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Capitalizing unexpected losses with A-IRB

Banks are exposed to many types of risks. Amongst the risk spectrum, credit risk is by far the largest and most elemental risk for a bank. It broadly refers to the probability that a client cannot (fully) repay its loan(s) and the losses the bank is therefore exposed to. To ensure that banks are able to endure such losses without becoming insolvent, international regulations have been imposed with respect to minimum capital requirements for unexpected losses. In 1988 the Basel Committee of Banking Supervision (BCBS) released a set of minimal capital requirements for banks, known as Basel I or the Basel Accords. Since first introduction, many more additional regulations and extensions have been published. The enhancements of the requirements in the Accords over the years show a shift from initial simplicity to more risk-sensitive requirements. In order to come up with risk-sensitive capital requirements the internal ratings-based approach (IRB) has been developed. This article will discuss the IRB approach and some parallels for banks, insurance companies and pension funds with respect to the calculation of credit risk.

WHAT IS A-IRB?

The advanced internal ratings-based approach (A-IRB) is a specific version within the IRB-framework for the banking and financial industry that supports the institution's measurement of credit risk using its own (advanced) internal models. It was initially proposed in 2004[1] as part of the Basel II capital adequacy rules to enhance the levels of trust, transparency, consistency and compliance in the capital markets playing field.

The capital calculated under the A-IRB approach has the sole purpose of measuring the unexpected losses over a one-year horizon, but does not cover the full loss spectrum an institution might face. Note that expected losses (i.e. normal "costs" of doing business) and stress/catastrophic losses (i.e. losses with tail risks in extreme events) are covered by different regulations, as described in Figure 1.

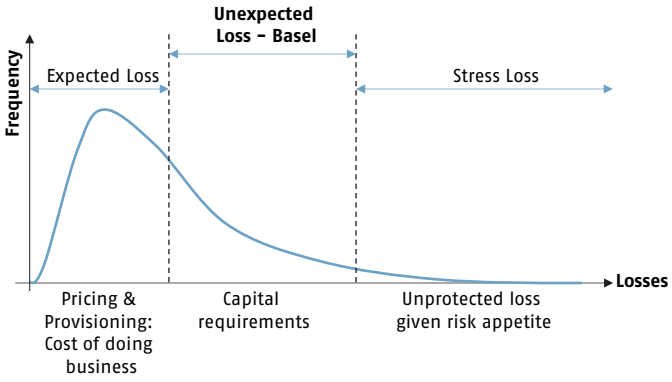

Figure 1: A bank's loss distribution calculated under different regulations. The distribution is reported with the occurrence frequency (y-axis) and the loss severity (x-axis).

The A-IRB models are generally able to provide the best risk differentiations for banks in the IRB framework and should hence be able to best reflect the risk-sensitive capital it has to hold. This is measured through risk-weighted assets (RWA), which are defined by the following formula for non-defaulted or performing retail loans:

$$RWA = 12.5 \times EAD \times LGD \times \left(N\left(\frac{N^{-1}(PD)}{\sqrt{1-R}} + \sqrt{\frac{R}{1-R}}\, N^{-1}(0.999) \right) - \mathrm{PD} \right) \times 1.06$$

Here, *EAD* is the Exposure at default, *LGD* is the Loss given default under downturn circumstances, *PD* is the Probability of Default and *R* is the correlation factor.

The formulas are prescribed by the regulator, where the LGD is conditioned on crisis events that are expected to occur once approximately every 10 years (i.e., based on historically observed downturn period requirements). The PD is a long-term average probability that is translated by the RWA-equation into a 1-in-1000 years stressed event. The determination of some of the components is left to the discretion of the banks, where model development teams mainly develop PD and LGD models. In addition, some *EAD* models

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might be required for the off-balance sheet exposures within the portfolio.

TIME TO MODEL!

Although the development of the model components is left to the banks, it does not mean that there is no guidance from the regulator. In Europe, there are clear guidelines, set forth by the European Banking Authority (EBA), on the models that are internally constructed within the IRB framework.

All models generally start with a thorough data processing exercise to retrieve data from multiple internal data sources and to prepare for model development. The challenges in modelling are often highly driven by the availability and quality of historical internal data. It is regulatory prescribed that a historical model development dataset should cover a sufficiently long time-span and at least one full business cycle (i.e., periods with good as well as bad economic conditions). Due to various reasons, it can be challenging to find sufficient representative data for the current portfolio that contains a full business cycle.

The PD model development contains two stages: ranking and calibration. First, risk drivers have to be found that can discriminate between 'good' (low PD) and 'bad' (high PD) clients. It is also possible that transformations or adjustments have to be applied to make risk drivers more predictive. This could for example include missing value treatment, outlier treatment and binning (making a discrete variable from a continuous variable). Risk drivers are first tested univariately for discriminatory power and, only if certain thresholds are satisfied, will be added to the multivariate analyses. Highly correlated risk drivers are usually removed. A logistic regression is used to determine the impact of every risk driver on the total PD ranking. After the ranking phase, the PD model will be calibrated. It is market practice to apply a binning algorithm onto the PD ranking and assign the year-weighted observed default rate per bin as calibration.

The LGD model is usually a combination of several subcomponents. A common model structure distinguishes between two default resolutions or outcomes. The defaulted client can either fully repay all missed payments and hence cure or the client's position can be liquidated by selling the collateral of the loan. This leads to:

$$LGD = CR \times LGC + (1-CR) \times LGL + IC$$

Here, CR is the cure rate or the probability that a defaulted client will recover from default, LGC is the Loss given Cure, LGL is the Loss given Liquidation and IC is the Indirect Costs for the treatment of defaults, such as costs of the special asset management department.

The LGD components can be estimated separately with different techniques. The cure rate model typically uses a similar logistic regression to the PD model. The loss for cured clients is primarily based on the loss due to a delay in received cash flows, i.e. discounting losses reflected by the net present value (NPV). This leads to relatively simple models based on the time in default and the interest rate. The LGL is the most complex component of the LGD. There are multiple techniques possible, but currently the structural approach is market practice. This means that the LGL is modelled as a combination of estimated cash flows. For a mortgage portfolio it could be:

$$LGL = \max\left(\frac{EAD - NPV\,(Expected\ Sale\ Proceeds\ House + NHG\ claim + other\ cash\ flows)}{EAD}, 0\right)$$

In case of a mortgage loan the bank will not receive more than the outstanding exposure on the loan, when the collateral is sold. Therefore, the house sale proceeds are capped. This makes the estimation not straightforward. The estimation of the NHG[2] claim is even more complex, since it depends on the coverage, the remaining loss after the house sale proceeds, and the applicable NHG rules during the origination of the loans.

DUE TO ALL THESE STEPS, THERE IS SUBSTANTIAL UNCERTAINTY INCLUDED IN THE MODEL

When all components of the LGD model are estimated and combined, the modelling is still not finished. The LGD model gives, after calibration, a good estimation of the expected loss under the effective market circumstances. However, the LGD in the RWA formula should reflect the estimates under downturn circumstances. The downturn methodology typically tries to establish a relation between macro-economic circumstances with the bank's internal loss data. This can be used to determine the appropriate loss under a macro-economic downturn scenario.

Due to all these steps, there is substantial uncertainty included in the model. This uncertainty may originate from several places, such as: data deficiencies, process changes within the bank, modelling techniques, estimation errors and uncertainty due to a limited number of observations. These are all captured in a Margin of Conservatism (MoC) and added on top of the LGD estimates. Note that a MoC is calculated for both PD and LGD models.

PROCESS TOWARDS MODEL USE

Development of internal credit risk models (A-IRB) is only one piece of the puzzle in the full model process. The process is visualized in Figure 2 and might take up to three or four years to be fully completed. Note that, before the process even starts, there should have already been a lengthy process for acquiring approval to build internal models and convert all EBA guidelines into proper internal model methodology standards.

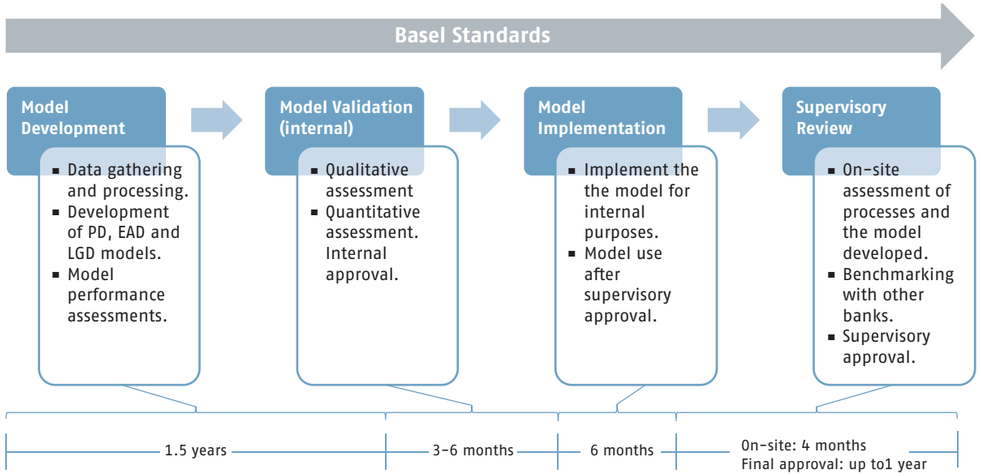

Figure 2: Schematic overview of the full model process towards using the model for capital calculations. Note that the timelines are approximations and might differ per model and institution.

All steps of the process are guided by the overarching Basel Standards that are in force at the time of the model development. The validation and review bodies do not only assess the correct inclusion of these corresponding guidelines in the developed model, but also have additional guidance on how to perform proper model assessments. For example, the supervisory body also performs benchmarking with the internal models of peer banks. Finally, even after acquiring formal approval from the supervisory body, it could still take time before the model can actually be used for the calculation of capital.

CAPITAL REQUIREMENTS OVER MULTIPLE REGIMES

The development of A-IRB models is a long and costly process. Furthermore, the average capital requirements are high and will rise the coming years due to new capital floors (both on model component and model output level) in Basel reforms. Therefore, many banks will likely adopt the strategy to sell part (securitize) of the assets to insurance companies and pension funds. This may result in a net benefit for the collaborating parties due to regulatory arbitrage that's present between the different regulations between banks (e.g., Basel), insurers (e.g., Solvency II), and pension funds (e.g., FTK).

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Some portfolios are more likely candidates to sell to an insurer or pension fund than others. For example, loans with long maturity, such as mortgages, could be more interesting for pension funds than for banks due to their willingness for long term funding. Also the ability to limit the capital requirements by an NHG guarantee differs. Table 1 presents corresponding differing capital requirements, indicating that an asset could yield different capital levels based on the balance sheet on which it is reported.

	Banks	Insurers	Pension Fund
Regulation	Basel IV	Solvency II	FTK
Confidence level	99.9%	99.5%	97.5%
NHG Recognition	Yes	No (in process)	Yes
Funding Terms	Short	Medium/Long	Long

Table 1: Regulatory differences over multiple regimes.

Some discrepancies with respect to capital requirements for different types of institutions make economic sense. An example is the duration argument. However, there are also unexplainable differences from a risk perspective, which could potentially lead to undesirable arbitrage. Awareness of the discrepancies and discussions on the validity thereof are important elements in preventing additional systemic risks. ■

1 – Prior to the full implementation of the Basel II framework on a global scale, the global financial crisis in 2008 led to a reform of the Basel Accords that resulted in even more stringent guidelines as per Basel III.

2 – NHG is a Dutch guarantee system to safeguard the borrower/lender in case of contractual payment issues or remaining debt after the sales of the house.