Deloitte.

Once in a Lifetime Change

PD Modelling under IFRS 9

Thomas Clifford, Pawel Tatarczyk and Robert Richter

CRC | Credit Research Centre

Introduction

The Team

Thomas Clifford

Tom is a Director in Deloitte's Financial Services Advisory Group. He specialises in credit risk modelling across the banking sector, having implemented, reviewed and applied credit risk models across the full spectrum of Retail, Commercial, Corporate and Wholesale lending operations. Tom has a Masters degree in Physics, an Honours degree in Financial Services and is a qualified Prince2 practitioner.

Pawel Tatarczyk

Pawel is a Manager in Deloitte's Financial Services Advisory Group. He specialises in credit risk measurement and modelling for the banking sector. Pawel has implemented, reviewed, applied and audited credit risk models across Retail, Commercial and Wholesale lending operations. Recently, Pawel has led the development of impairment modelling methodology design under IFRS 9 for a Top 10 UK retail bank. Prior to becoming a consultant, Pawel was a credit risk modeller for a Tier-1 UK Bank.

Robert Richter

Robert is an Assistant Manager in Deloitte's Risk and Regulation practice within credit risk. Robert has experience in impairment and capital model development, stress testing and forecasting in Retail Banking. Prior to joining Deloitte Robert worked in the Capital & Impairment Forecast Modelling team at Lloyds Banking Group. Robert is a native speaker in German and holds a Masters Degree in Economics from the University of Warwick.

We would like to extend our sincere thanks to Sam Tesseris whose hard work and commitment played a significant role in generating the results produced in this analysis and producing this presentation.

Introduction

Deloitte's Experience

Deloitte have extensive experience with IFRS 9 modelling, spanning multiple quantitative impact studies and the development of an IFRS 9 impairment calculation engine prototype for a Large UK Retail Bank.

Content

The purpose of this presentation is to discuss and outline the intricacies of Probability of Default (PD) modelling under IFRS 9. Furthermore we will share the lessons learnt from the development of an IFRS 9 impairment calculation engine prototype.

Deloitte have effectively leveraged prior knowledge to build an IFRS 9 compliant impairment calculation engine. The purpose of this presentation is to focus on PD modelling, as it is at the heart of IFRS 9.

EAD, LGD and Survival Rate modelling was also investigated as part of the prototype but is not covered as part of this presentation. Please contact the presenters should you have any questions on these modelling components.

This presentation covers the following areas:

- Overview of the IFRS 9 Framework
- The importance of PD under IFRS 9
- Incorporating Economics
- Markov Chains
- Presentation of Findings

Introduction

Client Experience

Deloitte have worked with various clients to support their IFRS 9 projects, ranging from small to medium and large UK Retail Banks. Furthermore we have gained international exposure as well.

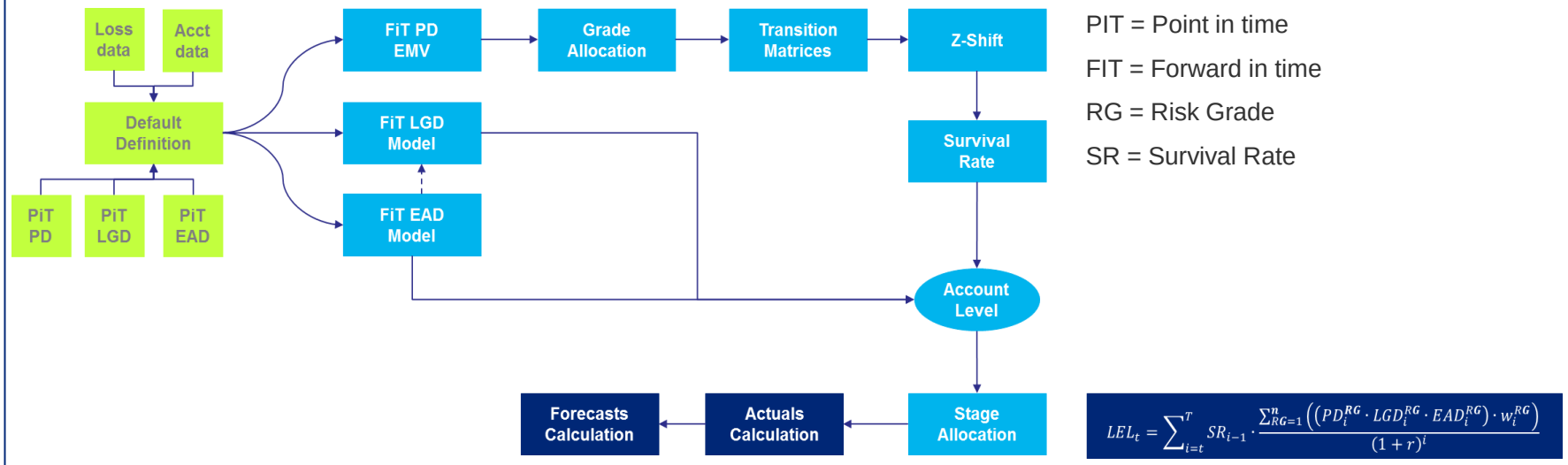
GE Capital

IFRS 9 Framework

Overview

Deloitte have designed a comprehensive framework to calculate the impairment stock and impairment charge under IFRS 9. The graph below outlines this methodology at a high level.

IFRS 9 Framework Flow Chart



IFRS 9 Framework Overview

The framework leverages existing Basel PiT PD, EAD and LGD estimates to ensure that the IFRS 9 modelling solution is integrated with existing model outputs.

The methodology is flexible to be tailored to secured, unsecured or business banking portfolios, ensuring consistency across portfolios and the possibility for knowledge transfer within the organisation. Portfolio specific components such as dynamic LGDs on secured portfolios for instance can be accounted for.

Furthermore, it aligns the actual and forecast calculation, thereby minimising complexity as well as computational requirements.

PD Modelling

At the heart of IFRS 9

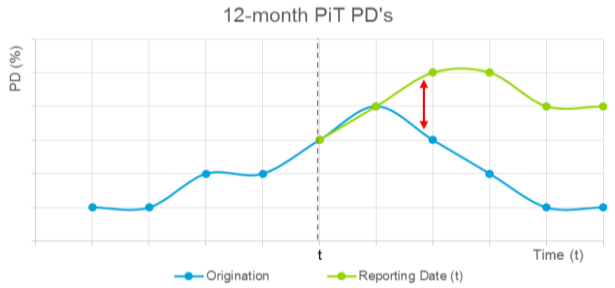
The assessment of whether lifetime expected credit losses should be recognised is based on significant increases in the likelihood or risk of a default occurring since initial recognition instead of on evidence of a financial asset being credit-impaired at the reporting date or an actual default occurring. (B5.5.7)

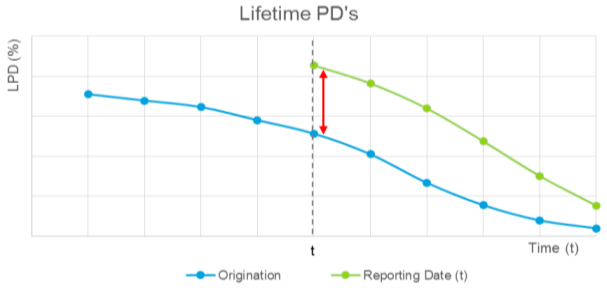
BCBS Guidance

The Committee also emphasises that, to assess whether a financial instrument should move to a lifetime expected credit loss (LEL) measure, the change in the risk of a default occurring over the expected life of the financial instrument must be considered. (A3)

Illustration

The 12 months PD may not capture a significant increase in credit risk, if the economic downturn is expected to occur at a later stage, as illustrated in the left hand graph. The Lifetime PD (LPD) captures this downturn and will therefore identify a SIICR sooner.





Key Consideration

Given the forward looking nature of IFRS 9 the12-month probability of default may not capture the future expectations around the performance of an asset.

Lifetime PD Modelling

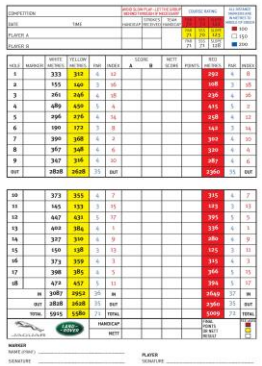
Overview

The difficulty underlying IFRS 9 is to construct a Lifetime PD schedule. The methodology Deloitte have used consists of three components, namely the PiT PDs, a regression model and a Markov Chain.

PiT PDs

The PiT PDs form the basis of the analysis are leveraged from the existing scorecards. The PiT PDs are used in two ways:

- Calculate the average PiT PD by risk grade
- Construct a migration matrix between risk grades

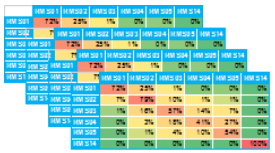


Regression Model

- The regression model incorporates the economic impact into the LPD.
- The model is based on an aggregated default rate that is regressed on various factors, including economic variables.
- Deloitte investigated whether Partial Least Squares or Panel models perform better.
- This analysis is presented on slides 8 and 9

Markov Chain

- Base matrix is adjusted for expected behaviour driven by the economy (Z-Shift)
- Markov Chain, consisting of individually z-shifted matrices determines transition behaviour at each future point in time



Outputs

These components are combined in the following way to produce a LPD:

- The Z-shifted Markov Chain produces the probability of being in any given risk grade at any given point in time
- Weights are combined with the average PiT PD of each risk grade to produce a LPD

Incorporating Economics into Lifetime PD

PLS vs. Panel – PLS showed superior results

Deloitte conducted a comparative study to analyse whether a PLS or Panel model yields more satisfactory results. This slides outlines the results of the Panel model.

Methodology

The Panel Regression modelled the default rate at a vintage level. The model captured the following factors simultaneously:

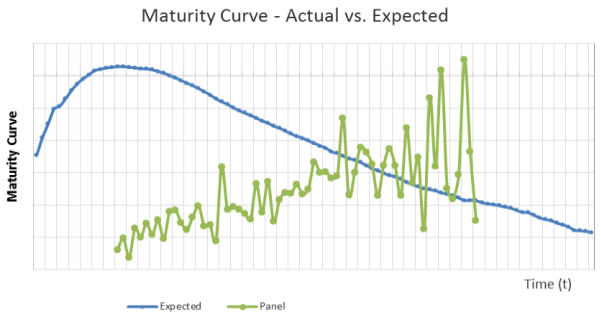
- **Economics**
- **Maturity** – Time an account has been on book
- **Vintage** – Captures differences in vintage quality (e.g. accounts booked during the financial crisis may exhibit different risk than accounts booked just prior to the crisis)

The results did not outperform the PLS model (presented on the next slide), especially the maturity curve did not meet the expected criteria.

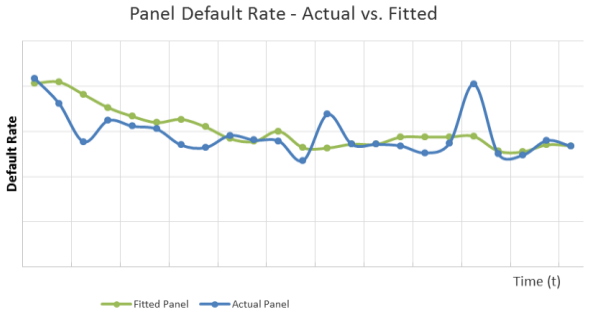
Questions:

- Do balanced or unbalanced sample yield better results?
- Should maturity be captured as the time component or dummy variables?

Maturity Curve



Model Performance



Incorporating Economics into Lifetime PD

PLS vs. Panel – PLS showed superior results

Deloitte conducted a comparative study to analyse whether a PLS or Panel model yields more satisfactory results. This slides outlines the results of the PLS model.

Methodology

Partial Least Squares breaks down the dependent variable into its specified components. The definition of the variable depends on the portfolio, but it should be aligned with existing arrears or default processes.

In this particular instance the chosen components were:

- **E** – Exogenous (i.e. Economic impact)
- **M** – Maturity (the number of months the account has been on book)
- **V** – Vintage (acquisition month)

The second step is to build an OLS regression model for the E series. This model is used to predict E into the future. The M and V components are kept constant for simplicity.

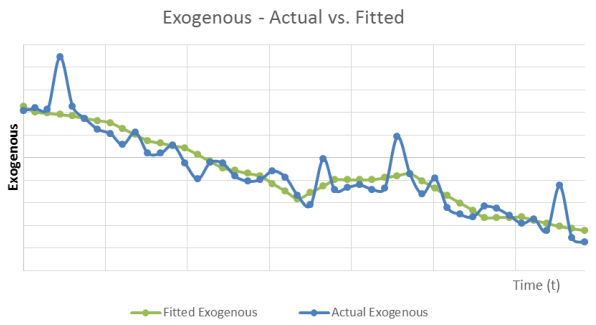
The model outputs are presented on the right hand side.

Regression Output

Regression Statistics	
R Square	0.8459
Adjusted R Sqare	0.8388
RMSE	0.14196
Observations	46

Coefficients	Value	P-value
Intercept	-58.32258	< 0.0001
Variable X	11.71803	< 0.0001
Variable Y	4.07462	0.0478

Model Performance



Markov Chain

Flexed in line with the economy

The requirement of IFRS 9 is to calculate the expected loss across all possible outcomes. Therefore the future risk grade of an account post migration needs to be taken into account. The Markov Matrix enables this and was flexed in line with the economy via a Z-Shift.

Methodology

- The Z-Shift targets the default rate for each risk grade, based on the outputs of the regression model.
- The aim is to move more customers into a bad risk grade during economic downturns and vice versa. This is done via a methodology called Z-Shift and is illustrated on the right hand side.
- The Base Matrix is determined with actual data, whereas the Benign and Stressed Markov Matrices have been adjusted, based on regression outputs.
- This methodology determines the probability of an account being in each risk grade at any given point in time.
- For instance an account in risk grade 1 has a 89% chance of staying in risk grade 1 in a benign economic scenario vs a 84% chance in a stressed scenario.

Base Markov Matrix

Risk Grade	1	2	3	4	Default
1	89%	6%	3%	2%	0.25%
2	4%	88%	4%	3%	0.75%
3	1%	5%	88%	5%	1.25%
4	1%	2%	5%	88%	5.00%
Default	0%	0%	0%	0%	100%

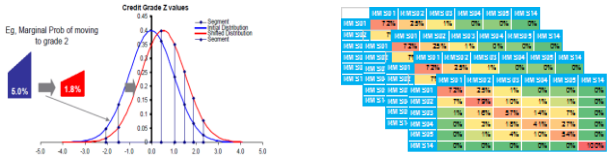
Benign Markov Matrix

Risk Grade	1	2	3	4	Default
1	89%	6%	3%	2%	0.15%
2	4%	88%	4%	3%	0.55%
3	1%	5%	88%	5%	1.00%
4	1%	2%	5%	90%	3.00%
Default	0%	0%	0%	0%	100%

Stressed Markov Matrix

Risk Grade	1	2	3	4	Default
1	84%	6%	5%	3%	2.00%
2	3%	83%	6%	4%	4.00%
3	1%	4%	81%	8%	5.75%
4	1%	1%	3%	84%	11.00%
Default	0%	0%	0%	0%	100%

Process



Lifetime PD Results

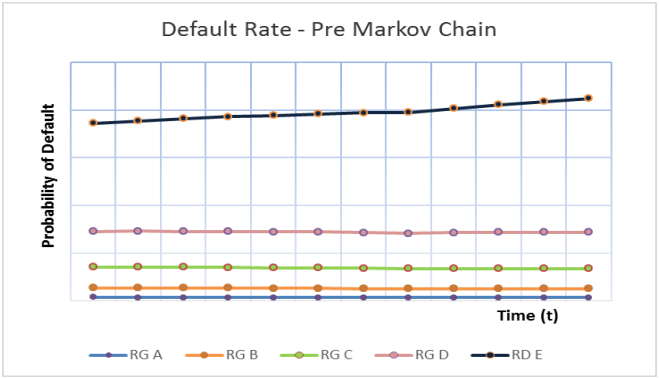
Lifetime PD used for LEL calculation and SIICR identification

The presented methodologies of PLS and the Markov Chain are combined to determine the Probability of Default for a segment at each point in time in the future. **The key take-away is that the model responds to economics and takes into account the probability distribution across risk grades.**

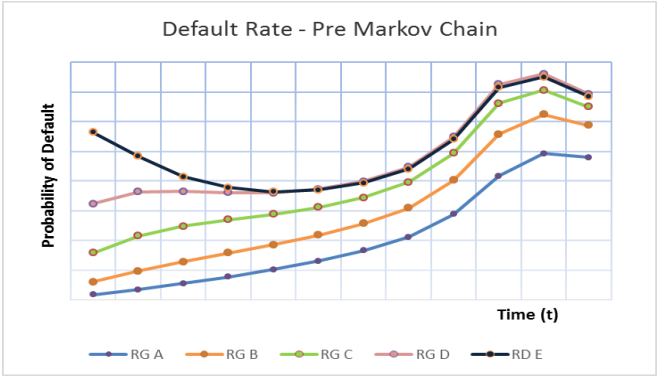
Methodology

- The following charts show the PD schedule over the lifetime of an account/ segment.
- The PDs at each point in time prior to taking transition probabilities into account are relatively stable as shown in the top graph.
- Incorporating the transition probabilities causes the PDs for each risk grade to converge.
- This mechanism facilitates the determination of a Significant Increase In Credit Risk.
- The methodology calculates the Lifetime PD at the segment level, however the calculation can be allocated to the account level.
- This methodology is combined with the calculated Survival Rates, EAD and LGD to determine the Lifetime Expected Loss under IFRS 9.

Pre Markov Chain



Post Markov Chain



Q&A

We welcome your feedback and inputs.