Leveraging banking credit risk modelling tools within a Internal Model framework

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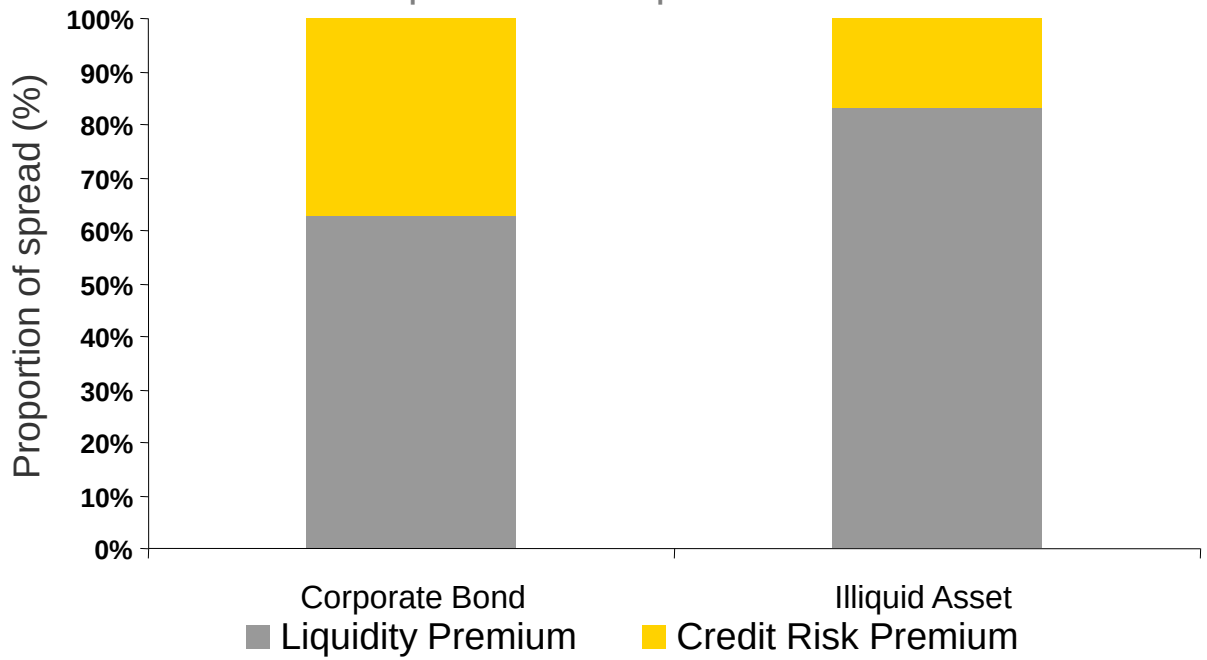
Contents

Background

Why do we focus on Illiquid Assets?

- Illiquid Assets have significantly higher liquidity premium
  - Smaller reserves required for annuities back by illiquid assets
  - Possibly lower capital requirements under internal models

Liquidity Premium is a higher proportion of spread for illiquid assets



Example Illiquid Assets

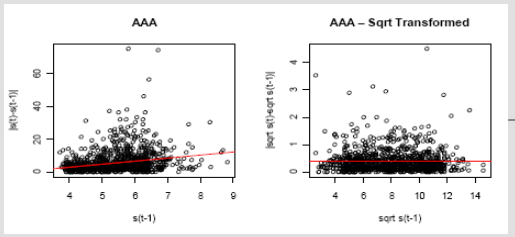
Assets	UK Spread	Key Features
Commercial mortgages	>300bp	► Require specialist skills to enter market ► High yield but relatively high default ► Immediate actions from the lenders in the event of foreclosures from borrowers
Infrastructure financing	>200bp	► Low default because of implicit government support for PFI; non-PFI has higher spread
Social housing	>150bp	► Low default because of implicit government support
Asset-backed securities	>250bp	► Create diverse pools of underlying assets ► Varying default risk and characteristics depending on asset.
Covered bonds	>100bp	► Collateral replaced by issuing institution and high quality
Liquidity swaps	50 – 100bp	► Indirect investments in overcollateralised illiquid assets
Student accommodation	>150bp	► Low default because of implicit government support
Solar bonds	>250bp	► Sometimes with explicit government guaranteed streams

Solvency II Capital Treatment

- The standardised Solvency II approach for the majority of these illiquid assets is to use the spread risk module
  - Ratings based spread risk charge * duration
  - Specific risk charge for unrated bonds
  - Covered bonds are treated similarly but lower charges per rating
  - ABS are treated similarly but higher charges per rating
  - Liquidity swaps may fall into the counterparty risk module
- Internal models would look to the underlying to model ABS
- Some insurers will be using the SII advanced approach, employing a PD / LGD approach

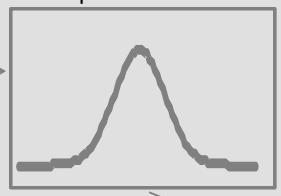
Traditional Approaches

Statistical Models



Transform spreads to iid

Fit spread distribution



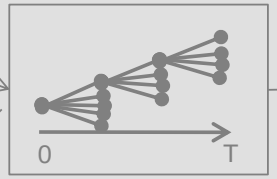
Spread Data Required

Reduced Form Models

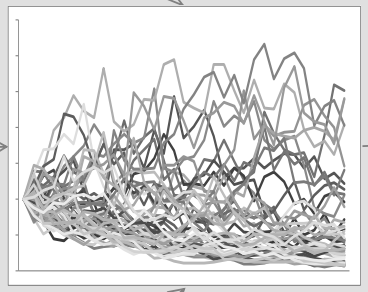
Rating

Transition Matrix

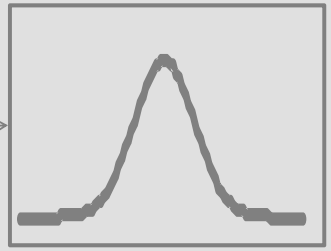
	AAA	AA	⋯	C	D
AAA	92.9	6.96	⋯	0.01	0.00
AA	0.64	90.75	⋯	0.02	0.01
⋮	⋮	⋮		⋮	⋮
C	0.00	0.10	⋯	52.66	34.03



Simulated credit spreads

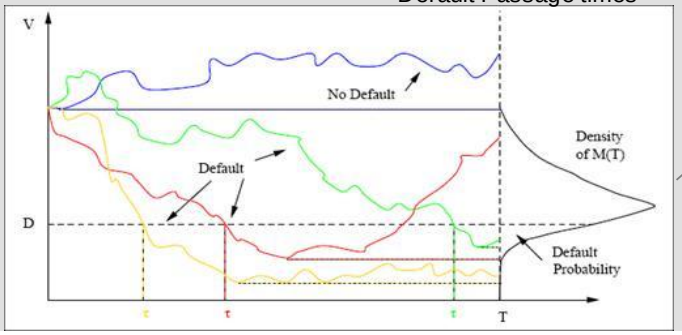


Simulated credit distribution



Structural Models

Default Passage times



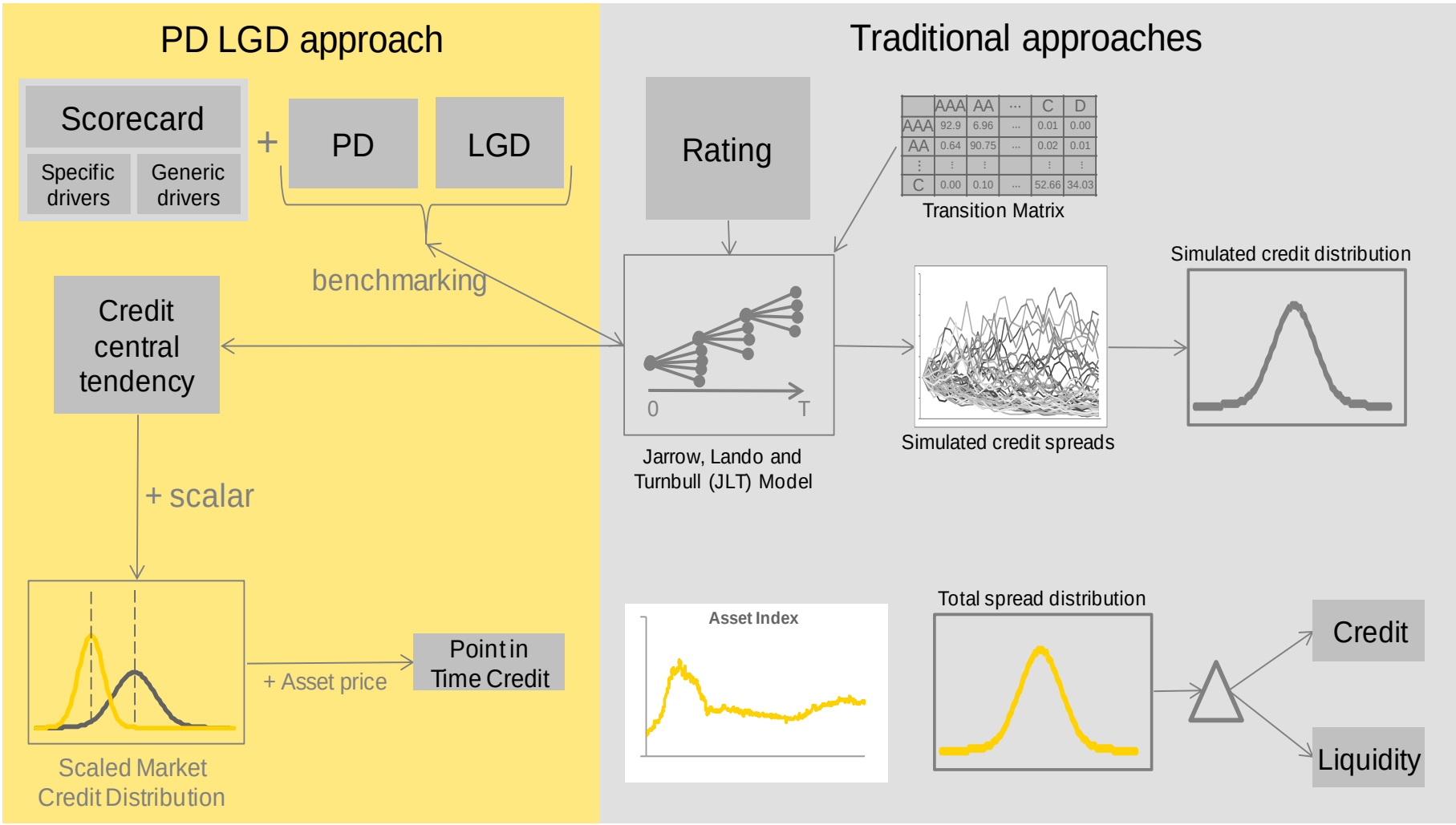
More Complex Modelling
Greater Data Requirements

Leveraging Basel II – a worked example

Overview of Basel II Internal Ratings Based (IRB) approach

- PD: probability of default (annualised). Usually 90dpd or unlikeliness to pay.
- LGD: economic loss given default. In Basel there is downturn and best estimate.
- PD / LGD feed into a regulatory formula under Pillar I in Basel. Formula is not necessarily useful for us, though serves as a benchmark
- Key benefit is the benchmarkability of PD and LGD assumptions and the tools built to support their assessment
- PD LGD provides a structure to the spread and a means to explore the likelihood vs. severity aspects of the spread, as well as the
- Examples include
  - PD scorecards
  - Low default techniques: upper bound of confidence interval for PD
  - LGD: collateral based (haircuts), market implied, historical workout

The big idea


PD LGD approach
Scorecard
Specific drivers
Generic drivers
+
PD
LGD
benchmarking
Credit central tendency
+ scalar
Scaled Market Credit Distribution
+ Asset price
Point in Time Credit
Traditional approaches
Rating
AAA AA ... C D
AAA 92.9 6.96 ... 0.01 0.00
AA 0.64 90.75 ... 0.02 0.01
C 0.00 0.10 ... 52.66 34.03
Transition Matrix
0
T
Jarrow, Lando and Turnbull (JLT) Model
Simulated credit spreads
Simulated credit distribution
Asset Index
Total spread distribution
Credit
Liquidity

Infrastructure example – PFI/PPP

Consider a portfolio of 20 Project Finance Initiative (PFI)/Public Private Partnership (PPP) based infrastructure loans. Let's assume these are fixed assets (e.g. Hospital & School buildings in an operational phase).

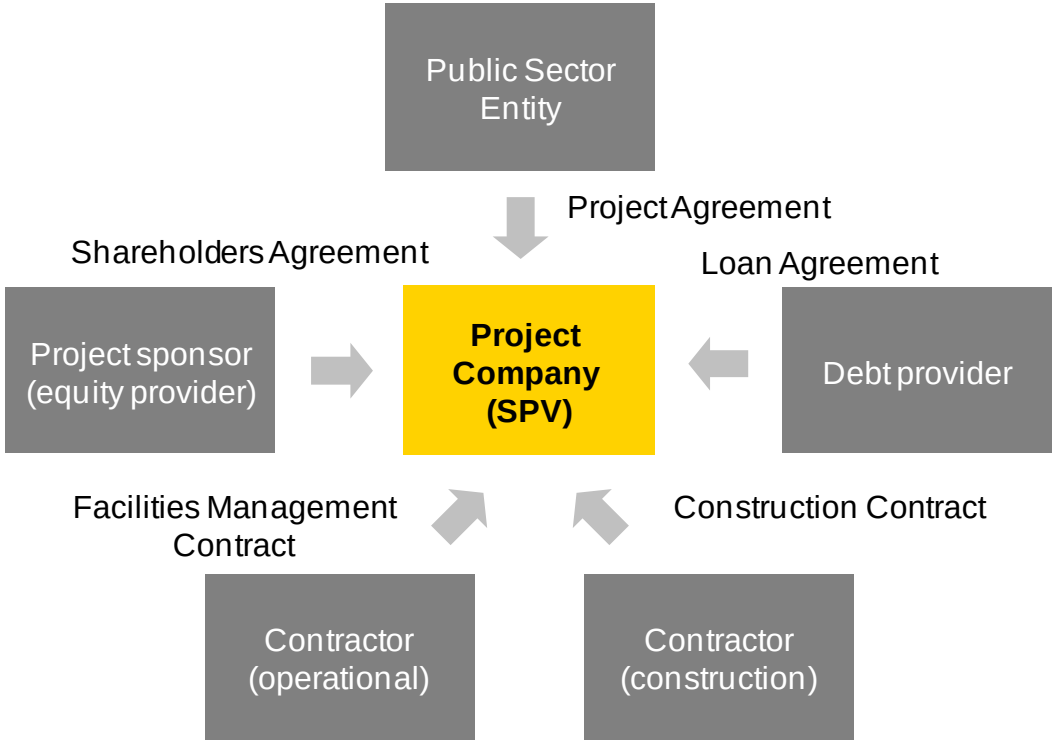
What are the challenges?

- Unrated loans with no equivalent bonds
- Nil to Limited relevant market data for spreads
- Limited historical experience of defaults
- Differentiation of risk drivers between types of infrastructure/project finance loans – e.g. PFI/PPP vs Private Infrastructure & broader Project Finance

Infrastructure – asset type

PFI/PPP Fixed assets – e.g. School and hospital buildings

- Availability based revenue stream (not demand-based)
- Construction vs Operational risks
- Equity support
- Other risk drivers



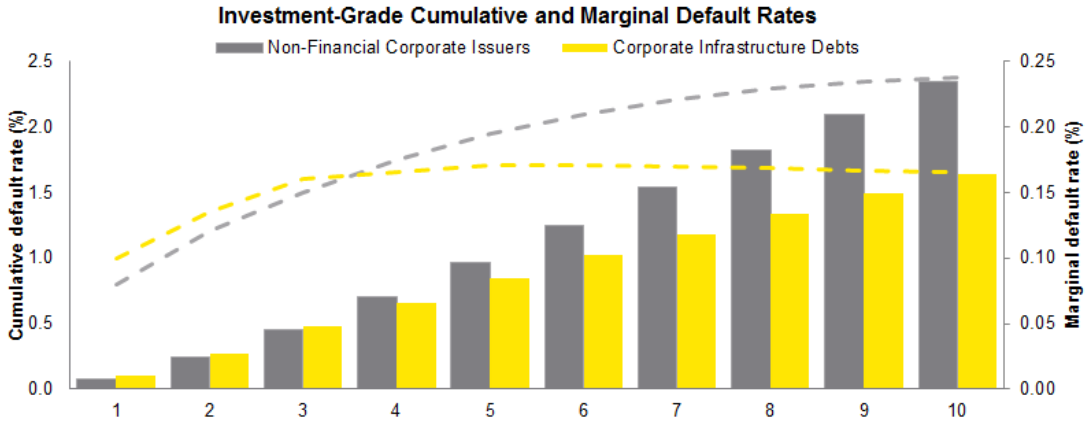
Outline of the approach

1. Consider an infrastructure loan portfolio…
2. Determine baseline PD assumptions
3. Determine LGD assumption
4. Determine and validate pure credit spread “central tendency”
5. Determine generic credit spread distribution
6. Rescale / calibrate to central tendency
7. Practical considerations
   - Validation
   - Unexpected defaults
8. Differentiation by individual asset characteristics

1. Setting PD

- A range of Through the Cycle (TTC) and stressed one year probabilities of default are presented below, sourced from reports by the major credit rating agencies

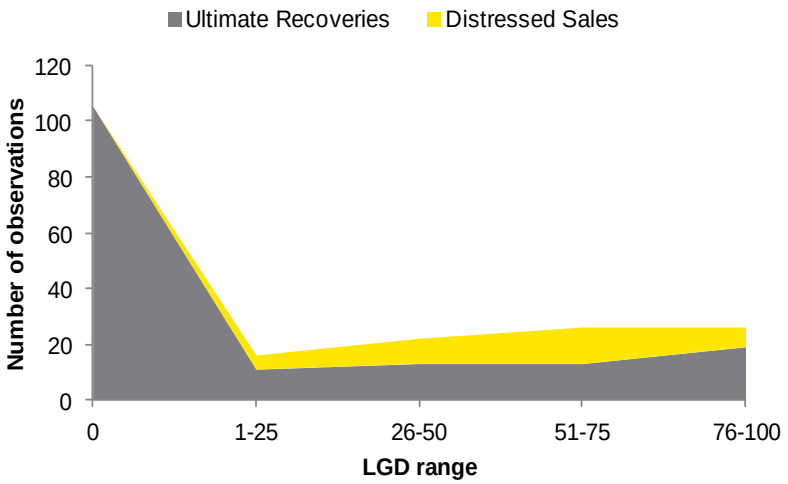
Ref.	PD	Source	Description
1	0.40%	Moody's Project finance study	Implied from the 10 year cumulative PFI/PPP default rate
2	1.65%	S&P project finance study	Average one year default
3	0.53%	Moody's infrastructure study	Implied from the 10 year cumulative default rate
4	0.13%	Moody's Project finance study	PD in Ref. 1 scaled to reflect project in the operational rather then the construction phase
5	0.56%	S&P project finance study	PD in Ref. 2 scaled to reflect project in the operational rather then the construction phase
6	0.18%	Moody's Infrastructure study	PD in Ref. 3 scaled to reflect project in the operational rather then the construction phase
7	7%	S&P project finance study	Extreme project finance PD observed over 1990-2010



Source: Moody's Infrastructure Default and Recovery Rates 1983-2012H1

2. Setting LGD - considerations

- Source data from ratings agencies
- LGD drivers are primarily the level of equity and availability payments
- LGD expected to be higher for construction-phase asset
- LGD expected to be lower for public-backed initiatives (PFI/PPP)
- Basel IRB benchmarks typically include a floor of 10%
- Combined with the assumed PD, the spreads implied were rank ordered and compared (where possible) to market values
- Need to be cognisant of portfolio concentration and exposure to a single or multiple defaults in portfolio (scenario analysis and stressed LGD)



Source: Moody's Default and Recovery Rates for Project Finance Bank Loans, 1983-2011

2. Setting LGD – investigation

LGDs			
Ref.	**LGD**	**Source**	**Description**
1	28%	S&P project finance average	Provides estimate of LGD across all project finance projects.
2	20.1%-21.7%	Moody's project finance average	Same as Ref. 1
3	16.8% -18.1%	Moody's operational phase project finance average	Provides estimate of LGD across all project finance projects in operational phase.
4	16.1% -19.7%	Moody's PFI/PPP project finance average	Provides estimate of LGD across all PFI projects.
5	10%	Basel LGD regulatory floor for residential property	Although this is not explicitly applicable to any of the loans it can be used as an overall floor for LGDs.
Stressed LGDs (useful for scenario analysis)			
6	50.4%-52.9%	Moody's distressed sale project finance average	Informs the stressed LGD assumption for scenario testing. This corresponds to the scenario where the financer liquidates the assets instead of managing them. Corresponds to c. 20% of defaults in Moody's study.
7	93%	Maximum historic LGD reported since 1990 from S&P project finance report	Included to illustrate the maximum LGD observed across project finance. This was experienced in the power sector, with severe failure in the integrity of the asset developed.

- Loans are for PFI infrastructure projects in their operational phase
- Two closest LGD references are therefore ref. 3 and 4
- Both contain a measure of conservatism: ref 3. is not specific to PFI and ref 4 contains losses observed in a number of projects in their development phase
- Based on these two reference points a conservative estimate of the LGD of 20% has been calibrated

LGD = 20%

3. Central tendency

Binomial Model

PD	LGD	Years to Maturity	Credit Spread
0.40% (ref. 1)	20%	20	7.7bps
1.65% (ref. 2)	20%	20	29.2bps
0.53% (ref. 3)	20%	20	10.2bps
0.13% (ref. 4)	20%	20	2.6bps
0.56% (ref. 5)	20%	20	10.7bps
0.18% (ref. 6)	20%	20	3.6bps

The PDs based on ref. 1, 3, 4, 5 and 6 provides comfort on the 15bps estimated by the JLT model. Although the PD based on ref. 2 is a large overestimate as it is based on all types of project finance, it provides a reference point suggesting that the credit spread is not underestimated.

LDP Approach: Benjamin Cathcart Ryan (BCR) Model

PD	#Cases*	#Defaults*	#Years*	Confidence
0.40% (ref. 1)	800	9	9	82.5%
0.53% (ref. 3)	800	9	9	89.4%
0.13% (ref. 4)	800	9	9	32.3%
0.56% (ref. 5)	800	9	9	92.3%
0.18% (ref. 6)	800	9	9	47.6%

Based on

- 20% LGD
- 20 years to maturity
- >90% confidence level on PD using BCR Model

Credit Spread = 11bps

PD c. 0.55%

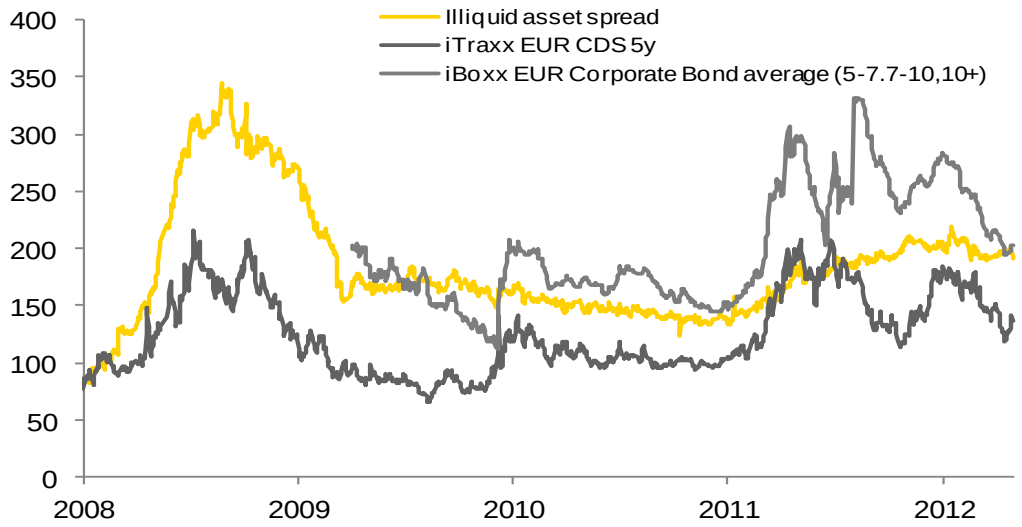
*The BCR assumptions i.e. Number of cases, defaults and years are derived from the Moody's project finance study which reports 18 defaults over 17 years in 805 PFI/PPP projects
* LDP = Low Default Portfolio Theory

4. Identify proxy Credit index

- The aim is to identify two indices which are representative of market credit. These will then be used as a proxy for the credit spread movements in the infrastructure asset spread.
- In order to identify the appropriate proxy various market indices are analysed by considering:
  - Market relevance
  - Availability
  - Correlation with the illiquid asset spread.

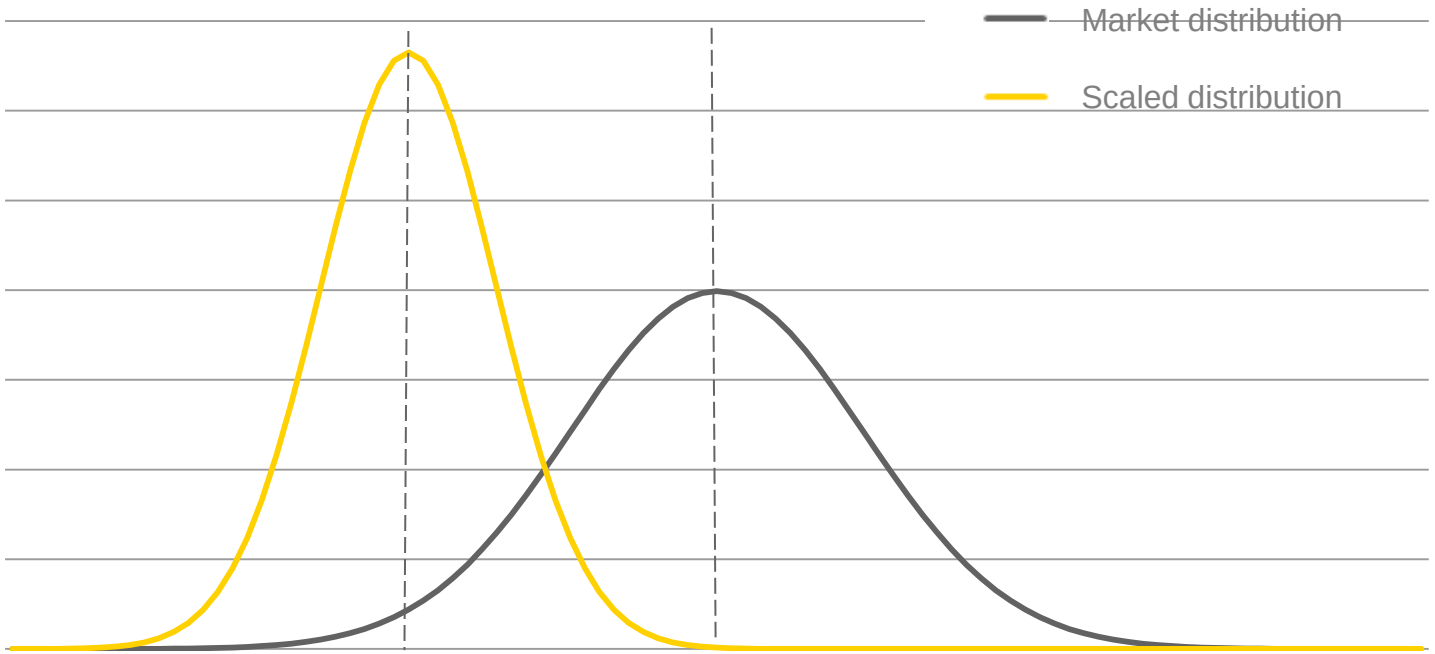
Potential credit indices

- CDS indices
- Corporate indices
- Other?



5. Transform the credit distribution

- After the credit indices have been identified a distribution is calibrated to the movements in these indices.
- A scaling is then applied to the credit distribution to align to the central tendency

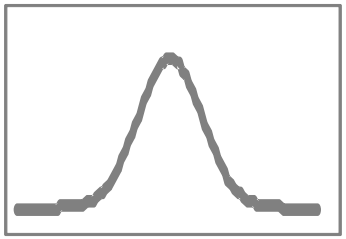


6. Validation framework

Stress and scenario analysis

- ►Stressed PDs
- ►Stressed LGDs
- ► Concentration risk (2 defaults)
- ►Largest exposure default

Credit spread distribution



Unexpected defaults

1. Statistical fluctuations in the absence of perfect diversification
2. Adverse conditions mean the portfolio level of risk changes with time

Investors require compensation which tends to exaggerate the pure credit component. This can be considered as a form of credit inspired incremental liquidity premium

Market reference points

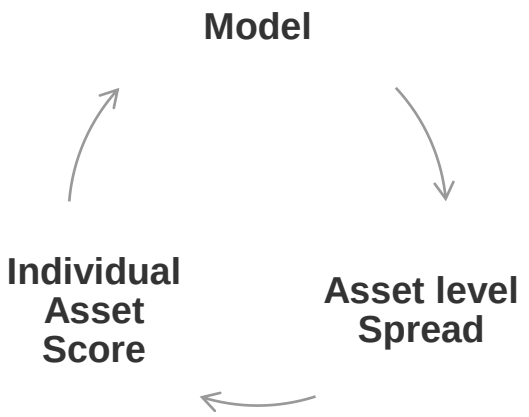
- ► Translate spreads during historical stressed times and express as 1 in X year events

Benchmark models

e.g. Comparison to Basel II

7. Individual asset risk

- The approach so far considers only a portfolio-level aggregate risk
- Diversified across asset holdings
- However, there will be differentiation across the individual holdings
- Build a scorecard based on individual risk drivers
- Challenging
- Limited asset-specific data
- Build risk-driver specific drivers utilising other asset classes
- Adjust scoring model through expert judgement



Closing remarks

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Closing comments

- PD and LGD provide a useful basis and a structured approach to credit spread modelling, enabling explicit decomposition of spread into credit and liquidity
- Techniques and tools have been developed in the banking sector – driven by Basel regulatory capital requirements – that enable assessment of PD and LGD for low default portfolios
- These can be leveraged by insurers to complement – rather than replace – existing / traditional methods

Thank you

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