Modelling Constant Level of Risk

Presentation at PRMIA/ISDA, May 8, 2007, London
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Introduction

- Aspects of modelling Incremental Default Risk
- Translating "constant level of risk" into a model
- Diversification between different liquidity horizons
- Implications on default risk in the trading book

Disclaimer: The views expressed in this paper are those of the author and do not necessarily reflect the position of Deutsche Bank AG.

Trading Book Review

The Application of Basel II to Trading Activities and the Treatment of Double Default Effects

July 2005

259. Since the Market Risk Amendment took effect, more credit risk-related products have been booked in the trading book. These positions include, for instance, credit default swaps (CDS) and tranches of collateralised debt obligations (CDO). The inclusion in the trading book of such products leads to a concomitant rise in default and jump-to-default risk, risks that are supposed to be captured in specific risk models, but which have proved difficult to capture adequately with VaR.

262. The 4xVaR multiplier has created a disincentive for banks to improve their specific risk models to attempt to capture better default and event risks because this would generally result in higher capital charges than simply applying the 4xVaR multiplier. […]

286. […] While no specific approach is prescribed for this calculation (it may be part of the bank's internal model or a surcharge from a separate calculation), all approaches will be subject to a soundness standard comparable to the IRB-based approach for credit risk, under the assumption of a constant level of risk, and adjusted, where appropriate, to reflect the impact of liquidity, concentrations, hedging, and optionality.

EU Directive

In addition, the institution shall have an approach in place to capture, in the calculation of its capital requirements, the default risk of its trading book positions that is incremental to the default risk captured by the VaR-based calculation as specified in the previous requirements of this paragraph. To avoid double counting an institution may, when calculating its incremental default charge, take into account the extent to which default risk has already been incorporated into the VaR calculation, especially for risk positions that could and would be closed within 10 days in the event of adverse market conditions or other indications of deterioration in the credit environment. Where an institution captures its incremental default risk through a surcharge, it shall have in place methodologies for validating the measure.

The institution shall demonstrate that its approach meets soundness standards comparable to the approach set out in Articles 84 to 89 of Directive [2000/12/EC], under the assumption of a constant level of risk, and adjusted where appropriate to reflect the impact of liquidity, concentrations, hedging and optionality.

IRB ~ 1 year, 99.9%

Ingredients

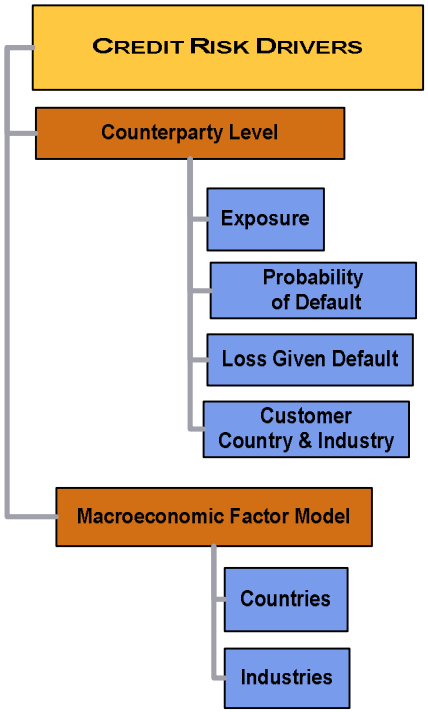
- Exposure: how much do we lose in case of default
- Credit portfolio model: simulate defaults in a portfolio (!) context
- Liquidity horizon model: what time does it take to sell or hedge default risk
- Short term PDs: how likely is default at short time horizons
- Rollover: how do we model constant level of risk

Focus will be on the last point!

And now let's implement the current guidance as directly as possible…

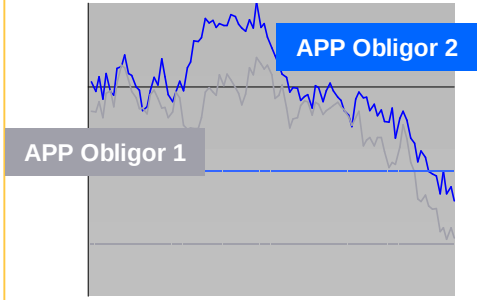
Economic Capital for Credit Risk

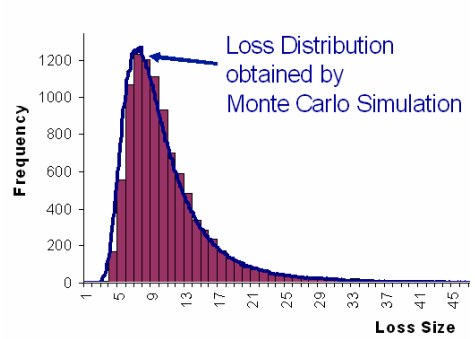
Inputs



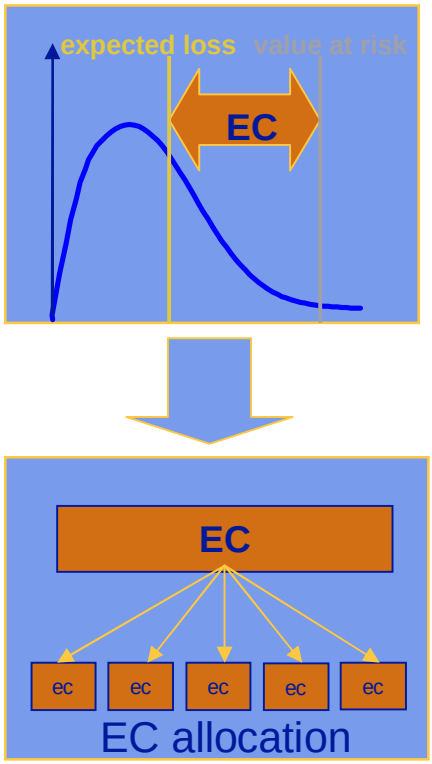
Aggregation (Monte-Carlo simulation)

Portfolio model for joint defaults





Outputs



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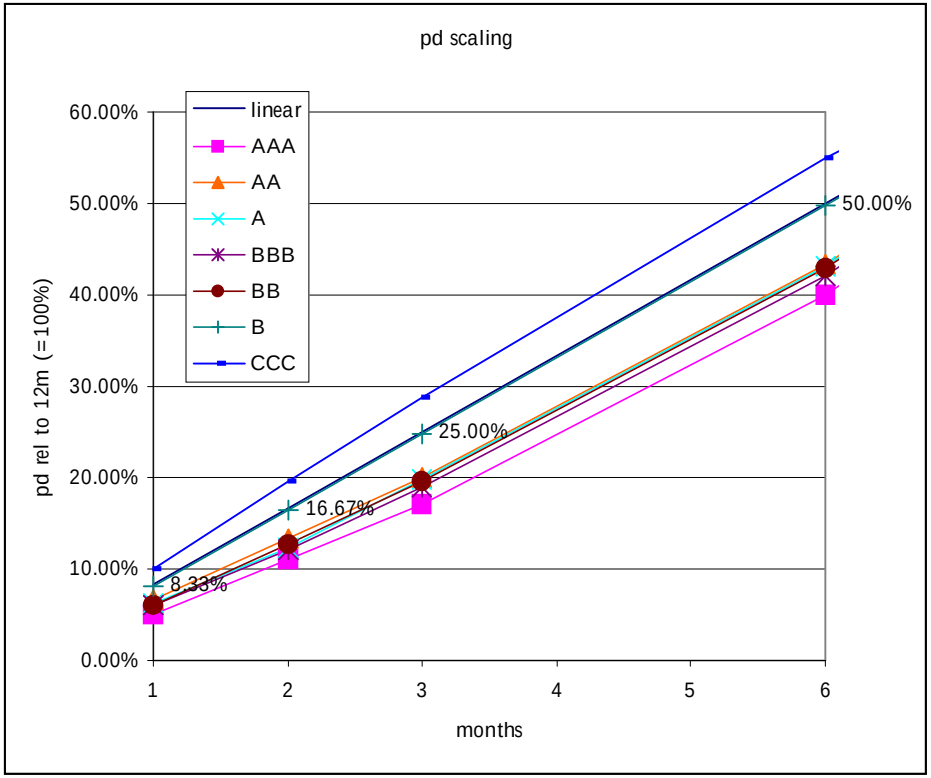
Short term PDs

- One standard approach assumes that rating migrations are Markov, ie. independent for non-overlapping time periods
- Under this assumption, short term PDs can be derived using a generator matrix approach (logarithm of one year transition matrix)
- All calculations below are based on a transition matrix and the generator matrix approach
- Default data seems to exhibit positive autocorrelation, thus we overestimate our short term PDs somewhat
- As will be seen below, our approach to constant level of risk does not need scaled PDs

Ø This is still an open research issue: no industry standard established yet!



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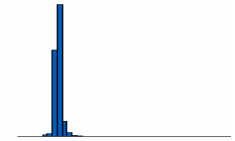
Constant level of risk (I)

Rollover and replacement of positions

- **If we assume constant level of risk taking, we need to**
  - Replace assets with changed credit quality with similar asset at liquidity horizon
  - This raises a lot of questions:
    - Shall we assume it is in the same name?
    - Shall we assume it is in the same industry/country?
    - Shall we distribute the exposure to other similar names in the portfolio?
    - What if no other or only few other names of same characteristic exist? Would we not increase concentration?
- **This approach is far from simple to implement directly…**
- **Alternative: Some have proposed simple scaling of default probabilities which is mathematically incorrect.**
- **But there is a direct approach:**

Constant level of risk (II)

What then is constant?



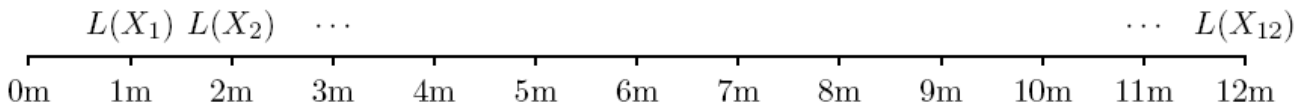
- **In a model, the loss distribution is THE characterizing property for risk!**

Constant Level of Risk == Same loss distribution

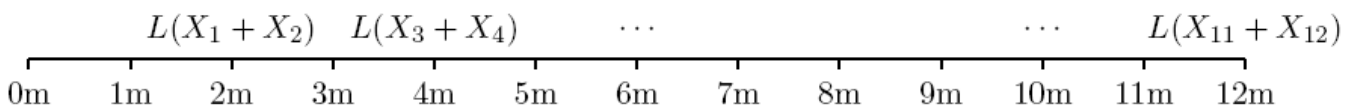
- **Example:**
  - Consider subportfolio assigned to one month liquidity horizon
  - Calculate one month loss distribution using one month default probabilities
  - For the second month we assume the same loss distribution again
  - The one year constant level of risk loss distribution is the convolution of 12 copies of the one month loss distribution
  - In Monte Carlo context, sum 12 independent draws from the one month loss distribution, repeat many times to derive one year loss distribution
- **So we need to implement a multi-period version of our credit model**

Constant level of risk (III)

Losses for 1m portfolio $\sum_{i=1}^{12} L(X_i)$

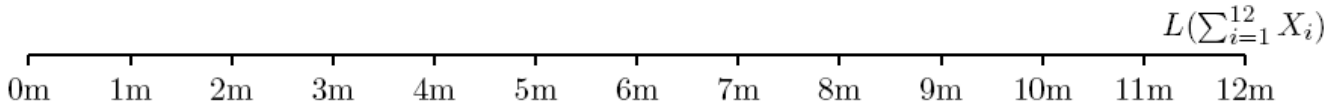


Losses for 2m portfolio $\sum_{i=1}^{6} L(X_{2i-1} + X_{2i})$



...etc...

Losses for 1y portfolio $L(\sum_{i=1}^{12} X_i)$



Total portfolio loss across all liquidity horizons

$$\sum_{i=1}^{12} L(X_i) + \sum_{i=1}^{6} L(X_{2i-1} + X_{2i}) + \cdots + L(\sum_{i=1}^{12} X_i)$$

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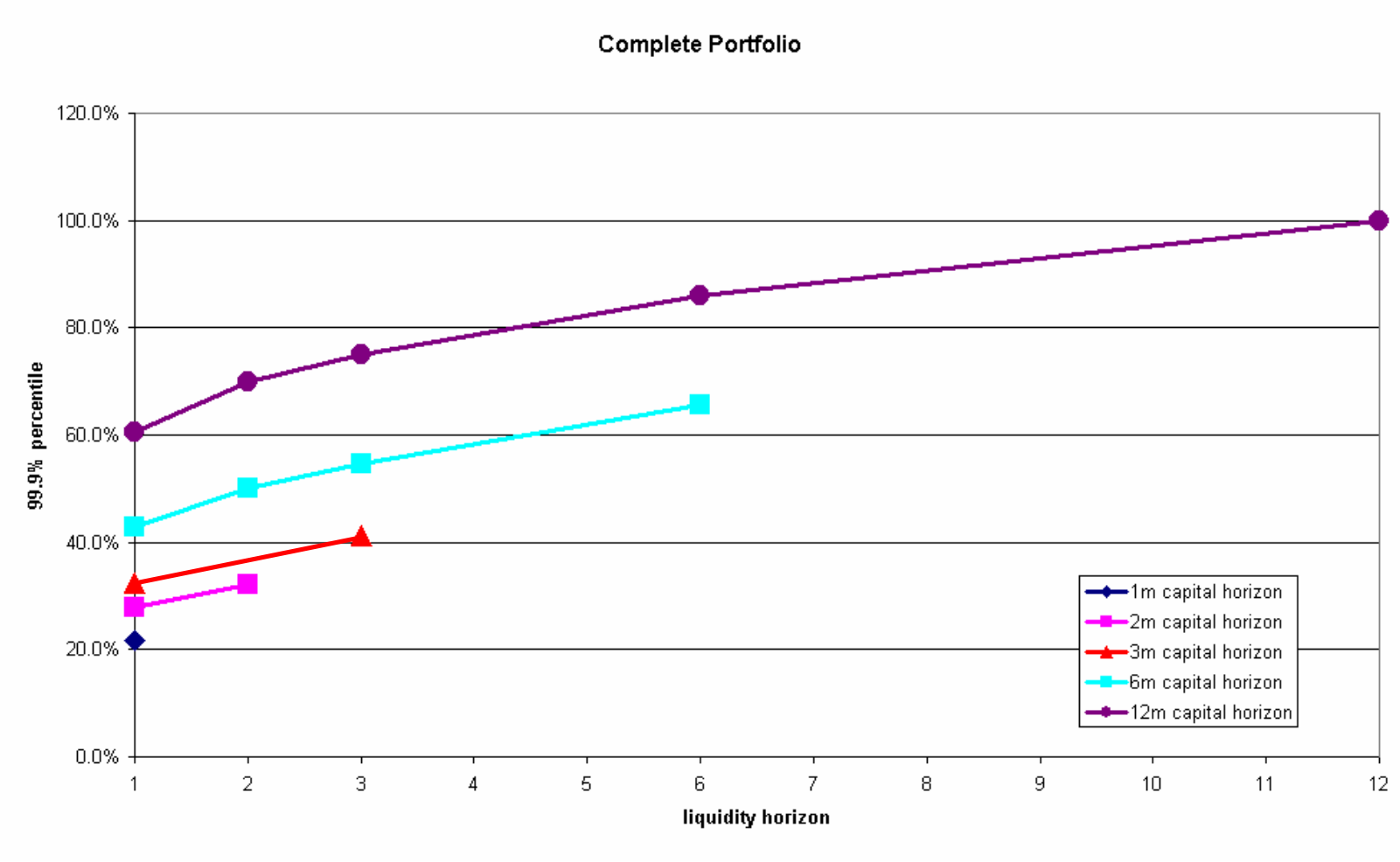
Results



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How do the capital charges compare?

IRB

Incremental Default Risk

Basel I
VaR

Dufourspitze

Ben Nevis

Warning: All heights and proportions are of illustrative character and only roughly indicative of real figures. Pictures taken from wikipedia and linked websites

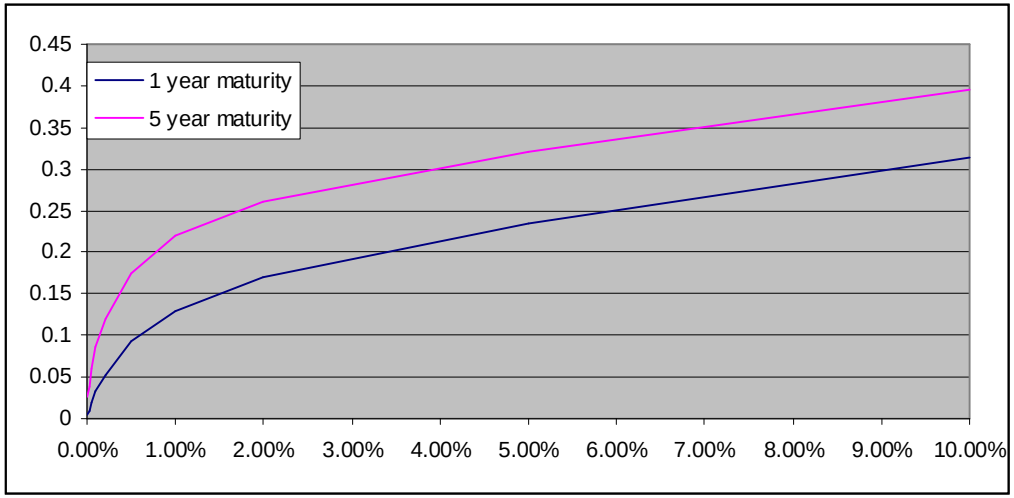
Olympus Mons

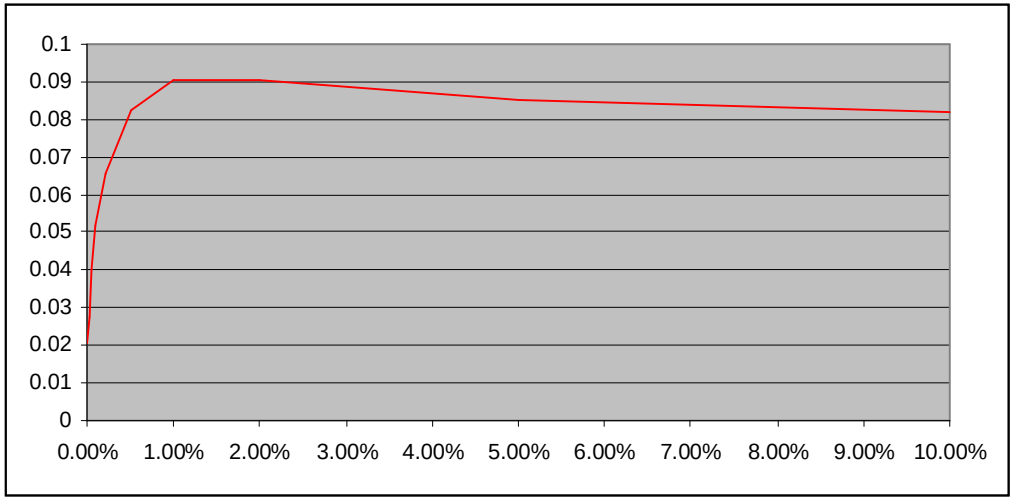
IRB Risk Weights

Capital requirement (K) = [LGD * N [(1 - R)^-0.5 * G (PD) + (R / (1 - R))^0.5 * G (0.999)] - PD * LGD] * (1 - 1.5 x b(PD))^ -1 × (1 + (M - 2.5) * b (PD)

The regulatory risk weights are not necessarily a monotonous function of default probability:

- for each position individually they are monotonous
- when netting long and short positions they are not:
  - long EUR 1 maturity 5 yrs
  - short EUR 1 maturity 1 yr





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Building Sites

Reduction of capital horizon

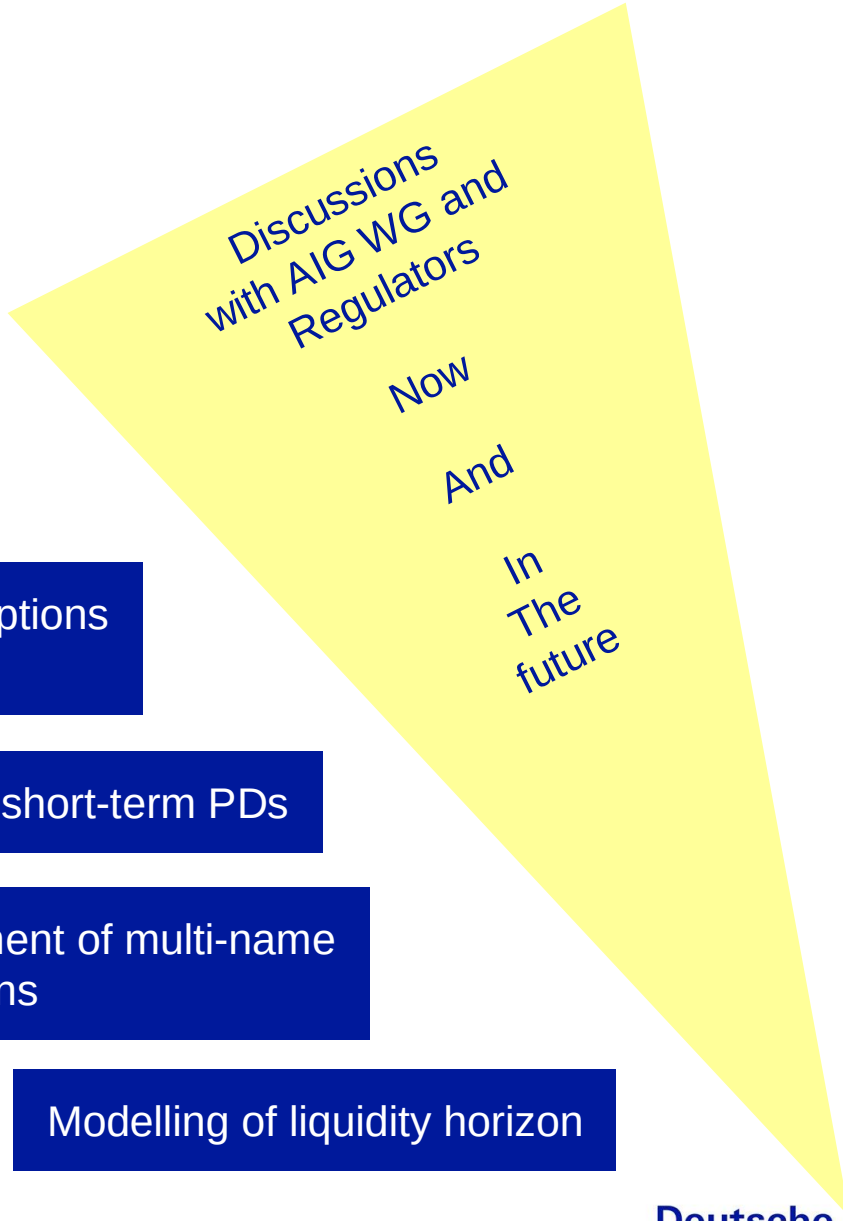
Diversification
- market risk
- other credit risk

Behavioural assumptions
e.g. stop/loss

Calibration of short-term PDs

Treatment of multi-name positions

Modelling of liquidity horizon



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Q&A

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