Competition, Asymmetric Information, and the Annuity Puzzle: Evidence from a Government-run Exchange in Chile

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November 1, 2018

Chile: Exception to Annuity Puzzle

- Previous literature has documented a lack of annuitization - "annuity puzzle" - in many countries
- In contrast, more than 70% of eligible retirees in Chile voluntarily annuitize
  - At very low markup over actuarially fair
- What lessons can we learn about this well-functioning market?

This paper

- Our approach: build and estimate flexible structural model of demand for retirement assets
- Goal: recover distributions of underlying primitives that govern annuitization and welfare in this setting
- Simulate reforms to the system to make it more similar to the US:
  - Evaluate effects on annuity demand & average cost functions
  - Compute welfare changes

Takeaways

- More unobserved heterogeneity and correlation across unobservables than has been posited by the previous literature
- Reforming the system to make it more similar to the US causes annuity demand to contract and rotate, can lead to market unravelling
- Welfare effects heterogenous: no system Pareto dominates
  - Low value of annuitization types prefer Chile to the US
  - High value of annuitization types prefer the US to Chile, even with unravelling

The Chilean Retirement Exchange

- Chileans save throughout their lives in private retirement accounts
- Access these funds through an exchange called SCOMP
- Elicit offers for different annuity contracts
- Retiree can choose an annuity offer, or to take "Programmed Withdrawal"
  - Government-set withdrawal schedule, savings continue to be invested
  - Front-loaded
  - Upon death, balance received by heirs

Types of Annuity Contracts

- Deferral period
- Guarantee period
- Free Disposal Amount
- Transitory rents
- Mixed PW

Data Sources

- Individual-level administrative dataset from SCOMP, 2004-2013
  - All info life insurance companies see about the retiree
  - Every offer made & choices
- $230,000$ retirees and over 30 million annuity offers
- Match to death records, see death by 2015
- Focus on single life annuitants:
  - Single men
  - All women before 2008, single women after

Descriptive Evidence

- Unconcentrated market
- Heterogeneity in accepted contract types
- (Almost) always low markups
- Heterogenous take-up of PW by wealth
- Adverse selection into annuities
- 20% of population takes dominated offers, but loss is low

Model

- Goal: comparisons across contracts with different flow payments over time, exposures to risk, and inheritance properties
- Set up a finite-horizon consumption-savings model with the following features:
  - Uncertain longevity/bankruptcy
  - CRRA utility
  - Bequest motive
- Given a level of risk aversion γ, outside wealth ω, bequest motive β, and mortality shifter μ, can calculate expected utility for an annuity offer or for PW
  - Solve numerically using EGM (Carroll (2011))

Demand Model

- Take grid over type space, solve C-S model for every offer-type
- Impose every type chooses highest-value offer

$$s_{iojr} = \begin{cases} 1 & \text{if } V^A(X^A_{ioj}, \theta_r) \geq \\ & \max[\max_{o',j' \in \mathcal{O}^A_i} V^A(X^A_{io'j'}, \theta_r), \max_{j' \in \mathcal{O}^{PW}_i} V^{PW}(X^{PW}_{ij'}, \theta_r)] \\ 0 & \text{otherwise} \end{cases}$$

- Estimate type probabilities that rationalize observed choices:

$$\min_{\pi} \sum_{i,o,j} (y_{ioj} - \sum_r s_{iojr} \pi_r)^2$$

subject to:

$$\pi_r \geq 0 \, \forall r \quad \sum_r \pi_r = 1$$

Demand Model - Concerns

- Purely financial model
  - No non-financial utility of the contract / firm
- Information revelation at the request stage
  - Can estimate conditional on request set
- Heterogeneity in distribution of types across observables
  - Estimate separately for gender / pension balance quartiles
- Choice of grid
  - Step 1: Take a 5% subsample of retirees, solve the problem for a 17^5 grid. Pick points with mass above 10^{-4}
  - Step 2: Solve the problem for all offers (1.2 MM) for each point in this grid (196)

Demand Model - Identification of Type Distribution

- For each consumer and type, have chosen offer
- Let S denote the $N \cdot O \times K$ matrix of choice probabilities, y dummy vector of choices
- At true type distribution ϕ_0, $E[y - S\phi_0] = 0$
  - Need invertibility of $(S'S)$: different types make different choices

Results - Main Takeaways

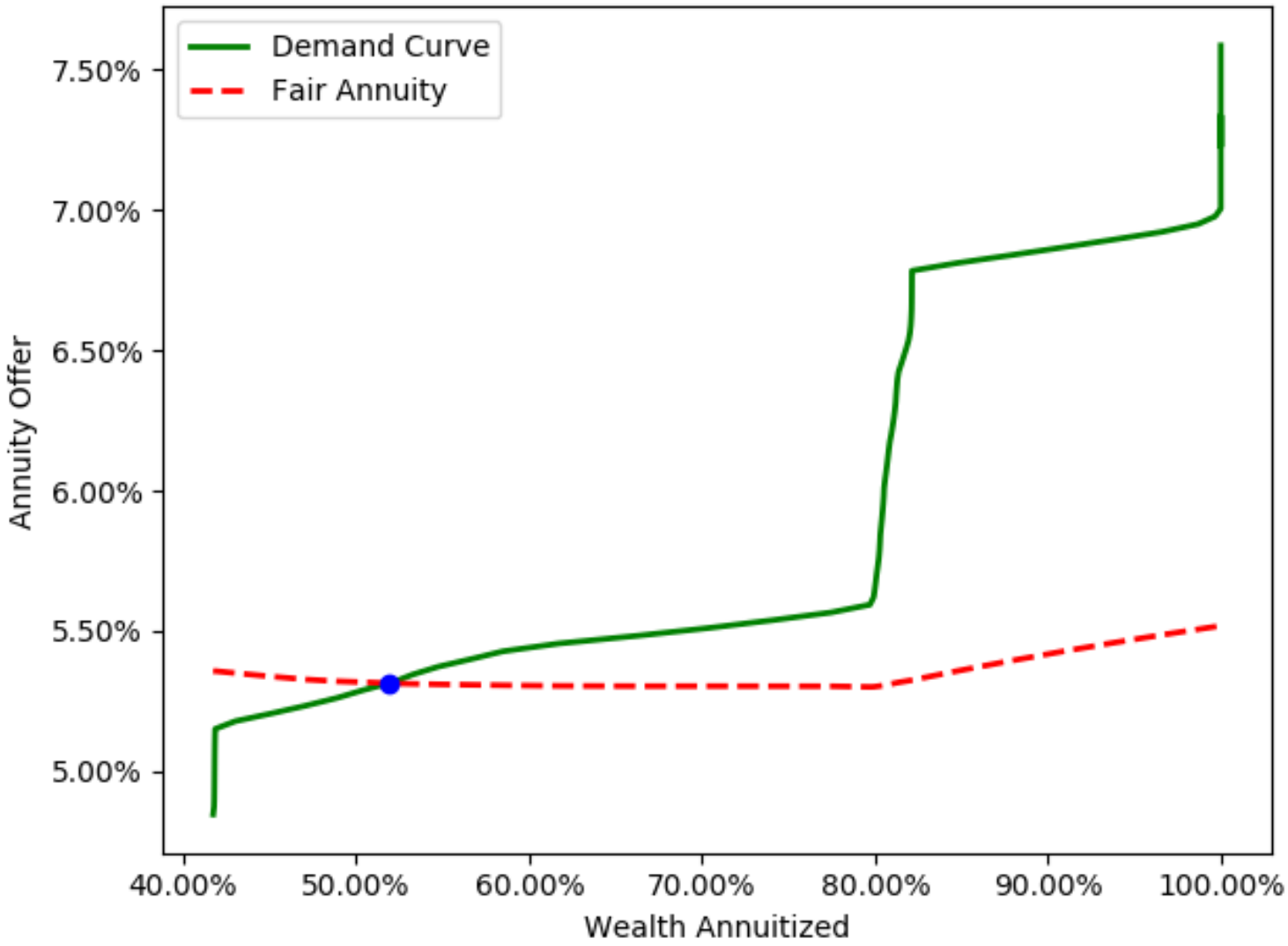
- Heterogeneity in bequest motive. Higher for women than for men
- Heterogeneity in mortality expectations relative to the table. Poorer individuals have higher mortality probabilities
- Distribution of outside wealth shifts to the right as pension balances increase
- Low heterogeneity in risk aversion, lower values than the literature
- Mortality probabilities negatively correlated with bequest motive, risk aversion

▸ Marginals ▸ Correlations

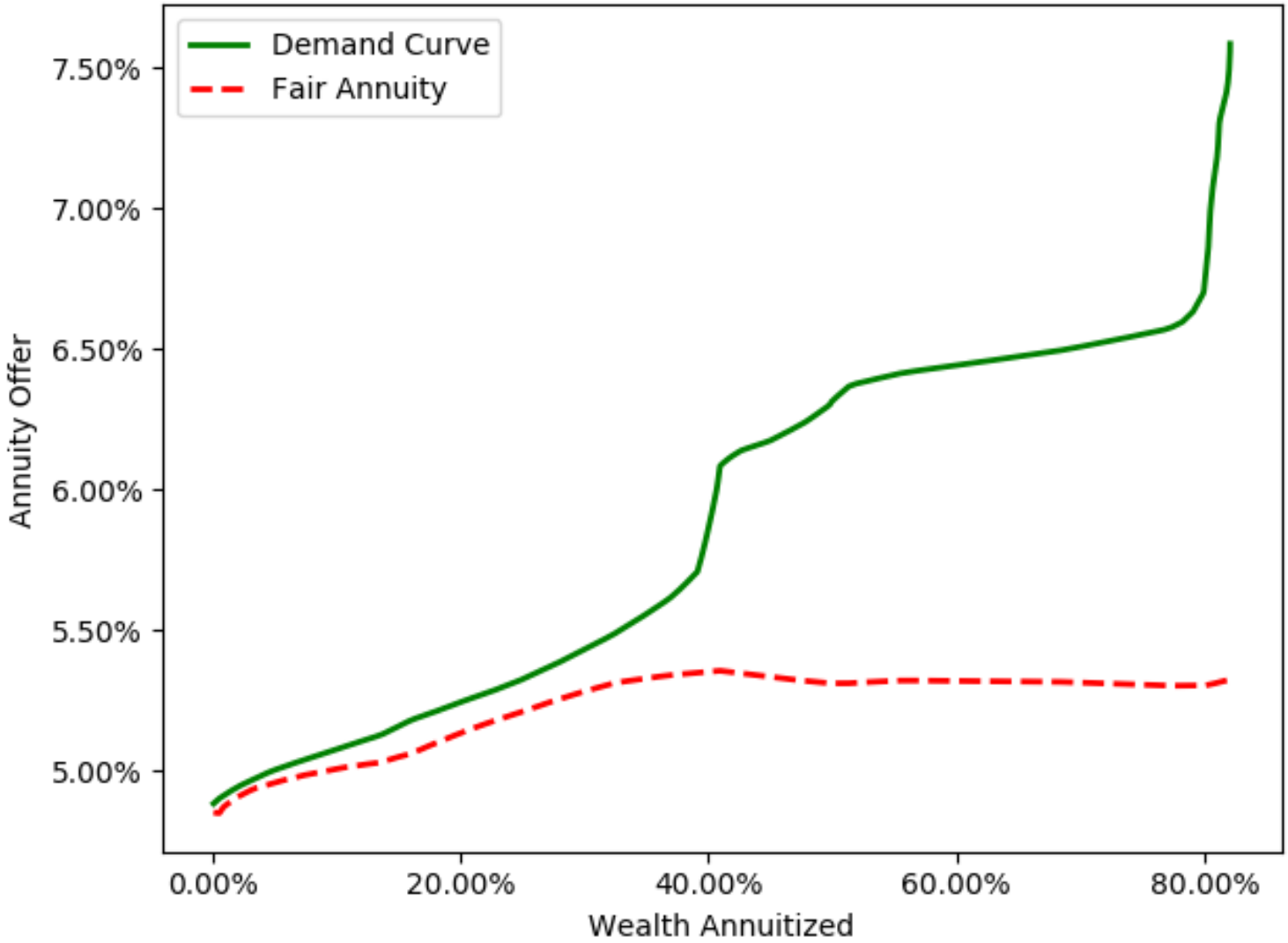
Annuity Market Equilibria

- Simulate market equilibria under stripped-down versions of the Chilean and US institutional framework
- Goal: to highlight the change in demand and average cost induced by the introduction of Social Security:
- In both Chile and the US:
  - Single annuity product, perfectly competitive market, pricing on gender and pension balance
  - Fractional annuitization
  - 1% bankruptcy probability, no insurance
- In Chile: alternative to annuity is PW
- In US: 50% of pension balance is allocated to Social Security (actuarially fair annuity), remainder can be annuitized or withdrawn lump-sum

Chilean Equilibrium, Female 2nd Quartile

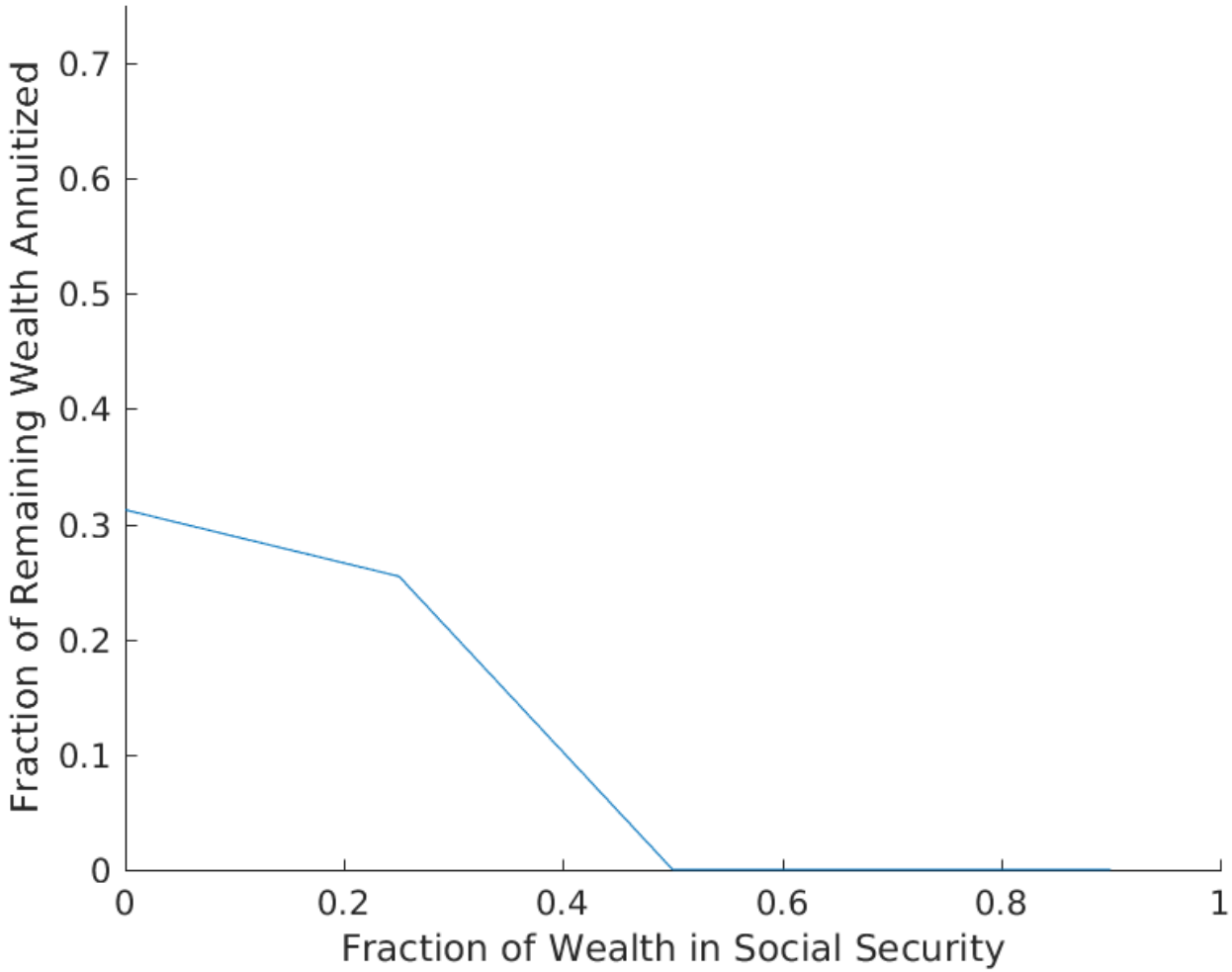


US Equilibrium, Female 2nd Quartile



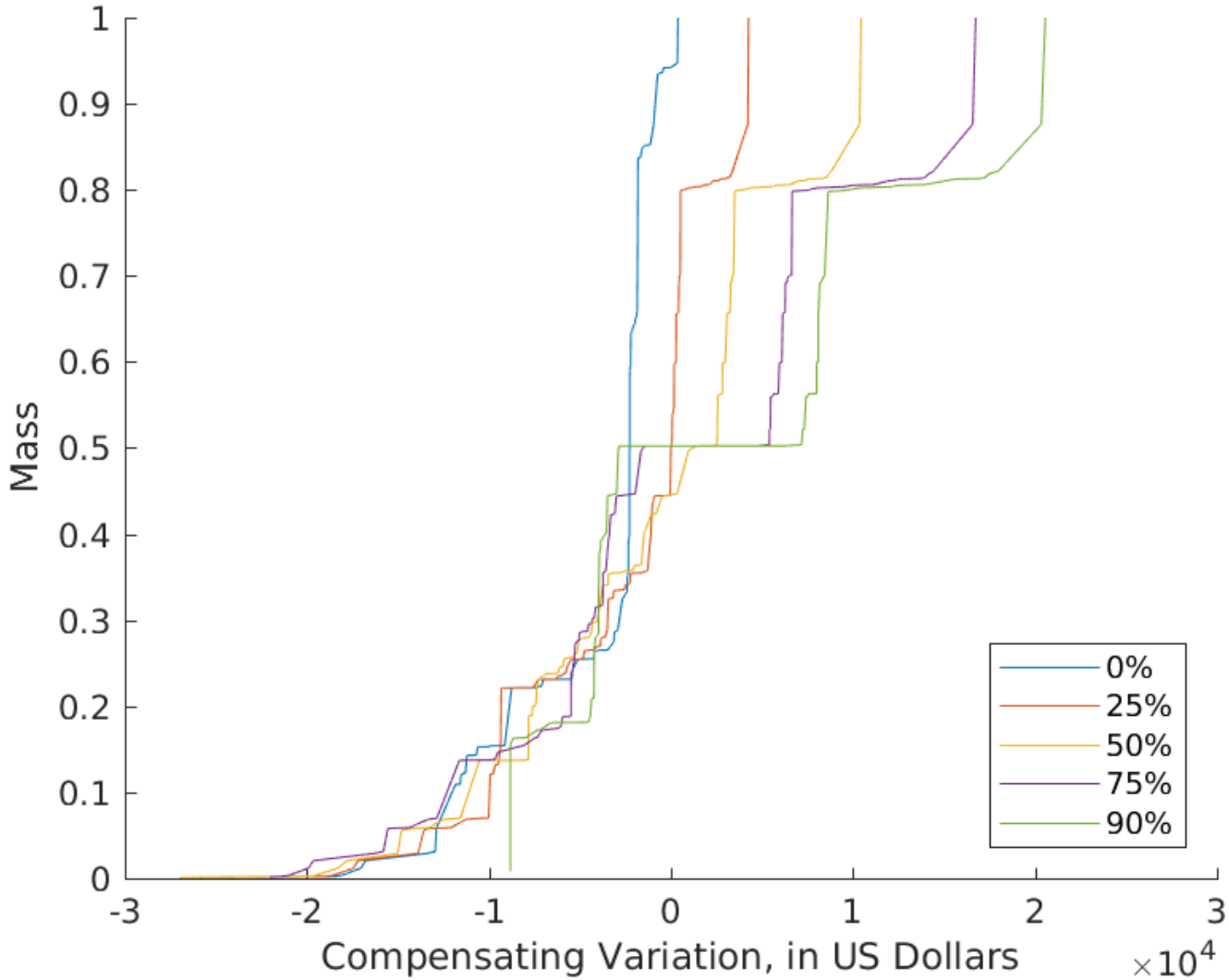
▸ Other sub-markets

US Equilibrium, Female 2nd Quartile, for Different Amounts in SS



▸ Other sub-markets

CV - Female Second Quartile



▸ Other sub-markets

Conclusion

- Have estimated flexible model of demand for retirement products
  - Find significantly more unobserved heterogeneity than what has been posited in previous work studying annuitization
  - Mortality correlated with several other unobservables, mitigates adverse selection
- Social Security:
  - Contracts and flattens demand curve: equilibrium is more fragile
  - Despite this, Chilean system does not dominate - heterogeneity in welfare effects
  - Low value of annuitization types prefer Chile to the US
  - High value of annuitization types prefer the US to Chile, even with unravelling

Additional Slides

Adverse selection into annuities - Gompertz

	(1) Time to Death
Choose annuity	-0.164**
	(0.0601)
Insurance co. agent	0.195**
	(0.0646)
Insurance broker	0.160*
	(0.0682)
Financial advisor	0.0841
	(0.103)
Direct thru insurance co.	0.133
	(0.189)
Wealth/age controls	✓
Observations	45091

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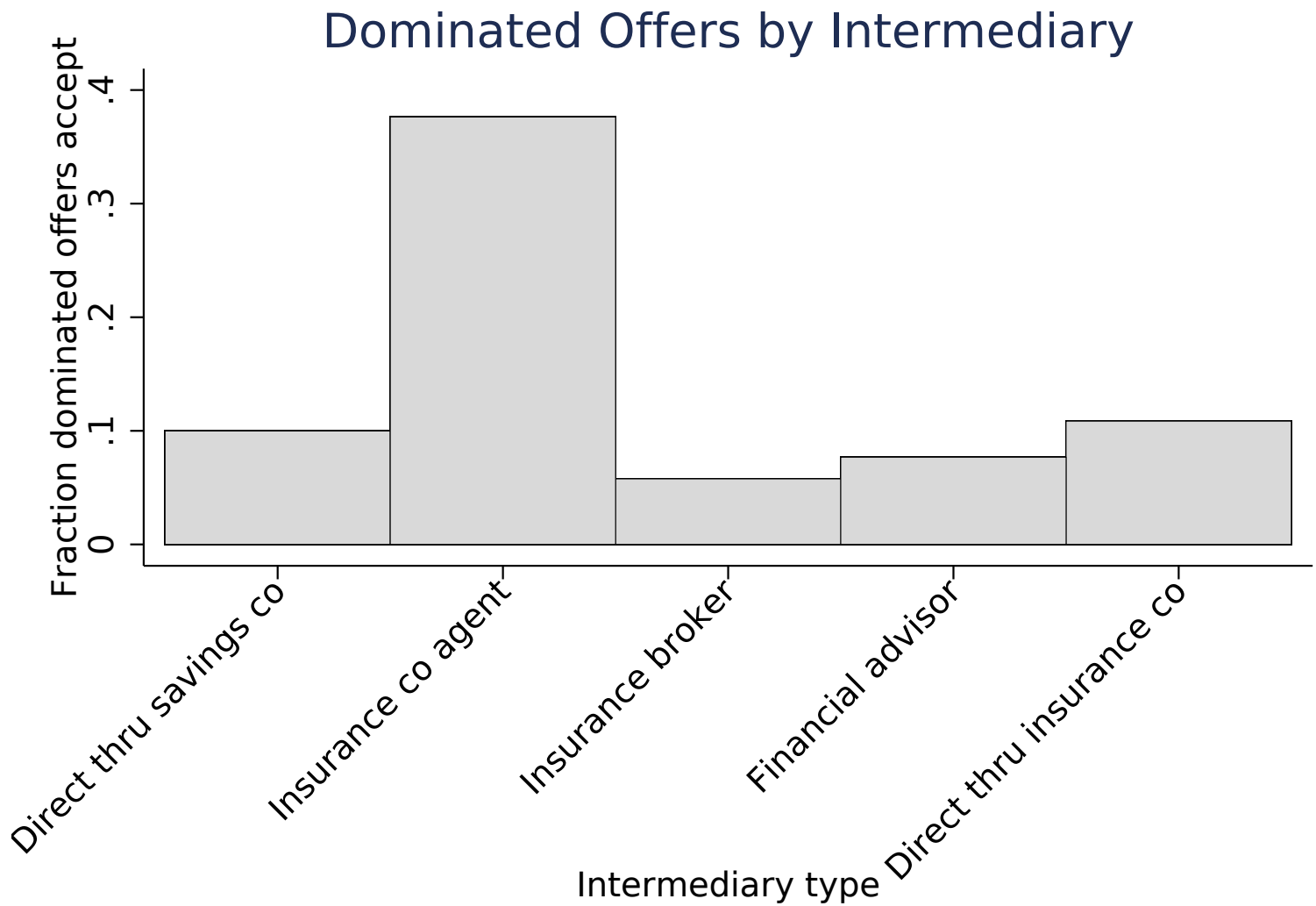
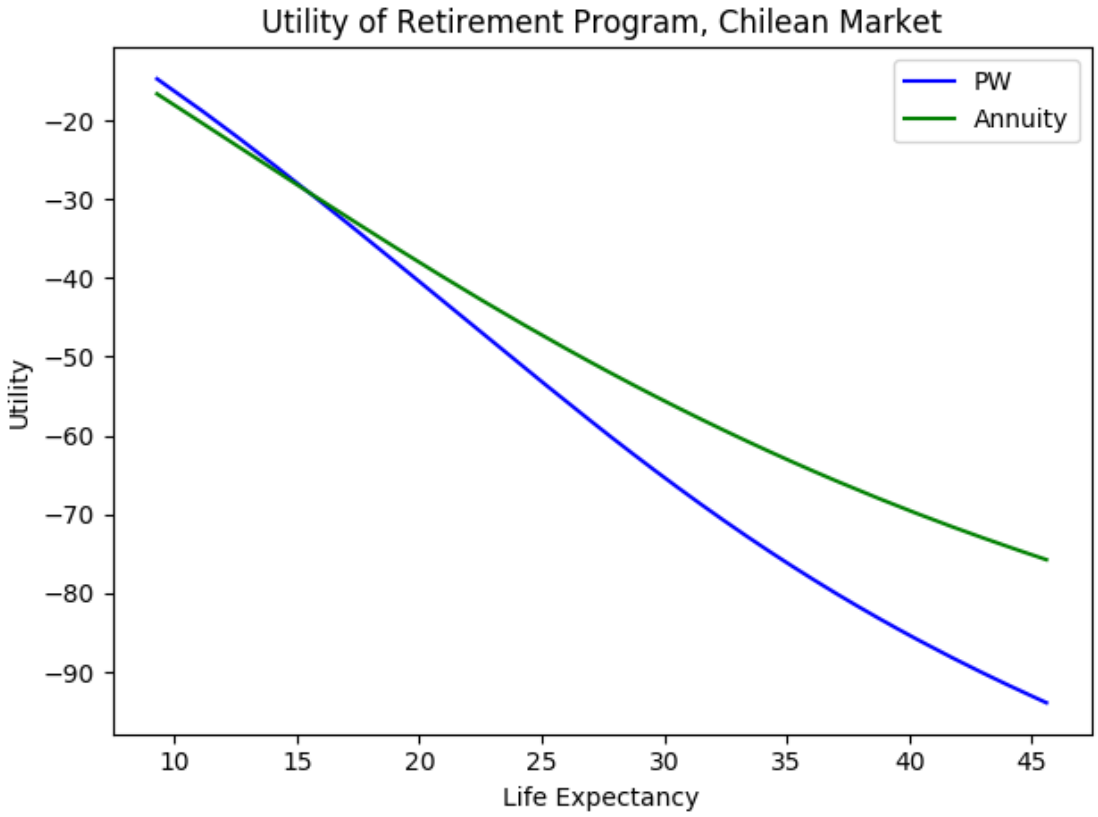
Dominated Offers and Intermediation



Utility comparison, Chilean system



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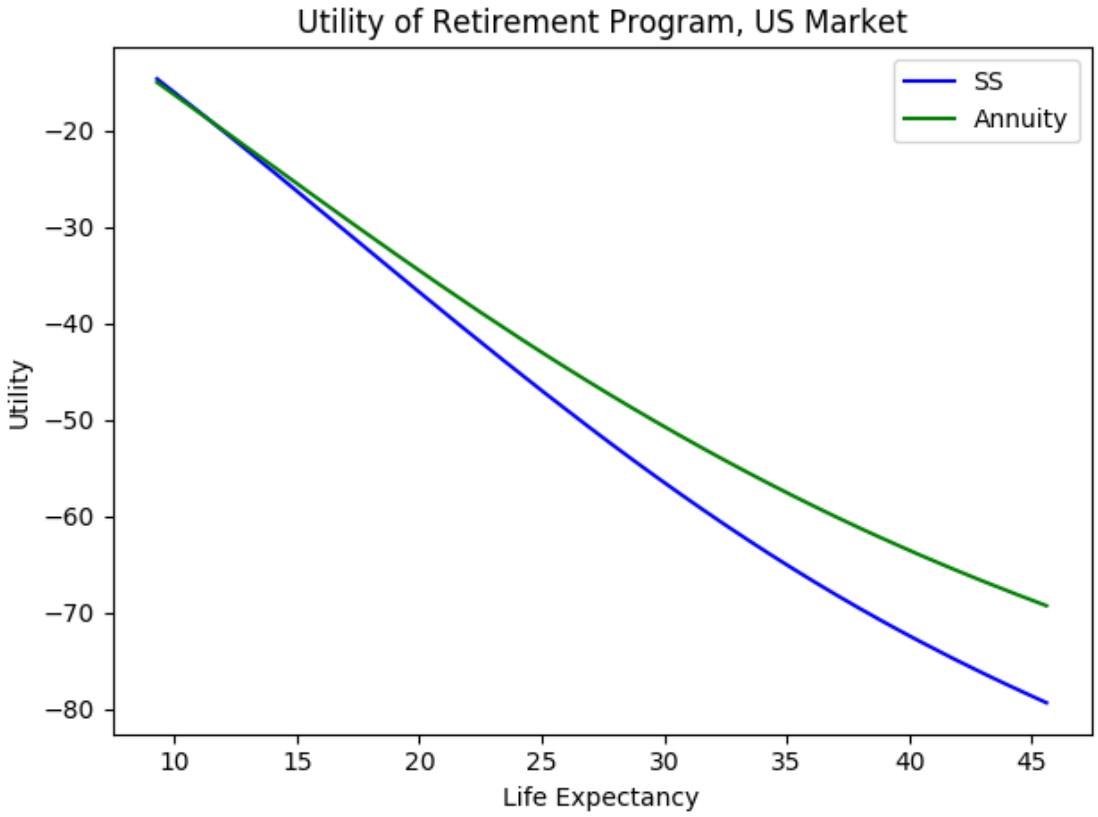
Calibration



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Map from Bequest Motive to Consumption

	Bequest Motive	Percentage Consumed
1	0	100.00%
2	8.99E-07	99.09%
3	6.07E-05	96.38%
4	7.58E-04	91.99%
5	4.85E-03	86.09%
6	2.20E-02	78.90%
7	8.21E-02	70.68%
8	2.72E-01	61.79%
9	8.52E-01	52.50%
10	2.60E+00	43.25%
11	8.05E+00	34.33%
12	2.61E+01	26.10%
13	9.06E+01	18.92%
14	3.44E+02	13.01%
15	1.37E+03	8.62%
16	4.63E+03	5.91%
17	7.89E+03	5.00%

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Results - Females in First Quartile

	Bequest Motive	Risk Aversion	Outside Wealth	Health Shifter	Mass
1	26.07	0.84	12.03	10	8.92%
2	26.07	0.84	4.60	0	8.92%
3	26.07	0.84	10.10	10	8.88%
4	90.66	0.84	6.31	-2	7.73%
5	7.58E-04	1.46	12.03	-2	7.53%
6	0.27	5.00	10.10	0	7.03%
7	26.07	0.84	8.17	10	7.02%
8	90.66	1.46	8.17	5	5.90%
9	0.85	5.00	8.17	0	5.42%
10	0.85	5.00	12.03	0	3.41%

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Results - Females in Third Quartile

	Bequest Motive	Risk Aversion	Outside Wealth	Health Shifter	Mass
1	26.07	0.84	10.10	10	7.91%
2	26.07	0.84	12.03	10	7.91%
3	90.66	0.84	6.31	-2	6.81%
4	6.07E-05	1.46	12.03	-2	6.53%
5	90.66	1.46	6.31	2	6.10%
6	26.07	0.84	4.60	0	5.97%
7	26.07	0.84	8.17	10	4.59%
8	7.58E-04	1.46	8.17	-5	4.32%
9	344.28	1.46	10.10	-2	4.02%
10	26.07	0.84	6.31	-2	3.43%

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Results - Males in First Quartile

	Bequest Motive	Risk Aversion	Outside Wealth	Health Shifter	Mass
1	0.27	5.00	10.10	0	16.47%
2	8.06	1.46	8.17	8	7.89%
3	26.07	0.84	4.60	0	5.85%
4	90.66	0.84	6.31	-2	4.98%
5	7.58E-04	1.46	8.17	-5	4.07%
6	7.58E-04	1.46	12.03	-5	4.06%
7	7.58E-04	1.46	10.10	-5	4.04%
8	90.66	1.46	8.17	2	3.63%
9	26.07	0.84	8.17	10	2.90%
10	26.07	0.84	10.10	10	2.88%

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Results - Males in Second Quartile

	Bequest Motive	Risk Aversion	Outside Wealth	Health Shifter	Mass
1	6.07E-05	1.46	10.10	5	21.67%
2	7.58E-04	1.46	6.31	0	7.92%
3	26.07	0.84	4.60	0	7.37%
4	7.58E-04	1.46	8.17	-5	6.60%
5	90.66	0.84	6.31	-2	6.16%
6	0.27	4.02	10.10	2	5.40%
7	0.85	2.22	10.10	8	4.84%
8	90.66	1.46	10.10	5	4.37%
9	2.60	3.09	10.10	0	3.92%
10	344.28	1.46	6.31	-2	2.92%

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Results - Males in Third Quartile

	Bequest Motive	Risk Aversion	Outside Wealth	Health Shifter	Mass
1	6.07E-05	1.46	10.10	5	24.68%
2	7.58E-04	1.46	8.17	-5	7.72%
3	26.07	0.84	4.60	0	6.62%
4	344.28	1.46	6.31	-2	6.16%
5	90.66	1.46	8.17	5	4.27%
6	26.07	0.84	12.03	-2	3.64%
7	2.60	2.22	8.17	8	3.42%
8	90.66	1.46	6.31	2	3.34%
9	0.85	5.00	8.17	0	3.13%
10	26.07	0.84	8.17	-2	3.01%

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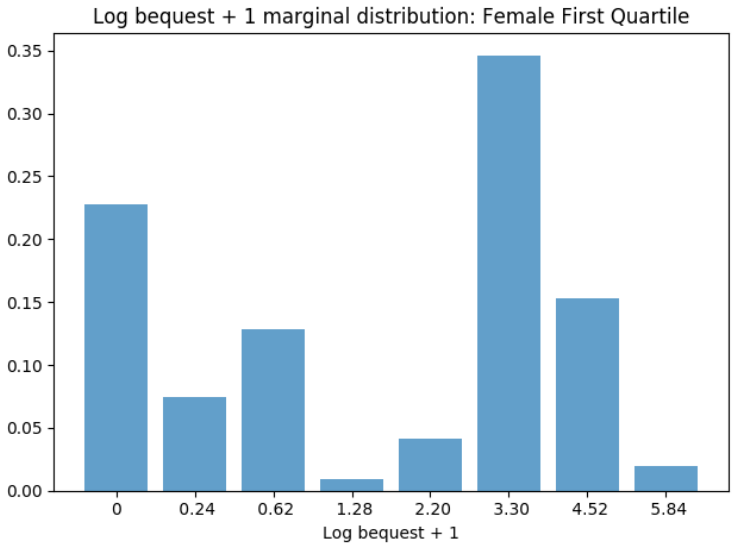
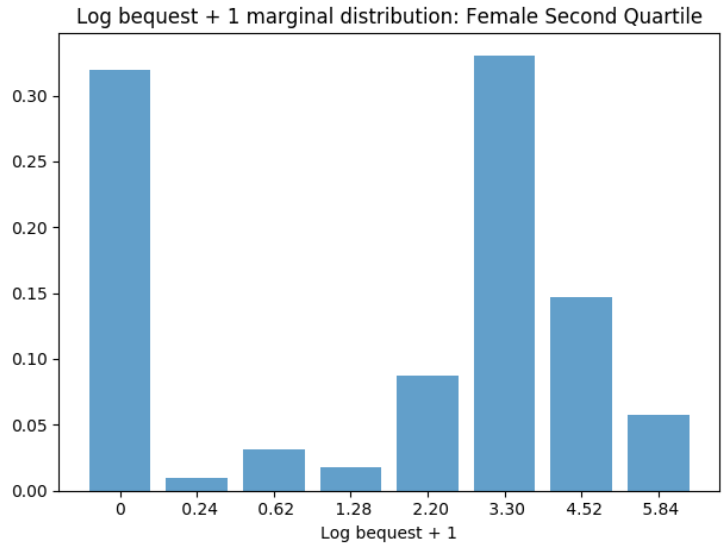
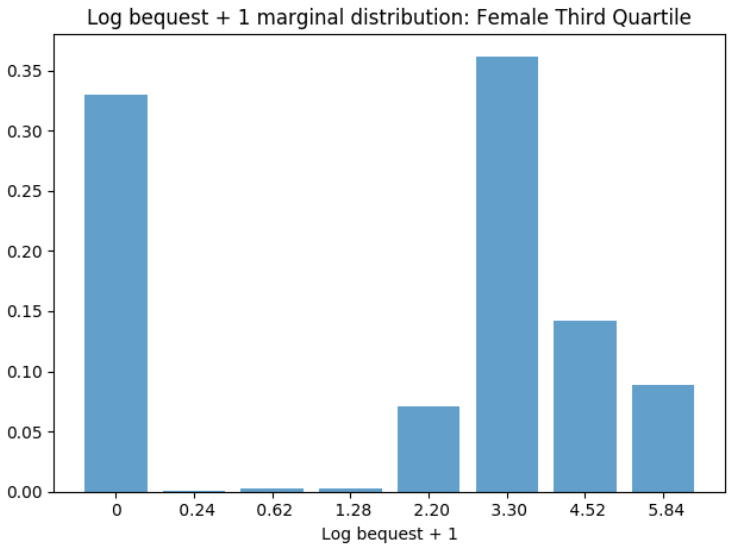
Fit

Gender	Female				Male			
Wealth Quartile	First	Second	Third	Fourth	First	Second	Third	Fourth
Fraction Annuitized								
Observed	0.65	0.70	0.71	0.64	0.39	0.66	0.71	0.62
Predicted	0.32	0.46	0.52	0.54	0.18	0.36	0.48	0.50
Fraction in Mixed Annuities								
Observed	0.08	0.07	0.07	0.04	0.01	0.02	0.02	0.03
Predicted	0.05	0.05	0.05	0.05	0.02	0.04	0.04	0.07
Fraction in Deferred Annuities								
Observed	0.22	0.30	0.34	0.26	0.06	0.17	0.17	0.15
Predicted	0.07	0.11	0.14	0.13	0.02	0.04	0.06	0.06
Fraction in Guaranteed Annuities								
Observed	0.53	0.59	0.60	0.52	0.25	0.48	0.48	0.41
Predicted	0.12	0.23	0.27	0.26	0.03	0.09	0.16	0.19
Two-year mortality								
Observed	1.55%	1.71%	1.32%	1.33%	6.39%	5.42%	4.37%	2.95%
Predicted	1.23%	1.14%	1.14%	1.15%	3.77%	3.05%	2.79%	2.98%
Number of observations	426566	692103	738509	697265	65402	139733	181948	210611
Number of consumers	9083	9180	9023	8412	2768	2800	2735	2676
Unobserved heterogeneity levels	194	194	194	194	194	194	194	194
MSE	0.02	0.01	0.01	0.01	0.03	0.02	0.02	0.01
R2	0.60	0.47	0.43	0.42	0.74	0.58	0.48	0.45







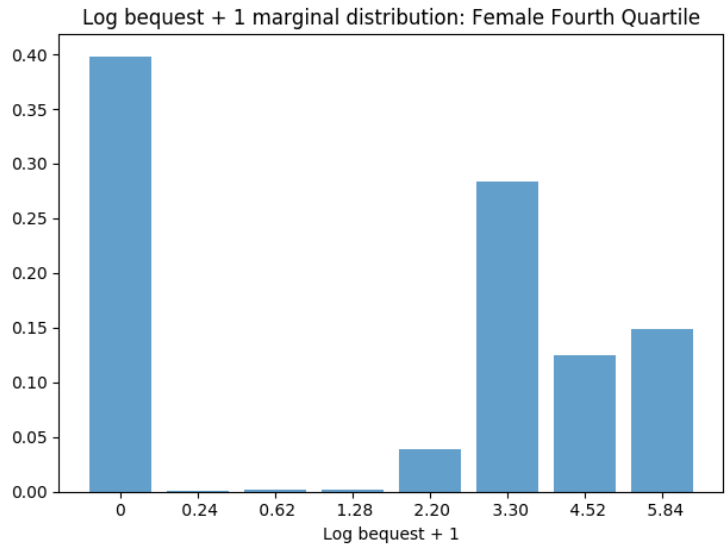


Figure: Marginal Distribution of Bequest Motive - Females

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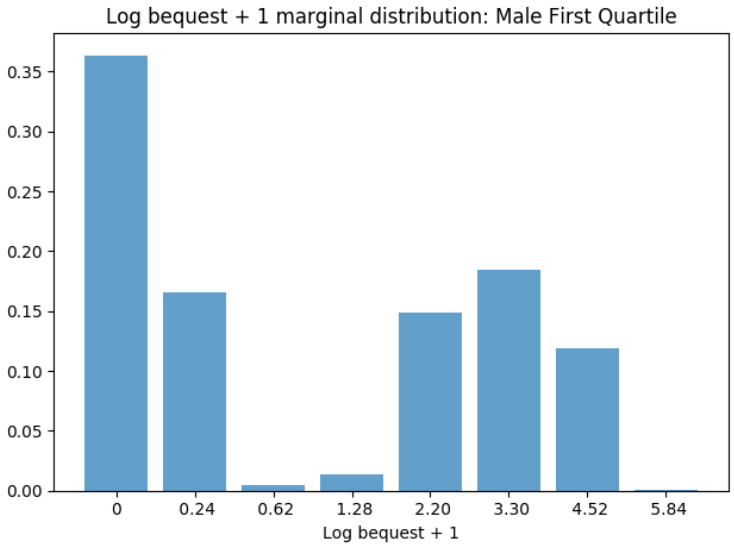

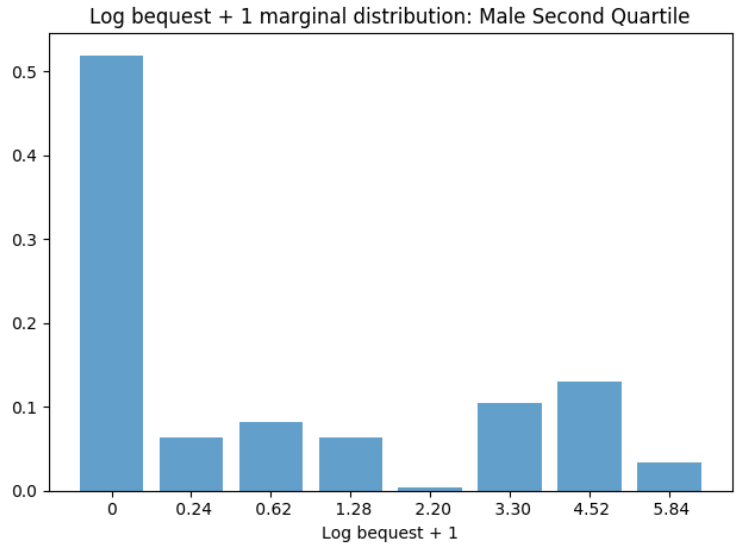

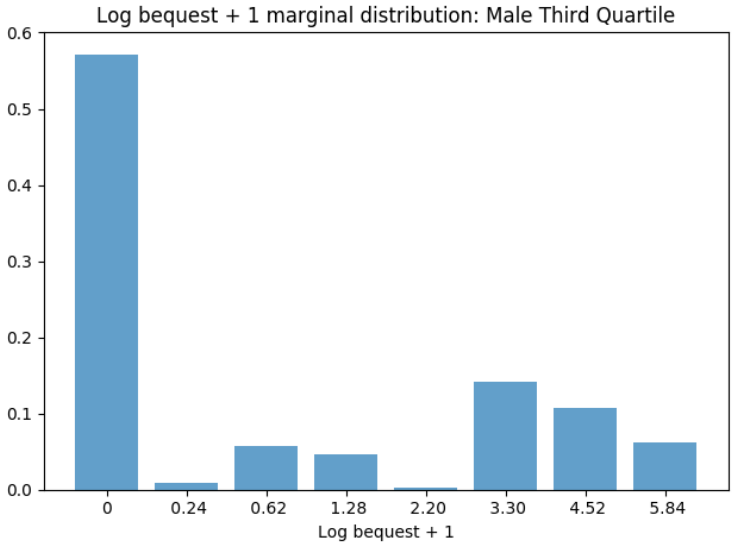

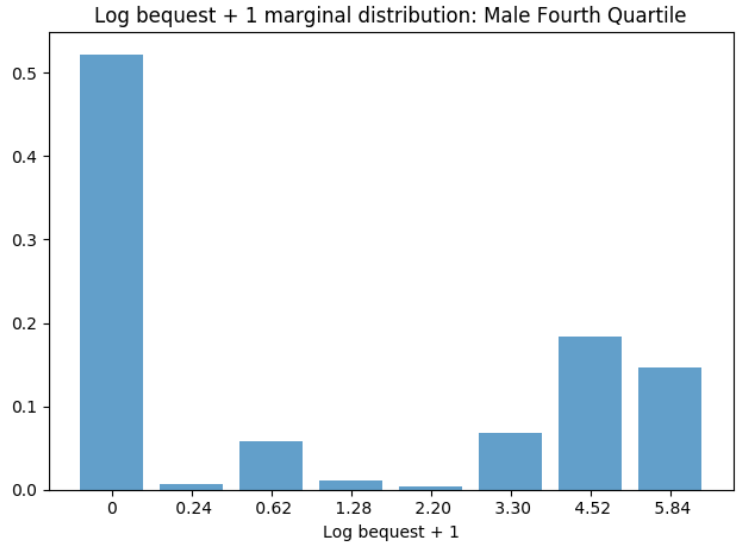

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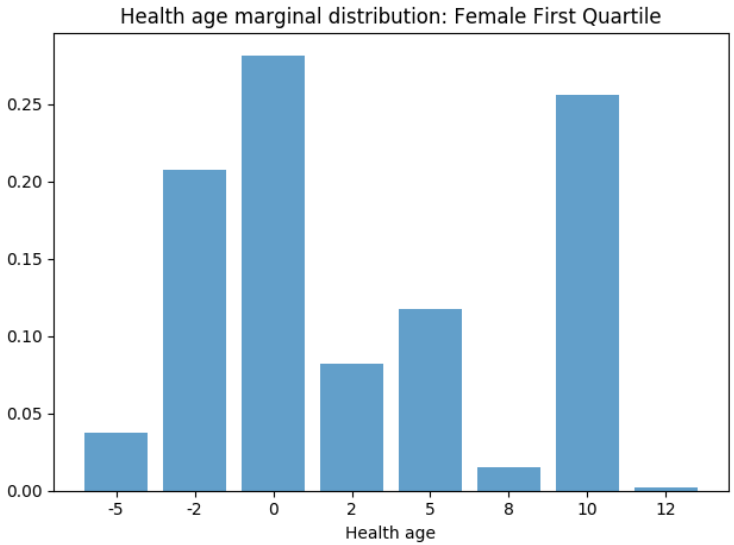

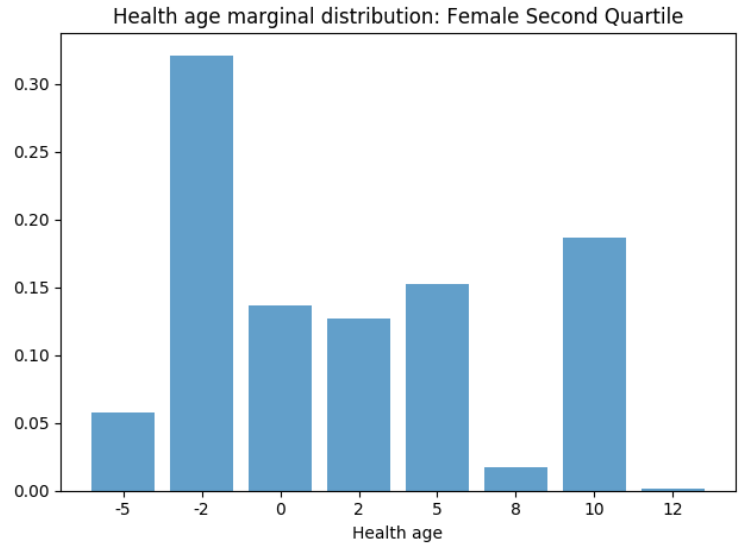

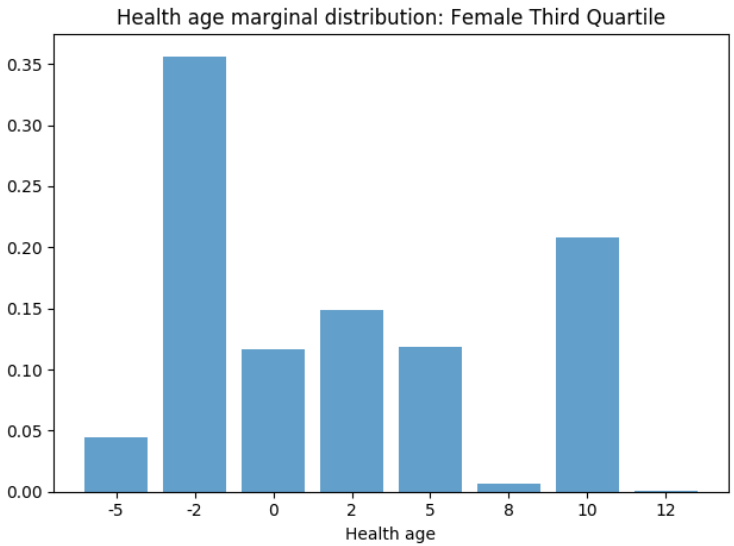

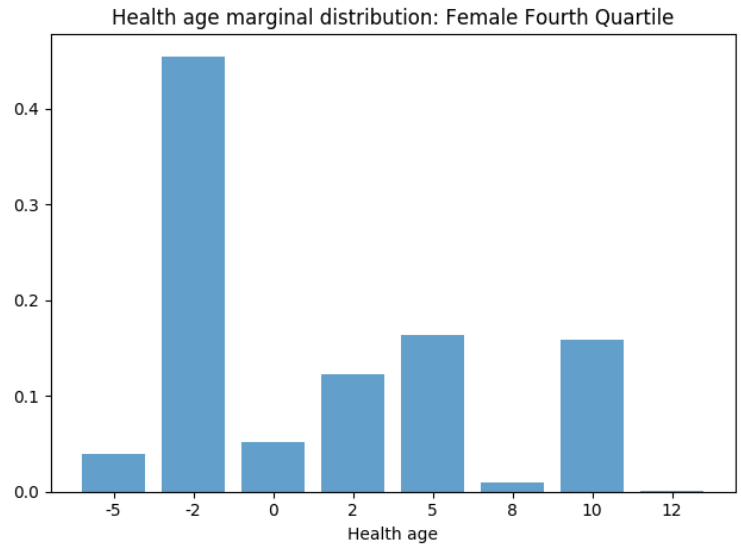

Figure: Marginal Distribution of Health Shifter - Females

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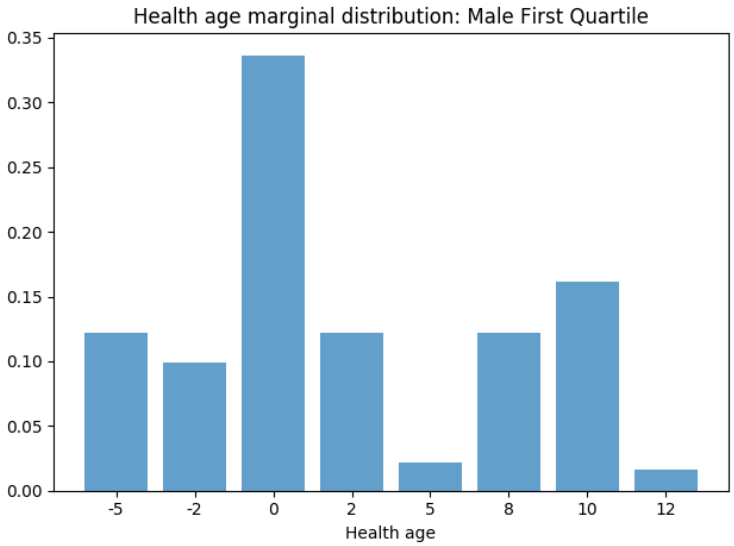

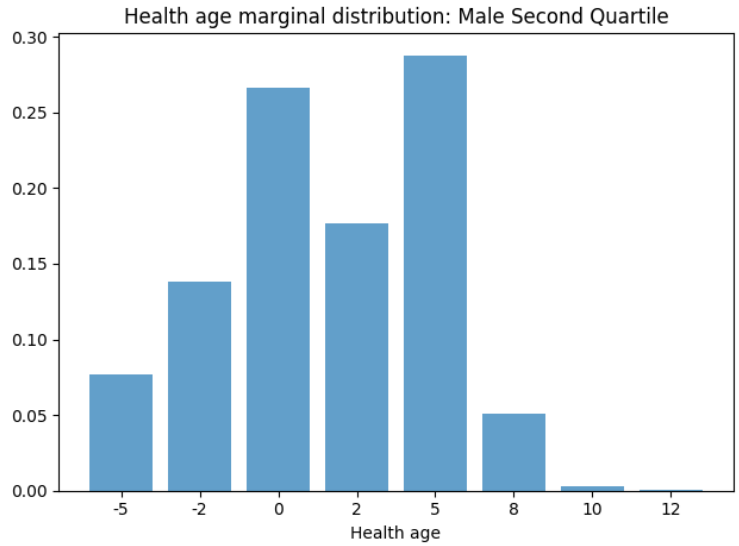

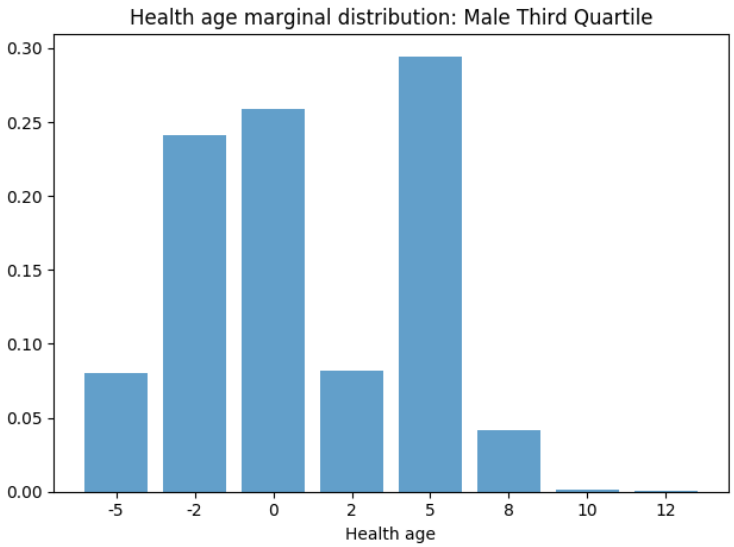

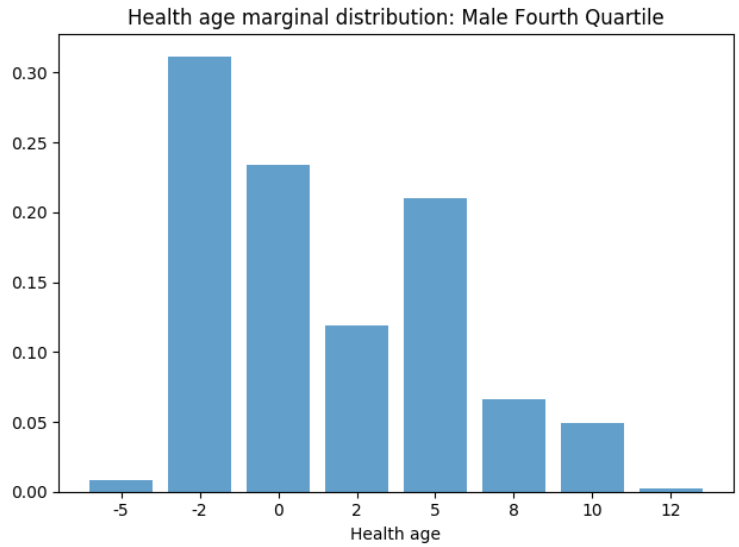

Figure: Marginal Distribution of Health Shifter - Males

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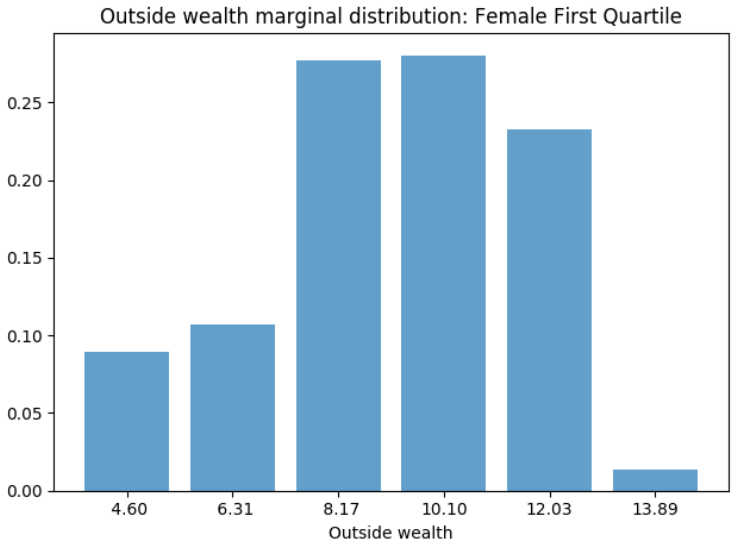

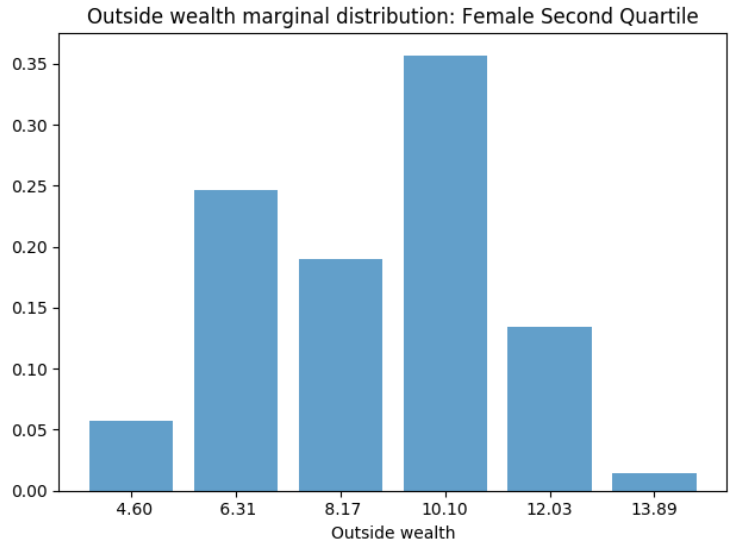

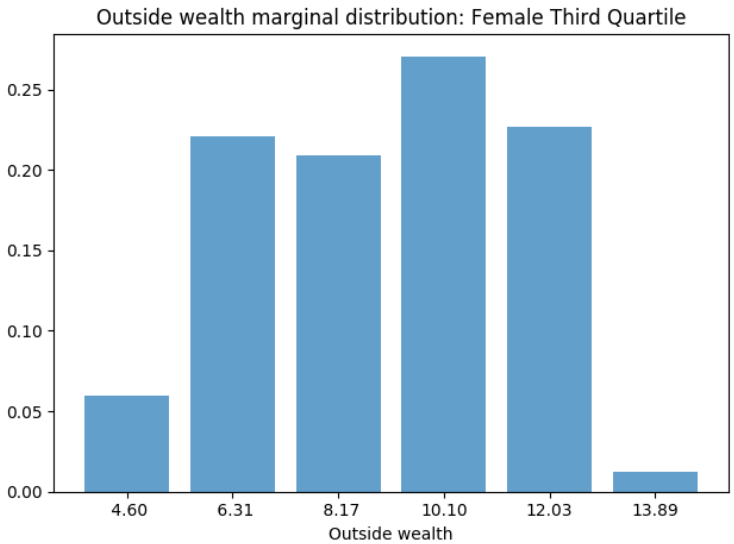

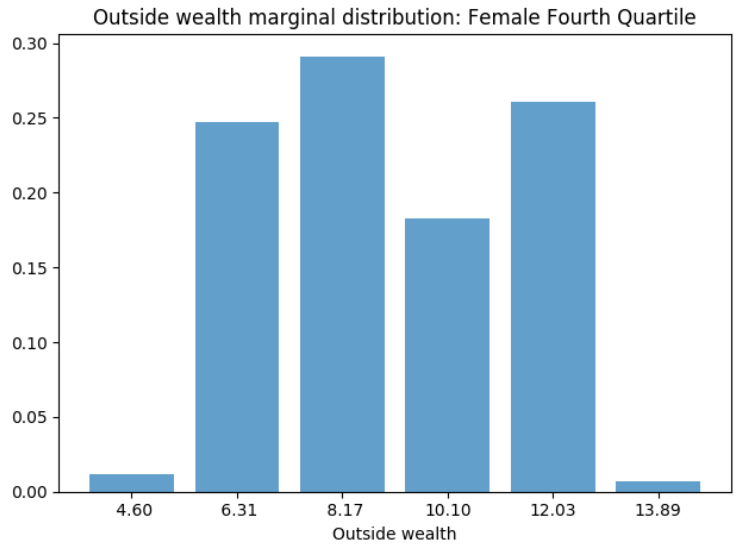

Figure: Marginal Distribution of Outside Wealth - Females

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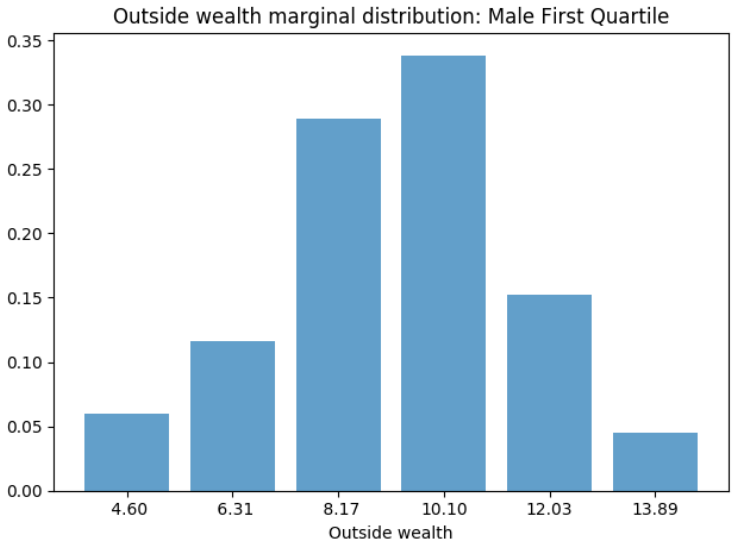
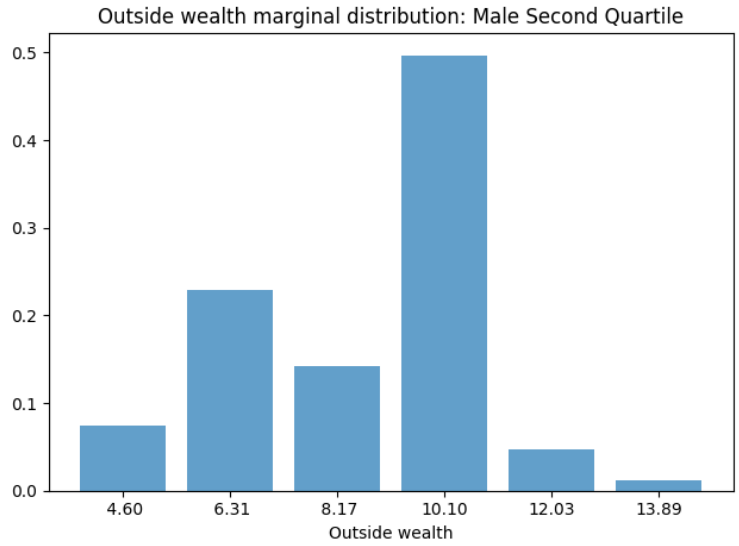
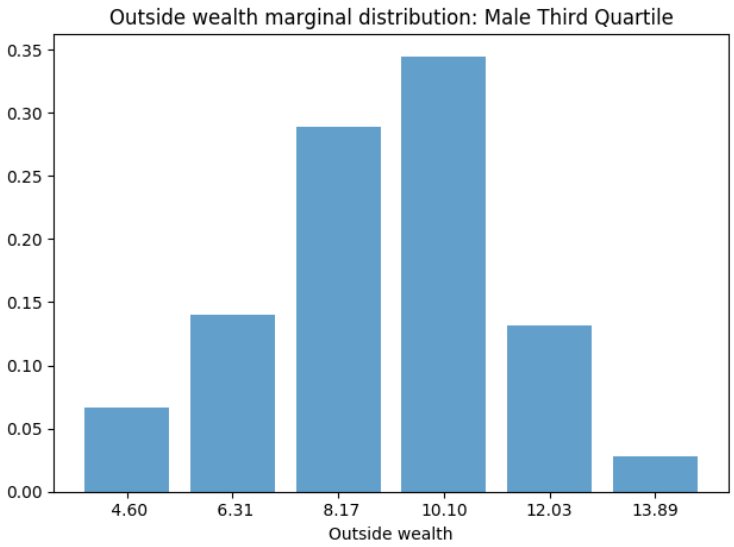






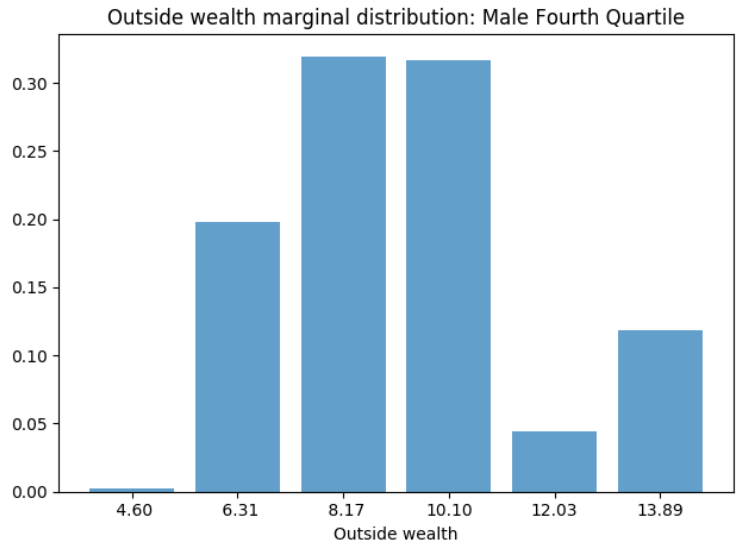
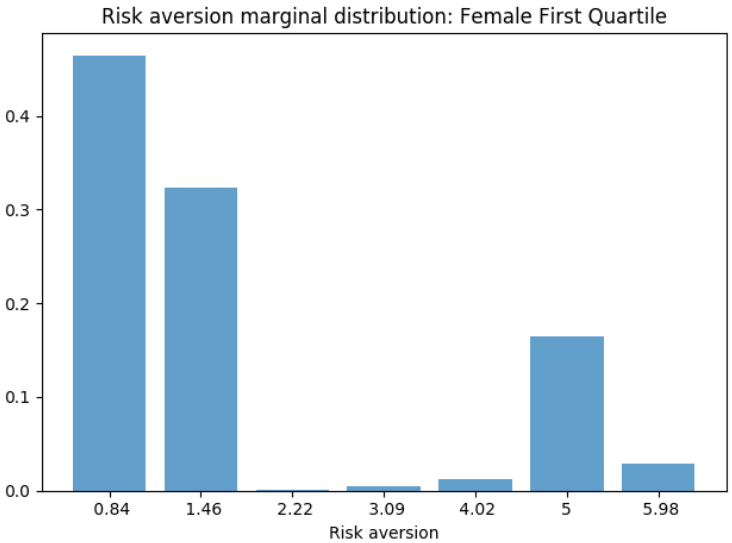
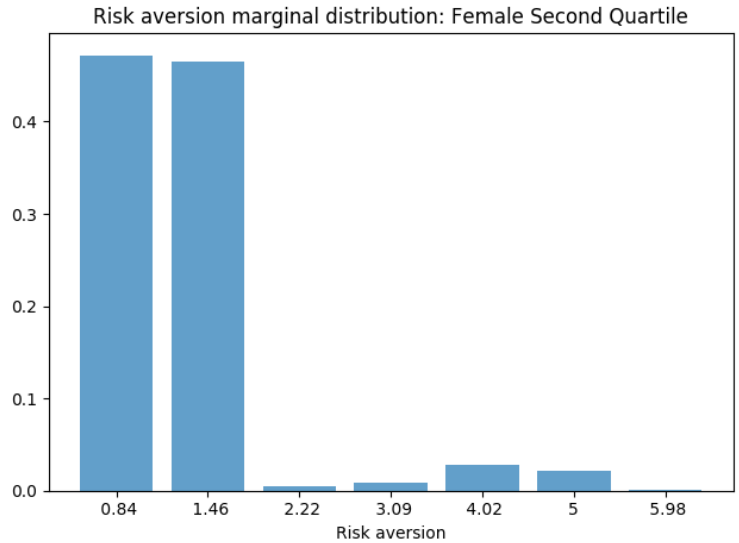
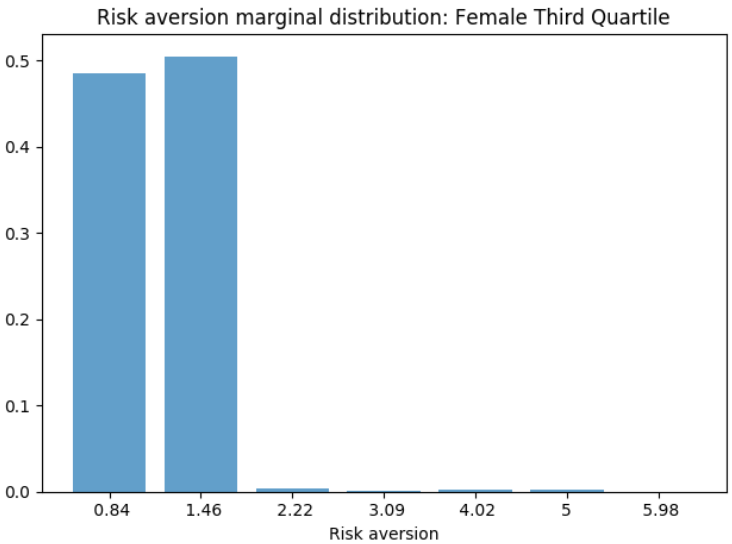


Figure: Marginal Distribution of Outside Wealth - Males

Back







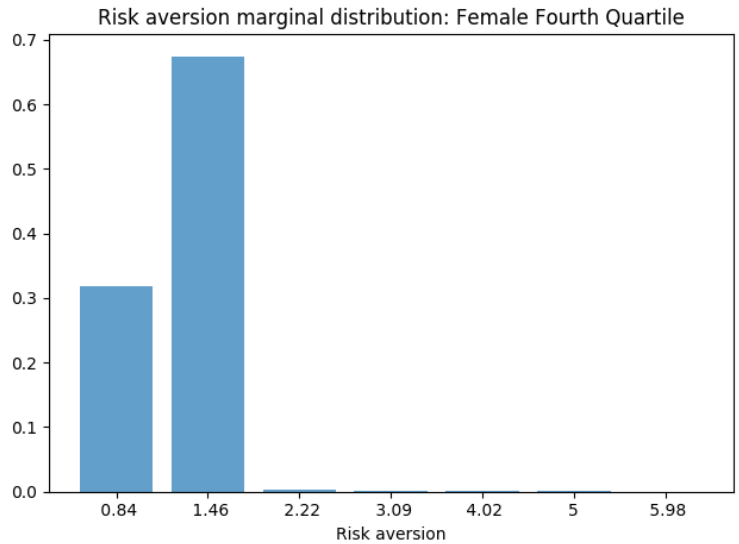
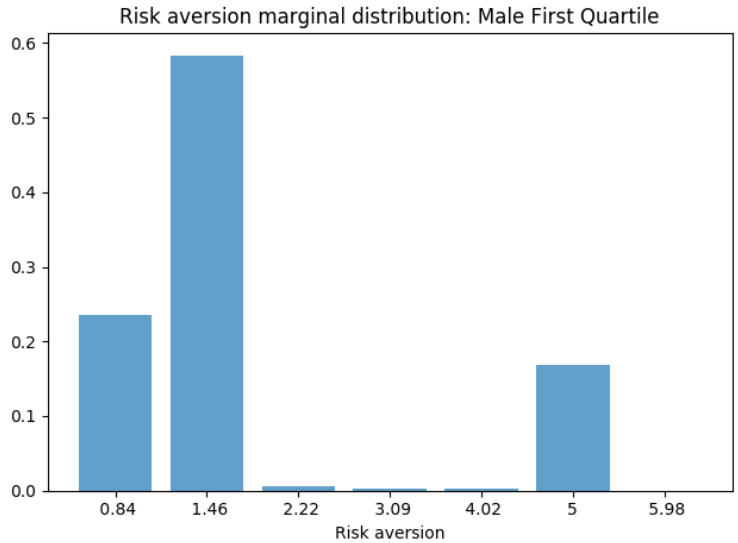
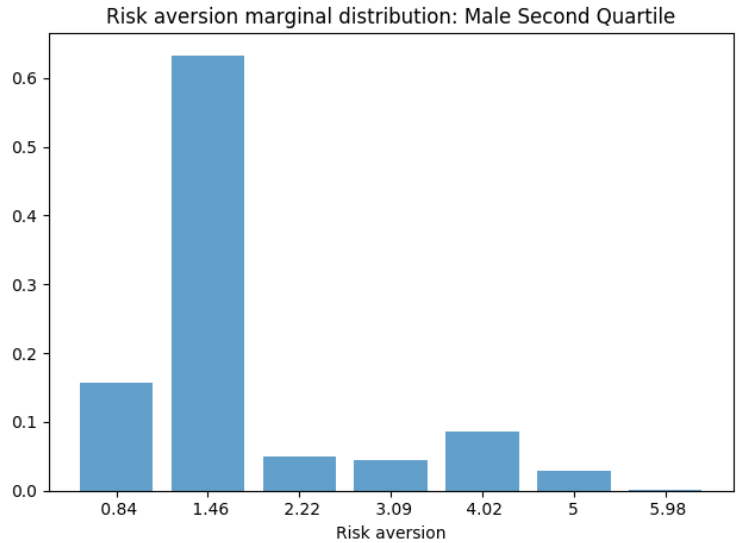
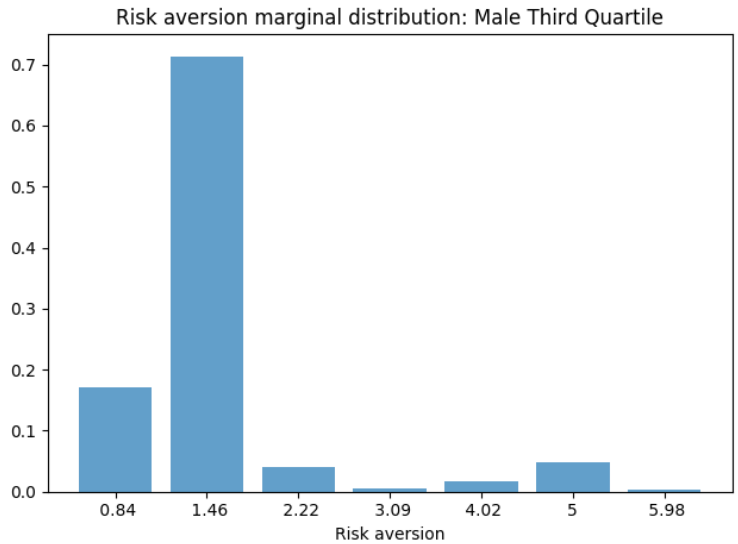


Figure: Marginal Distribution of Risk Aversion - Females

Back







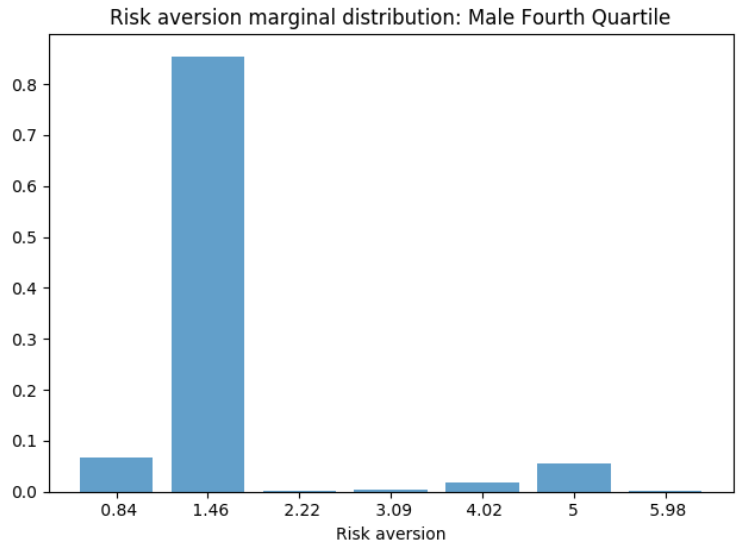


Figure: Marginal Distribution of Risk Aversion - Males

Back

	Bequest Motive	Risk Aversion	Outside Wealth	Health Shifter
Bequest Motive	1.00	-0.04	0.22	-0.32
Risk Aversion	-0.04	1.00	-0.34	-0.27
Outside Wealth	0.22	-0.34	1.00	0.20
Health Shifter	-0.32	-0.27	0.20	1.00

Table: Correlation between unobservable types, Female First Quartile

◂ Back

	Bequest Motive	Risk Aversion	Outside Wealth	Health Shifter
Bequest Motive	1.00	-0.22	0.31	-0.15
Risk Aversion	-0.22	1.00	-0.30	-0.08
Outside Wealth	0.31	-0.30	1.00	0.20
Health Shifter	-0.15	-0.08	0.20	1.00

Table: Correlation between unobservable types, Female Second Quartile

Back

	Bequest Motive	Risk Aversion	Outside Wealth	Health Shifter
Bequest Motive	1.00	-0.26	0.33	-0.32
Risk Aversion	-0.26	1.00	-0.21	0.14
Outside Wealth	0.33	-0.21	1.00	0.10
Health Shifter	-0.32	0.14	0.10	1.00

Table: Correlation between unobservable types, Female Third Quartile

Back

	Bequest Motive	Risk Aversion	Outside Wealth	Health Shifter
Bequest Motive	1.00	-0.26	-0.15	-0.36
Risk Aversion	-0.26	1.00	-0.44	0.18
Outside Wealth	-0.15	-0.44	1.00	0.10
Health Shifter	-0.36	0.18	0.10	1.00

Table: Correlation between unobservable types, Female Fourth Quartile

Back

	Bequest Motive	Risk Aversion	Outside Wealth	Health Shifter
Bequest Motive	1.00	0.12	-0.01	-0.23
Risk Aversion	0.12	1.00	-0.32	-0.31
Outside Wealth	-0.01	-0.32	1.00	0.23
Health Shifter	-0.23	-0.31	0.23	1.00

Table: Correlation between unobservable types, Male First Quartile

Back

	Bequest Motive	Risk Aversion	Outside Wealth	Health Shifter
Bequest Motive	1.00	-0.22	0.44	0.12
Risk Aversion	-0.22	1.00	-0.32	-0.20
Outside Wealth	0.44	-0.32	1.00	0.40
Health Shifter	0.12	-0.20	0.40	1.00

Table: Correlation between unobservable types, Male Second Quartile

Back

	Bequest Motive	Risk Aversion	Outside Wealth	Health Shifter
Bequest Motive	1.00	-0.21	0.19	0.10
Risk Aversion	-0.21	1.00	-0.44	-0.12
Outside Wealth	0.19	-0.44	1.00	0.10
Health Shifter	0.10	-0.12	0.10	1.00

Table: Correlation between unobservable types, Male Third Quartile

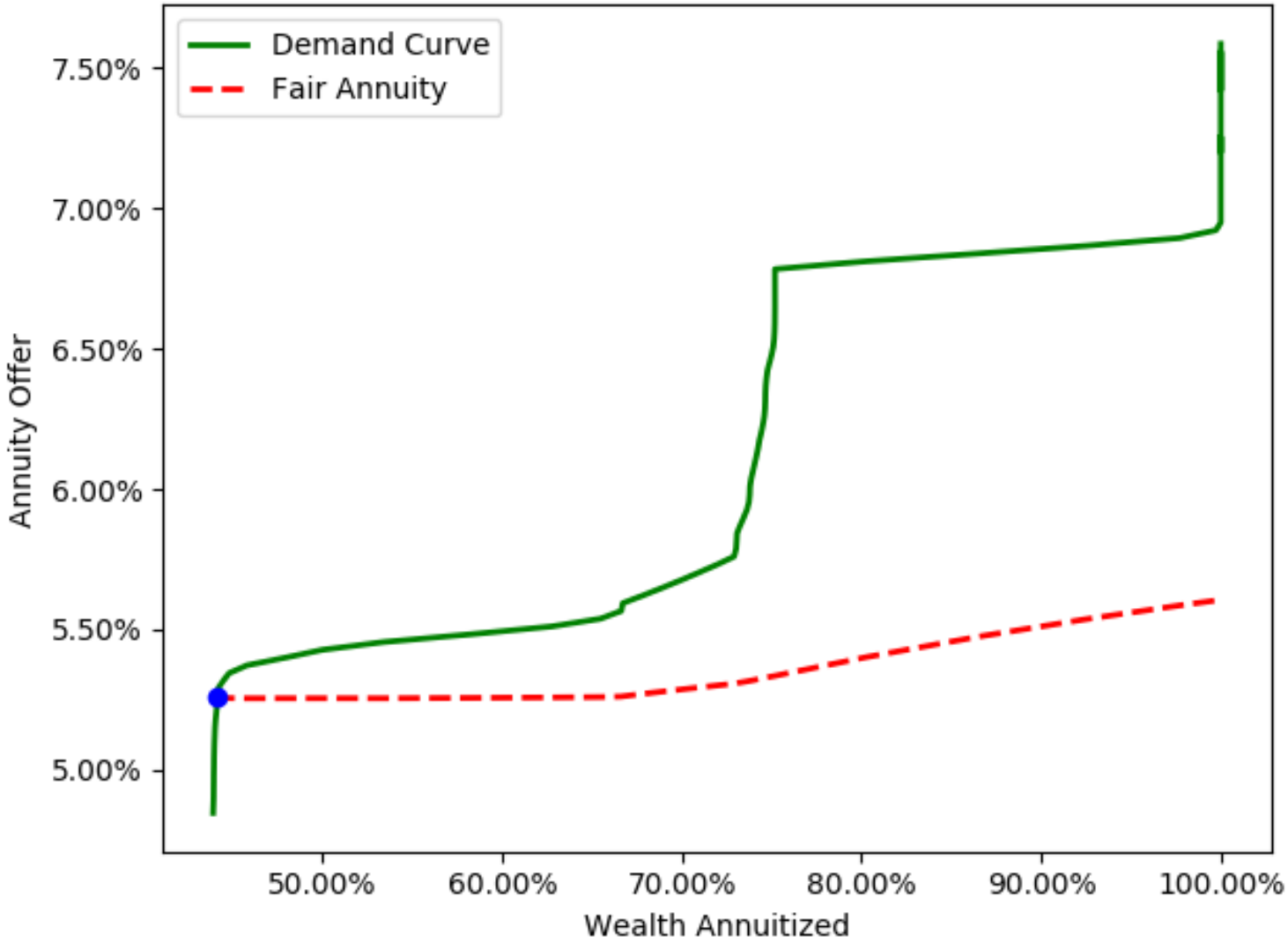
Back

	Bequest Motive	Risk Aversion	Outside Wealth	Health Shifter
Bequest Motive	1.00	-0.23	0.11	-0.09
Risk Aversion	-0.23	1.00	-0.50	-0.14
Outside Wealth	0.11	-0.50	1.00	0.13
Health Shifter	-0.09	-0.14	0.13	1.00

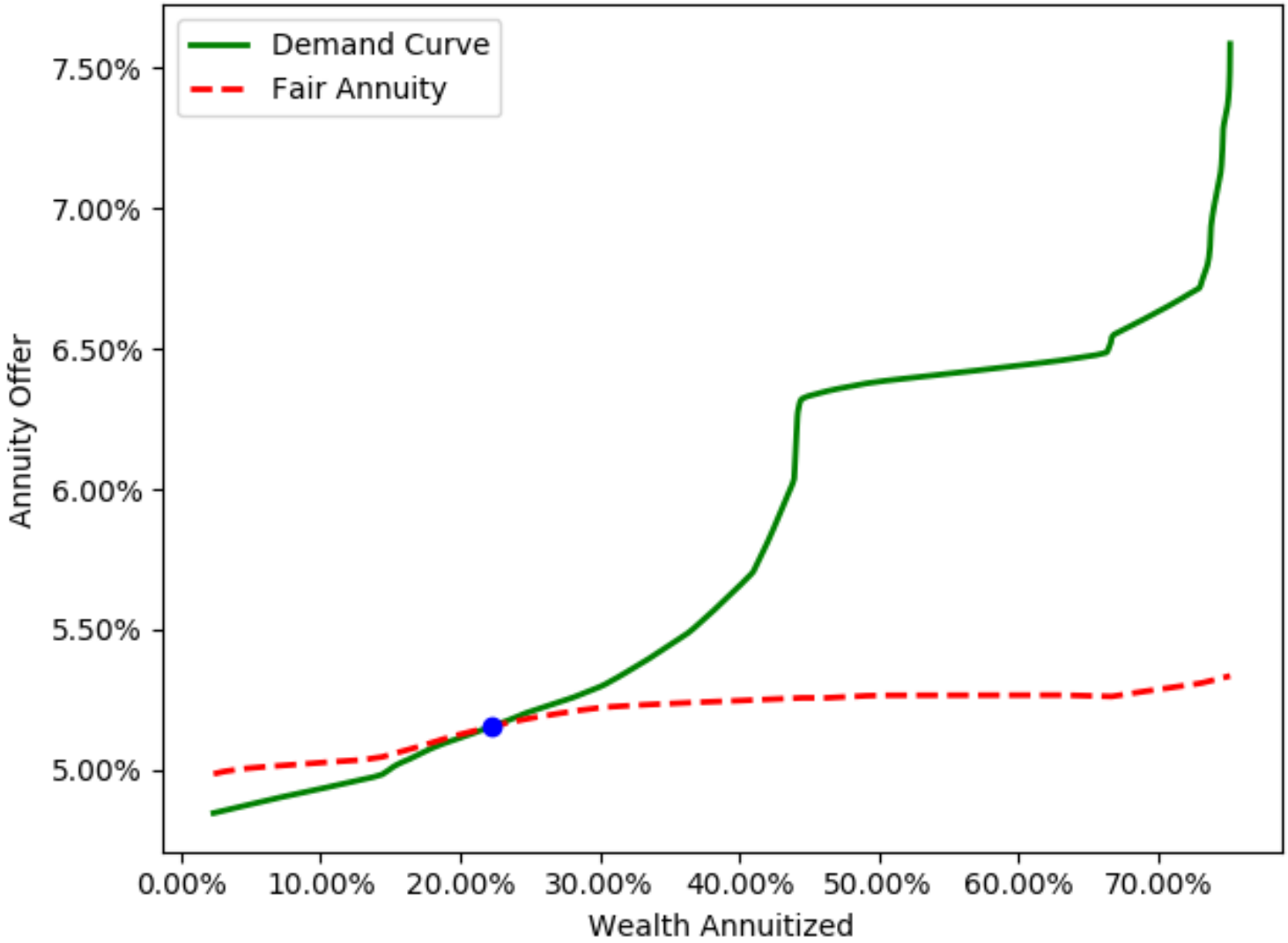
Table: Correlation between unobservable types, Male Fourth Quartile

Back

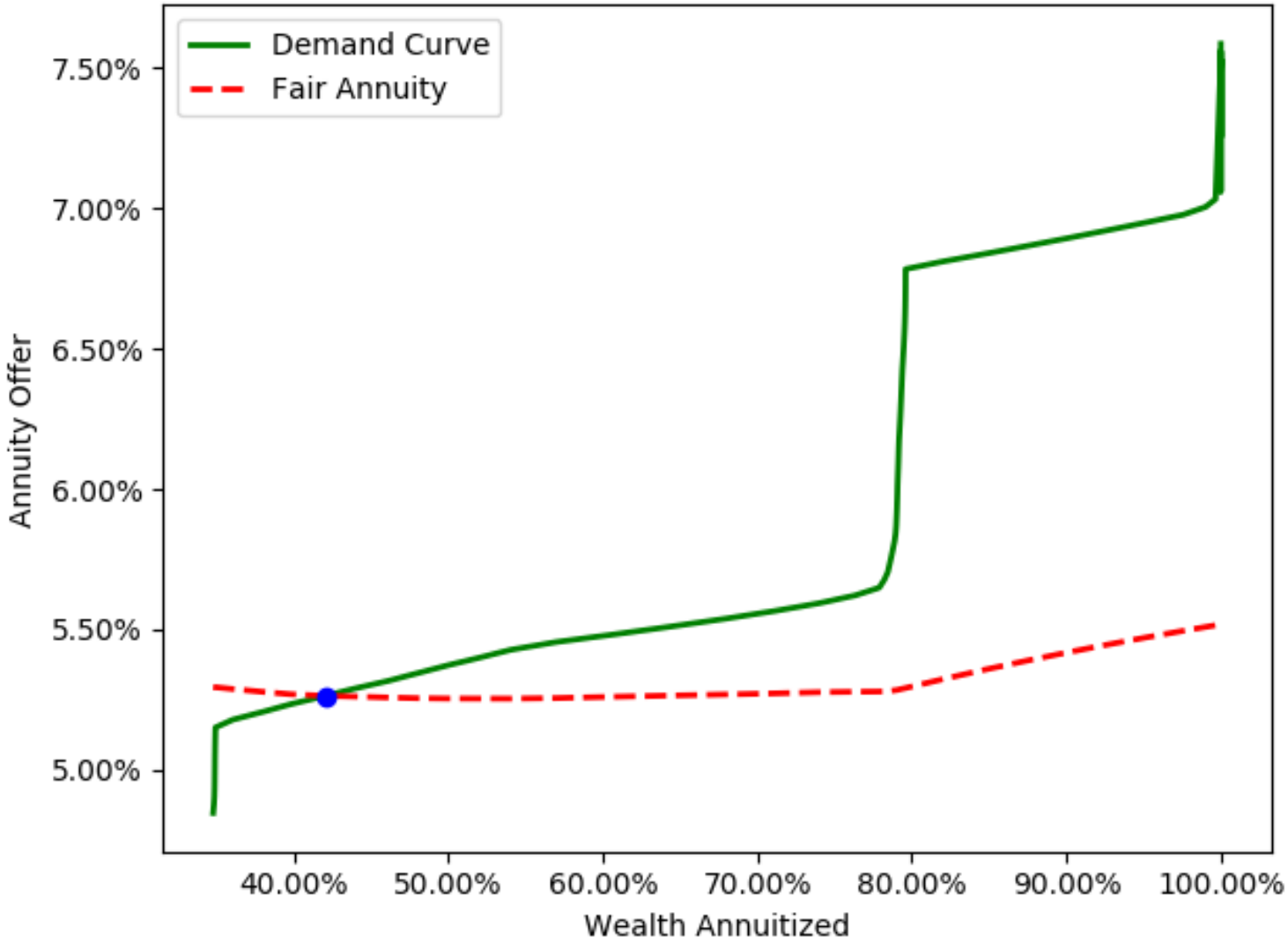
Chilean Equilibrium, Female 1st Quartile



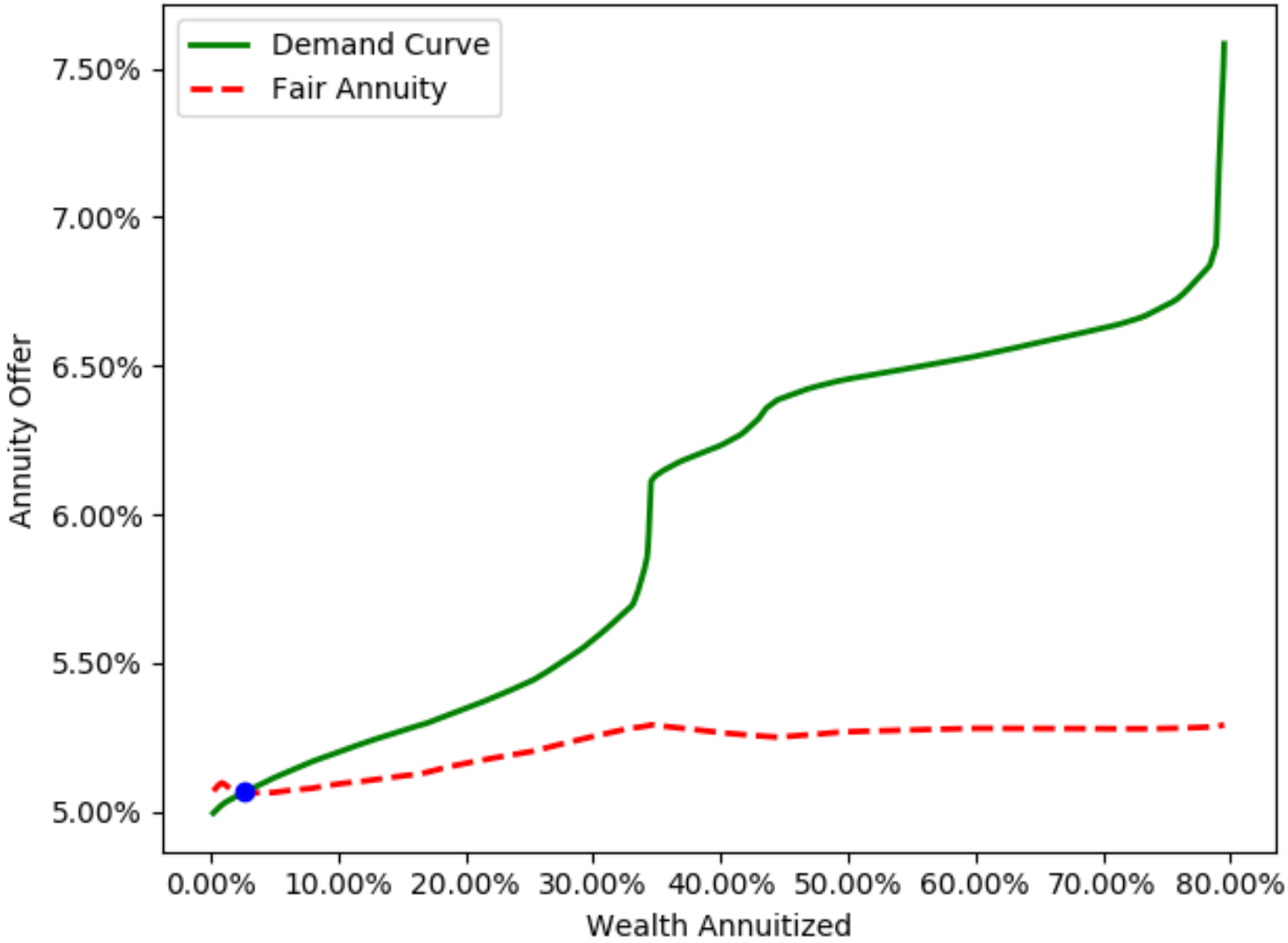
US Equilibrium, Female 1st Quartile



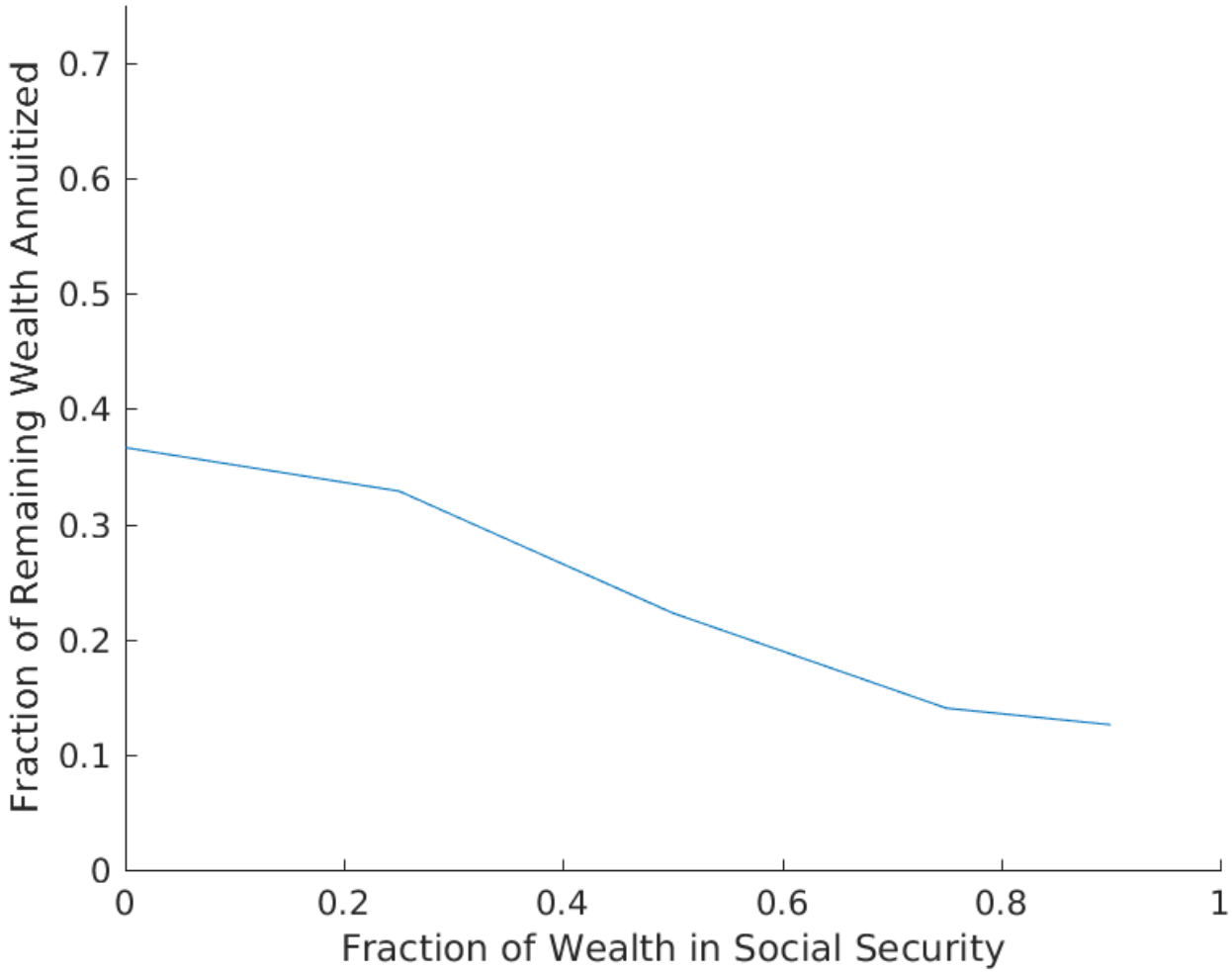
Chilean Equilibrium, Female 3rd Quartile



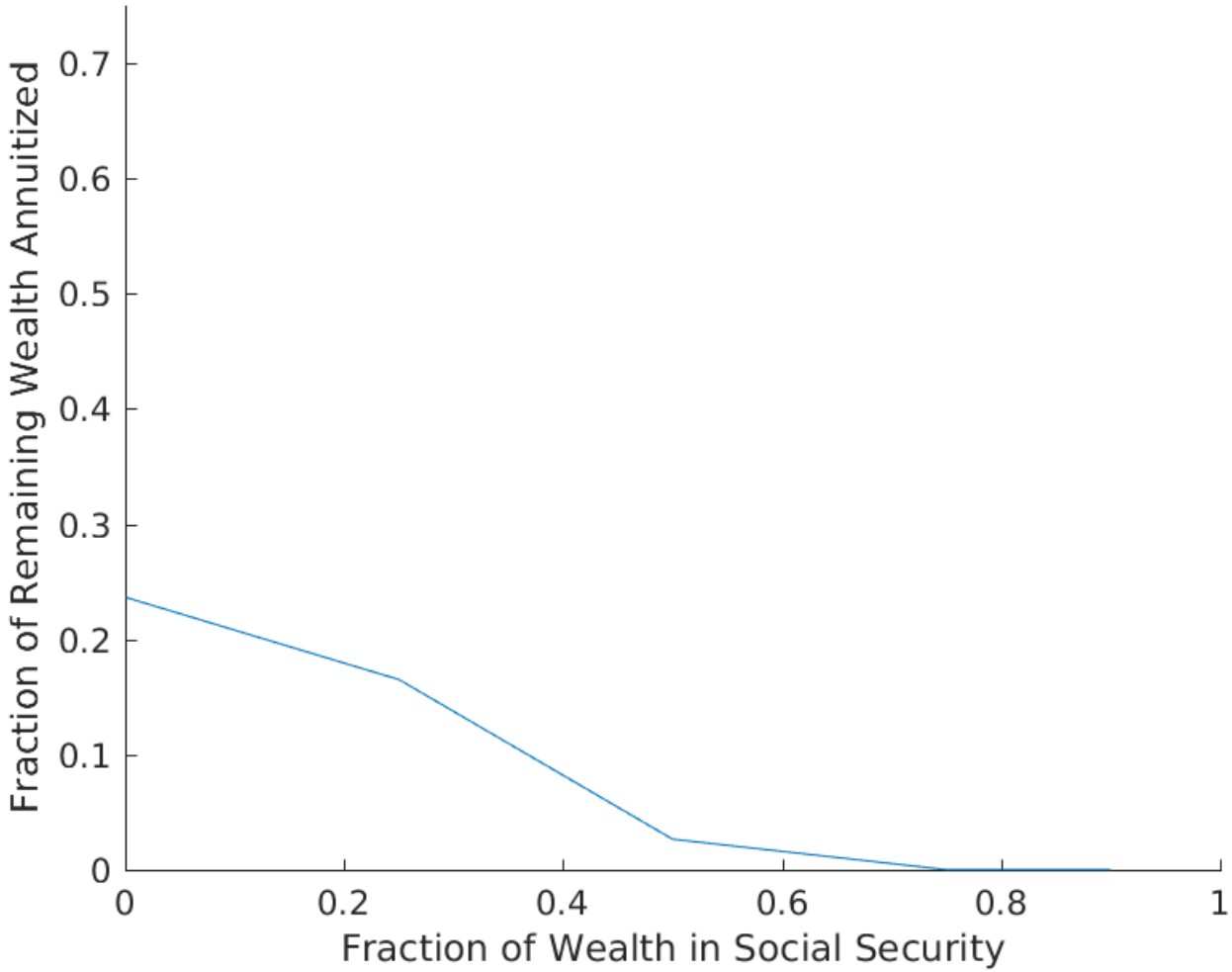
US Equilibrium, Female 3rd Quartile



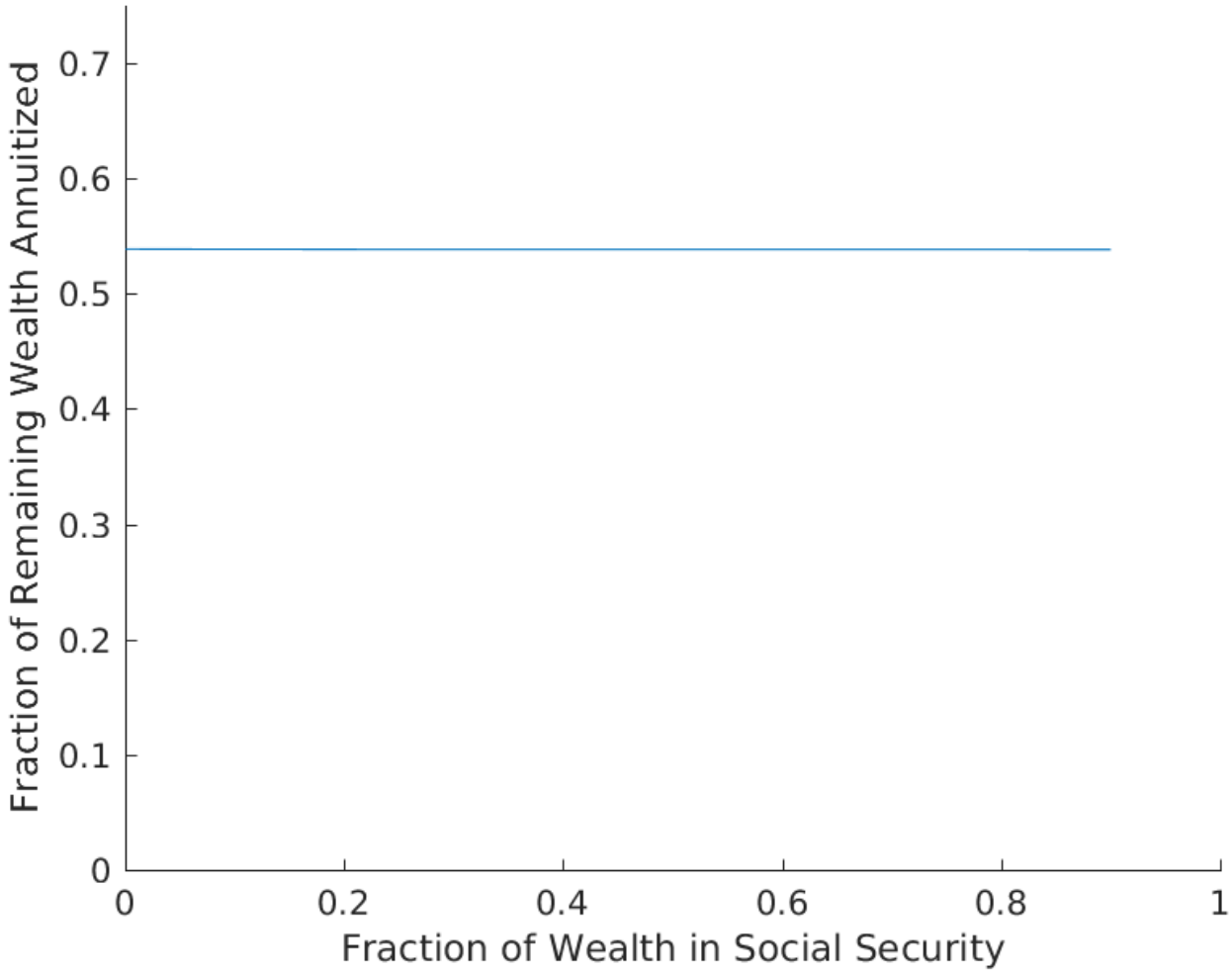
US Equilibrium, Female 1st Quartile, for Different Amounts in SS



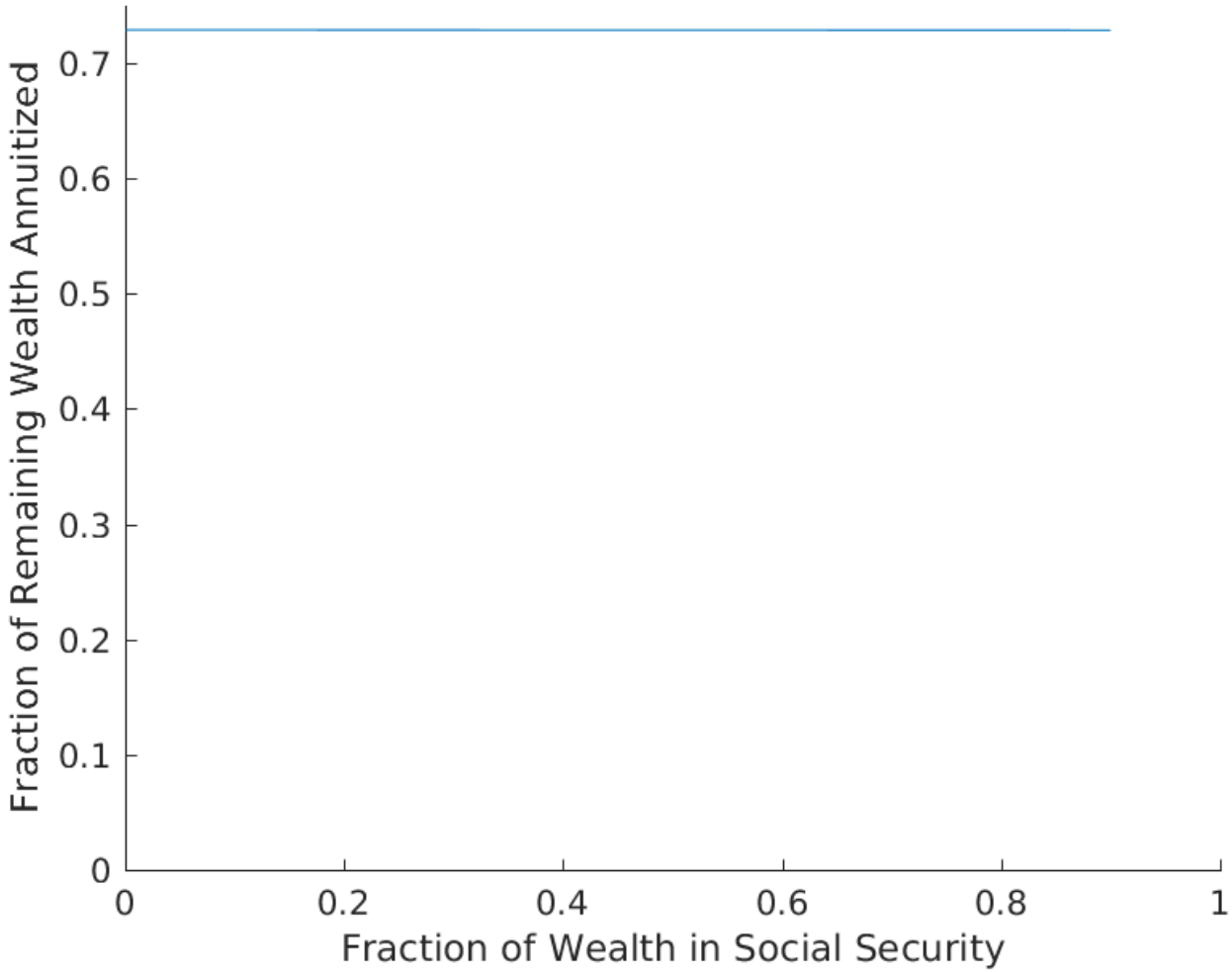
US Equilibrium, Female 3rd Quartile, for Different Amounts in SS



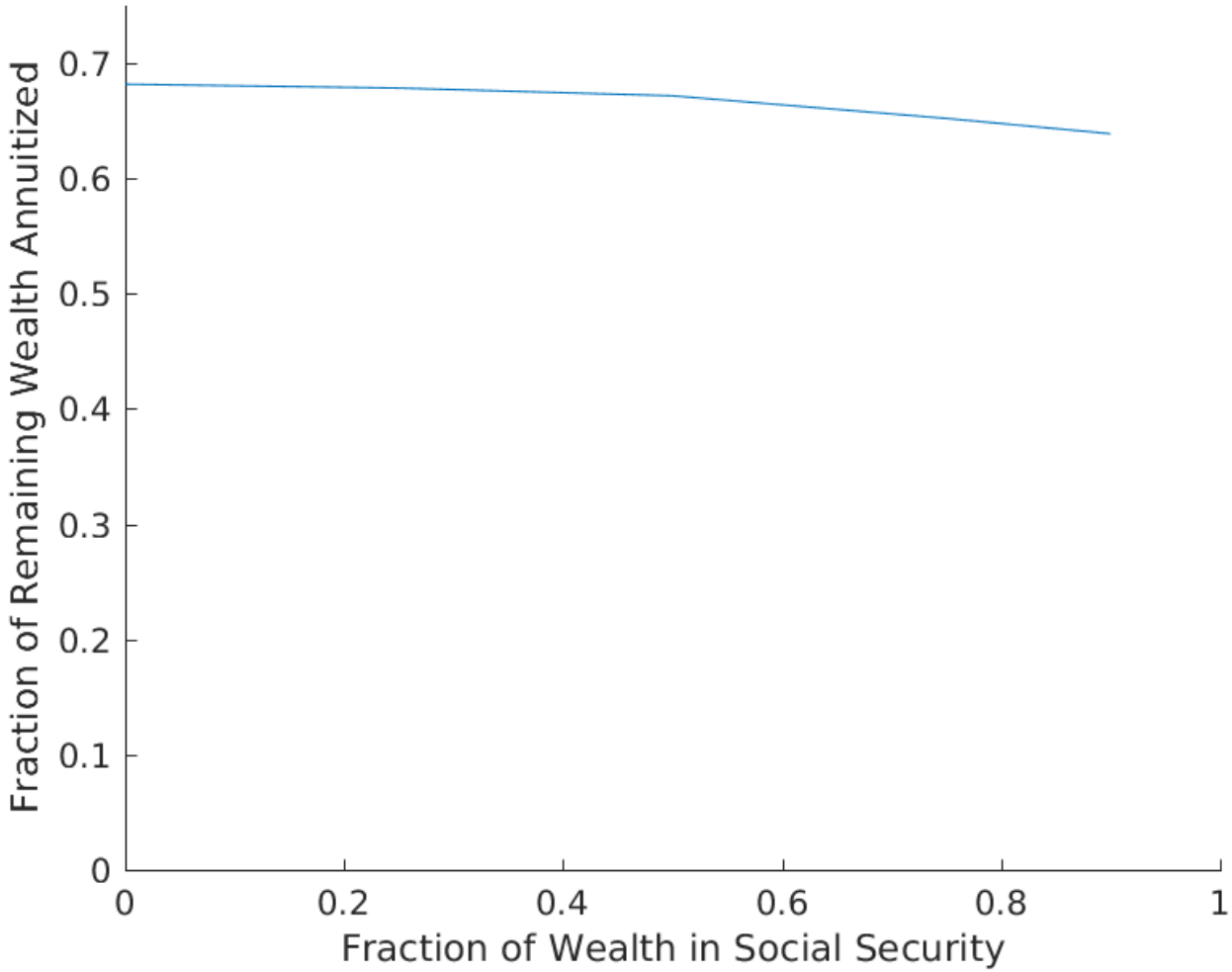
US Equilibrium, Male 1st Quartile, for Different Amounts in SS



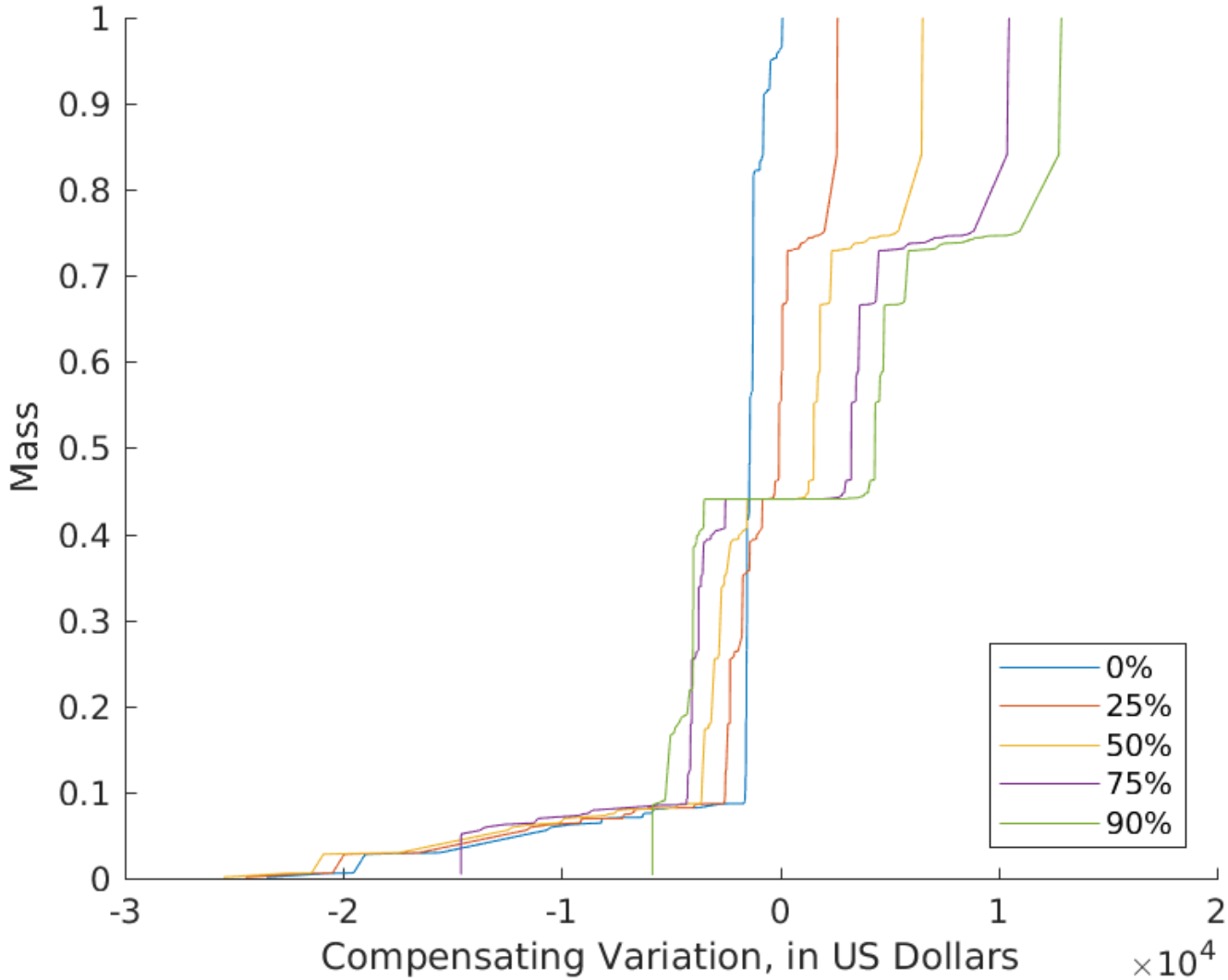
US Equilibrium, Male 2nd Quartile, for Different Amounts in SS



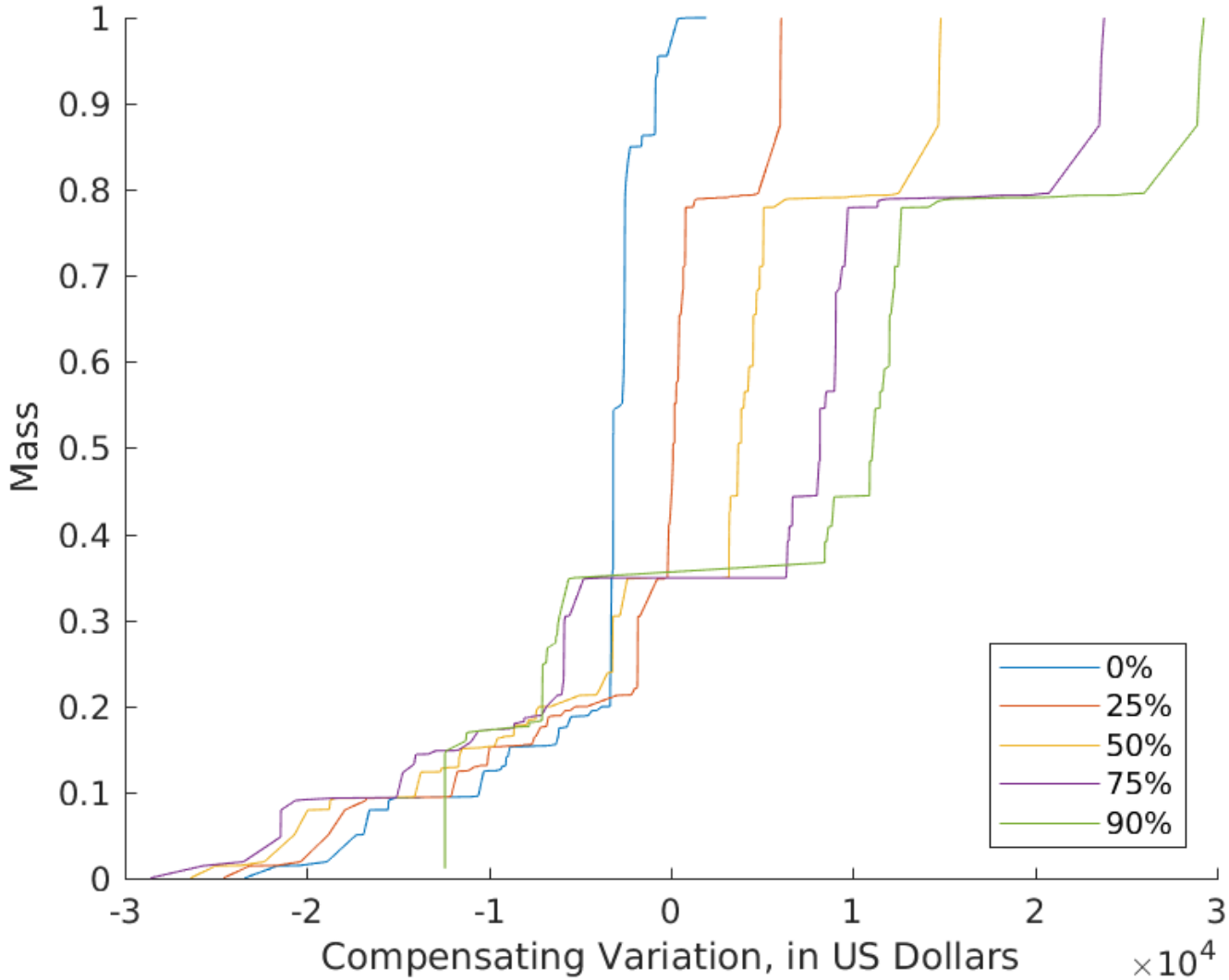
US Equilibrium, Male 3rd Quartile, for Different Amounts in SS



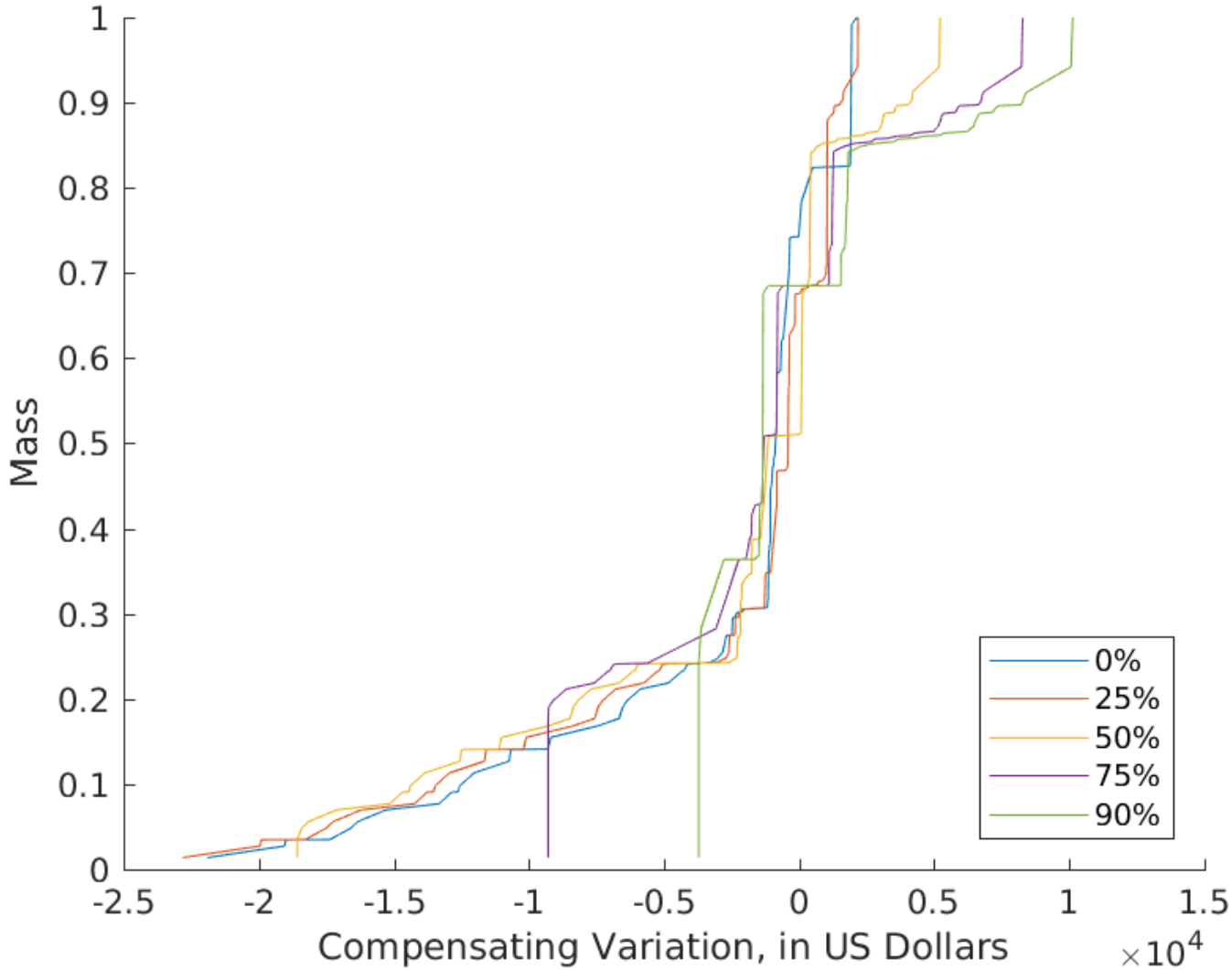
CV - Female First Quartile



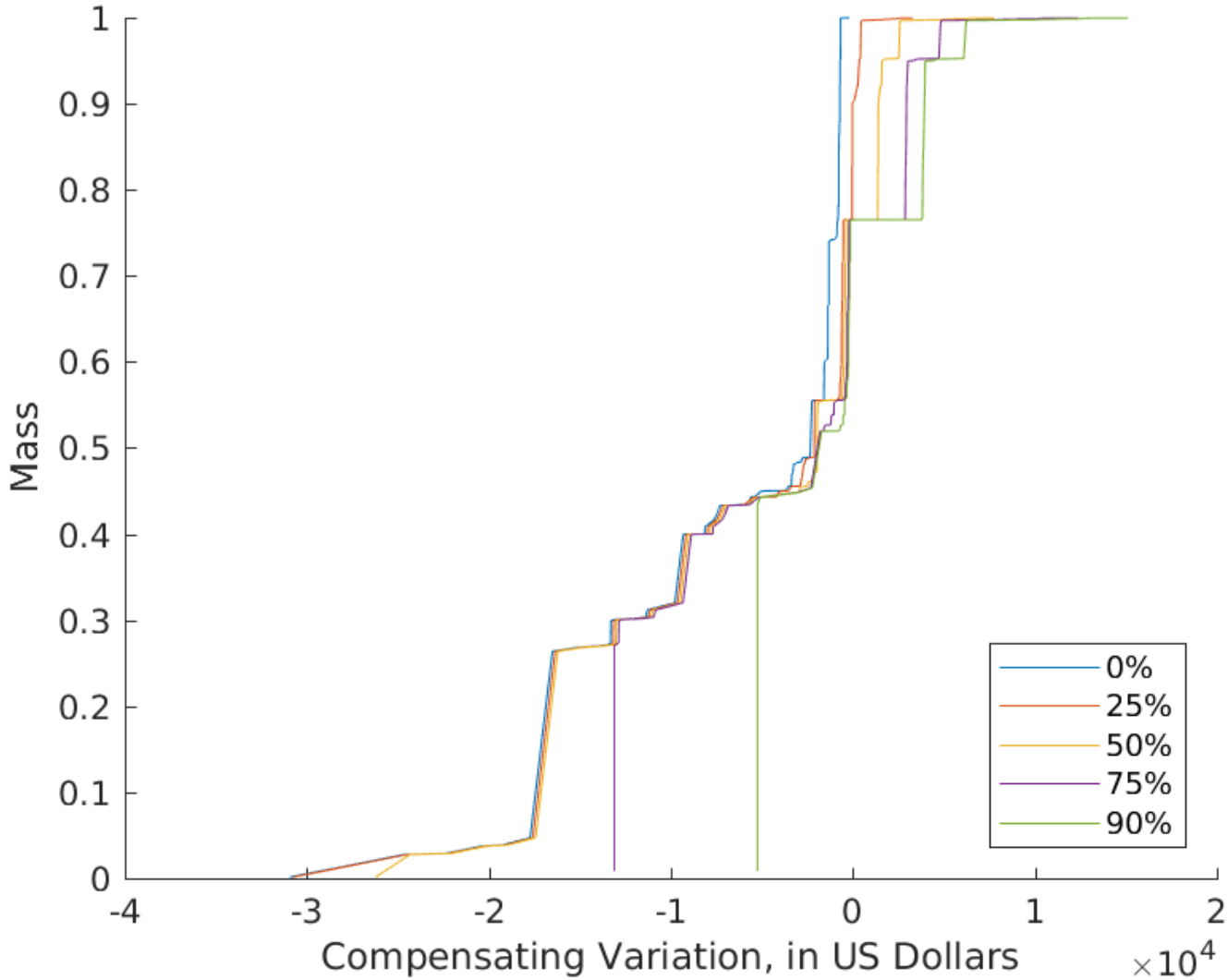
CV - Female Third Quartile



CV - Male First Quartile



CV - Male Second Quartile



CV - Male Third Quartile