.90**	0.61	0.67
h	0.42	0.37	0.02	0.29
$\overline{g_A}$	-1.22***	-1.01**	-0.58	-0.94
$\overline{g_B}$	0.00	0.21	-0.42	-0.70

Misspecification analysis