Hubbard, Skinner and Zeldes (1994) - The Importance of Precautionary Motives in Explaining Individual and Aggregate Savings

Hubbard, Skinner, and Zeldes (1994) present a finite-horizon model of the life-cycle to understand individual and aggregate savings (is partial equilibrium). Model has three permanent/fixed types, two exogenous shocks (income and health expeditures), and one endogenous state (assets). Implementing it involves solving the value function problem, and then simulating panel data and life-cycle profiles. The same model is also used by Hubbard, Skinner, and Zeldes (1995). From the perspective of designing algorithms that are capable of handling a wide variety of situations the models key challenges are a consumption floor (which introduces a non-concavity in the return function) and the need to handle permanent/fixed types and age-dependence (both of parameters, and more difficultly of shocks and shock transition probabilities). I note that the original paper had three authors, three programmers, and six research assistants versus the one person that it took to replicate all of the computational half of the paper showing the advance in computing power and the usefulness of efforts like VFI Toolkit and QuantEcon.

From the perspective of replication the article fails to mention a number of important points. First, it does not give the masses of each of the three different fixed (education) types (e.g., what fraction of the total population is of type 'college'). This is not a problem for all the figures but is for most entries in the tables.[1] Second, the article does not mention a number of assumptions for the non-baseline models; for example it is not mentioned that for the 'certainty' model lifespans are limited to age 80 rather than 100 (period 80), and while it is mentioned that a correction is made for the mean value of stochastic income, no equivalent correction for mean value of medical expenses is mentioned and appears not to have been made. Third, it does not describe the initial conditions for how agents first appear in the panel data simulations. It is also worth observing that the regressions in Table 3 are presumably based on the same panel data simulations as where used for Tables 1 & 2, in which case they do not account for the stochastic probability of death (the formulae in Appendix for how to calculate various elements of Tables 1 and 2 implicitly state that the underlying panel data must not include the stochastic probability of death as they include corrections for it).

The Figures of the paper all reproduce. The exact numbers of Tables 1, 2, and 3 do not, but the general outline of the results and findings for Tables 1, 2 & 3 is unchanged and support the conclusions of Hubbard, Skinner, and Zeldes (1994). While the results of Table 2 point in broadly the same direction they are much weaker in the replication.

[1] I have 'ballparked' them based on alternative sources for 1984 as fractions of US population (pg 1 of Russell Sage foundation Educational Attainment and Achievement chartbook.)

Table 1: Table 1 of Hubbard, Skinner and Zeldes (1994)

	Parameter Assumptions		—-Asset-Income Ratio—-				—-Savings Rate—-			
			No High School	High School	College	Aggre-gate	No High School	High School	College	Aggre-gate
Certain Lifespan,	$\delta = 0.03,$	$\gamma = 3$	6.86	5.57	3.93	5.31	0.08	0.06	0.05	0.06
earnings, and	$\delta = 0.03,$	$\gamma = 1$	4.37	3.90	3.04	3.72	0.05	0.05	0.04	0.05
out of pocket	$\delta = 0.03,$	$\gamma = 5$	3.59	2.18	0.60	1.96	0.04	0.02	0.01	0.02
medical	$\delta = 0.015,$	$\gamma = 3$	7.32	6.09	4.39	5.80	0.09	0.07	0.05	0.07
expenses	$\delta = 0.10,$	$\gamma = 3$	5.07	3.61	2.15	3.43	0.06	0.04	0.03	0.04
Uncertain Lifespan,	$\delta = 0.03,$	$\gamma = 3$	7.47	5.89	4.18	5.67	0.17	0.13	0.10	0.13
earnings, and										
medical										
expenses										
$\bar{C} = \$1$										
Uncertain Lifespan,	$\delta = 0.03,$	$\gamma = 3$	4.89	4.60	3.69	4.37	0.11	0.11	0.10	0.10
earnings, and	$\delta = 0.03,$	$\gamma = 1$	3.08	2.93	2.29	2.76	0.06	0.06	0.05	0.06
medical	$\delta = 0.03,$	$\gamma = 5$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
expenses	$\delta = 0.015,$	$\gamma = 3$	5.65	5.37	4.32	5.10	0.14	0.13	0.11	0.12
$\bar{C} = \$7000$	$\delta = 0.10,$	$\gamma = 3$	2.39	1.97	1.55	1.91	0.05	0.04	0.04	0.04

Note: Based on baseline grid size for assets of 1501, and shocks of 21 and 21.

Table 1
Simulated Asset-Income Ratios and Saving Rates

	Parameter Assumptions	Asset-Income Ratio: No High School	Asset-Income Ratio: High School	Asset-Income Ratio: College	Asset-Income Ratio: Aggregate	Saving Rate: No High School	Saving Rate: High School	Saving Rate: College	Saving Rate: Aggregate
Certain lifespan, earnings, and out of pocket medical expenses	δ=.03, γ=3	2.13	2.53	2.27	2.37	.021	.025	.023	.024
	δ=.03, γ=1	2.13	2.53	2.27	2.37	.021	.025	.023	.024
	δ=.03, γ=5	2.13	2.53	2.27	2.37	.021	.025	.023	.024
	δ=.015, γ=3	2.79	3.27	2.78	3.03	.028	.032	.028	.030
	δ=.10, γ=3	0.68	0.62	0.86	0.70	.007	.006	.009	.007
Uncertain lifespan, earnings, and medical expenses $\bar{C}$ = \$1	δ=.03, γ=3	7.40	6.06	4.71	5.99	.167	.133	.119	.136
Uncertain lifespan, earnings, and medical expenses $\bar{C}$ = \$7000	δ=.03, γ=3	4.72	4.74	4.20	4.59	.108	.108	.108	.108
	δ=.03, γ=1	2.72	2.81	2.31	2.65	.053	.054	.051	.053
	δ=.03, γ=5	5.75	5.74	5.23	5.60	.140	.137	.139	.138
	δ=.015, γ=3	5.58	5.66	5.09	5.48	.131	.131	.132	.131
	δ=.10, γ=3	2.11	1.92	1.59	1.87	.044	.039	.040	.040

Source: Authors' calculations.
Note: The actual ratios (using data from the 1984 PSID) of total net worth to total family income are 3.69, 3.80, and 4.80 for the three groups, respectively. The ratio of private net worth to aggregate disposable income, using 1984 data from the Federal Reserve's *Flow of Funds Accounts*, is 4.64.

Table 2: Original Table 1 of Hubbard, Skinner and Zeldes (1994)

Table 3: Table 2 of Hubbard, Skinner and Zeldes (1994)

Percentage of Households with Consumption Approximately Equal to Income
(Absolute Average Savings Rate < 0.5 Percent of Income

	PSID			Simulated $\delta = 0.03$, Floor=\$7000			Simulated $\delta = 0.10$, Floor=\$1		
Age	NHS	HS	Col.	NHS	HS	Col.	NHS	HS	Col.
<29	0.362	0.059	0.060	0.106	0.123	0.216	0.002	0.006	0.137
30-39	0.157	0.064	0.040	0.097	0.087	0.184	0.071	0.080	0.275
40-49	0.067	0.017	0.025	0.101	0.072	0.075	0.156	0.168	0.196
50-59	0.103	0.032	0.011	0.119	0.124	0.100	0.146	0.173	0.148
60-69	0.095	0.020	0.038	0.098	0.137	0.158	0.099	0.103	0.122
Total	0.116	0.038	0.031	0.083	0.093	0.107	0.085	0.129	0.245
For Households with Initial Assets < 0.5 x Average Income									
<29	0.389	0.080	0.069	0.113	0.129	0.220	0.000	0.000	0.132
30-39	0.205	0.101	0.052	0.115	0.110	0.216	0.000	0.022	0.330
40-49	0.133	0.045	0.031	0.132	0.078	0.101	0.000	0.012	0.236
50-59	0.272	0.114	0.135	0.134	0.075	0.048	0.000	0.078	0.143
60-69	0.302	0.083	0.381	0.086	0.087	0.070	0.071	0.308	0.428
Total	0.252	0.087	0.060	0.123	0.146	0.207	0.052	0.235	0.439

NHS=No high-school, HS=High-school, Col.=College. Numbers for PSID are those of original study, not part of replication.

Note: Based on baseline grid size for assets of 1501, and shocks of 21 and 21.

Table 4: Original Table 2 of Hubbard, Skinner and Zeldes (1994)

Table 2:
Percent of Actual (PSID) and Simulated Households With Consumption Approximately Equal to Income
(Absolute Average Saving Rate < 0.5 Percent of Income)

	PSID			Simulated $\delta = .03$, Floor = \$7000			Simulated $\delta = .10$, Floor = \$1		
Age	NHS	HS	Col.	NHS	HS	Col.	NHS	HS	Col.
<29	.362	.059	.060	.332	.163	.263	.000	.000	.019
30-39	.157	.064	.040	.231	.093	.167	.000	.000	.073
40-49	.067	.017	.025	.212	.045	.035	.023	.005	.018
50-59	.103	.032	.011	.148	.027	.002	.023	.026	.007
60-69	.095	.020	.038	.131	.038	.015	.018	.005	.031
Total	.116	.038	.031	.204	.067	.086	.013	.007	.033
	For Households with Initial Assets < 0.5 × Average Income								
<29	.389	.080	.069	.494	.226	.377	.000	.000	.040
30-39	.205	.101	.052	.484	.231	.314	.000	n/a	.070
40-49	.133	.045	.031	.613	.310	.189	.000	n/a	.000
50-59	.272	.114	.135	.565	.331	.000	n/a	n/a	.000
60-69	.302	.083	.381	.735	.362	.360	n/a	n/a	n/a
Total	.252	.087	.060	.545	.250	.303	.000	.000	.043

Source: PSID and authors' calculations.

Notes: Average saving rates equal average annual saving during a five-year period (1984–89 for data from the PSID) divided by the average annual real income over the period. The tabulations reported in the second table are based on households whose initial assets (in 1984 in the PSID data) are less than half their average income. The symbol n/a denotes no simulated household in this cell.

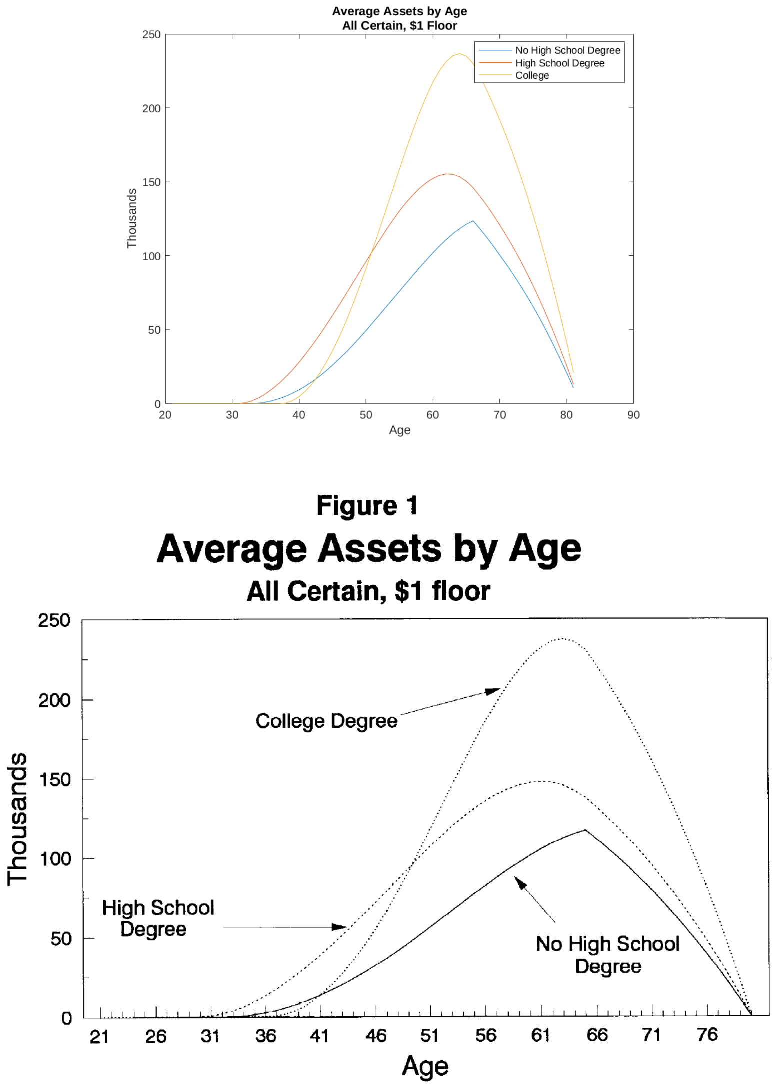


Figure 1: Figure 1 of Hubbard, Skinner and Zeldes (1994)

Table 5: Table 3 of Hubbard, Skinner and Zeldes (1994)

Dependent Varialbe	$\Delta C*$	$\Delta ln(C)*$	$\Delta ln(C)**$	$\Delta ln(C)**$
		$\delta = 0.03$, Floor=$7000		
ΔY	0.438			
	(308.21)			
$\Delta ln(Y)$		0.000	0.000	0.000
		(NaN)	(NaN)	(NaN)
Age				NaN
				(NaN)
Age^2				NaN
				(NaN)

Source: Simulated data from model under the benchmark case ($\delta = 0.03$, $\gamma = 3$) with a consumption floor of $7000. Absolute values of t-statistics are in parentheses. The Campbell and Mankiw (1989) coefficient (in levels, corresponding to the first column) is 0.469, and the Lusardi (1993) coefficient (in logs, corresponding to columns 2 through 4) is 0.409.

*: Instruments are two and three year lags of consumption and income, as well as age and age-squared.

**: Instruments are one, two and three year lags of consumption and income, as well as age and age-squared.

Note: Original regressions by Cambell-Mankiw were on aggregate data. Here are on microdata.

Note: Based on baseline grid size for assets of 1501, and shocks of 21 and 21.

Table 6: Original Table 3 of Hubbard, Skinner and Zeldes (1994)

Table 3:
Campbell-Mankiw-Lusardi Euler Equations
Using Simulated Data from the Dynamic Programming Model

Dependent Variable	ΔC^*	$\Delta ln(C)^*$	$\Delta ln(C)^{**}$	$\Delta ln(C)^{**}$
		$\delta = .03$, Floor = $7000		
ΔY	0.411			
	(38.74)			
$\Delta ln(Y)$		0.512	0.498	0.489
		(40.11)	(41.29)	(14.63)
Age				0.109
				(0.61)
Age^2				-0.163
				(1.10)

Source: Simulated data (38520 observations) from the dynamic programming model under the benchmark case ($\delta = 0.03, \gamma = 3$) with a consumption floor of $7000. Absolute values of t-statistics are in parentheses. The Campbell and Mankiw (1989) coefficient (in levels, corresponding to the first column) is 0.469, and the Lusardi (1993) coefficient (in logs, corresponding to columns 2 through 4) is 0.409.

* Instruments are ΔC and ΔY, each lagged two and three years, age, and age^2.
** Instruments are ΔC and ΔY, each lagged one, two, and three years, age, and age^2.

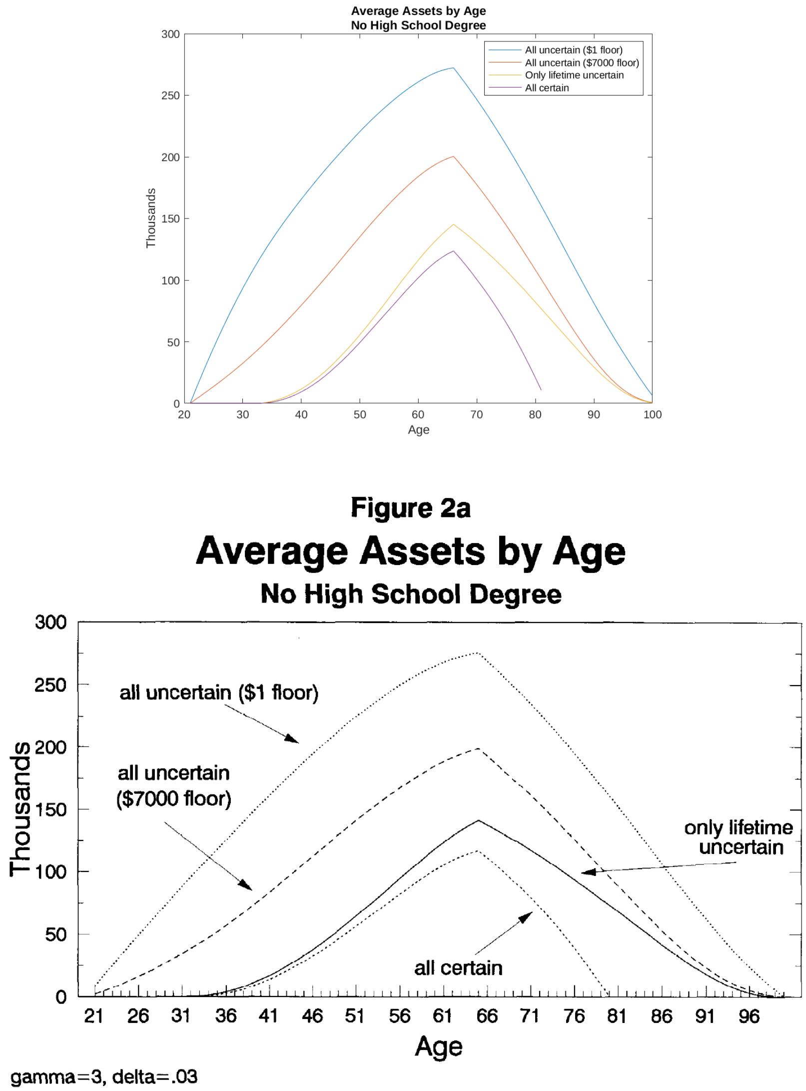
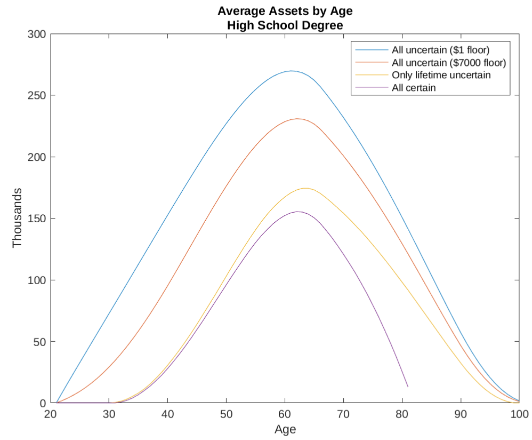


Figure 2: Figure 2a of Hubbard, Skinner and Zeldes (1994)



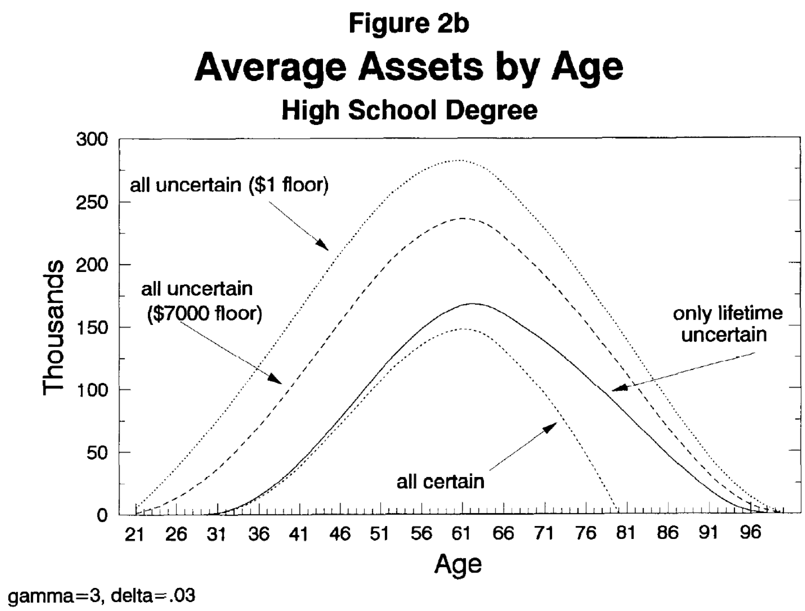
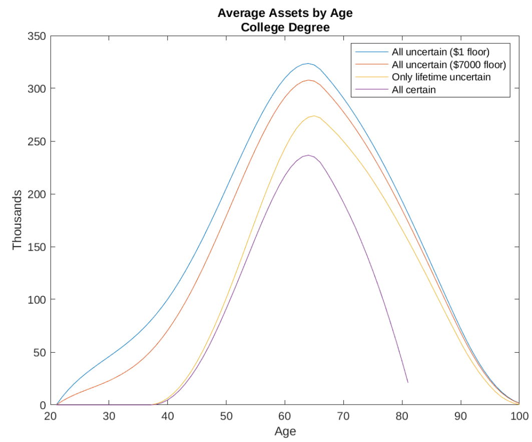


Figure 3: Figure 2b of Hubbard, Skinner and Zeldes (1994)



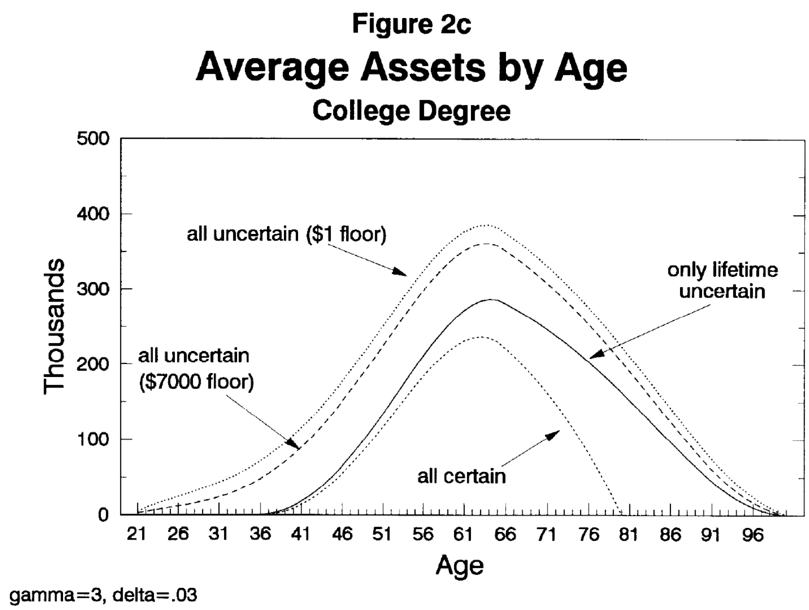
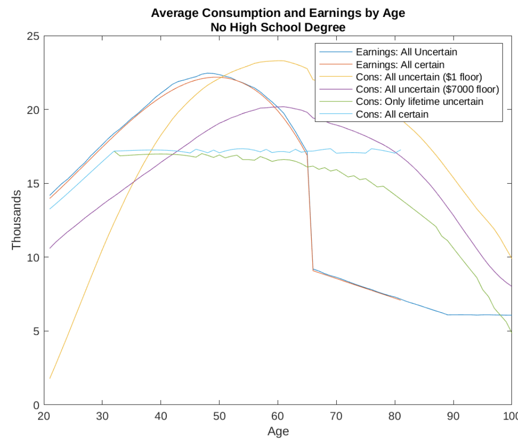


Figure 4: Figure 2c of Hubbard, Skinner and Zeldes (1994)



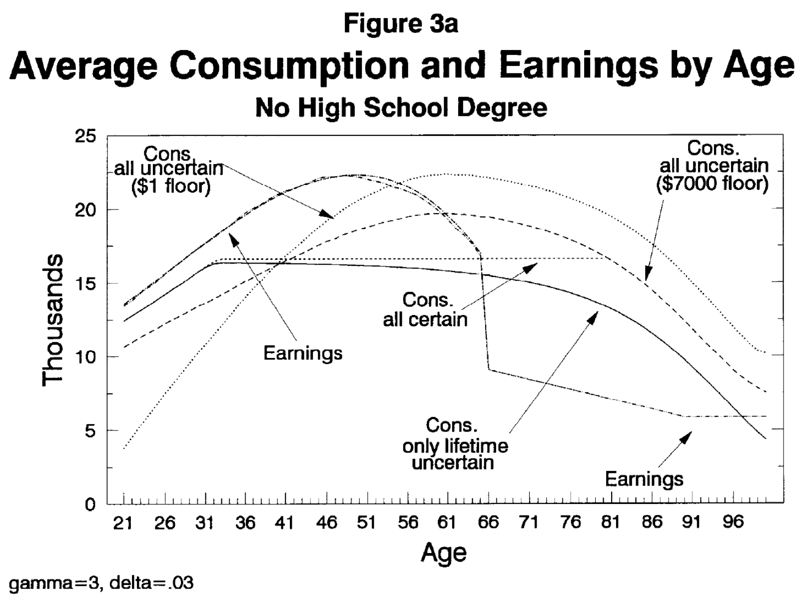
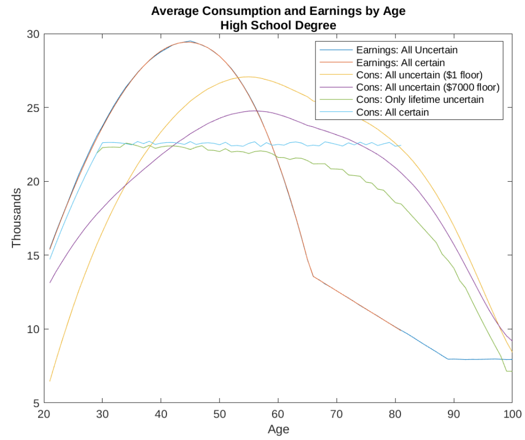


Figure 5: Figure 3a of Hubbard, Skinner and Zeldes (1994)



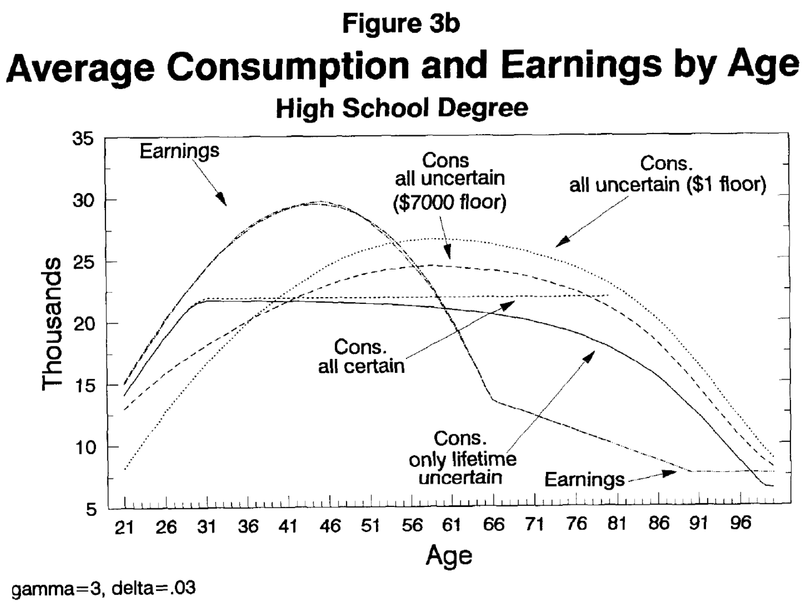
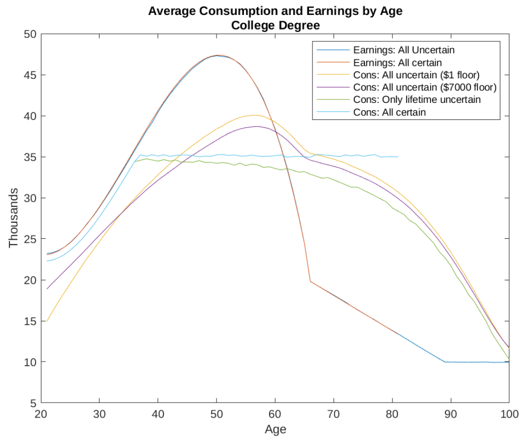


Figure 6: Figure 3b of Hubbard, Skinner and Zeldes (1994)



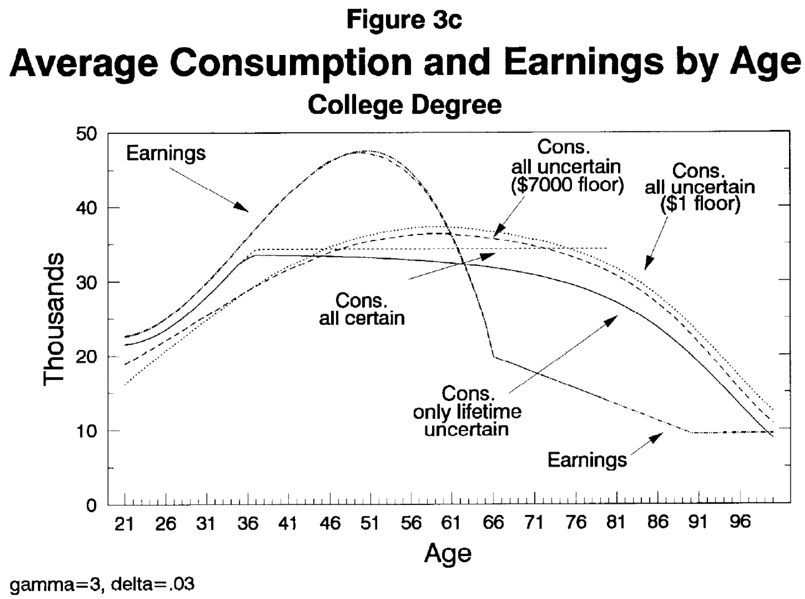


Figure 7: Figure 3c of Hubbard, Skinner and Zeldes (1994)

References

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