Dynamic Dependence in Corporate Credit

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Research Questions

• Industry reports suggest that diversification benefits in corporate credit markets have gone down.
  – How do we model dynamic dependence in credit markets?
  – How do we measure diversification benefits?
• Do credit spreads, volatility and correlation have separate dynamics?
• Which economic variables drive credit and equity correlations?
Credit Default Swaps (Markit)

• Hedging
  – CDS allow capital or credit exposure constrained businesses (banks for example) to free up capacity.
  – CDS can be a short credit positioning vehicle. It is easier to buy credit protection than short bonds.
  – CDS may allow users to avoid triggering tax/accounting implications that arise from sale of assets

• Investing
  – Investors take a view on deterioration or improvement of credit quality of a reference credit
  – CDS offer the opportunity to take a view purely on credit
  – CDS offer access to hard to find credit (limited supply of bonds syndicate)
  – Investors can tailor their credit exposure to maturity requirements, as well as desired seniority in the capital structure
  – CDS require little cash outlay and therefore creates leverage
Overview

1. Data
2. Volatility Models
3. Copula Models
4. Credit Diversification Benefits
5. Economic Drivers of Copula Correlations
1. Data

- 5-year-CDS quotes each Wednesday.
- From Markit: 226 individual firms included in the first 18 series of the CDX North American investment grade index.
- Data range: from 10/01/2001 to 22/08/2012.
- Exclude 3 firms with fewer than 52 consecutive weeks in our sample.
- Construct time series of default intensities from CDS premia using constant default intensity model.
CDS Spreads for 9 Sample Firms
CDS Spreads for 9 Industries:

- Basic Materials
- Consumer Goods and Services
- Energy
- Financials
- Healthcare
- Industrials
- Technology
- Telecommunications Services
- Utilities

Industry Median and Industry IQR
Some Market Events in our Sample

- 19/07/2002  WorldCom Bankruptcy
- 05/05/2005  Ford and GM Downgrade to Junk
- 08/10/2005  Delphi Bankruptcy
- 06/08/2007  Quant Meltdown
- 16/03/2008  Bear Stearns Bankruptcy
- 15/09/2008  Lehman Bankruptcy
- 10/03/2009  Stock Market Trough
- 05/08/2011  US Sovereign Debt Downgrade
Threshold Correlations

• Use the weekly log differences in 1) CDS premia, 2) default intensity and 3) equity prices.

• Standardize the weekly “returns” using sample mean and volatility.

• Compute threshold correlations:

\[
\bar{\rho}_{ij}(x) = \begin{cases} 
\text{Corr}(\bar{R}_i, \bar{R}_j \mid \bar{R}_i < x, \bar{R}_j < x) & \text{when } x < 0 \\
\text{Corr}(\bar{R}_i, \bar{R}_j \mid \bar{R}_i \geq x, \bar{R}_j \geq x) & \text{when } x \geq 0,
\end{cases}
\]

• Where x is measured in standard deviations from the mean.
Bivariate Threshold Correlations.
Median and IQR across Firm Pairs

Panel A: CDS Spreads

Panel B: Default Intensities

Panel C: Equity Prices

Standard deviations from the mean
2. Dynamic Volatility Models

- Univariate models on weekly log diffs for each of 3 series on 223 firms.
- Up to ARMA(2,2) for the conditional mean. Model selection by AICC.
- Engle and Ng (1993) NGARCH(1,1) for the conditional variance.
CDS Spread Vols. for 9 Firms
CDS Spread Vols for 9 Industries: Industry Median and Industry IQR
Threshold Correlations on Shocks.

Median and IQR
3. Dynamic Asymmetric Copula (DAC)

• Key Challenge: 223 firms and thus 24,753 correlations that change week by week.

• Crucial ingredients:
  – Allow for different start and end times for each firm. Patton (2006).

• DAC model developed in Christoffersen and Langlois (JFQA, 2013) and Christoffersen, Errunza, Jacobs and Langlois (RFS, 2012).
- Median and IQR of bivariate copula correlations.
- CDS spread, default intensity and equity log diffs.
- Note shift in 2007 in credit but not in equity correlations.
CDS Spread Copula Correlations. Median and IQR with all other firms.
CDS Spread Correlations for 9 Industries: Within Industry Median and Industry IQR
4. Conditional Diversification Benefits (CDB)

- Using Expected Shortfall (ES), we define CDB as

\[
CDB_t(p) = \frac{ES_t(p) - ES_t(p)}{ES_t(p) - ES_t(p)},
\]

- Upper bound on CDB is ES average across firms (no diversification benefits). Lower bound is portfolio VaR (no tail).

- Gaussian version (when \( p = 50\% \)):

\[
VolCDB_t = 1 - \frac{\sqrt{1^T \Sigma_t 1}}{1^T \sigma_t},
\]
- 5% CDB for EW credit portfolio (top) and EW equity portfolio. (bottom).
- **Selling** CDS and buying equity.
- VIX on right-hand scale. Key dates in vertical bars.
- Note: Deterioration in CDB in both markets. Began in credit in 2007.
- 5% CDB for credit portfolios (top) and equity portfolio (bottom).
- Optimized weights (dash) on industry Avr. portfolios. Also EW industry weights (solid).
- Note: Deterioration in CDB is partly circumvented when optimizing weights.
5. Economic Drivers of Credit and Equity Correlations

• Macro and market variables considered
  – The CDX North American investment grade index level is used to proxy for the overall level of risk in credit markets.
  – The VIX index represents equity market risk.
  – The term structure is captured by a level variable, the 3-month US Constant Maturity Treasury (CMT), and a slope variable, the 10 year CMT index minus the 3-month CMT.
  – The crude oil price as measured by the West Texas Intermediate Cushing Crude Oil Spot Price.
  – The inflation level as measured by CPI.
  – Consumer confidence measured by the US Consumer Confidence Index (seasonally adjusted).
Correlation Regression
Preliminary Findings

• When using first-differences in median correlation regressed on first-differences of macro and market variables in univariate regressions, we find that
  – VIX drives up credit and equity correlations.
  – Consumer confidence drives down both credit and equity correlations.
  – CDX drives up credit correlations.
  – Crude oil price drives down both credit and equity correlations.
  – The interest rate drives down credit correlation.

• We also run regression on spreads and spread volatility. Regressions on levels. Multivariate regressions.
Summary

• We have estimated a dynamic asymmetric copula model on 223 firms which each have different start and end dates.
• Credit spread levels, volatility and dependence are found to have separate dynamics. Credit and equity prices also have different dynamics.
• Credit dependence appears to be permanently higher after 2007. Equity dependence not so.
• Diversification benefits have declined in both EW credit and EW equity portfolios. This decline in diversification benefit can be reduced by optimizing benefits on industry portfolios.
• We find some scope for economic drivers of credit and equity dependence.
Appendix: Credit Events in the Sample

- CIT Group
- Delphi
- FHLMC
- FNMA
- Washington Mutual
- Tribune
- Lear
- Eastman Kodak
- Residential Cap

See:
http://creditfixings.com/CreditEventAuctions/fixings.jsp