Managing Retirement Risks with Reverse Mortgage Loans and Long-Term Care Insurance

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11\textsuperscript{th} International Longevity Risk and Capital Markets Solutions Conference
7 - 9 September 2015, Lyon France
Topic Coverage

1. Introduction
2. Financial Assets and Risks
3. Model Framework
4. Results
5. Conclusion
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1. Introduction

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Two important risks in individuals’ retirement planning: health shocks and house price risk

LTC costs are increasingly higher and the increasing trend is projected to continue (Congressional Budget Office, 2004; Shi and Zhang, 2013)

LTC costs funding scheme
- Australia: lifetime stop-loss mechanism
- U.S.: Medicaid and Medicare + private insurance + personal payment

The private LTC insurance market is an important supplement (Glendinning et al., 2004; Colombo et al., 2011)

Important to take into account health risk in a lifecycle model (Ameriks et al., 2011; Yogo, 2009)
Research Motivation

- Two important risks in individuals’ retirement planning: health shocks and **house price risk**
- Large component of wealth in home equity (Home-ownership rate: 80% for 65+)
- House price dynamics in the optimal portfolio choice field
  - Not taking into account housing asset (Ameriks et al., 2011)
  - Unrealistic model: Deterministic, Binomial, Log-Normal (Yogo, 2009; Davidoff, 2010; Yao and Zhang, 2005; Li and Yao, 2007)
- Motivation for use of a more realistic time series model, borrowing ideas from studies in other fields (e.g., Chen et al., 2010; Lee et al., 2012; Yang, 2011)
- Path dependent house price dynamics - complexity in lifecycle model
- Asset rich but cash poor: Role for equity-release products
Research Questions

- How can retirees use reverse mortgage and private long-term care insurance (LTCI) to better manage retirement risks?
- What is the impact of house price and health risks on retirees’ optimal portfolio choice?
- What is the welfare gain when reverse mortgage and/or private LTCI are added to the menu?
- What are the interacting effects between reverse mortgage and private LTCI?
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Overview

- Financial assets
  - Risk-free asset
  - House
  - Reverse mortgage loans
  - Long-term care insurance

- Risks
  - Health dynamics and mortality risk: Markov model
  - House price: ARIMA-GARCH
Health Dynamics

- 1 - Healthy (difficulty in no ADLs)
- 2 - Mildly disabled (difficulty in 1 ADL) and staying at home
- 3 - Severely disabled (difficulty in 2+ ADLs) and staying at home
- 4 - Institutionalized
- 5 - Dead

Assumption: moving into a nursing home is non-reversible

Health transition rates/probabilities estimated using GLM (Fong et al., 2013)

Data: Health and Retirement Studies (HRS)
Long-Term Care Insurance

- LTC costs
  - depend on health states \( i \in \{2, 3, 4\} \)
  - increase at the inflation rate \( f_s \)

\[
LTC_t^i = LTC^i \exp \left( \sum_{s=1}^{t} f_s \right)
\]  

- Public LTC insurance: \( GI = 10\% \) (Different from empirical 71% covered by Medicare and Medicaid)
- Private LTC insurance
  - paying premium at age 65
  - choosing coverage \([0, 1 - GI]\)
  - actuarially fair premium calculated using estimated health dynamics
  - funds LTC costs when severely disabled (State 3) or moving to LTC facilities (State 4)
House Value Model

- Housing consumption: Lower when moving into LTC facilities
- Capital Growth: ARMA-GARCH

\[ y_t = \psi y + \sum_{i=1}^{p} \phi_i y_{t-i} + \sum_{j=1}^{q} \theta_j z_{t-j} + z_t, \]

\[ \sigma_t^2 = \psi \sigma^2 + \sum_{i=1}^{m} \mu_i \sigma_{t-i}^2 + \sum_{j=1}^{n} \nu_j z_{t-j}^2, \]

(2)

- \( y_t \): house price growth rate
- \( \sigma_t^2 \): conditional variance given information up to \( t - 1 \)
- We select the optimal lags in the ARMA-GARCH model (Li et al., 2010; Chen et al., 2010)
- The optimal specification is a ARMA(2,4)-GARCH(1,1)
House Price Projection

**Figure.** House value projections based on the ARMA(2,4)-GARCH(1,1) model of house value growth rates. The current house value is assumed to be $300,000.
Reverse Mortgage

Reverse mortgage loan balance

\[ RMLB_t = \begin{cases} 
RM \cdot e^{(r_f + \pi)t}, & \Lambda_t \in \{1, 2, 3\} \\
0, & \Lambda_t \in \{4, 5\} 
\end{cases} \]  

- **RM**: lump sum reverse mortgage loan at age 65
- **\( r_f \)**: risk-free rate
- **\( \pi \)**: mortgage insurance premium rate for providing no-negative equity guarantees (Shao et al., 2015; Chen et al., 2010)
- Repayment is triggered when admitted to LTC facilities (State 4) or dead (State 5)

\[ \min\{RMLB_t, HV_t\} \]
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Utility and Bequest

- Contemporary utility

\[
U(C_t, H_t) = \frac{\left( C_t^\eta H_t^{1-\eta} \right)^{1-\gamma}}{1 - \gamma},
\]

- \(C_t\): non-housing consumption
- \(H_t\): housing consumption
- \(\gamma\): the risk aversion parameter
- \(\eta\): Cobb-Douglas aggregation parameter

- Bequest motive

\[
B(W_t) = \beta \frac{W_t^{1-\gamma}}{1 - \gamma},
\]

- \(\beta\): bequest motive strength
- \(W_t\): bequest wealth
Utility Maximization

\[ V(t, i, G_t) = \max_{O_t} \mathbb{E} \left[ U(C_t, H_t) + \alpha \left( \sum_{j \neq 5} p_{x+t}^{ij} V(t + 1, j, G_{t+1}) + p_{x+t}^{i5} B(W_{t+1}) \right) \right] \bigg| \mathcal{F}_t \]

s.t. Wealth Dynamics

- \( O_t = (C_t, RM, PI) \): choice variables
- \( i \): health state
- \( G_t = (B_t, HV_{1:t}) \): non-health state variables
- \( p_{x+t}^{ij} \): annual probability of transitions from State \( i \) to State \( j \)
- \( V(t, i, G_t) \): value function

Optimization methods:

- **Endogenous Grid Method** to avoid time-consuming root-finding routine
- **Regression method** to allow for path dependent house price dynamics and avoid the “Curse of Dimensionality”
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Certainty Equivalent Consumption (CEC) for a 65-year-old female endowed with $500k initial liquid wealth and a house worth $300k.
Optimal Consumption Path

$500k initial liquid wealth and a house worth $300k

LT VR: ratio of reverse mortgage loan to house value
PI: long-term care insurance coverage
Proportion of the Alive

Starting with a cohort of 100,000 65-year-old healthy females
Optimal Liquid Wealth Path

$500k initial liquid wealth and a house worth $300k

- `LTVR`: ratio of reverse mortgage loan to house value
- `PI`: long-term care insurance coverage
Optimal Bequest Wealth Path

$500k initial liquid wealth and a house worth $300k

- LTVR: ratio of reverse mortgage loan to house value
- PI: long-term care insurance coverage
**Welfare Analysis**

**Table.** Percentage increase of the value function achieved when retirees have access to reverse mortgage loans and/or long-term care insurance.

<table>
<thead>
<tr>
<th></th>
<th>No Private LTCI</th>
<th>With Private LTCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Reverse Mortgage</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>With Reverse Mortgage</td>
<td>5.74%</td>
<td>7.07%</td>
</tr>
</tbody>
</table>

**Table.** Retirees’ willingness to pay for having access to reverse mortgage loan and/or long-term care insurance ($1,000).

<table>
<thead>
<tr>
<th></th>
<th>Reverse Mortgage</th>
<th>Private LTCI</th>
<th>Both</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>72.48</td>
<td>-4.91</td>
<td>90.20</td>
</tr>
</tbody>
</table>

- Home equity substitutes LTCI
- Bundle reverse mortgage and private LTCI
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Conclusion

- We use a discrete time life-cycle model, taking into account health shocks and house price risk
- A more realistic (path dependent) house price process is used
- Optimal portfolio choice with respect to consumption, reverse mortgage, and private long-term care insurance
- Welfare gains for having access to both products
- Insights into product designs of combining reverse mortgage and private LTCl: Demand side
- What about supply side?
  - Reduced adverse selection
  - E.g., people with bad health – higher risk for LTCl but lower risk for reverse mortgage
References


