Credit Default Risk
&
Correlated Defaults

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Agenda

Credit Risk

Merton's Model for Credit Risk

Basel Rules - Incremental Risk Charge

Multivariate Factor Models

Correlated Defaults

Empirical Evidences

Summary

We briefly present a multi-factor Gaussian copula portfolio model for default risk. The model assumes three types of systematic factors driving the asset returns, hence the value of each company. These factors represent the state of the global economy and the economic conditions of different geographical regions and industries. The corresponding factor loadings play a key role in the model, as they capture the correlation structure between the asset returns of different companies and therefore influence the joint probabilities of default. Higher correlation between the returns of different companies in a portfolio increases the likelihood that multiple companies will default simultaneously, thus increasing the likelihood of extreme losses in the portfolio. Hence, accurately measuring these correlations is essential for the identification of portfolio risk.

We describe a possible methodology for measuring the correlations between asset returns of different companies, which can be used for calibrating the corresponding factor loadings. The approach relies upon single-name CDS spread data. We will also present the structure of correlations obtained using this methodology.

Credit Risk Modelling

- Credit Risk
- Credit Ratings (S&P, Moody's, Fitch …)
- Probability of Default *(PD)*

	Rating Category	PD lower bound (in bps)	PD upper bound (in bps)
Investment Grade	AAA	0	0.16
	AA	0.16	2.39
	A	2.39	9.28
	BBB	9.28	35.95
Non Investment	BB	35.95	139
	B	139	539
	CCC / CC / C	539	10,000

- Recovery Rate *(R)* & Loss Given Default *(LGD)*
- Expected Loss = *PD * LGD*
- Credit Spread: price paid for the risk
  - Bonds: risk-free rate + credit spread
  - CDS (Credit Default Swaps): credit spread

Credit Risk Modelling

Hazard rate (λ):

$$P(default\ between\ T\ and\ T + \Delta t \mid no\ default\ until\ T) = \lambda * \Delta t$$

Probability of default:

$$PD[0; t] = 1 - e^{-\int_0^t \lambda(\tau) d\tau}$$

Credit spread:

$$\lambda(t) * T * (1 - R) = s(T) * T$$

Hazard rate:

$$\lambda(t) = \frac{s(T)}{1 - R}$$

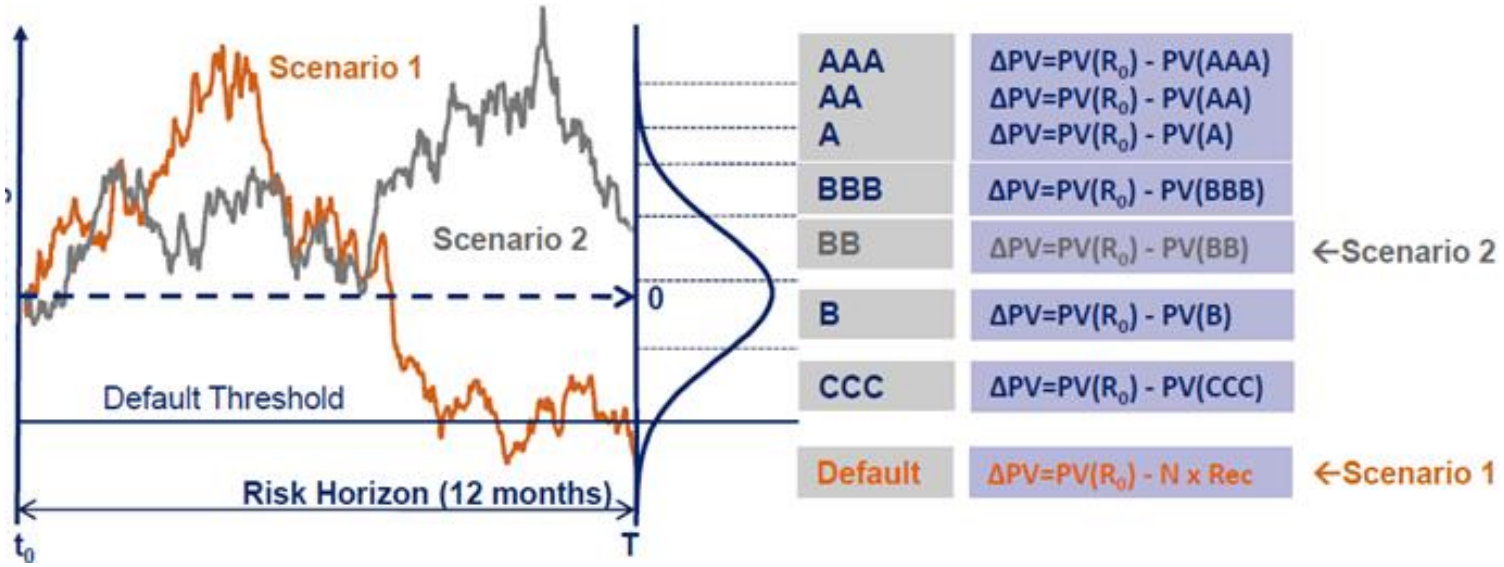
Market: $s(T), R \implies$ Calculate λ, PD

Merton Model – Single Names

- Modelling Probability of Default & Rating Migrations
- Modelling Single Issuers
- Company (Asset) Value: Stochastic Process (Brownian Motion)

$$dV(t) = (\alpha * V(t) - C)dt + \sigma * V(t) * dz$$

- Thresholds for default and raging migration



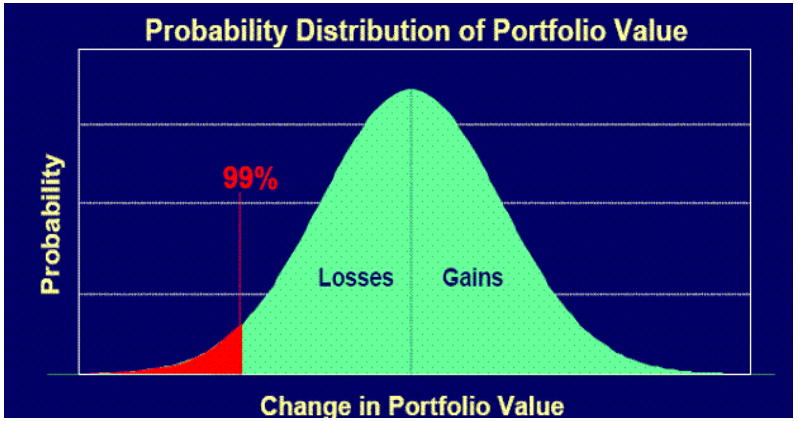
Merton Model – Portfolios

- Multiple Asset Return Processes
- Multiple Rating Migrations & Defaults
- Correlation Structure

Incremental Risk Charge

Regulatory Requirements (Basel 2.5, 2013)

- Risk scope
  - Defaults
  - Rating migrations
- VaR-type model at 99.9% confidence level (max loss we can suffer…)
- Capital Horizon: 1 year
- Correlations between default and credit migration events among obligors (may depend on industry or region)
- Capital Requirement



Modelling Framework

- Portfolio-level Merton Models
- Factor Models (correlation structure)
- Monte Carlo Simulation

Factor Models – Correlations

Normalized log return of the company's asset value:

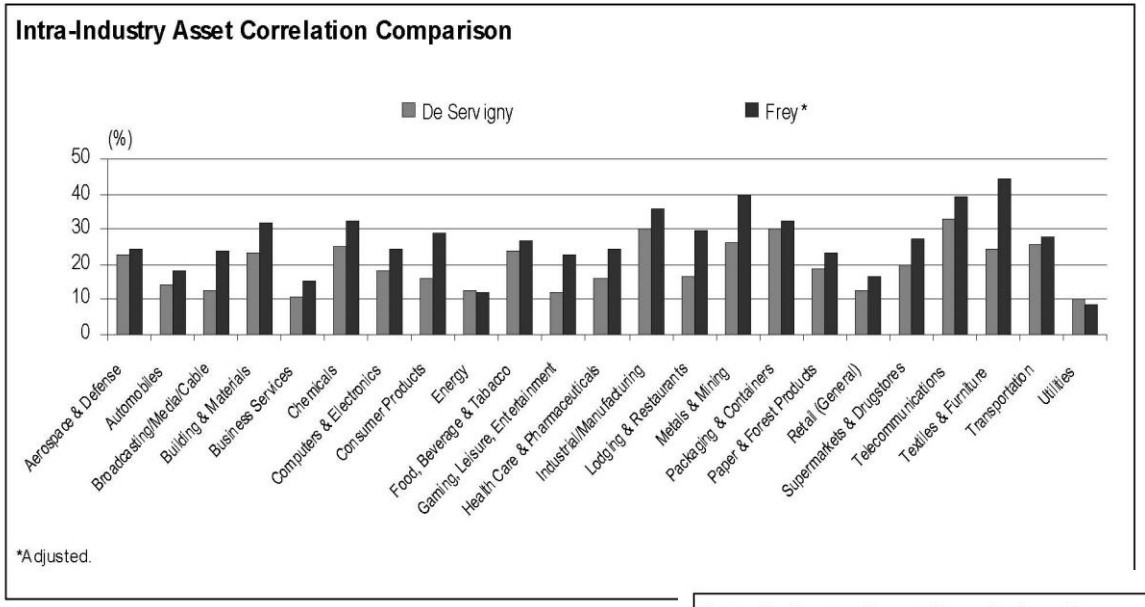
$$r_i = \underbrace{R\,X_i}_{\text{Systematic Risk MARKET}} + \underbrace{\sqrt{1-R^2}\,\varepsilon_i}_{\text{Idiosyncratic Risk ISSUER}} = R \sum \underbrace{\beta_{i,k}}_{\text{Issuer-specific factor loadings}} \overbrace{F^k}^{\text{Systematic Factors}} + \sqrt{1-R^2}\,\varepsilon_i \sim N(0,1)$$

- Impact of systematic vs. idiosyncratic risk driven by parameter R
- Systematic factors *(F)*: e.g. global economy, regional or industry effects
- Correlations of default and migration events are driven by correlation matrix of systematic factors and the factor loadings of the issuers
- Higher correlation → more simultaneous defaults
  → more extreme losses in the portfolio → HIGHER RISK

Estimating Asset Correlations

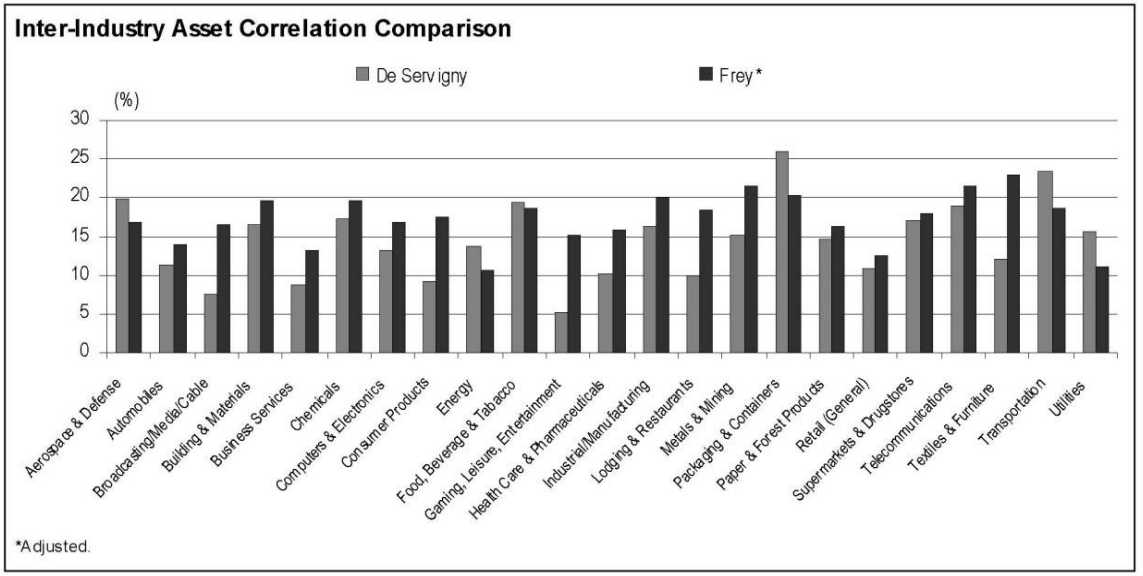
- From historical **default** information
  - Long history
  - Defaults are rare events
- From historical **rating migration** information
  - more information
  - Ratings are more subjective, not always consistent, lagging
- From **equity** information
  - Wide coverage of industry and geography
  - Liquid markets, high frequency data
  - Equity prices are contaminated by information that is unrelated to credit risk
- From **credit spread** information
  - Readily available
  - Universe of liquid credit is smaller than equity universe
  - Shorter history for CDS

Estimating Asset Correlations – EQ data



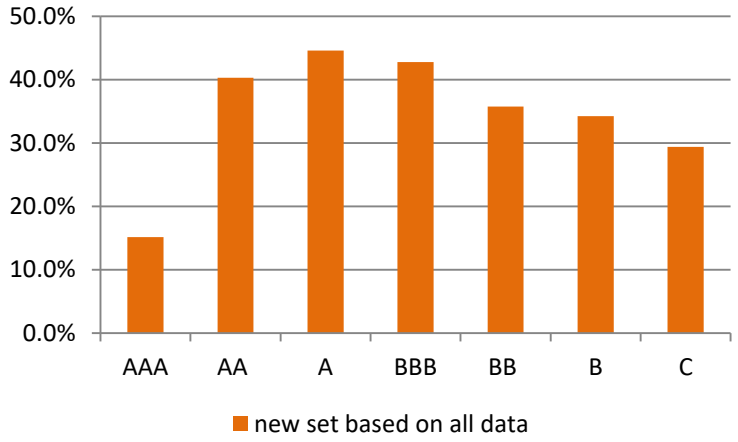
For companies in the same industry: correlations range between 10% - 45%

For companies in different industries: correlations range between 5% - 25%

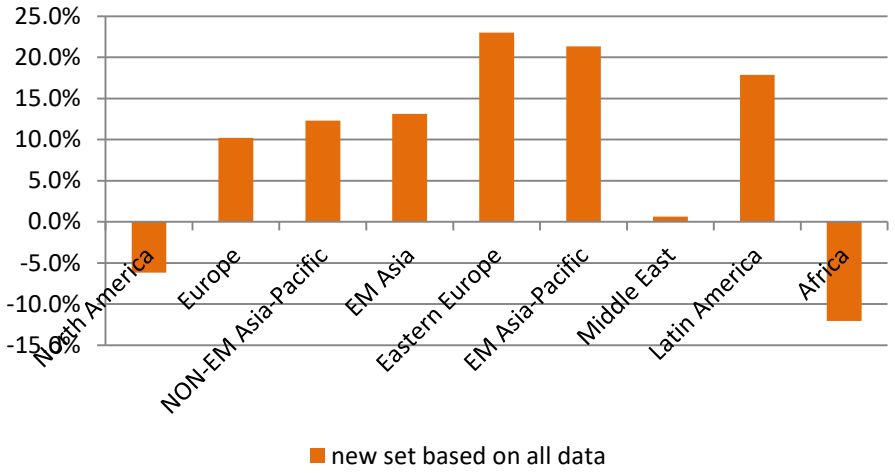


Estimating Asset Correlations – CDS data

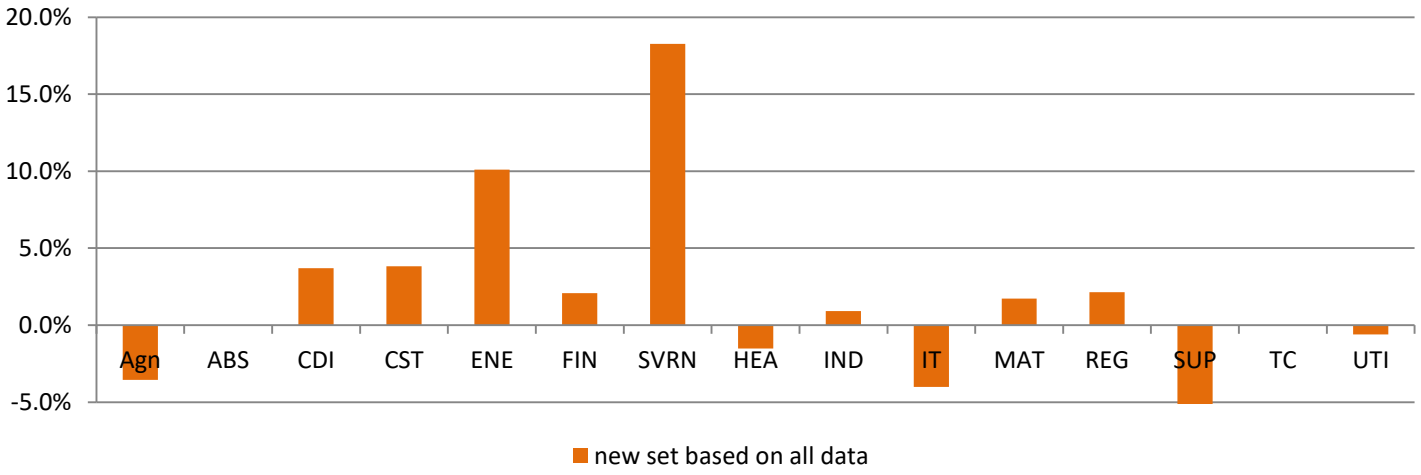
Global correlations



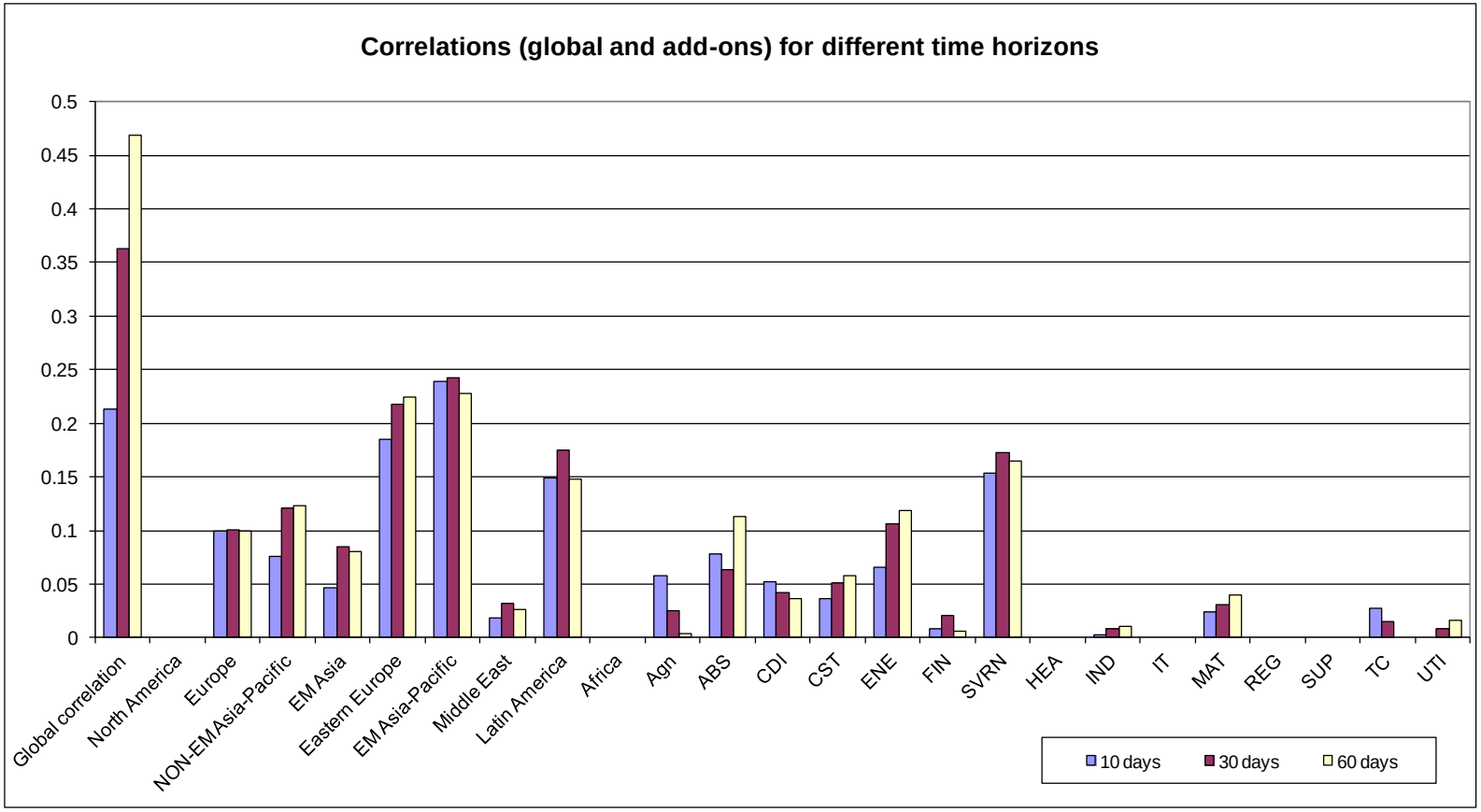
Regional extra correlations



Industry extra correlations



Estimating Asset Correlations – CDS data



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