Actuaries Institute

Basel II retail modelling approaches
PD Models

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Agenda

Introduction

Section 1 : Background to IRB models

Section 2 : Through the cycle methodologies

Section 3 : Structural models and their practicalities

Introduction

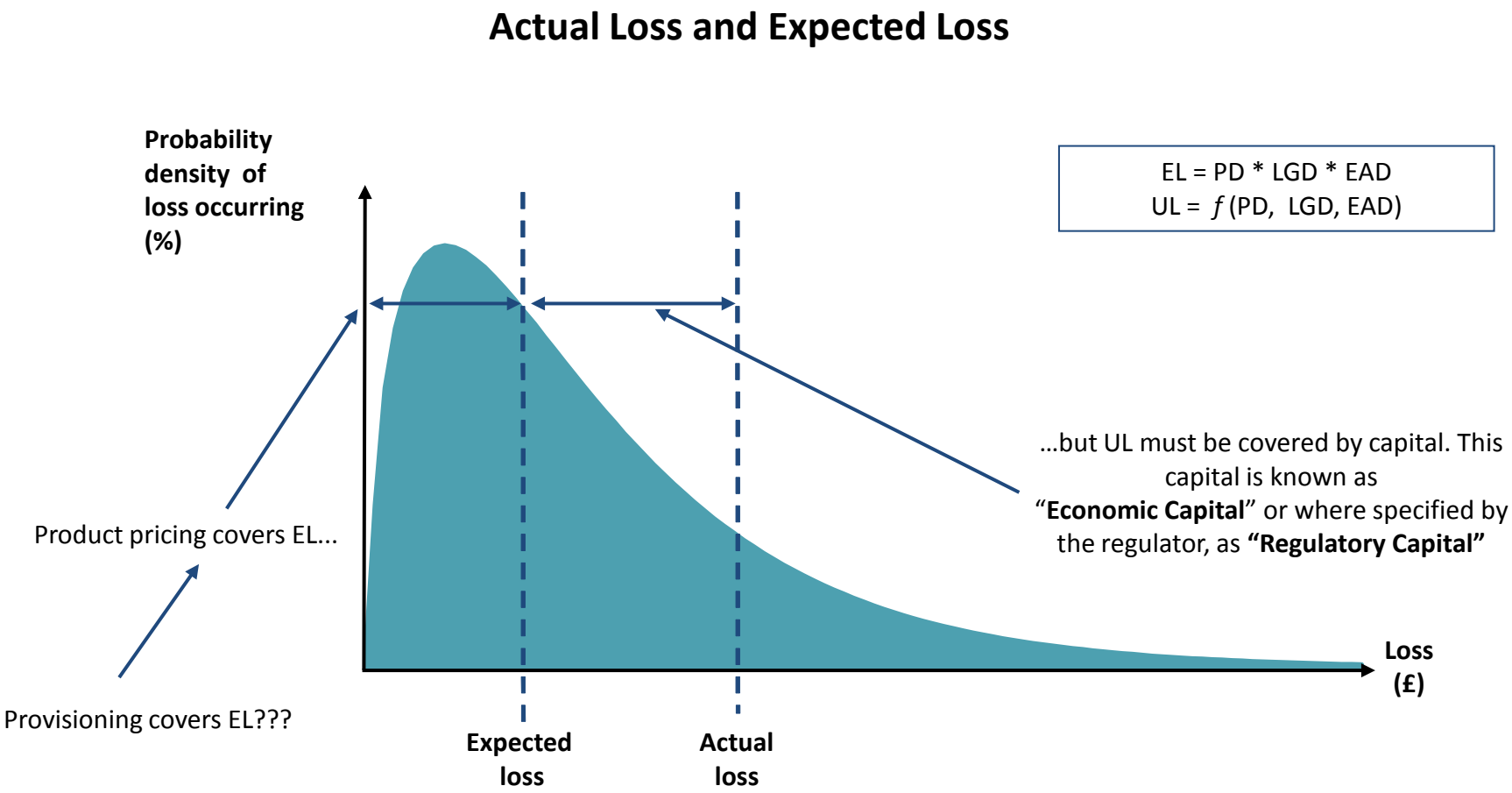
- Basel II process has greatly increased the sophistication and profile of credit risk measurement within financial institutions,
- But challenges still exist in the development of credit models, and particularly in the calculation of probability of default (PD):
- The Regulatory bar has increased
- Incorporate what we have learnt from the GFC
- Desire for less capital volatility has led to an increased focus on Through the Cycle (TTC) PD models
- This session will look at the challenges faced by financial institutions in developing their TTC PD models for retail portfolios
- This session will also discuss the two broad methodologies being applied to retail TTC model development.

Section 1

Background to internal ratings based (IRB) models

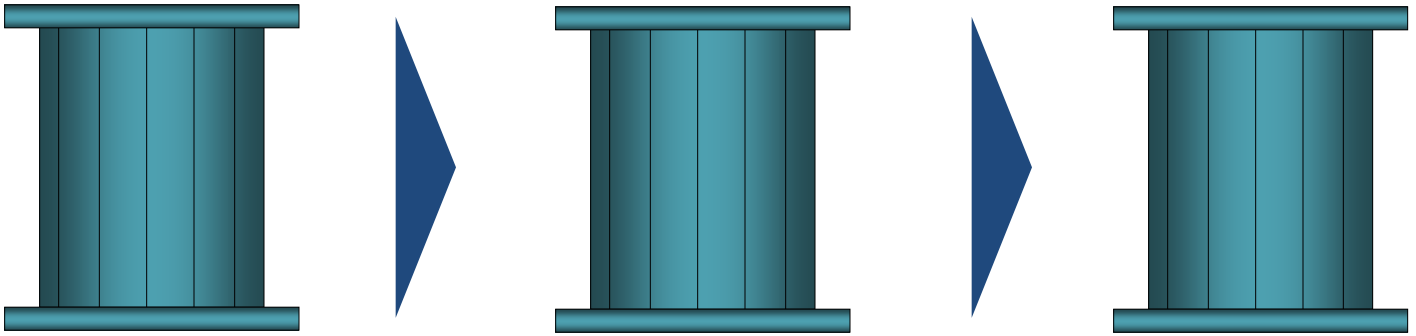
Overview of Basel II

Why the need for capital?



Overview of Basel II

Overarching Framework



Pillar 1

Minimum capital requirements

- Credit risk
- Operational risk
- Market risk

Pillar 2

Supervisory review

- Supervisory review of risk management and regulatory capital

Pillar 3

Market discipline

- Enhanced disclosure

Overview of Basel II

Capital and Internal Ratings Models

Basel II allows firms to use one of two broad approaches to the calculation of capital:

- Standardised Approach: uses supervisory risk weights to calculate capital based primarily on the asset class
- Internal Ratings Based Approach: allows firms to model the key parameters of PD, LGD and EAD which are then input into a regulatory RW function to calculate capital

A long-run PD requirement

Basel II introduced the concept of a long-run PD, which is commonly associated with the expected default rates over a period of time covering at least an economic cycle.

The introduction of this concept has major modelling implications that have to be addressed while considering each bank environment and constraints.

Best practices

Every method for estimating the long run PDs must include the following elements:

- A firm must estimate PDs by grade from long-run averages of 1 year default rates
- The long-run average must include default rates from a representative mix of good and bad years for the economy
- PDs must be forward-looking – a simple extrapolation from historical data is only a starting point

Constraints

The choice of the methodology must also consider the constraints inhibiting TTC PD development:

- Data constraints: missing data and length of data,
- Lack of economic cycle within Australia
- Differing downturns not necessarily predictive of future downturns

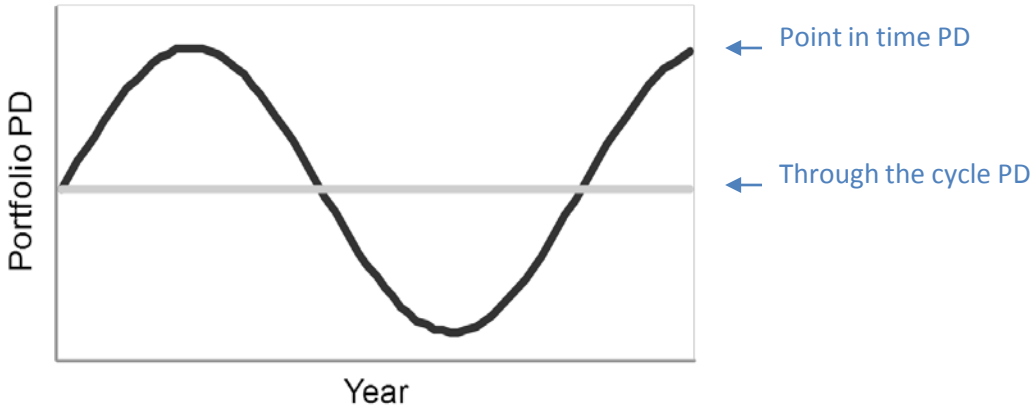
Rating philosophies

Point in time vs. through the cycle PD

The choice of drivers in the rating system leads to two stylised approaches to PD modelling. The nature of the model is usually determined by the degree of cyclicality in the underlying model drivers

- A **point in time (PIT)** probability of default (PD) assesses the likelihood of default at that point in time. As it assesses risk at a point in time, the borrower will move up or down rating grades through the economic cycle.
- **Through the cycle (TTC)** PDs, in contrast, predict average default rate performance for a particular customer over an economic cycle and ignore short run changes to a customer's PD.

A PIT rating system is generally prevalent in day-to-day risk management of retail portfolios. These two extremes are stylised and in reality many rating systems are hybrid approaches



Rating philosophies

Key differences between the two rating philosophies:

Rating philosophy	Point in time	Through the cycle
Grade allocation	Grade assigned changes with the economic cycle	Grade assigned not dependent on economic cycle
Response to economic cycle		
Long run PD estimates by PD grade / Credit score distribution	PD estimates **by grade** do not change, but the overall portfolio average PD changes as there is migration between grades	On average there is no rating migration, so capital requirements remain constant
PD by grade	Changes from period to period due to ratings migration	Constant through cycle
Observed default rates by grade	Actual default rates in each grade remain unchanged	Actual default rates in each grade change
Impacts		
Capital requirements	Cyclicality in capital requirements is eliminated by the use of cyclical scalar	No volatility in capital requirements *

* In practice capital requirements will change as the portfolio composition changes the underlying risk – TTC models only dampen the volatility due to the economic cycle

Why the drive for TTC models?

- Stability of capital requirements (particularly when capital is scarce)
- Regulatory expectations
- Boards
- Shareholders desire for stability of return

Section 2

Through the cycle methodologies

Approaches to modelling retail TTC PDs

- *Account ratings move over the cycle given more recent economic conditions*

- *Cyclicality in capital requirements is eliminated by the use of counter-cyclical variable scalar*

The variable scalar approach = Point in time rating model + Variable scalar model

v.s.

The structural model = Through the cycle rating model + Maturity adjustment

- *Predicts average default rate performance over an economic cycle*
- *Ignores short run changes to an account's PD*

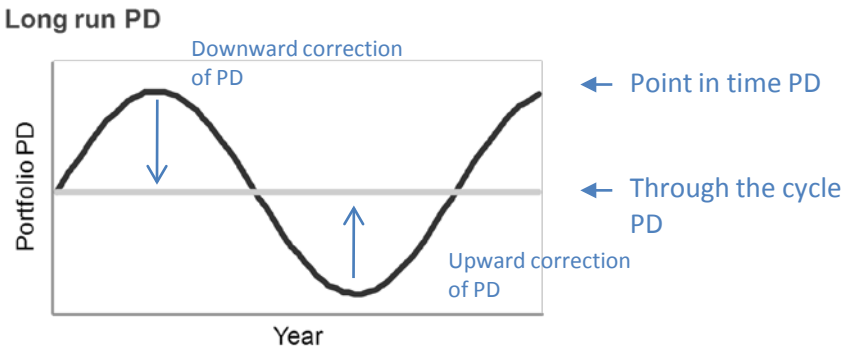
- *Under this model, ratings move as maturity changes*

The variable scalar approach

Based on the concept of "variable scalar" introduced by the FSA, different variants of this approach have been developed to convert PIT to TTC PDs.

The variable scalar approach

- The scalar approach consists of converting the PIT PD to a TTC PD via a scalar that varies throughout the credit cycle. This method has been termed the "variable scalar" approach by the FSA.
- In a benign period with low credit losses, the scalar will adjust the PIT PD upwards to the TTC PD. In a downturn period with high credit losses, the adjustment will be downwards.
- The scalar adjustment should be calibrated at risk grade level
- Critical that model reflects the changing risk of the portfolio and does not become a quasi-standardised approach



UK FSA's Four Principles for scalar approach

1. Both the initial calculation of and subsequent changes to the scalar must be able to take account of changes in default risk that are not purely related of the changes in the cycle.
2. A firm must be able to accurately measure the long run default risk of its portfolio even if there were no changes in the business written.
3. A firm must use a data series of appropriate length in order to establish the long run default risk.
4. A firm must be able to demonstrate the appropriateness of the scaling factor being used across a portfolio.

The structural models

More recently, alternate methodologies to model TTC PD at a loan level have been developed.

The structural models

- The second approach consists of building a separate rating system for TTC PD rather than adjusting an existing PiT model.
- Under this approach, TTC PDs are determined by utilizing macroeconomic variables and non-cyclical risk drivers to predict default rates over an economic cycle.
- A variant of this approach exists where TTC PDs are estimated at loan level but exclude macroeconomic variables. Effectively, the model becomes a more sophisticated way to average TTC loss based on non-cyclical characteristics.
- By non-cyclical we mean drivers that are not affected by changes in economy. This excludes segment characteristics like behaviour score and includes characteristics such as original loan amount or original loan to value ratio, product type, region and so on.

The two main examples of a TTC PD structural model are:

- TUI Model
- Dual-time Dynamics

Reserve Bank of New Zealand's *TUI (Tool for Unobserved-event Investigation) Model* is used for residential mortgage portfolios in New Zealand. The model correlates the loan default process with macroeconomic risk drivers (mortgage interest rate, unemployment rate and house price index) and customer characteristics (Loan to Value Ratio and Debt Service Ratio). The long-run TTC probability of default is then generated by running a range of macroeconomic scenarios over an economic cycle. This model can be used when there is limited long run and 'tail-end' events data.

Dual-time Dynamics Modelling is used by some firms when vintage data is available. The model separates underlying quality, maturation effects and exogenous effects (management actions and macroeconomics variables). To generate long-run TTC PD estimate, simulations are run across many economic scenarios over an economic cycle.

Global trends

The UK, Australia and New Zealand are exploring the use of structural models

Europe

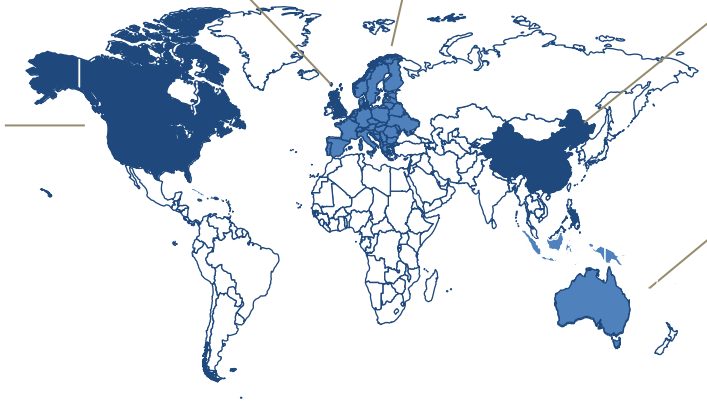
Focus in Europe is given to translating a short run PIT to a long run PIT, rather than building a TTC model.

UK

Most banks still rely on variable scalar approaches in the UK, however the use of structural models has increased as FSA's principles for variable scalars have tightened up.

Asia

Asian banks also mainly rely on PIT models.



Australia

Australian banks have started to explore structural models.

US

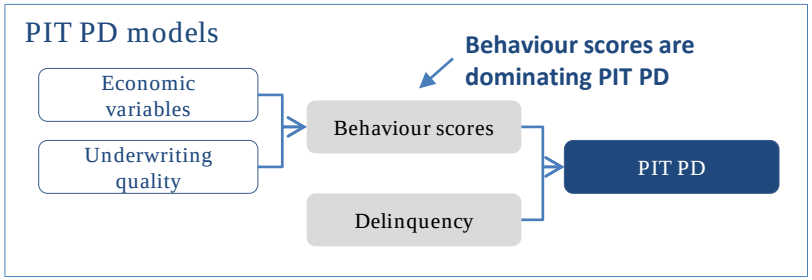
US banks (not regulated under Basel II) primarily use PIT models and adjust their estimates to long-term averages for capital calculation.

New Zealand

With the exception of the residential mortgages portfolio, banks were usually estimating TTC PDs via scalar approaches. Similar to the Australian banks, they have started to explore further structural models.

Australian market overview and trends

- In Australia, there is a move towards using structural based modelling approaches.
- In Australia, there is also a move away from using behavioural scores, missed payment and days past due variables which are present in many PIT PD models.



- These variables fluctuate with the economic cycle and their presence within current PIT PD models rather than macroeconomic variables means that the link with the (economic) cycle is not clearly established.

Advantages and disadvantages

Each approach will have different benefits and requirements for each portfolio, calling for segment based modelling approaches.

	Variable scalar	Structural model
Simplicity	🔴 Multiple models with different objectives, benefits, limitations and linkages	🟡 Easier to communicate and understand
Data requirements	🔴 Data needs to cover a full economic cycle May need to normalise previous scorecards	🔴 Data needs to cover a full economic cycle
Cyclicality	🟡 TTC PDs have to be recalibrated on a yearly basis to reflect movements in PIT estimates	🟢 Structural models give cycle invariant estimates that reflect the mix of business
Use test	🟢 Explicit link between operational credit decisioning models and TTC capital models.	🟡 Clear link to TTC capital decisions only

Legend

🟢 No material issue

🟡 Issue that should be considered

🔴 Material issue which must either be addressed or fully accepted by the bank

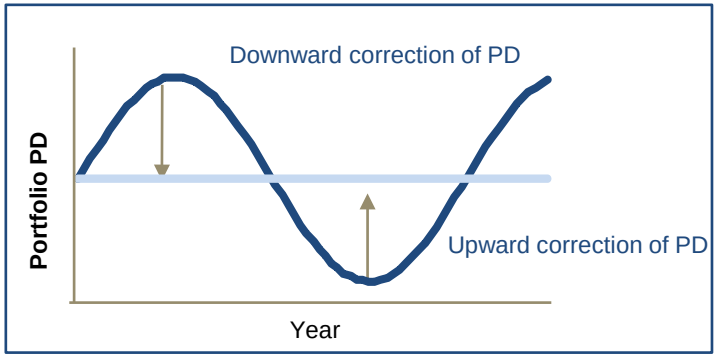
Section 3

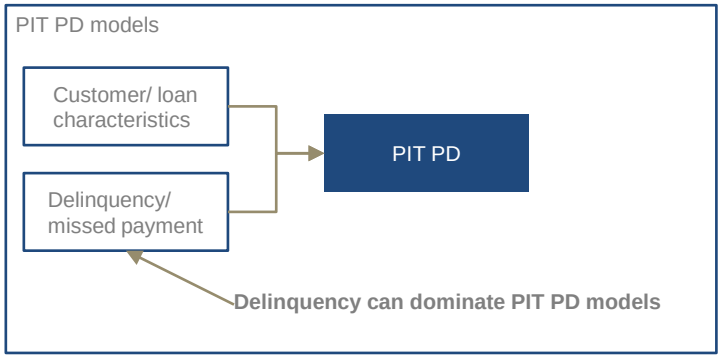
Structural models and their practicalities

Moving away from scalar approach

All major Australian banks moving towards implementation of structural models, due to limitations of the scalar approach.

- Current over reliance on delinquency status and behaviour scores
- Small percentage of loans in delinquent category, but delinquency makes up most of the predictive power of model
- Effect of portfolio composition changes is typically swamped by these delinquency type variables
- Positive credit bureau information may impact this in future





How does a structural model work

Banks are conducting further research into TTC methodology

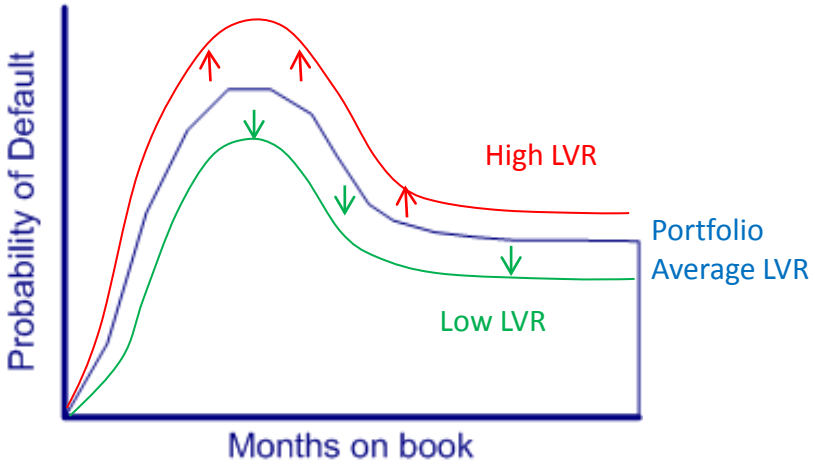
- Utilising **non-cyclical risk drivers** and **macroeconomics variables** to predict default rates over a complete economic cycle
- Recognises that for retail portfolios, banks do not typically collect customer information other than at origination
- Non-cyclical components such as loan to value ratio (LVR) and debt service ratio (DSR) used to measure the "quality" of the loan
- Recognises that delinquency is a precursor to default, makes no attempt to model <90dpd delinquency i.e. removes behavioural components
- This allows **changing portfolio composition** over time to be identified and the capital held by banks adjusted accordingly

How does a structural model work (2)

Structural model built up from various non-cyclical risk drivers, giving relatively stable measure of PD over time

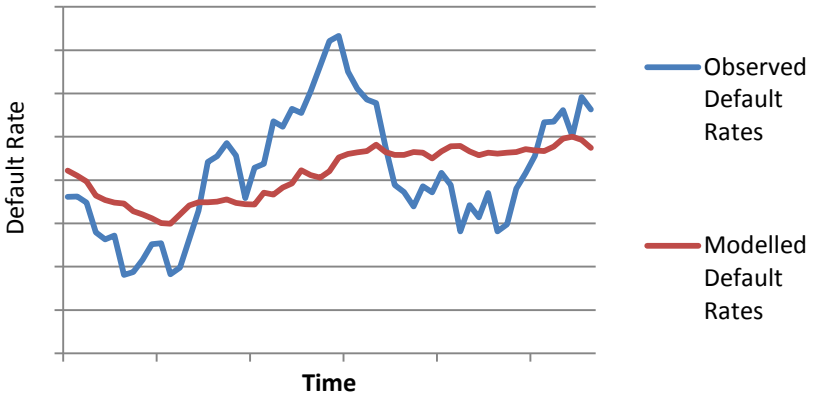
Dual time dynamics method splits loans into homogenous segments with similar maturity profile

This shifts vertically for individual loans depending on their underlying quality factors



Over available data period, the structural model should give a relatively flat measure of PD

TTC PD only changes due to movements in portfolio quality or a change in the maturity profile of the portfolio



Calibrating to long-run default rate

Different approaches can be used to meet the Basel requirement of a long-run default rate

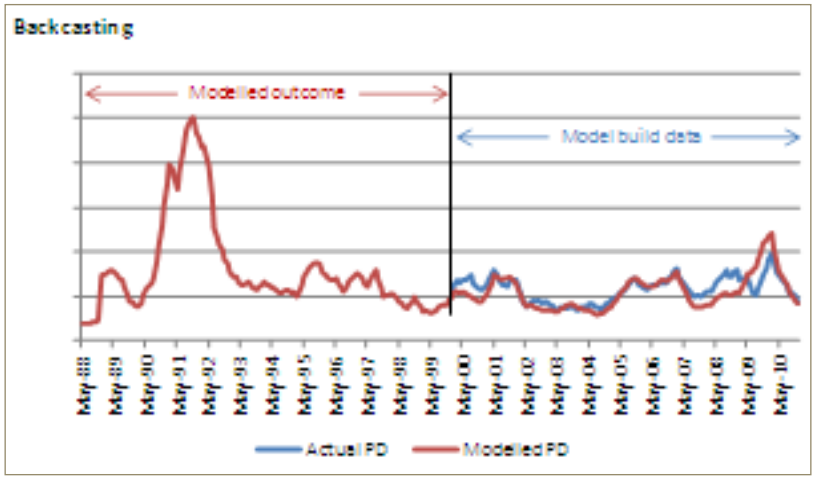
Historic data (internal vs external)

•Issues with availability of historical internal data

•Possible use of industry data or other suitable benchmark

Back-casting economic model

- Model using predictive economic variables
- Need to have static relationships over time
- Consider current portfolio composition
- Back out impact from management actions



Economic simulations

- Uses similar economic model to back-casting
- Need to estimate multivariate distributions (TUI models assumes normal)
- Range of simulation techniques to use

*Important whatever method used, results overlaid with expert judgment

Further considerations

There are a number of further issues to consider in the design and implementation of a through-the-cycle structural model

- Practical issues with data:
    - need sufficient data points to build a robust model
    - allowing for hardship rules in data collection and default definitions
    - requirement to meet the Basel definition of default

- In theory structural model can be extended to non-mortgage retail portfolios, however inherent volatility in other segments may cause difficulties

- Moving from scalar approach to structural model could have varying impacts on risk weighted assets and capital requirements for the major Australian banks

Questions?

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