Sovereign Credit Risk and Exchange Rates

Evidence from CDS Quanto Spreads

Patrick Augustin
McGill

Mikhail Chernov
UCLA

Dongho Song
Johns Hopkins

Discussion:

Eben Lazarus
MIT

FMA Conference on Derivatives and Volatility

November 2018

What this paper does

Question:

- Relationship between **twin D's**, default and devaluation
- What does it mean for the € if a eurozone country were to default?
  - in the core vs. periphery?
  - at different horizons?

Answer: State-of-the-art affine model:

- **Main inputs:** CDS **quanto** spreads for eurozone, "default" events
- **Outputs:** Everything you might want to know about Q's above *(and more!)*
  - **1-week** prob. of devaluation given default: 5% ($\mathbb{P}$), 77% ($\mathbb{Q}$)
  - **1-year** prob. of devaluation given default: 0.02% ($\mathbb{P}$), 0.85% ($\mathbb{Q}$)
    [where **devaluation** $\equiv$ depreciation greater than 3 SDs]

What I'll do

Really interesting paper, lots of moving parts

Discussion: Try to understand and review the basics

1. Review intuition for why quanto spreads might be useful
   - *(and why they might not)*
2. Mapping from data to model
3. Numerical results

Outline

1. Quanto Spreads: Intuition
2. Mapping: Data to Model
3. Results

Quanto spreads

Consider US investor conducting following strategy:

1. Buy T-maturity €-denominated CDS for EZ country, notional \$1 $=$ €$1/S_0$
   - Pay premium €$\,C_0^{€}/S_0$ **upfront** (timing is unimportant)
   - Receive **loss given default** €$\,L_\tau/S_0$ at default date τ if $\tau \leqslant T$, 0 otherwise
2. Sell T-maturity \$-denominated CDS for same country, notional \$1
   - Receive premium $\$C_0^{\$}$
   - Pay $\$L_\tau$ given default event

[different-currency CDS began trading 2010]

Assume constant risk-free rates (unimportant), constant and known loss given default L (important). Then:

$$C_0^{€} = L \times \mathbb{E}_0^*[e^{-r(\tau\wedge T)}\, \mathbb{1}\{\tau \leqslant T\}\, S_{\tau\wedge T}/S_0]$$

Quanto spreads

Consider US investor conducting following strategy:

1. Buy T-maturity €-denominated CDS for EZ country, notional $\$1 = €1/S_0$
   - Pay premium $€\, C_0^{€}/S_0$ **upfront** (timing is unimportant)
   - Receive **loss given default** $€\, L_\tau/S_0$ at default date τ if $\tau \leqslant T$, 0 otherwise
2. Sell T-maturity \$-denominated CDS for same country, notional \$1
   - Receive premium $\$C_0^{\$}$
   - Pay $\$L_\tau$ given default event

[different-currency CDS began trading 2010]

Assume constant risk-free rates (unimportant), constant and known loss given default L (important). Normalized quanto spread:

$$\frac{C_0^{\$} - C_0^{€}}{C_0^{\$}} = \frac{L \times \mathbb{E}_0^*[e^{-r(\tau \wedge T)}\, \mathbb{1}\{\tau \leqslant T\}\,(1 - S_{\tau\wedge T}/S_0)]}{L \times \mathbb{E}_0^*[e^{-r(\tau\wedge T)}\, \mathbb{1}\{\tau \leqslant T\}]}$$

Quanto spreads

Consider US investor conducting following strategy:

1. Buy T-maturity €-denominated CDS for EZ country, notional $\$1 = €1/S_0$
   - Pay premium $€\, C_0^{€}/S_0$ **upfront** (timing is unimportant)
   - Receive **loss given default** $€\, L_\tau/S_0$ at default date τ if $\tau \leqslant T$, 0 otherwise
2. Sell T-maturity \$-denominated CDS for same country, notional \$1
   - Receive premium $\$C_0^{\$}$
   - Pay $\$L_\tau$ given default event

[different-currency CDS began trading 2010]

Assume constant risk-free rates (unimportant), constant and known loss given default L (important). Normalized quanto spread:

$$\frac{C_0^{\$} - C_0^{€}}{C_0^{\$}} = \frac{\mathbb{E}_0^*[e^{-r(\tau\wedge T)}\, \mathbb{1}\{\tau \leqslant T\}\, (1 - S_{\tau\wedge T}/S_0)]}{\mathbb{E}_0^*[e^{-r(\tau\wedge T)}\, \mathbb{1}\{\tau \leqslant T\}]}$$

Quanto spreads

Consider US investor conducting following strategy:

1. Buy T-maturity €-denominated CDS for EZ country, notional $\$1 = €1/S_0$
   - Pay premium $€\, C_0^{€}/S_0$ **upfront** (timing is unimportant)
   - Receive **loss given default** $€\, L_\tau / S_0$ at default date τ if $\tau \leqslant T$, 0 otherwise
2. Sell T-maturity \$-denominated CDS for same country, notional \$1
   - Receive premium $\$C_0^{\$}$
   - Pay $\$L_\tau$ given default event

[different-currency CDS began trading 2010]

Assume constant risk-free rates (unimportant), constant and known loss given default L (important). Normalized quanto spread:

$$\frac{C_0^{\$} - C_0^{€}}{C_0^{\$}} = \mathbb{E}_0^*\left[1 - \frac{S_{\tau\wedge T}}{S_0}\right] - \mathrm{Cov}_0^*\left(\frac{e^{-r(\tau\wedge T)}\,\mathbb{1}\{\tau \leqslant T\}}{\mathbb{E}_0^*[e^{-r(\tau\wedge T)}\,\mathbb{1}\{\tau \leqslant T\}]}, \frac{S_{\tau\wedge T}}{S_0}\right)$$

Spread seems to give nice info on twin D's, but only works for constant L!

Loss given default

Should we think constant L is reasonable?

- Authors say: *"in line with the literature on CDS pricing (Pan and Singleton, 2008)"*
- This seems fine for emerging market or corporate CDS, since $\mathbb{E}_t^*[L_\tau] \approx \mathbb{E}_t[L_\tau]$
- But time-varying risk premium on magnitude of default seems likely to be important for eurozone

Loss given default

Should we think constant L is reasonable?

- Evidence from Cruces and Trebesch (*AEJ Macro, 2013*):

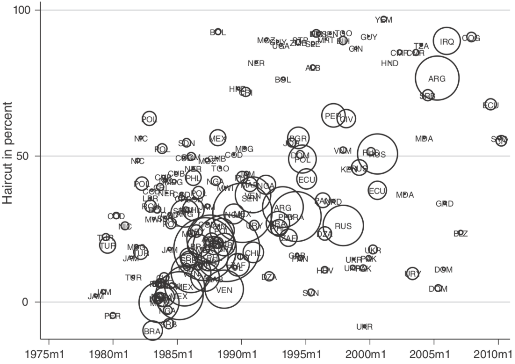


FIGURE 1. HAIRCUTS AND DEAL VOLUMES OVER TIME

Notes: This figure plots the size of H_{SZ} (from equation (2)) expressed in percentage points across countries and time. The circle size reflects the volume of debt restructured in 1980 real US dollars. Haircuts range from almost nil to larger than 95 percent. The maximum haircut shows a secular rise and the cross sectional dispersion of haircuts increases over time. See footnote 20 for a discussion of the negative haircuts.

Loss given default

Should we think constant L is reasonable?

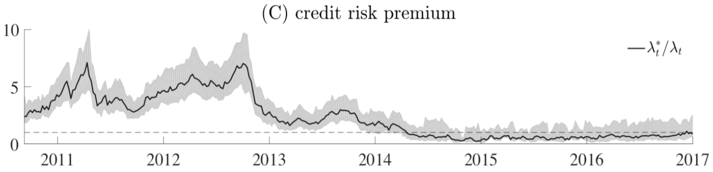
- Everything is identified in the context of the model anyway — all of the above is simply for intuition — so why not just parameterize the relationship between default magnitude and other factors?
- Title would maybe be different, since quanto spreads no longer give direct evidence on twin D's in this more general world
- But model output may be more reasonable
  - More on this in a few minutes

Outline

1. Quanto Spreads: Intuition
2. Mapping: Data to Model
3. Results

Affine model and estimation

- Authors consider complex affine model for SDF and term structures of CDS, FX rate, and interest rates
  - I have very little to say about this
- But some questions about model estimation:
  - Need to estimate using both $\mathbb{P}$ and $\mathbb{Q}$
  - But very little evidence on $\mathbb{P}$ for actual sovereign default...
  - ... so *"we deem a credit event to have occurred if a weekly change in the 5-year quanto spread is above the 99th percentile of the country-specific distribution of quanto spread changes"*
  - Since these aren't really defaults, end up underestimating risk premium for default itself: sometimes negative in the model!



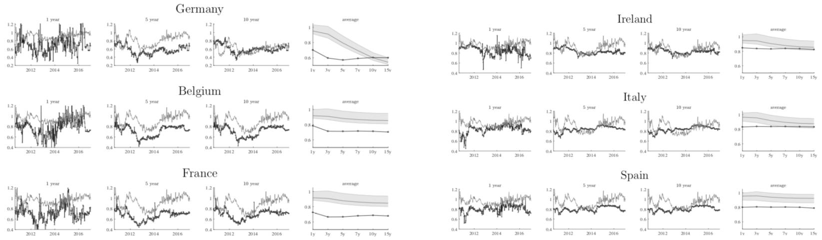
Affine model and estimation

- Authors consider complex affine model for SDF and term structures of CDS, FX rate, and interest rates
  - I have very little to say about this
- But some questions about model estimation:
  - Also would love to have more intuition behind why the **term structure** of quanto spreads gives important information in estimation
  - *"[T]he term structure of credit premia is flat if both the default intensity and depreciation rates are iid but correlated with each other. This result establishes a useful benchmark for interpreting [the data]."*
  - *"We study countries in the Eurozone because their quanto spreads pertain to the same exchange rate and monetary policy, allowing us to link cross-sectional variation in their term structures to cross-country differences in fiscal policies."*
  - Sounds interesting!

Outline

Main results: Twin D’s

Figure 9
Relative quanto spread and expected depreciation rate



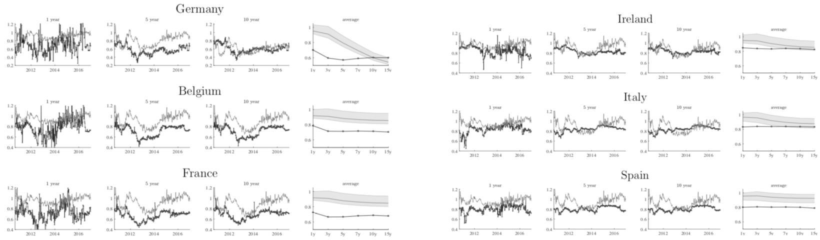
Notes. In this figure, we plot the observed relative quanto spreads (black-circled lines) and the model-implied expected depreciation rate $E_t^*[S_{\tau\wedge T}/S_t]$ for $T = 1, 5$, and 10 years, together with their sample averages in the last column (gray-shaded areas correspond to 90% credible intervals). The results are for Germany, Belgium, France, Ireland, Italy, and Spain.

- Model-implied $\mathbb{E}_t^*[S_{\tau\wedge T}/S_t]$ (gray) $< 1 \implies$ euro depreciation given default
  - Very large for Germany and France; lines up with intuition, reduced-form evidence in Kremens (2018)
- But observed quanto spread (black) often above $\mathbb{E}_t^*[S_{\tau\wedge T}/S_t]$

$$\implies \mathrm{Cov}_t^*\left(\frac{e^{-r(\tau\wedge T)}\,\mathbb{1}\{\tau\leqslant T\}}{\mathbb{E}_t^*[e^{-r(\tau\wedge T)}\,\mathbb{1}\{\tau\leqslant T\}]}, \frac{S_{\tau\wedge T}}{S_0}\right) \geqslant 0\ ?$$

Main results: Twin D's

Figure 9
Relative quanto spread and expected depreciation rate



Notes. In this figure, we plot the observed relative quanto spreads (black-circled lines) and the model-implied expected depreciation rate $E_t^*[S_{\tau\wedge T}/S_t]$ for $T = 1, 5,$ and 10 years, together with their sample averages in the last column (gray-shaded areas correspond to 90% credible intervals). The results are for Germany, Belgium, France, Ireland, Italy, and Spain.

- Model-implied $\mathbb{E}_t^*[S_{\tau\wedge T}/S_t]$ (gray) $< 1 \implies$ euro depreciation given default
  - Very large for Germany and France; lines up with intuition, reduced-form evidence in Kremens (2018)
- But observed quanto spread (black) often above $\mathbb{E}_t^*[S_{\tau\wedge T}/S_t]$
- Missing time variation in loss given default?

Final Notes

- Really interesting paper, getting at important questions
- Would love more transparency in relationship between model and results
- Some room for generalization