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Reverse Mortgage Design

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Motivation

- Increasing concerns about the sustainability of social security systems to provide adequate pension income to retirees.
- What is the role of housing wealth for the financing of retirement consumption?
- The motivation for investigating the role of housing wealth is straightforward:
  - Homeownership rates are particularly high among U.S. households.
  - Housing assets constitute the single most important component of their wealth.
- We need to consider the different risks that retirees face, their motives for saving, and the ways through which the release of home equity could be achieved.
- Release home equity through downsizing or by moving into rental accommodation.
  - Retirees do not appear to purchase a house of lower value or to discontinue homeownership.
  - The few that discontinue homeownership do so only late in life.
- Why? Bequest motive? Precautionary motives arising from uncertain life span or from medical expenditures? Hedging against house price risk? Psychological reasons?

Introduction

- Release home equity using reverse mortgages, but limited demand. Why?
  - Aversion to debt?
  - Difficult in understanding the different features of reverse mortgages?
  - Bequest and precautionary savings motives?
  - Financial terms/design and costs of reverse mortgages?
- We build a model of the consumption and asset choices of retired homeowners:
  - Retirees are subject to multiple sources of risk: uncertain life span, health risk, medical expenditure shocks, interest rate risk and house price fluctuations.
  - Our analysis is quantitative: we use several data sources to parameterize these risks.
- Given the risks, pension income and assets of retired homeowners, can the model generate homeownership and saving decisions that match the data including a limited demand for reverse mortgages?
- Which characteristics of reverse mortgage products do different retirees value the most? What is the best way to design them?

Preview of Results

- Precautionary savings motives or a bequest motive have difficulty matching the rates of homeownership observed in the data:
  - There is a simple economic reason: housing is lumpy and risky.
- Model two alternative explanations:
  - For psychological reasons retirees derive utility from remaining in the same house.
  - Retirees value property maintenance less than potential buyers of the property.
- Welfare calculations show that for such retirees reverse mortgages can be beneficial.
- But the insurance provided by the government induces model hazard on the part of borrowers and lenders:
  - Higher insurance premium is fairly ineffective at limiting moral hazard, and it can exacerbate the problem.
  - Lower loan limits is a more effective mechanism.

Some Related Literature

- Precautionary savings and medical expenditures:
  - Palumbo (1991), De Nardi, French and Jones (2010).
- Asset de-accumulation during retirement, focusing on homeownership:
  - Venti and Wise (2001), Poterba, Venti and Wise (2011).
- Portfolio choice during retirement:
  - Yogo (2012)
- Reverse mortgages:
  - Mayer and Simmon (1994)
  - Caplin (2002)
  - Davidoff (2014)
  - Hanewald, Post, and Sherris (2014)
  - Telyukova and Nakajima (2014)

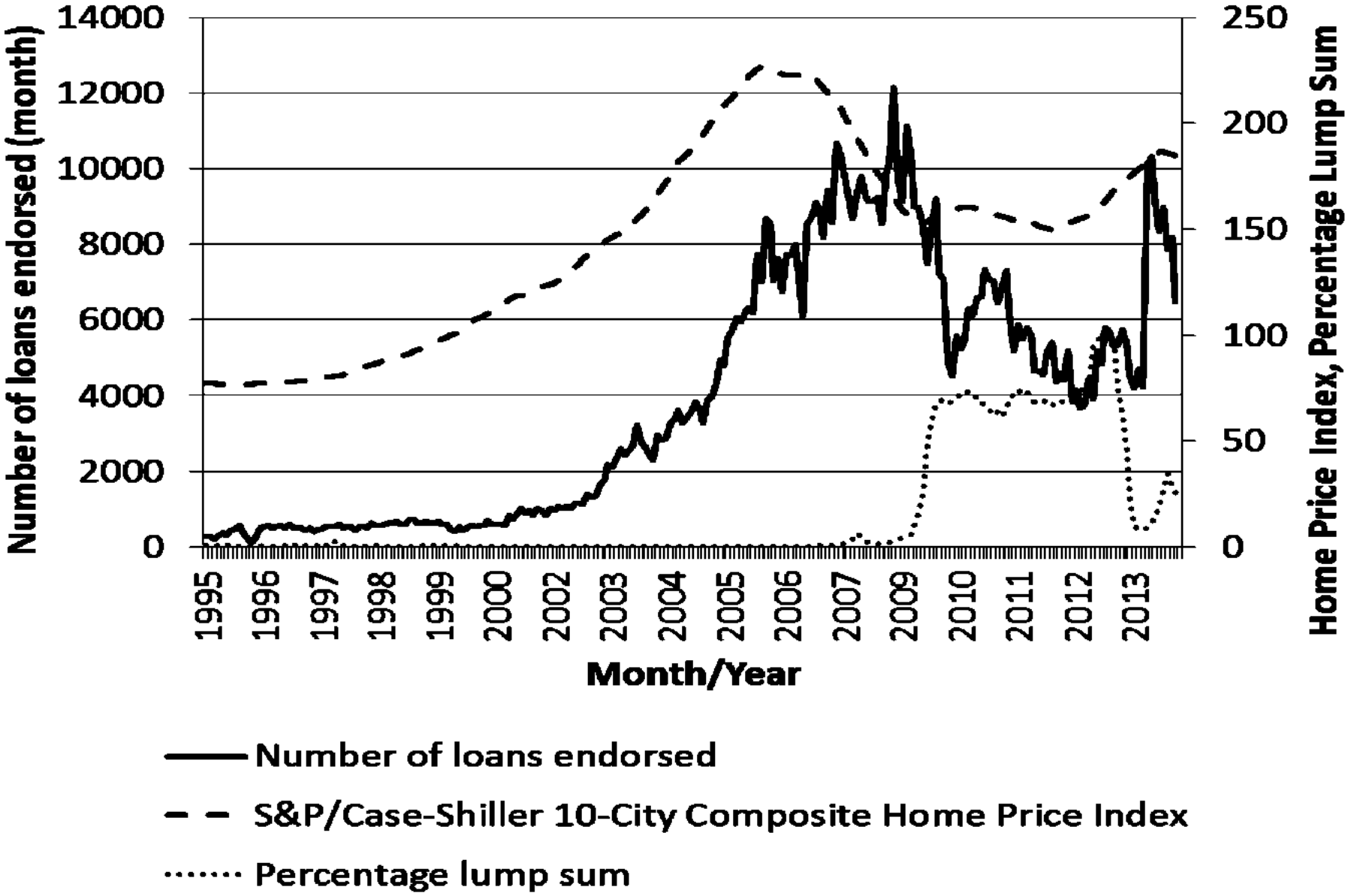
Presentation Outline

- Motivation and introduction
- Reverse mortgage products
- The model
- Model parameterization
- Model without reverse mortgages
- Introduce reverse mortgages:
  - Flexible
  - Lump-sum
- Cash-flows of lenders and the insurance agency
- Conclusion and future research

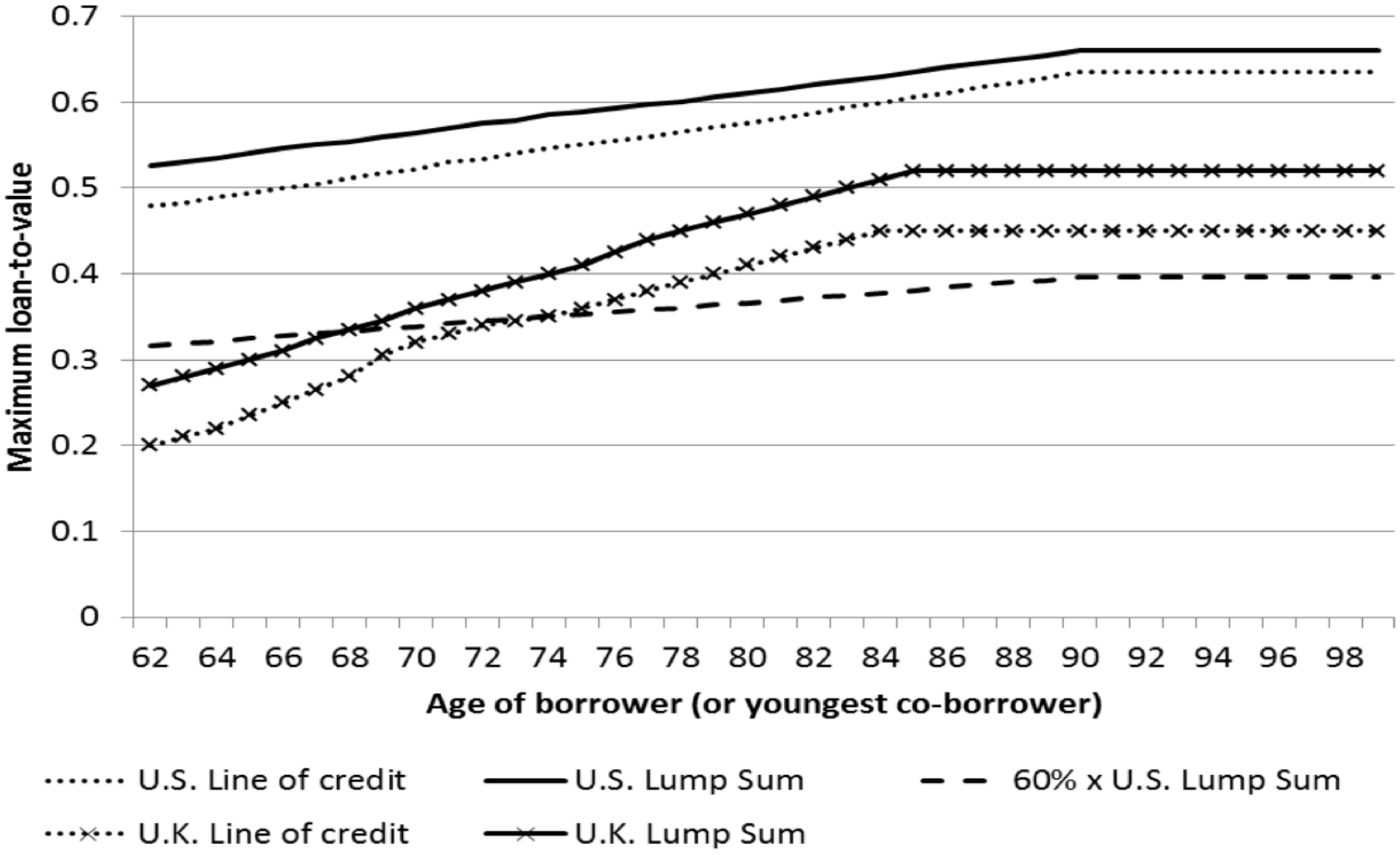
Reverse Mortgages Products

- Retired homeowners have access to reverse mortgages:
  - They require no regular monthly payments
  - Interest is added to the previously outstanding loan balance
- In the U.S. reverse mortgage market, most of the contracts are originated under the Home Equity Conversion Mortgage (HECM):
  - Insured by the Federal Housing Administration (FHA).
  - Borrow up to a fraction of the value of their house in the form of an upfront lump-sum or a line of credit.
  - The loan repayment becomes due when the borrower sells the house, moves out or dies.
  - If the proceeds from the house sale are lower than the outstanding loan balance the FHA insurance will cover the difference.
- In the U.K. reverse mortgages have similar features except there is no insurance provided by the government.

Reverse Mortgages Products



Reverse Mortgages Products



Reverse Mortgages Products

Description	United States Amt ·	60% of Max	Amt ✇	60% of Max	United Kingdom (in U.S. Dollars)
Loan origination fees		1500		1500	925
Mort ins (House val= 70k)		350		1750	
Other closing costs		2000		2000	964
Total		3850		5250	1889

Description	United States Flexible	Lump-sum	United Kingdom Flexible	Lump-sum
Int rate index: 1-month LIBOR	0.0016			
Lender's margin	0.0250			
Loan rate	0.0266	0.0506	0.0619	0.0739
Mortgage insurance	0.0125	0.0125		
Initial total loan rate	0.0391	0.0631	0.0619	0.0739
Di¤ to standard mortgage rate	0.0147	0.0198	0.0338	0.0370
HECM expected loan rate	0.0535	0.0506		

The Model: Preferences

- Retirees live for a maximum of *T* periods, face mortality risk. They derive utility from housing *H* and non-durable consumption *C*.

$$u(C_t, H_t) = (1 + \delta h_t) \frac{\{[\theta^{\frac{1}{\epsilon}} C_t^{\frac{\epsilon-1}{\epsilon}} + (1-\theta)^{\frac{1}{\epsilon}} (\omega_t H_t)^{\frac{\epsilon-1}{\epsilon}}]^{\frac{\epsilon}{\epsilon-1}}\}^{1-\frac{1}{\sigma}}}{1-\frac{1}{\sigma}}$$

- In case of death derive utility from bequeathed wealth.

$$v(W_{t_D}) = b \frac{W_{t_D}^{1-\frac{1}{\sigma}}}{1-\frac{1}{\sigma}}$$

- In each period heath status h_t can be good or bad. The transition probability matrix depends on age, permanent income, and a vector of other individual characteristics.
- The conditional survival probabilities and the out-of-pocket medical expenditures are a function of the same variables and of health status.
  - Medical expenditures are subject to persistent shocks.

The Model: Income and financial assets

- The retiree receives in each period that he/she is alive a real pension $Y_t=Y$. This is a measure of his/her permanent income.
- The retiree starts retirement with non-annuitized financial assets or cash-on-hand X_1.
- Non-consumed financial assets are invested in a one-period bond with real return R_{1t}. Its log return is given by:

$$r_{1t} = \mu_r(1-\phi_r) + \phi_r r_{1,t-1} + \varepsilon_t$$

- We assume the log expectation hypothesis for the term structure of interest rates.

The Model: Housing

- Individuals start retirement as homeowners of a given house size $\overline{H}$.
- House prices fluctuate over time. Normalize initial house prices to one. We assume that changes in the log price of housing follow a random walk with drift:

$$\Delta p_{t+1}^{H} = \mu_H + \eta_{t+1};$$

- In each period retired homeowners decide whether to sell the house and move into rental accommodation, and which house size to rent.
- The house sale is associated with a monetary cost equal to a proportion λ of current house value.
- Homeowners must pay annual maintenance and insurance costs and property taxes equal to proportions m_p and τ_p of house value.
- The period t rental cost of housing U_t is a proportion of current house value, equal to the user cost of housing plus a rental premium:

$$U_t = [R_{1t} - \mathrm{E}_t[(\exp(\Delta p_{t+1}^{H}) - 1] + \tau_p + m_p + \varphi] P_t^H H_t$$

The Model: Reverse Mortgages

- For the flexible loan, the interest rate is a spread over short-rates. The loan carries interest rate risk. If under the loan limit, may decide how much to borrow in each period.
- For the lump-sum loan, the interest rate is a spread over long-rates (10-year bonds). The interest rate is fixed at mortgage initiation. The whole amount is borrowed up-front.
- The evolution of outstanding debt, for the flexible (*F*) and lump-sum (*LS*) loans, respectively:

$$D^S_{LS,t+1} = D^S_{LS,t}(1 + R_{10,t_0} + \psi_{LS})$$

$$D^S_{LC,t+1} = (D^S_{LC,t} + D^C_{LC,t})(1 + R_{1t} + \psi_{LC})$$

- In case of a house sale the value of the debt outstanding is deducted from the proceeds of the sale and goes to the loan provider.
- Retirees retain homeownership and benefit/suffer from any increases/decreases in the value of their house.
- The mortgage loan is non-recourse.

The Model: Cash-flows of lenders and agency

- Loan losses are insured by a government agency. The cash-flows received by lenders for loan type *j= flexible, lump-sum*:

$$CF^{L}_{j,t_0} = -D^{C}_{j,t_0} - l^{TP}_{j}$$

$$CF^{L}_{j,t} = -D^{C}_{j,t} - \psi^{MIP}_{j} D^{S}_{j,t}$$

$$CF^{L}_{j,t'} = D^{S}_{j,t'}$$

- The insurance agency collects the mortgage insurance premium (MIP) in periods before loan termination. And at loan termination:

$$CF^{A}_{j,t'} = MIN[0, (1-\lambda) P^{H}_{t'} \overline{H} - D^{S}_{t'}]$$

- Our model is partial equilibrium, but under certain assumptions we are able to specify a pricing kernel, that we use to calculate the risk-adjusted present discounted value of cash-flows.

Model Solution

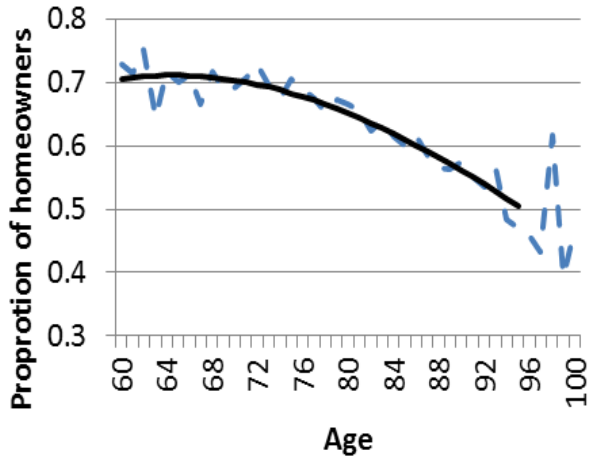
- Choice variables: non-durable consumption, for homeowners whether to sell the house, debt choice and for renters which house size to rent.
- State variables: age, cash-on-hand, current interest rates, house prices, whether currently homeowner, health status, medical expenditures, and level of outstanding debt.
- We solve the model numerically by backwards induction.

Model Parameterization

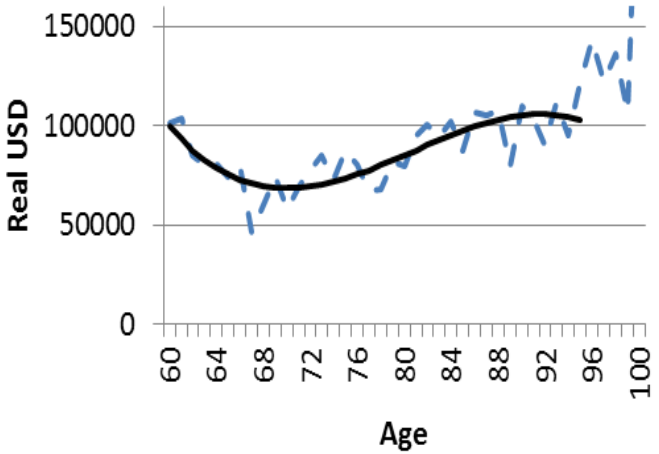
- Our focus is quantitative, use several data sources to parameterize it:
  - Need to take into account the correlations observed in the data: retirees with higher house values, have higher permanent income and better health.
- Health and Retirement Study data:
  - Survey of American individuals carried out every two years.
  - Data from 1996 to 2010.
  - Rand version of the data, combined with information from exit interviews.
- Control for cohort effects and different levels of permanent income:
  - Permanent income is the average real non-asset income that the retired individual receives over the years in which he/she appears in the data.
  - Based on permanent income, group individuals into quintiles.
- Parameterization for retirees follows De Nardi, French and Jones (2010).
- Other data: US treasury yields data, Case-Shiller house price data, National Reverse Mortgage Lenders Association mortgage calculator.
- Where possible, try to use parameters from the literature.

Estimated Age Profiles: Cohort and Permanent Income Fixed effects

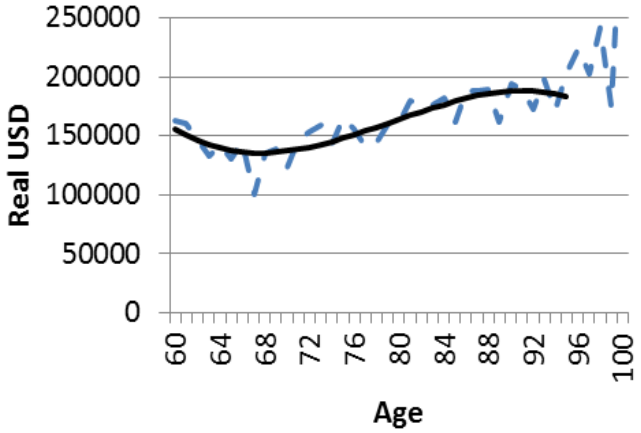
Panel A: Homeownership



Panel B: Wealth excl. housing



Panel C: Wealth



Permanent Income and Assets

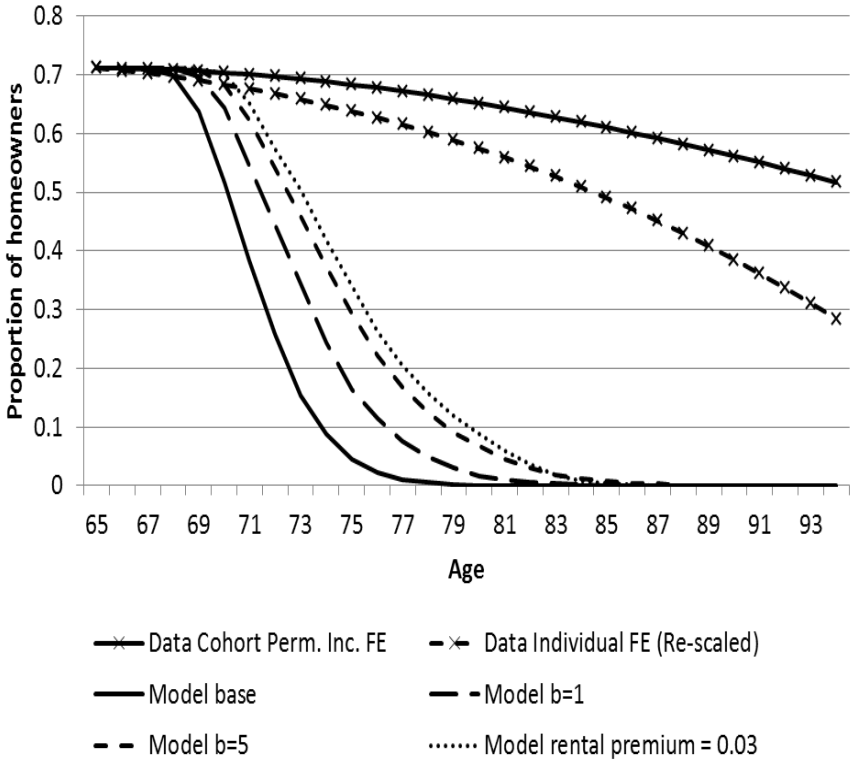
Panel A: All cohorts at age 65									
	Permanent income		Wealth excl. house		Housing wealth		Homeownership		Health
Group	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Bad
1	5465	5917	51562	1507	38699	0	0.51	1	0.49
2	8818	8714	54310	5102	45363	7475	0.59	1	0.31
3	11786	11836	82170	17846	73320	43316	0.72	1	0.22
4	15749	15608	122586	23102	79977	60284	0.81	1	0.22
5	27793	25412	142639	55829	103244	74754	0.89	1	0.19
Panel D: All cohorts at age 65, conditional on homeownership									
	Permanent income		Wealth excl. house		Housing wealth				Health
Group	Mean	Median	Mean	Median	Mean	Median			Bad
1	5315	5775	91329	6738	76547	47968			0.43
2	8736	8561	84478	11025	77309	50113			0.31
3	11869	11914	105375	31000	101381	72193			0.19
4	15827	15619	128094	34193	98694	82532			0.19
5	28010	25575	154497	62656	115963	84810			0.18

Baseline Parameters

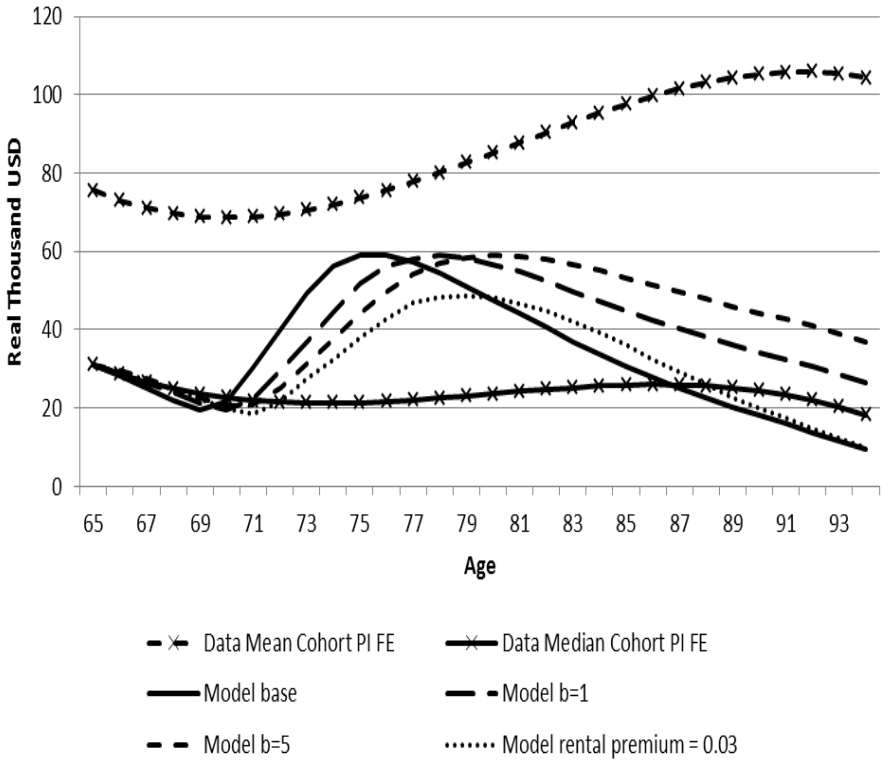
Description	Parameter	Value
Preference parameters		
Discount factor		0.97
Non-durable cons exp. share		0.80
Housing expenditure share		0.20
Utility from good health		-0.36
Elasticity of substitution		1.25
Coefficient of intertemporal subs.		0.27
Preference for homeownership		1.0
Bequest motive		0
Tax rates and other parameters		
Income tax rate		0.20
Property tax rate		0.015
Property maintenance		0.025
Rental premium		0.010
Lower bound on consumption		$2,630
Transaction costs of house sale		0.06
Asset returns		
Mean log real rate		0.012
Stdev of the real rate		0.018
Log real rate AR(1) coefficient		0.825
Term premium		0.005
Mean log real house price growth		0.003
Stdev house price return		0.10

Model Results

Panel A: Homeownership rates



Panel B: Cash-on-hand

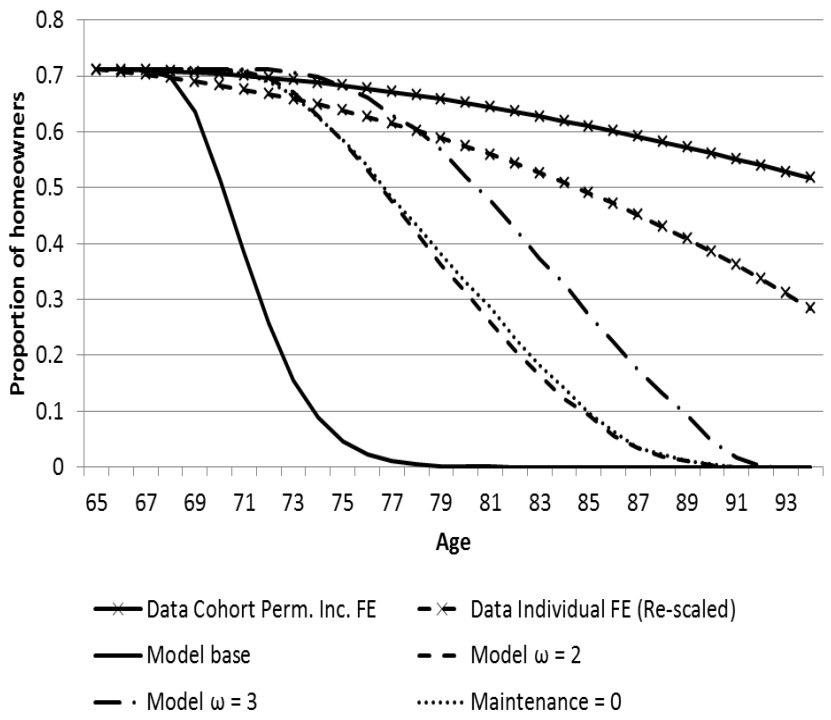


Model results, means by homeownership decision

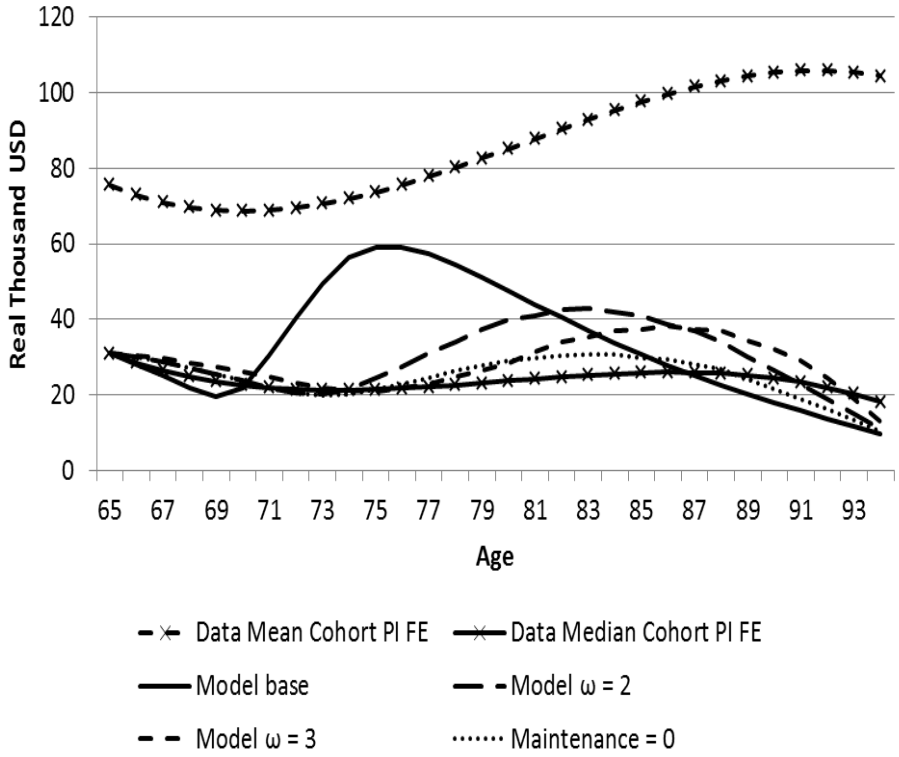
Variable	Sell house	Remain homeowner
Age	71.84	68.18
Consumption	7.87	8.41
Previous period cons.	8.15	8.44
Cash-on-hand	9.42	11.59
Medical expenditures	2.89	1.15
Previous period med. exp.	2.36	0.96
House price	1.05	1.01
Interest rate	0.01	0.01
Dummy for good health	0.62	0.87

Preference for homeownership

Panel A: Homeownership rates

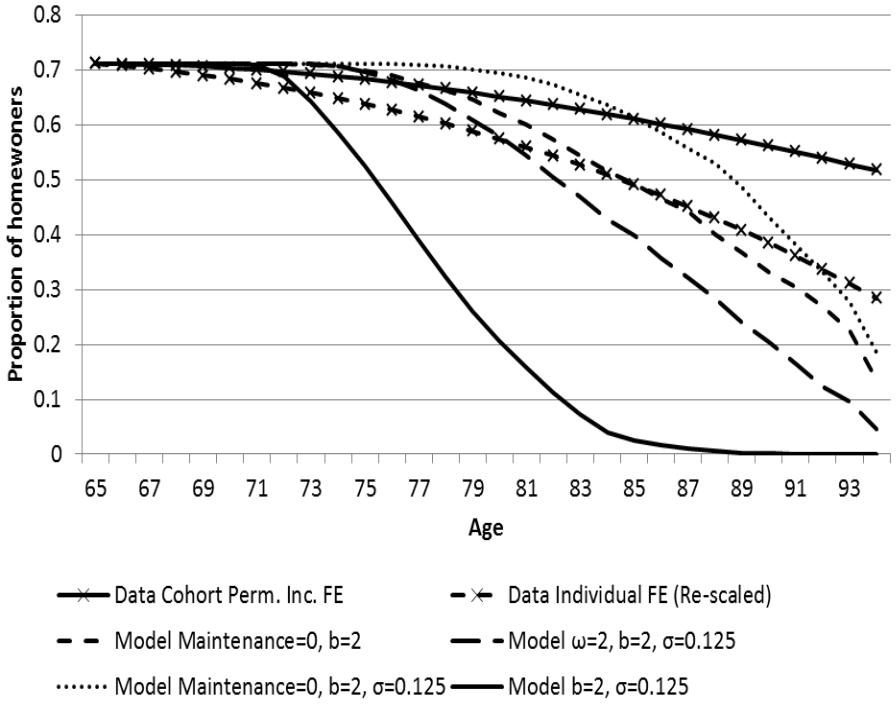


Panel B: Cash-on-hand

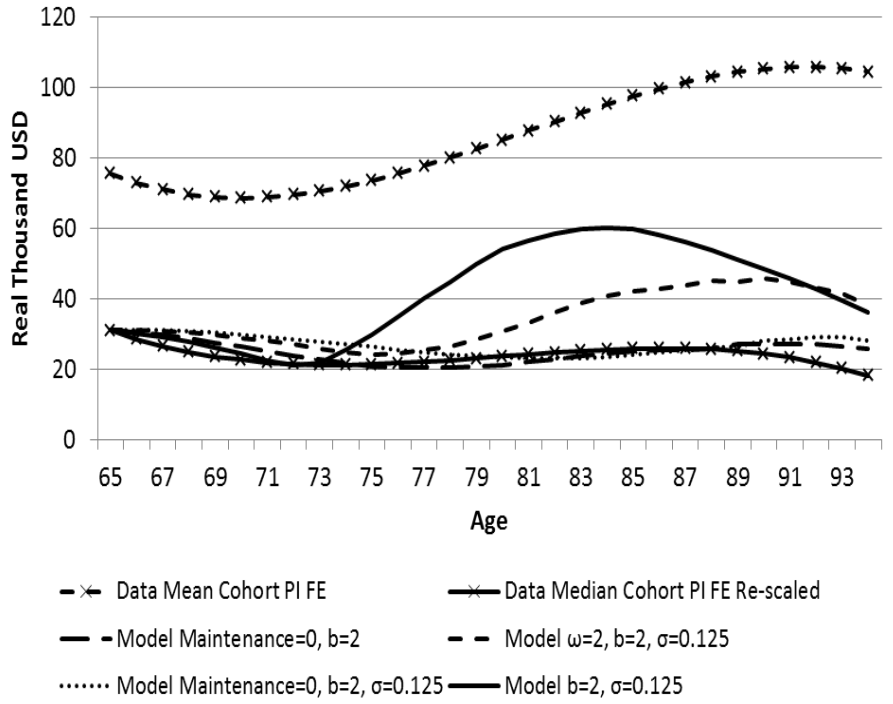


Different Parameter Combinations

Panel A: Homeownership rates

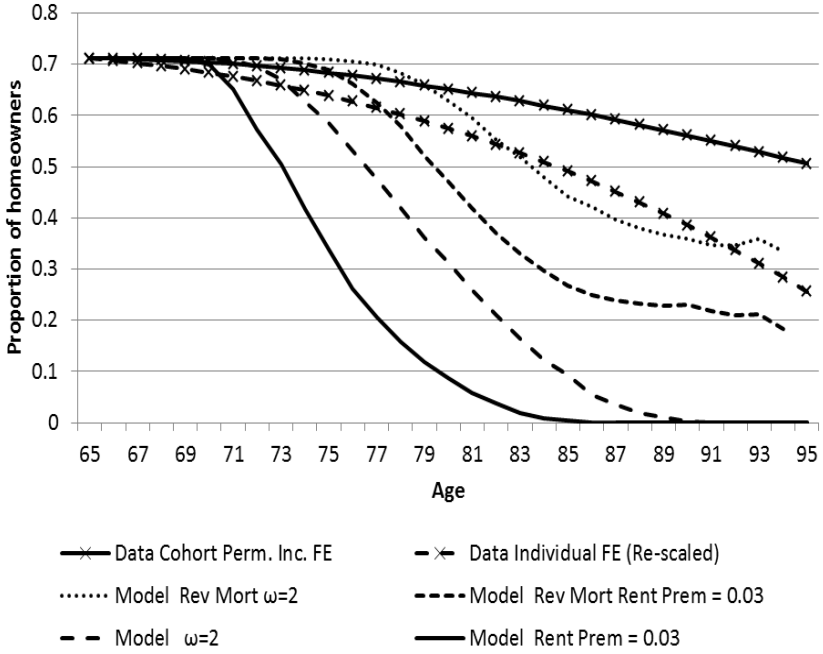


Panel B: Cash-on-hand

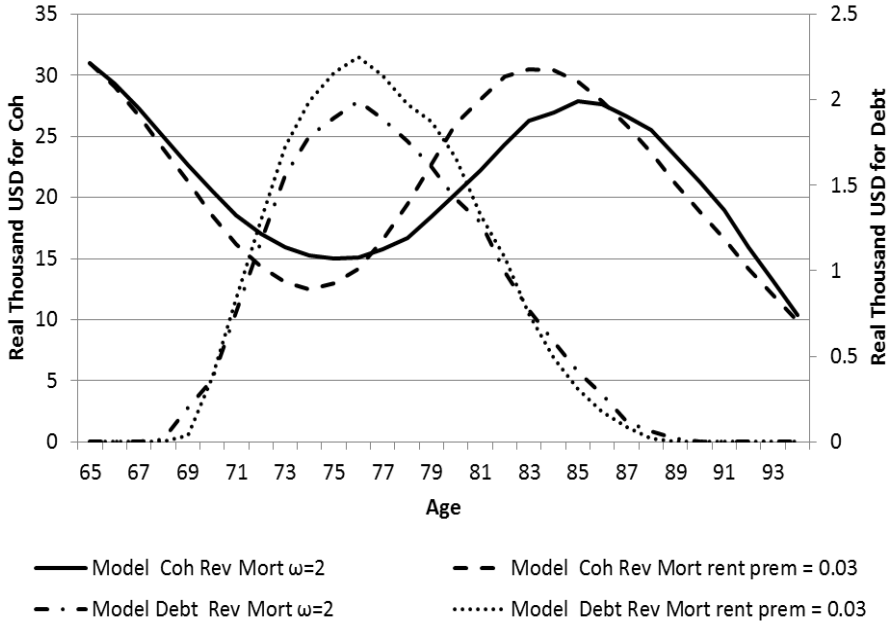


Flexible Reverse Mortgages

Panel A: Homeownership rates



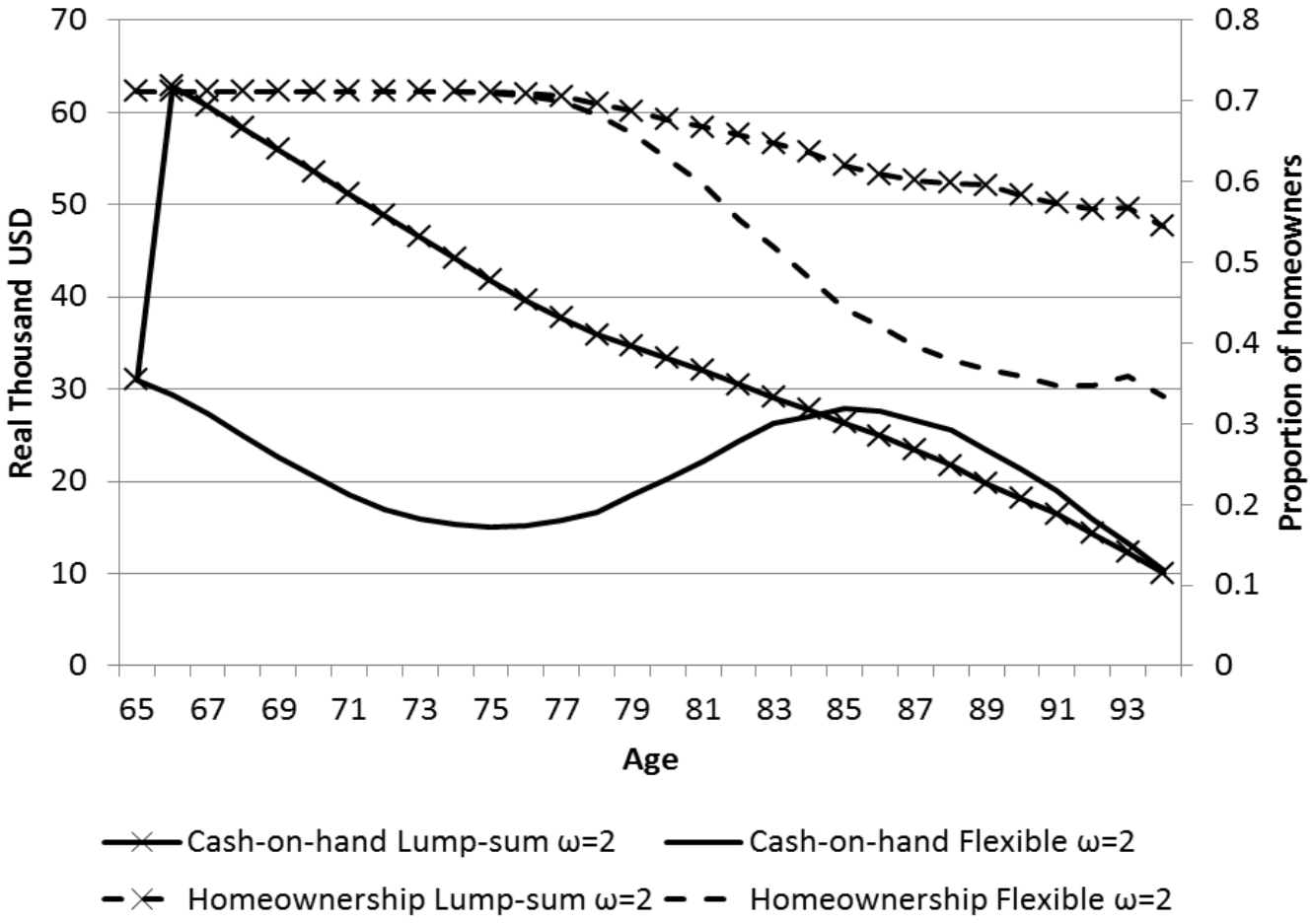
Panel B: Cash-on-hand and debt drawn



Flexible reverse mortgages

Age group	Base	δ= 2	Prem= 0.03	= 2	δ= 2 = 0 25	= 2 = 0 25
			Panel A: Average homeownership rates			
65 - 69	0.70	0.71	0.71	0.71	0.71	0.71
70 - 74	0.47	0.56	0.71	0.71	0.71	0.71
75 - 79	0.10	0.16	0.62	0.69	0.60	0.71
80 - 84	0.02	0.02	0.38	0.56	0.16	0.68
85 - 89	0.01	0.00	0.24	0.40	0.05	0.53
90 - 94	0.01	0.00	0.21	0.35	0.02	0.32
			Panel B: Average annual amount drawn			
65 - 69	0.04	0.00	0.01	0.04	0.00	0.00
70 - 74	1.29	0.49	1.25	1.13	0.18	0.16
75 - 79	1.84	0.68	2.08	1.83	0.63	0.67
80 - 84	0.55	0.67	1.06	1.01	0.66	0.82
85 - 89	0.00	0.00	0.12	0.18	0.17	0.58
90 - 94	0.00	0.00	0.00	0.00	0.00	0.18
			Panel C: Welfare gains of reverse mortgages at age 65			
Perc of wealth	-12.57	-15.71	7.64	27.35	-12.37	4.26

Lump-sum mortgages



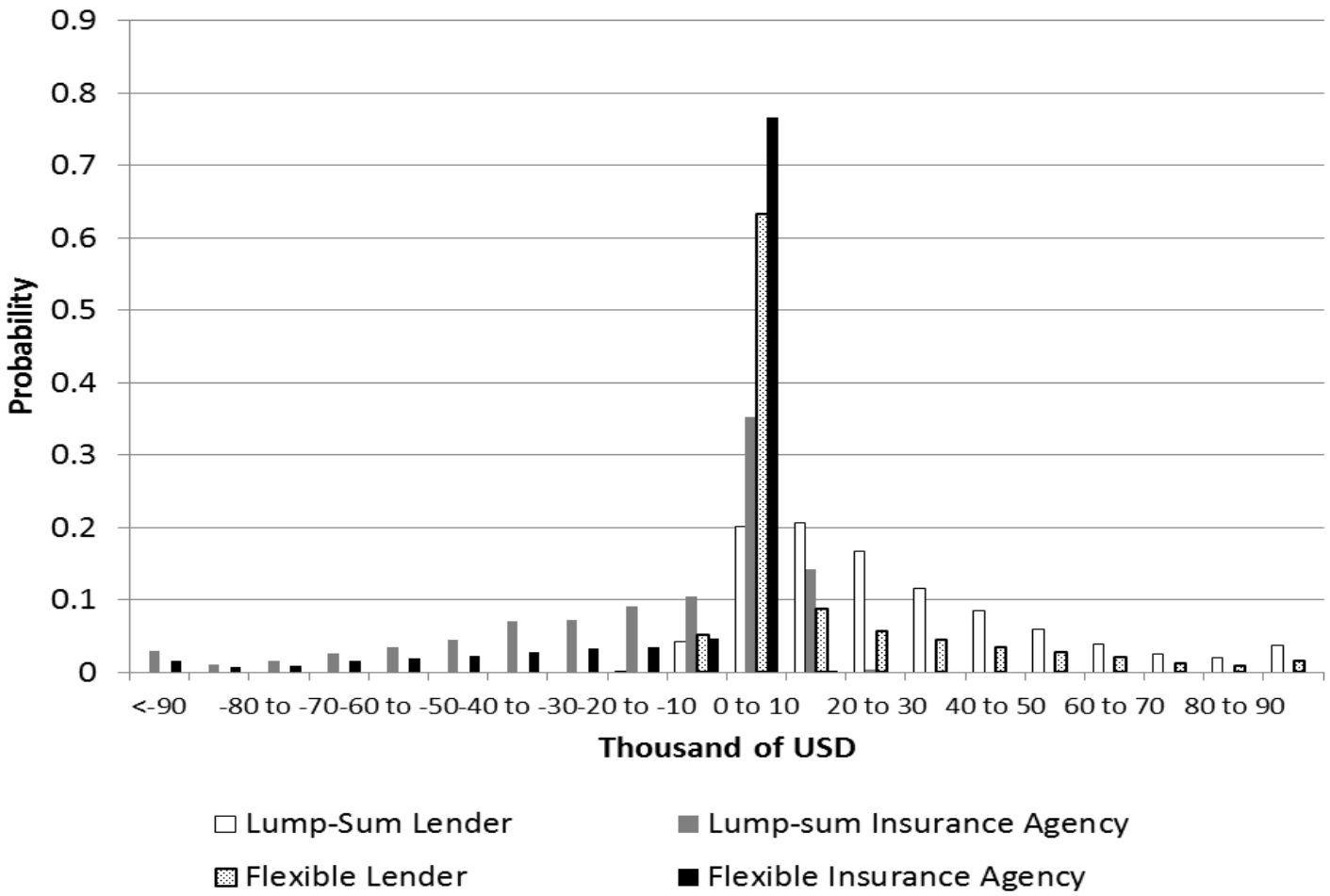
PV of cash-flows for lenders and the insurance agency

Discount rate	Rent prem = 0.03	Flexible		Lump-sum
		= 2	= = 2 = 0.0125	= 2
		Lender		
Bond yield	9.2	13.1	7.2	29.5
Risk-adjusted	10.3	14.3	8.0	29.7
		Insurance agency		
Bond yield	-3.3	-5.3	-1.5	-10.1
Risk-adjusted	-4.8	-7.3	-2.7	-13.3

Paramater value	PV of cash-flows		Welfare gain
	Lenders	Agency	of retirees
Ins. prem = 0.0125	29.7	-13.3	24.6
Ins. prem = 0.02	32.6	-14.7	17.7
Ins. prem = 0.03	36.9	-17.5	12.6
Pr. limit fact. = 0.541	29.7	-13.3	24.6
Pr. limit fact. = 0.50	27.2	-9.7	19.3
Pr. limit fact. = 0.40	21.2	-2.2	6.7
Pr. limit fact. = 0.35	18.2	0.6	2.3
Pr. limit fact. = 0.324*	16.7	0.3	4.8

* Lower initial mortgage insurance premium.

Distribution of PV of risk-adjusted cash-flows



Conclusion

- The financing of retirement consumption is an issue of great concern to many individuals and policy makers. Can housing be used to finance it?
- The existing evidence is not encouraging:
  - Many old households do not discontinue homeownership.
  - The demand for reverse mortgages has been limited.
- Our analysis shows that precautionary savings and bequest motives do not provide a full explanation.
  - Difficulty explaining the homeownership and wealth de-accumulation patterns observed in the data.
- Preference for staying in the same house possible explanation. The benefits of reverse mortgages for such individuals may be large.
- The analysis of the cash-flows of lenders and the government agency has shown that the insurance provided may induce moral hazard:
  - Increases in the insurance premium may be ineffective in addressing it.

Future Research

- Explore the issue of property maintenance further:
  - Impact on the value of collateral.
- Investigate which other loan characteristics may be beneficial for retirees without inducing moral hazard.
- Changes in the environment: lower pension income, etc.
- Other?

THANK YOU