A Study of Mortgage Prepayment Risk

presented by
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Chairman
Action Group for Banking
The UK Actuarial Profession comprises a number of practice boards, including the Finance & Investment Board, which set up the Action Group for Banking to develop the profession’s understanding of banking and facilitate the placement of actuaries at working level with banks.
The Actuarial Profession’s Mortgage Prepayment Project

- Many of the asset and liability risks facing banks and insurance companies are similar.
- The prepayment risk faced by banks writing fixed rate mortgages is comparable with lapse risk on life and general insurance policies. But, the terminology used by banking professionals and actuaries to describe these risks is very different.
- To explore how actuarial techniques can be used to manage banking risks, we conducted a study of prepayment risk on behalf of the actuarial profession.
- Eight UK mortgage lenders, representing about 65% of existing UK mortgage lending, took part in the study.
- A report discussing the study will be published by the Institute of Actuaries (www.actuaries.org.uk)
Participants

- Abbey National
- Bradford & Bingley
- Alliance Leicester
- Bristol & West
- Bank of Scotland
- Halifax
- Barclays
- Nationwide
- Council of Mortgage Lenders
Overview of the UK fixed rate mortgage market

- Fixed Rate Products
  - 2 Year
  - 3 Year
  - 5 Year
  - Some longer fixes

- Product Risk Management Strategies
  - Funding assumptions
  - Flat or tiered charges
  - Mark-to-market charges
Four topics to highlight

- Analysing Trends
- Predicting Behaviour
- Retaining Customers
- Pricing & Designing Products
At each stage a range of analytical techniques are used to:

| Investigation to understand the past | Life and general insurance policy lapse rate analysis.  
| Build models of the future | Mortality rate investigations.
| Motor insurance pricing rate cards.  
| Household insurance pricing rate cards.  
| Retention models for life insurance policies.  
| Mortgage indemnity insurance.  
| Manage the business | Embedded value models.  
| Costing product guarantees.  
| Capital requirements.  
| Customer management. |
Analysing trends:
Actual prepayment rates vary considerably

**Financial Incentive to Prepay**

- High Incentive
- Medium Incentive
- Low Incentive

**Time since drawdown**

**Prepayment rate**
Analysing trends: Interaction between variables

Financial Incentive to Prepay vs Prepayment Charge

Prepayment rate

Charges

High

Low

Financial Incentive to Prepay

Low

High
Analysing trends:
Drivers that affected actual prepayment rates

- Late months in the fixed rate period
- Large financial incentive to prepay
- Small prepayment charges
- High house price inflation
- Large loans
- First time buyers
- Broker / branch acquisition channel

- Early months in the fixed rate period
- Small financial incentive to prepay
- Large prepayment charges
- Low house price inflation
- Small loans
- Existing borrowers
- Direct acquisition channels
Predicting behaviour: Multiple drivers

- The profiles reflect observed prepayment rates from the mix of business actually written. But, even when sub-segments of the data are profiled, the profiles still reflect the impact of multiple drivers on prepayment rates.

- Predictive models estimate the impact of individual factors by taking account of the interactions between variables. Unlike the profiles, they identify causal relationships.

- The predictive models built in the study were developed using generalised linear models and decision trees. These techniques are used by insurance companies to determine the relative risk of customer segments.

- For example, one application of these models would be assessing the relative risk of different drivers with different vehicles when setting motor insurance premiums.
### Predicting behaviour: Rate cards to predict prepayment rates

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Levels</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time since draw down</td>
<td>1</td>
<td>75%</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>133%</td>
</tr>
<tr>
<td>Financial incentive to repay</td>
<td>1</td>
<td>66%</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>150%</td>
</tr>
<tr>
<td>Loan size</td>
<td>1</td>
<td>75%</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>125%</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>150%</td>
</tr>
</tbody>
</table>
Retaining customers: Decision trees identify clusters of customers likely to prepay

In first year

Yes

Does not prepay

No

Low financial incentive

y

Does prepay

n

Not near the end

y

Low house price inflation

n

Does prepay

Does prepay
Retaining customers: Retention strategies can then be developed

These customers are unlikely to leave - **wait**

- In first year
  - Does not prepay
    - Low house price inflation
      - Does not prepay
      - Does prepay
    - Does prepay
  - Low financial incentive
    - Does not prepay
    - Does prepay

These customers are looking for better rates - **consider offering them a new rate now.**

These customers will be looking for a new mortgage soon - **offer them a new product now**

These customers may decide to move again - **wait for them to approach you**
Pricing: Costing prepayment under different interest rate scenarios

Monthly cost of prepayment

Expected cost of prepayment under two interest rate scenarios

<table>
<thead>
<tr>
<th>Interest rate scenario</th>
<th>1% Fall now</th>
<th>2% Fall now</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost as a % of balance</td>
<td>0.6%</td>
<td>1.9%</td>
</tr>
</tbody>
</table>
Pricing:
Designing products to reduce prepayment risk

A CAT standard charge of 1% per annum of outstanding fixed term

Expected cost of prepayment under two interest rate scenarios

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<th>Interest rate scenario</th>
<th>1% Fall now</th>
<th>2% Fall now</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost as a % of balance</td>
<td>-0.1% (was 0.6%)</td>
<td>0.6% (was 1.9%)</td>
</tr>
</tbody>
</table>
Pricing: Assessing risk over different interest rate scenarios

- Mean
- 99th percentile

[Graph showing probability distribution with cost on the x-axis and probability on the y-axis.]
Four topics to highlight

- Analysing Trends
- Predicting Behaviour
- Retaining Customers
- Pricing & Designing Products
All these topics are expanded on in the paper.
USEFUL WEB ADDRESSES
UK Actuarial Profession
www.actuaries.org.uk

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