Rabobank

TopQuants

Incremental Risk Charge

Martin van Buren

Agenda

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- High-Level Framework
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Introduction

New regulations prescribe augmented trading book capital by 1/1/2012:

$$RC = \underbrace{3 * VaR(99\%,10day)}_{\text{current RC}} + \underbrace{IRC + 3 * stressedVaR(99\%,10day) + securitisation\ risk}_{\text{additional RC}}$$

- IRC: risks in the trading books that are beyond the VaR, i.e.: default/migration
  - IRC is the Incremental Risk Charge
  - VaR does not necessarily include default or extreme migrations
  - Should be covered as part of IRC
- stressedVaR: VaR based on stressed period, e.g. 07/08 scenario
- securitisation risk: defined by IRB risk weights
- ICAAP (Jan 2010)
  - IRC for Economic Capital
  - Based on the same methodological framework
  - Possibly different input parameters

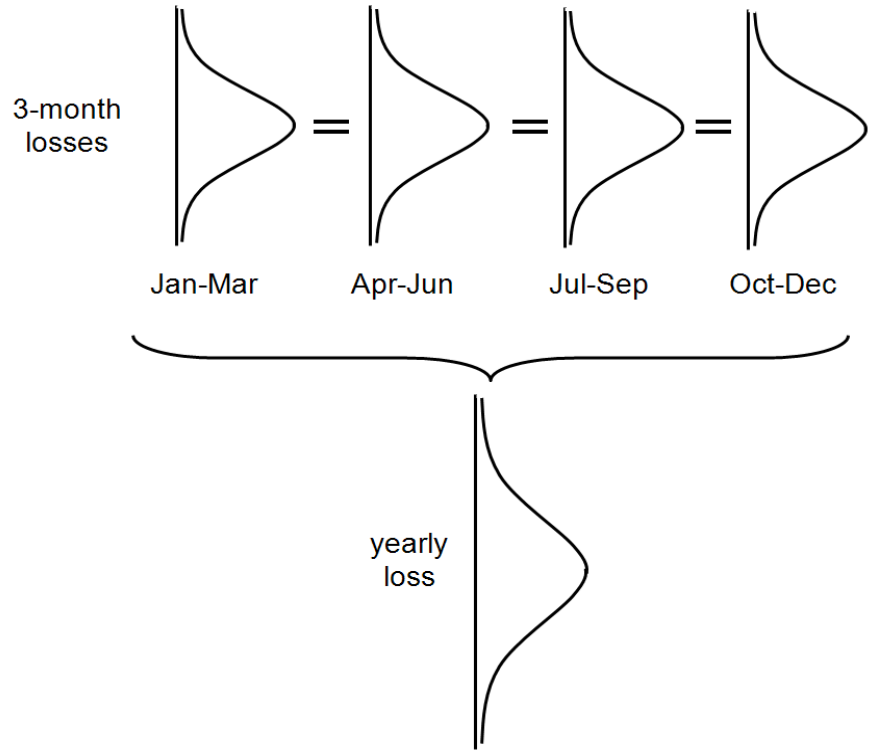
Constant Risk Assumption

- Important difference between banking book and trading book:
  - Banking book: positions are held **to maturity**.
  - Trading book: positions are continuously bought and sold **before their maturity**.
- Therefore, it would be inappropriate to base credit risk on 1-year PDs.

- Solution: Regulator allows to use the **short-term** PDs that correspond to the time we are vulnerable to credit events, i.e. the liquidity horizon.

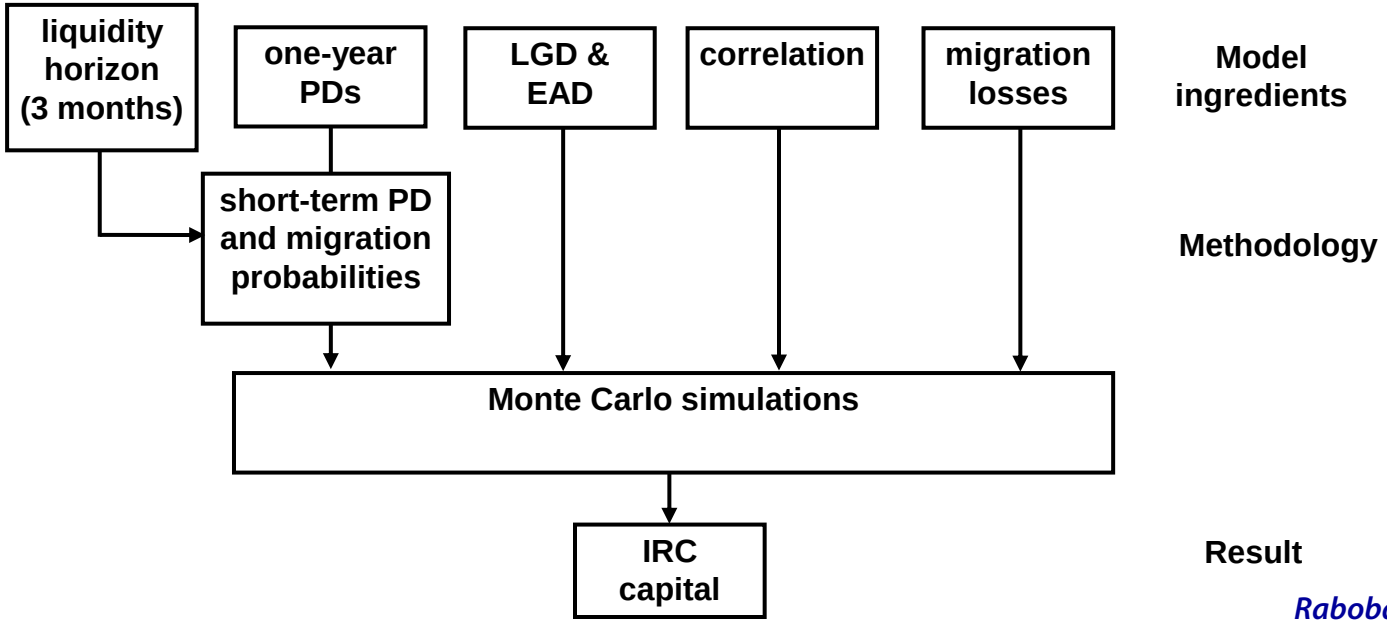
- Still, the capital horizon is one year.

- Solution: Regulator introduced the constant risk assumption:
  - Determine the liquidity horizon.
  - Refresh portfolio after each liquidity horizon.
  - Capitalize for 1 year by *roll over*.

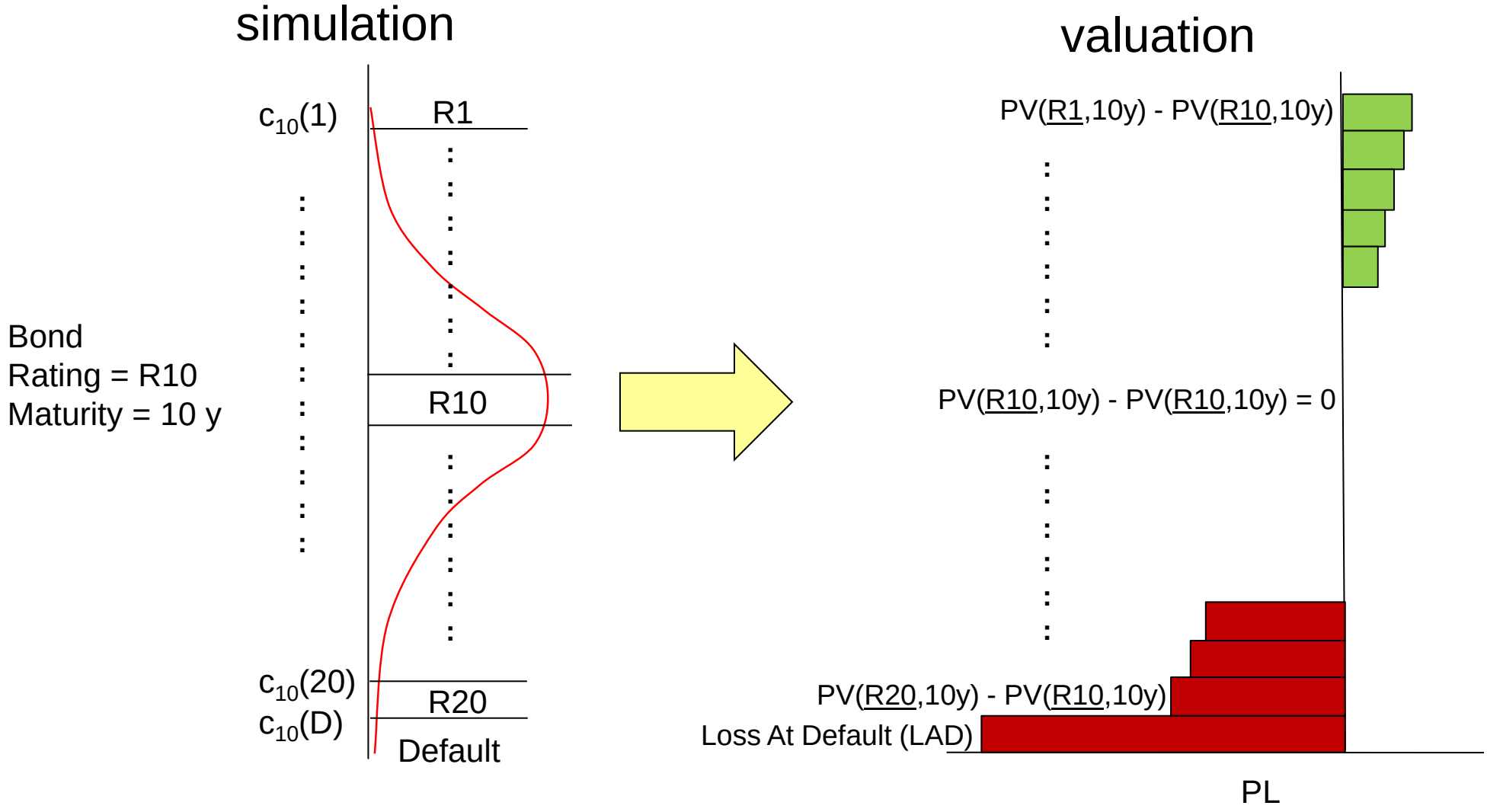


High-Level Framework

- Monte Carlo simulation based on one-factor model
  - Usage PD and LGD (models) from the Banking Book (IRB approach)
  - Constant risk assumption:
    - Draw portfolio loss for one liquidity horizon
    - Repeat drawing and sum losses until one year
    - Take 99.9% level
  - Automatically captures name concentrations

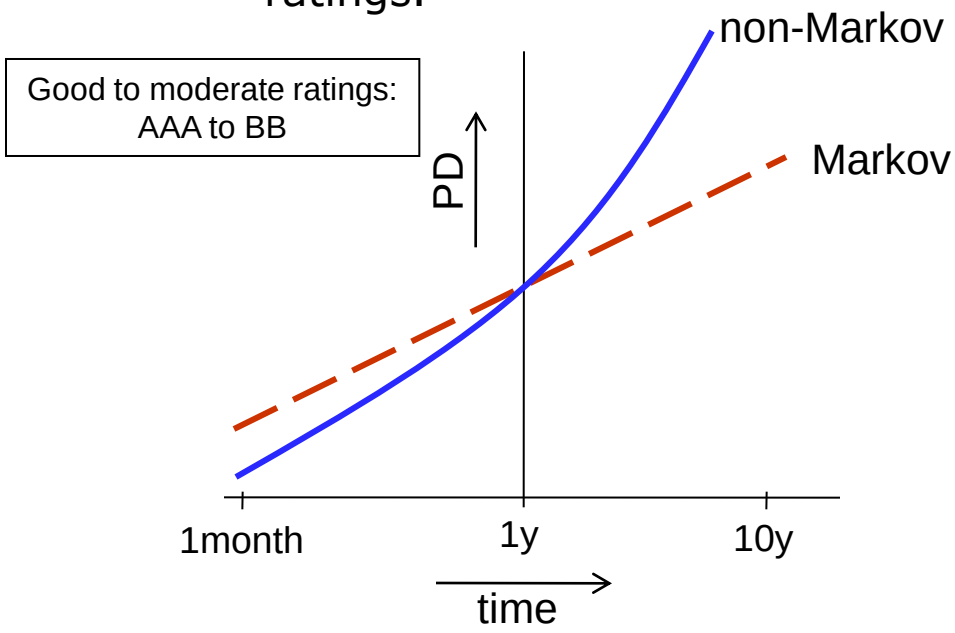


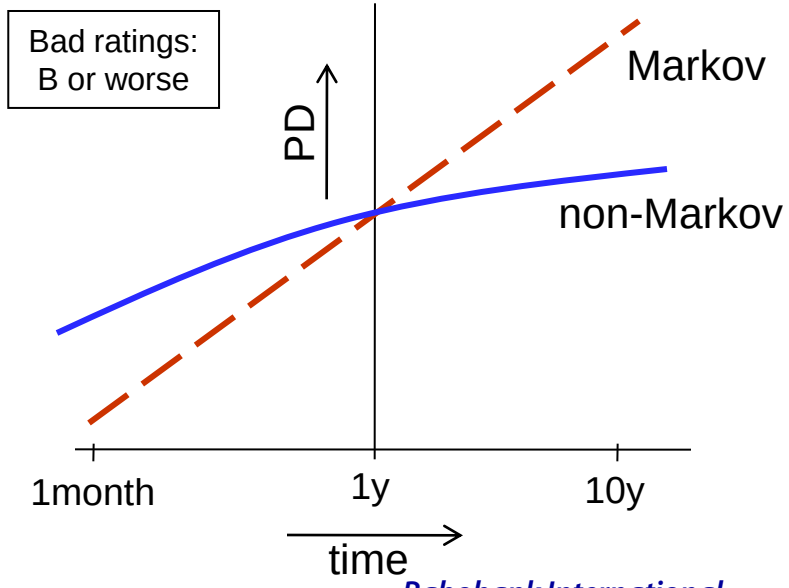
High-Level Framework



Short-term PDs / Migration Probs

- PD term structure based on *Non-Markovity*:
  - Issuer that has recently been downgraded has a higher probability to be downgraded further, and *vice versa*.
  - Future default probability of default depends on rating *history*, rather than the *current* rating only.
  - Good ratings: lower short-term PD under non-Markovity
  - Bad ratings: higher short-term PD under non-Markovity
  - Short liquidity horizon can lead to higher IRC for portfolio with very bad ratings.





Short-term PDs / Migration Probs

Alternatives for input data:

1. Credit data: Use historically observed rating migrations
    1. Historical migration frequencies of S&P grades;
    2. Smoothing;
    3. Mapping to internal ratings.

2. Market data: Use credit-spread implied ratings
    1. Assign ratings on the basis of credit spread per bucket;
    2. Use this to generate own market-implied rating migrations;
    3. Apply same method as described above.

Concerns market-implied PDs:

- Illiquidity of credit spreads (only 5y tenor is reasonably liquid).
- Conversion from risk-neutral to real-world PDs.
- Pro-cyclicality: market stress increases market-implied PDs, thus IRC.
- Majority of banking industry tends to use credit approach.

Default Loss

- Loss At Default = MtM – recovery
  = MtM – (1-LGD)*notional
- MtM might be lower than recovery given by (1-LGD)*notional.
- MtM:
  - based on prevailing prices in the market
  - issuer-specific
  - changes continuously
- LGD:
  - Loss Given Default from banking book framework (IRB approach)
  - generic models (e.g. depends on sector/region/rating)
  - constant until (country) review
- Future:
  - Monitor LAD, and potentially review LGD models
  - Potentially stochastic LGD

Migration Loss

Two approaches:

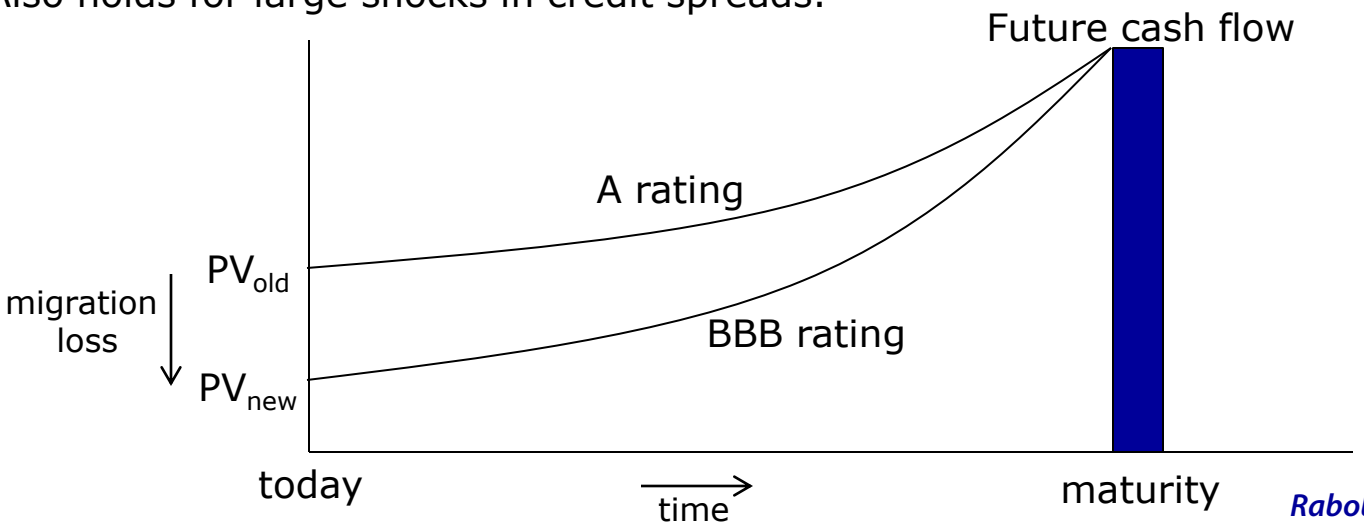
1. Duration approach:

   PL ≈ duration * Δspread + ½ * convexity * $(\Delta spread)^2$

   Δspread: difference generic credit spread
   duration: linear price change as a result of 1 bp credit spread change
   convexity: captures non-linear price changes

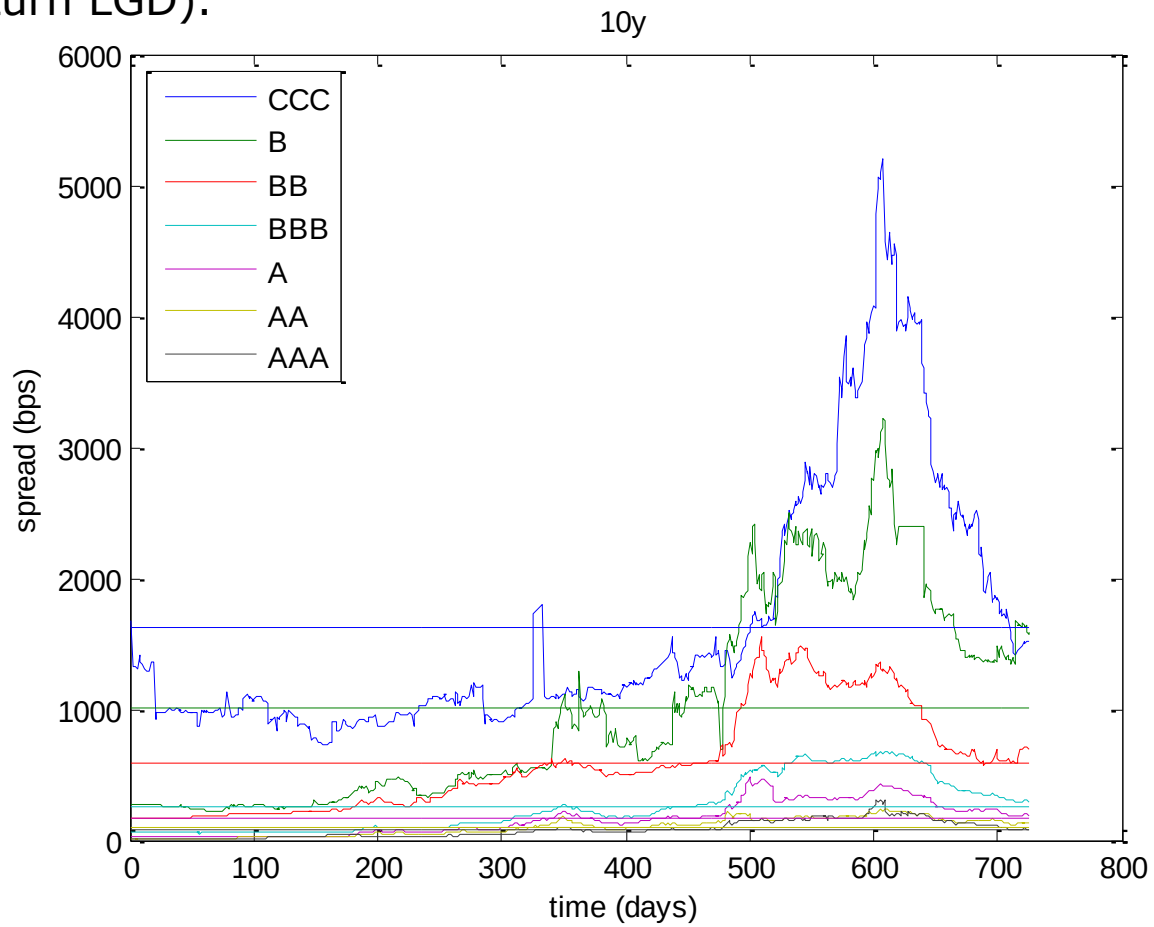
2. Present Value (PV) approach:

   - Future cash flow discounted to PV with average credit spread corresponding to rating.
   - Captures non-linearity automatically.
   - Also holds for large shocks in credit spreads.



Migration Loss

- Volatility in the credit spreads can lead to volatile solvency (pro-cyclicality)
- Therefore, we take averages of credit spreads through time.
- Stochastic credit spreads do not lead to significantly higher IRC (captured by downturn LGD).



Basis Risk

No.	Basis risk	Potential Basis Risk Scenario	Solution
1	Seniority	Subordinated bond hedged by senior protection	Seniority captured by LGD models
2	Issuer rating	Internal and external rating of an issuer are not in line with each other.	Rating mapping determined by clear hierarchy.
3	Asset rating	Deals from same issuer have different asset ratings.	Deviations asset ratings explained by different seniority (already captured by LGD)
4	Maturity	Long position hedged by short position with other maturity.	-Maturity reflected by MtM. -Distinguish all spread tenors. -Discount over maturity.
5	Maturity	Hedge matures before liquidity horizon.	Ignore hedges that mature before liq hor.
6	Vintage	CDS index with different vintages are based on different pools, i.e. no perfect hedge.	No netting when vintage CDS index is different.
7	Products	CDS may not pay out when the bond defaults	Big Bang protocol (see next slide)

Basis Risk

- Regulation prescribes: "[...], hedging or diversification effects associated with long and short positions involving different instruments or different securities of the same obligor ("intra-obligor hedges"), as well as long and short positions in different issuers ("inter-obligor hedges"), may not be recognised through netting of exposure amounts. Rather, such effects may only be recognised by capturing and modelling separately the gross long and short positions in the different instruments or securities." -- Par. 27 of BCBS159
- Modelling bond and CDS separately can lead to breakdown of name concentration:

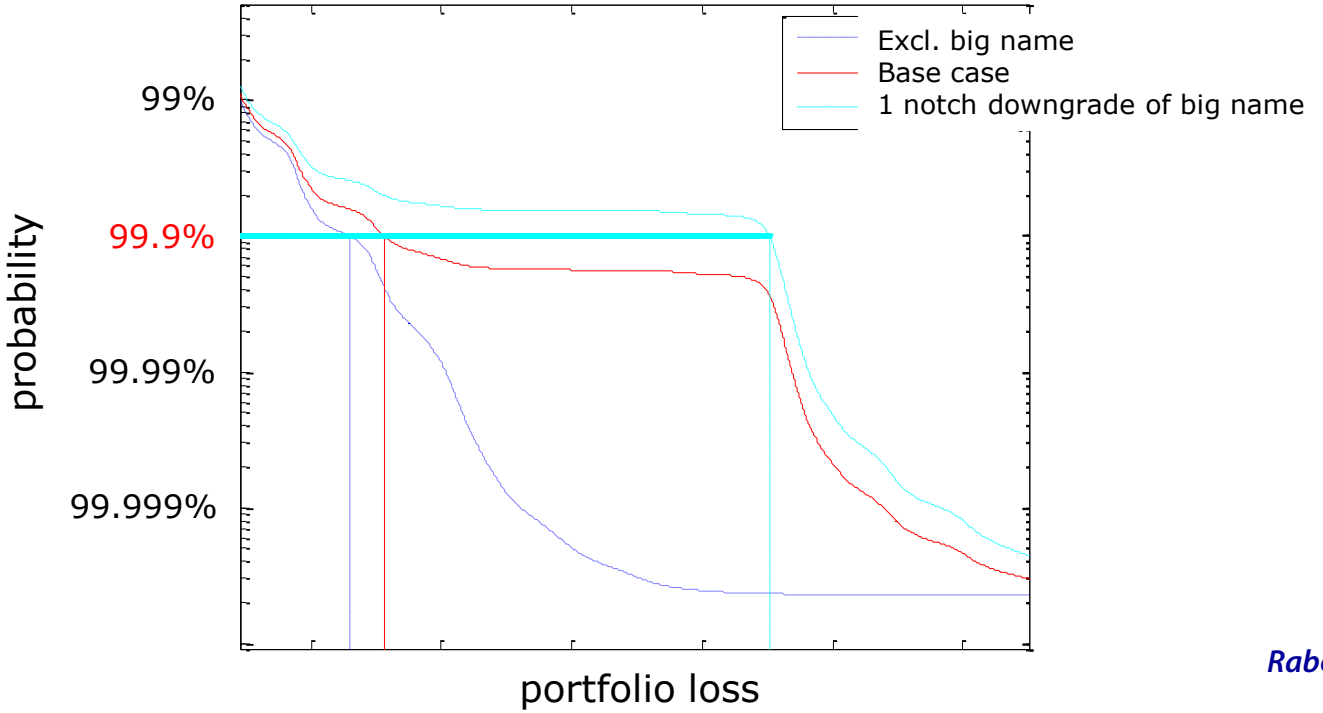
issuer	product	expo
A	bond	100
A	CDS	-100
net A		**0**

issuer	product	expo
B	bond	100
B	CDS	100
net B		**200**

- However, there is no material basis risk:
  - No default mismatch: bond and CDS default definitions are the same.
  - No recovery mismatch:
    - ISDA "Big Bang Protocol" imposes CDS's are cash-settled by par minus recovery, where recovery is determined by auction.
    - We can bring our own bond to auction, so that we can deliver the bond and get back par.
- Therefore, we aggregate the bond and CDS from the same issuer.

Name Concentration

- Large name concentration can cause big "step" is loss distribution.
  - Upgrade or downgrade can lead to instability in solvency.
  - Uncertainty in PDs cause model risk.
- Consequence of (i) IRC defined by VaR(99.9%);
  (ii) IRC should capture name concentration.
- Capital determined by max of average over 12 weeks and most recent value. This only smoothens IRC at the low side, but not at the peaks.
- Consideration Expected Shortfall, or average of several quantiles.



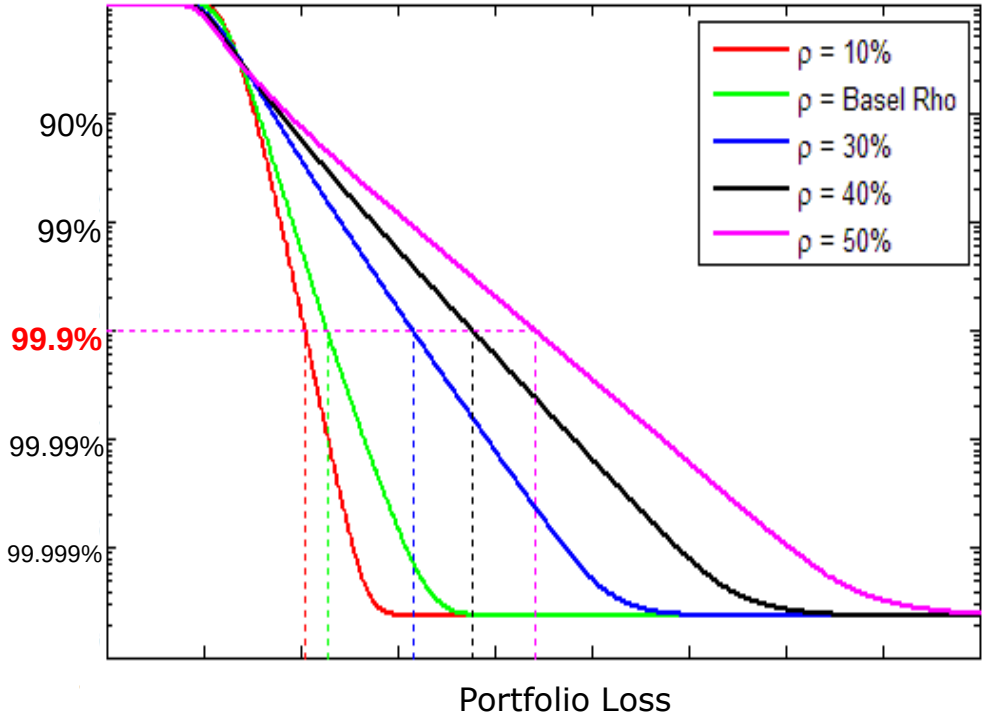
Correlation

Correlation reflects pair-wise asset movements of issuers in Merton-like model, i.e. defaults/downgrades happen simultaneously.

- Model choice:
  - One-factor model
  - Multi-factor model
  - Other models
- Data to assess correlation:
  - equity prices
  - joint default/migration probabilities
  - credit spreads
- Further research to correlation ongoing.

Correlation

- We test impact on granular portfolio.
- Conclusion: model in line with expectations; increased correlation, then increased IRC.



Final Remarks

- IRC will lead to significant increase in trading book capital.

- Opportunity to "regulatory arbitrage"
  - Moving positions from trading book to banking book (if approved by national regulator).

- Regulator seems quite conservative with regards to:
  - input parameters (liquidity horizon, netting, etc.),
  - no diversification between banking book and trading book,
  - a lot of double-counting in IRC, VaR and stressVaR:
    "Het IRC-model moet worden beschouwd als een additionele kapitaaleis bovenop de bestaande – op VaR-gebaseerde – solvabiliteitseisen voor specifiek positierisico. Niettemin is het financiële ondernemingen toegestaan om het solvabiliteitsvereiste voor wanbetalings- en migratierisico – voor zover dat reeds wordt afgedekt door het IRC-model – buiten het VaR-model te laten. Dit om eventuele dubbeltelling in de solvabiliteitseisen te verminderen." -- WFT 4:7

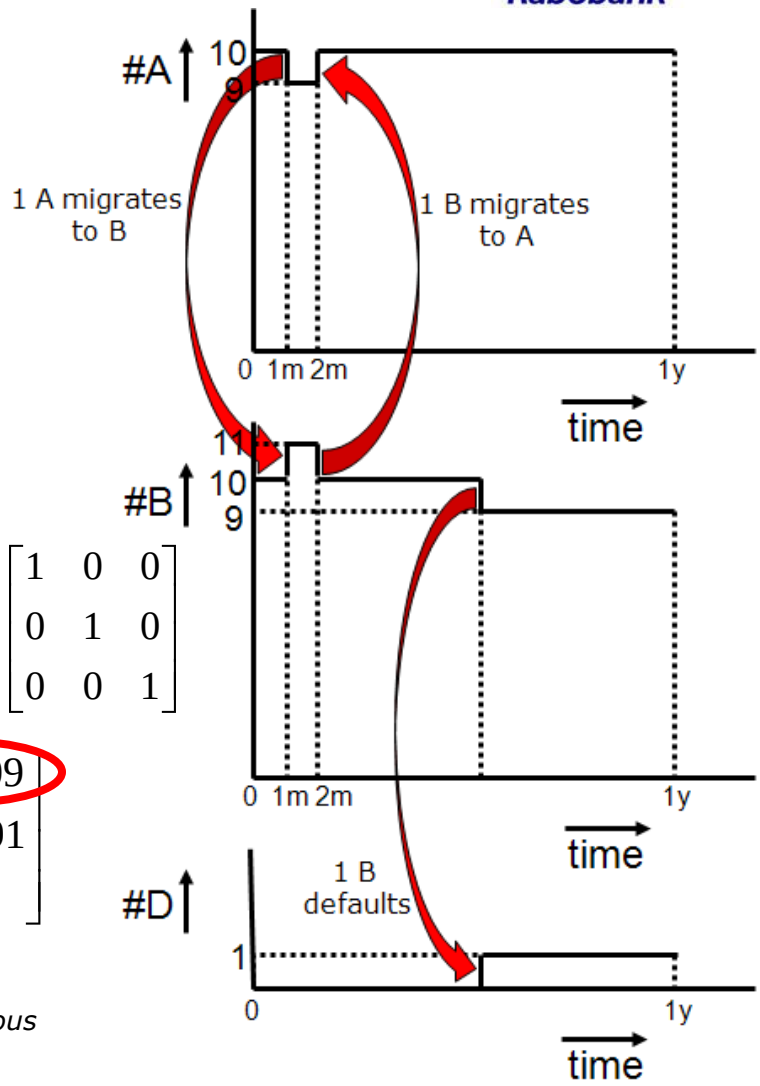
Appendix: Short-term Migration Probs

- Ratio Method
  - #D/#AAA
  - Disadvantage: hardly any AAA defaults, especially on a short time horizon.
- More efficient alternatives:
  - Generator Matrix Method
  - Aalen-Johanson Method
- Example:

$$M_{0-1m} = \begin{bmatrix} \frac{9}{10} & \frac{1}{10} & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \quad M_{1m-2m} = \begin{bmatrix} 1 & 0 & 0 \\ \frac{1}{11} & \frac{10}{11} & 0 \\ 0 & 0 & 1 \end{bmatrix} \quad M_{2m-6m} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \frac{9}{10} & \frac{1}{10} \\ 0 & 0 & 1 \end{bmatrix} \quad M_{6m-1y} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$M_{0-1y} = M_{0-1m} * M_{1m-2m} * M_{2m-6m} * M_{6m-1y} = \begin{bmatrix} 0.90909 & 0.08181 & 0.00909 \\ 0.0901 & 0.81818 & 0.09091 \\ 0 & 0 & 1 \end{bmatrix}$$

$PD_A > 0$



Lando, D., Skodeberg, T., *"Analyzing Rating Migration and Rating Drift with Continuous Observations"*, 16 November 2000