Equity Release Products: Product Design, Pricing and Risk Analysis

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Overview

• The results of two studies:
  o Risk Management and Payout Design of Reverse Mortgages by Daniel Cho, Katja Hanewald and Michael Sherris
  o Developing Equity Release Markets: Risk Analysis for Reverse Mortgage and Home Reversion by Daniel Alai, Hua Chen, Daniel Cho, Katja Hanewald, and Michael Sherris

• Research funded by
  o ARC Centre of Excellence in Population Ageing Research (CEPAR)
  o ARC Linkage Project 2008 LP0883398, Managing Risk with Insurance and Superannuation as Individuals Age (industry partners: PwC, APRA, World Bank)
Motivation

- Population ageing: How to finance retirement income, longevity risk and health costs?

- Substantial assets in housing

- Equity release products allow retirees to convert their housing wealth into liquid assets while staying in their home
  - Increasingly used by retirees
  - Concerns about solvency of providers and product designs
The Australian Equity Release Market

- Dominated by reverse mortgages with
  - variable interest rates
  - a lump-sum payout
- RM market grew despite the GFC
- Home reversion is available in Sydney and Melbourne through Homesafe Solutions since 2005

![Graph showing the growth of the loan book and number of contracts from 2005 to 2012. The loan book is measured in billions and the number of contracts is measured from 0 to 45,000. The graph is sourced from Senior Australians Equity Release Association (SEQUAL), Deloitte, 2005-2012.]
Outline

- Aim of the research:
  A. Quantify and compare risk and profitability for different reverse mortgage designs (lump-sum, lifetime income, inflation-indexed lifetime income)
  B. Quantify and compare risk and profitability for reverse mortgages vs. home reversion contracts

- Plan for this session:
  o Product description
  o Methodology used for A. and B.
  o Results A.
  o Results B.
  o Wrap-up and discussion
Reverse Mortgages vs. Home Reversion

- **RM**
  - The provider loans the borrower a lump sum or an income stream and obtains a mortgage charge on the borrower’s house.
  - The contract is terminated upon the death or permanent move-out of the customer, at which time the property is sold and the proceeds are used to repay the outstanding loan.
  - In Australia, a no negative equity guarantee (NNEG) must be included in the contract.

- **HR**
  - The provider purchases the ownership right over the customer's property (or a share of the property).
  - The home is sold at discount, and the contract includes a lease for life (LL) agreement.
  - The contract is terminated upon the death or permanent move-out of the customer.
Major Risks in Reverse Mortgages and Home Reversion

- **RM**
  - Delayed termination (longevity)
  - Interest rates
  - House price depreciation

- **HR**
  - Delayed termination (longevity)
  - House price depreciation
  - Rental yield appreciation
Methodology

- Markov termination model
- Vector Autoregressive (VAR) model: economic scenarios, stochastic discount factors
- Pricing of NNEG
- Simulation of product cash flows
- Cash flow analysis, risk metrics and sensitivity analysis
Termination Model

• Multi-State Markov Model
  o Single, female policyholder aged 65, 75 and 85
  o Mortality: estimated from Australian mortality data (ages 50-105, 1950-2009) from the Human Mortality Database

• Factors of Termination (Ji, 2011)
  o At-home mortality: scaled-down mortality rates
  o Long-term care incidence: age-dependent factor applied to base mortality rates
  o Prepayments/Refinancing: dependent on the contract duration
VAR(2) Economic Model

\[ z_t = \mu + A_1 z_{t-1} + A_2 z_{t-2} + \varepsilon_t, \text{ where } \varepsilon_t \sim N(0, I) \]

State variables:

<table>
<thead>
<tr>
<th>Variables</th>
<th>Definition</th>
<th>Mortgage rate: 3-month zero coupon rate plus fixed margin</th>
</tr>
</thead>
<tbody>
<tr>
<td>d ln ZC025I</td>
<td>(\Delta \ln(3\text{-month ZC index}))</td>
<td></td>
</tr>
<tr>
<td>ZC10S</td>
<td>Spread between 3-month and 10-year ZC yields</td>
<td></td>
</tr>
<tr>
<td>d ln H</td>
<td>(\Delta \ln(\text{Sydney house price index}))</td>
<td></td>
</tr>
<tr>
<td>d ln R</td>
<td>(\Delta \ln(\text{Sydney rental index}))</td>
<td></td>
</tr>
<tr>
<td>d ln GDP</td>
<td>(\Delta \ln(\text{Australian GDP}))</td>
<td></td>
</tr>
<tr>
<td>d ln CPI</td>
<td>(\Delta \ln(\text{NSW CPI}))</td>
<td></td>
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</tbody>
</table>
Stochastic Discount Factors

- Develop a methodology to derive stochastic discount factors (SDR) based on the VAR model (Cochrane and Piazzesi, 2005)

- Discount factors are correlated with
  - Short rate dlnZC025I (-)
  - House price growth rates dlnH (+)
  - Interest rate spread (+)
Pricing

• Reverse mortgages
  o Termination: loan repayment capped by no negative equity guarantee (NNEG)
  o NNEG is priced using stochastic discount factors
  o NNEG financed by mortgage insurance premium paid by borrowers
  o Loan amount accrues quarterly with interests and insurance premium

• Home reversion
  o Initial payout reduced to reflect value of the lease for life agreement (LL)
  o LL priced using stochastic discount factors
  o Termination: provider receives equity share

• Provider finances payouts through existing capital and leveraging
Results: Different Reverse Mortgages Designs

- Average loan balance ($L_t$) and house price ($H_t$) with 90% confidence intervals

LS = lump-sum  
IS = fixed income stream  
IIS = inflation-indexed income stream
Results: Different Reverse Mortgages Designs

<table>
<thead>
<tr>
<th>Contract</th>
<th>Payment</th>
<th>NN</th>
<th>p(p.a.)</th>
<th>EPV</th>
<th>VaR</th>
<th>CVar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lump-sum</td>
<td>240,000</td>
<td>239</td>
<td>0.01%</td>
<td>51,977</td>
<td>-40,395</td>
<td>-36,336</td>
</tr>
<tr>
<td>Fixed income stream</td>
<td>8,133</td>
<td>6,404</td>
<td>0.41%</td>
<td>35,829</td>
<td>7,742</td>
<td>14,176</td>
</tr>
<tr>
<td>Inflation-indexed income stream</td>
<td>6,835</td>
<td>9,714</td>
<td>0.64%</td>
<td>30,859</td>
<td>17,411</td>
<td>23,506</td>
</tr>
</tbody>
</table>

- Base case (age=75, LTV=40%, φ=92%, no mortality improvements, VAR(2) model):
  - Lump-sum RMs are more profitable and require less risk-based capital than income stream RMs
  - explains why this product design dominates in most markets

- Borrower's age, LTV, leverage ratio φ and mortality improvements
  - Are important drivers of the profitability and riskiness of RMs
  - Do not change the main conclusion
A Comment on LTVs

Deloitte/SEQUAL (2012): “… younger borrowers still utilise larger proportions of their available facility with an average 9% loan to value ratio for those aged up to 65 years where there is an average maximum LVR available of 14%. Those aged over 80 however only accessed an average of 20% LVR against an average maximum of 34%.”
A Comment on LTVs

• Our results indicate that reverse mortgage providers in Australia could consider
  ○ increasing maximum LTVs
  ○ decreasing insurance premium rates or on-going fees
to support growth of the Australian reverse mortgage market

• Sensitivity analysis: among all factors, the initial age of homeowners has a profound
  and significant impact on payoffs and risks of equity release product providers
  • Age-specific LTVs need to be set carefully
Results: Reverse Mortgages vs. Home Reversion

<table>
<thead>
<tr>
<th>LTV</th>
<th>Reverse Mortgage</th>
<th></th>
<th></th>
<th></th>
<th>Home Reversion</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NN</td>
<td>E[RM]</td>
<td>VaR</td>
<td>CVaR</td>
<td>LL</td>
<td>E[HR]</td>
<td>VaR</td>
<td>CVaR</td>
</tr>
<tr>
<td>15%</td>
<td>0</td>
<td>29,623</td>
<td>0</td>
<td>0</td>
<td>35,764</td>
<td>25,906</td>
<td>-3,873</td>
<td>-6,564</td>
</tr>
<tr>
<td>45%</td>
<td>3,636</td>
<td>83,052</td>
<td>0</td>
<td>-7,293</td>
<td>107,292</td>
<td>77,719</td>
<td>-11,618</td>
<td>-19,691</td>
</tr>
<tr>
<td>55%</td>
<td>14,178</td>
<td>90,087</td>
<td>-34,914</td>
<td>-49,778</td>
<td>131,134</td>
<td>94,989</td>
<td>-14,201</td>
<td>-24,067</td>
</tr>
<tr>
<td>64%</td>
<td>39,280</td>
<td>82,155</td>
<td>-78,849</td>
<td>-93,941</td>
<td>152,593</td>
<td>110,533</td>
<td>-16,524</td>
<td>-28,005</td>
</tr>
</tbody>
</table>

- Base case (age=65, $\phi=100\%$, no mortality improvements, VAR(2) model):
  - LTV<50%: RM are more profitable than HR and bear nearly no risk
  - Higher LTV: HR more profitable and less risky
Summary and Conclusions

- The key risks associated with reverse mortgages and home reversion plans are
  - House price risk:
    - A substantial risk, large idiosyncratic component (Hanewald and Sherris, 2013; Shao, Sherris and Hanewald, 2013)
    - Pricing based on average house prices substantially underestimates risks (Shao, Sherris and Hanewald, 2012)
  - Longevity risk/health risks: uncertain termination

- Importance of product design:
  - Lump-sum favoured over annuity structure in profit/risk traded-off → longevity risk
  - Role of age-specific LTVs
Discussion Points

- Home reversion scheme is attractive to homeowners:
  - Debt-free; limits the share of home equity that is released
  - Longevity risk, interest rate risk and house price risk are transferred to the provider
- Attractive asset class to investors
  - Different risk profile than direct property investment
  - The interests of investors and consumers are aligned: both want home value to rise
- However, the market for home reversions has been developing slowly
  - Demand side reasons: lack of awareness and low financial literacy
  - Supply side: liquidity is probably the major concern of investors
- Government can help by setting adequate regulatory standards and by providing information
Thank you very much!

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References


