Consumption Behavior, Annuity Income, and Mortality Risk of the Elderly

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Motivation

- A simple life-cycle model without uncertainty predicts that individuals save when they are young and draw down their assets after retirement.
- The empirical evidence does not support that wealth declines with age (e.g. Van Ooijen et al 2014, Porteba et al. 2011).
- Hurd(1989, 1999) explains saving behavior of elderly singles and couples by adding lifetime uncertainty and bequest motives.
- This study aims to test the predictions of the life-cycle models proposed by Hurd (1989, 1999).

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Related Literature

Hurd (1989, 1999) focusses on retired individuals. His models predict that:

- Total consumption is greater than annuity income after retirement (unless individuals have a strong bequest motive)
- The higher the initial wealth, the higher the difference between total consumption and annuity income is.
- The growth rate of consumption decreases as individuals' mortality risk increases, for both couples and singles.

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Related Literature

This paper is closely related to Salm (2010). He finds that the consumption growth decreases with higher mortality rates for elderly singles (using the 2001 and 2003 waves of CAMS survey)

- Differences:

1. The prediction regarding the relation between wealth and the difference between total consumption and annuity income has not been tested before.
2. We extend the theoretical model of Hurd (1999) for couples and test if the consumption growth decreases as the mortality risk of the couple increases in old age.

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The Singles Model (Hurd 1989)

Consumers maximize the following expected utility function from the beginning of the retirement phase, until the maximum age L.

$$\sum_{\tau=t}^{L}(1+\rho)^{t-\tau}\, a_{\tau}^{t} u(c_{\tau}) + \sum_{\tau=t}^{L}(1+\rho)^{t-1-\tau}\, m_{\tau+1}^{t} V\left((1+r)A_{\tau}\right)$$

s.t.

$$A_{\tau} = (1+r)A_{\tau-1} + y - c_{\tau} \qquad \tau = t,\ldots,L$$

$$A_{\tau} \geq 0$$

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The Singles Model (Hurd 1989)

The solution of the maximization problem without liquidity constraints:

$$u'(c_t) = \frac{1+r}{1+\rho}\left(\left(1-m_{t+1}^t\right)u'(c_{t+1}) + m_{t+1}^t V'\left((1+r)A_t\right)\right)$$

In case of a CRRA utility function, $u(c_t) = c_t^{1-\gamma}/(1-\gamma)$, and no bequest motive the Euler equation becomes:

$$\Delta \ln c_{t+1} = \frac{1}{\gamma}\ln\left(\frac{1+r}{1+\rho}\right) + \frac{1}{\gamma}\ln\left(1-m_{t+1}^t\right)$$

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The Singles Model (Hurd 1989)

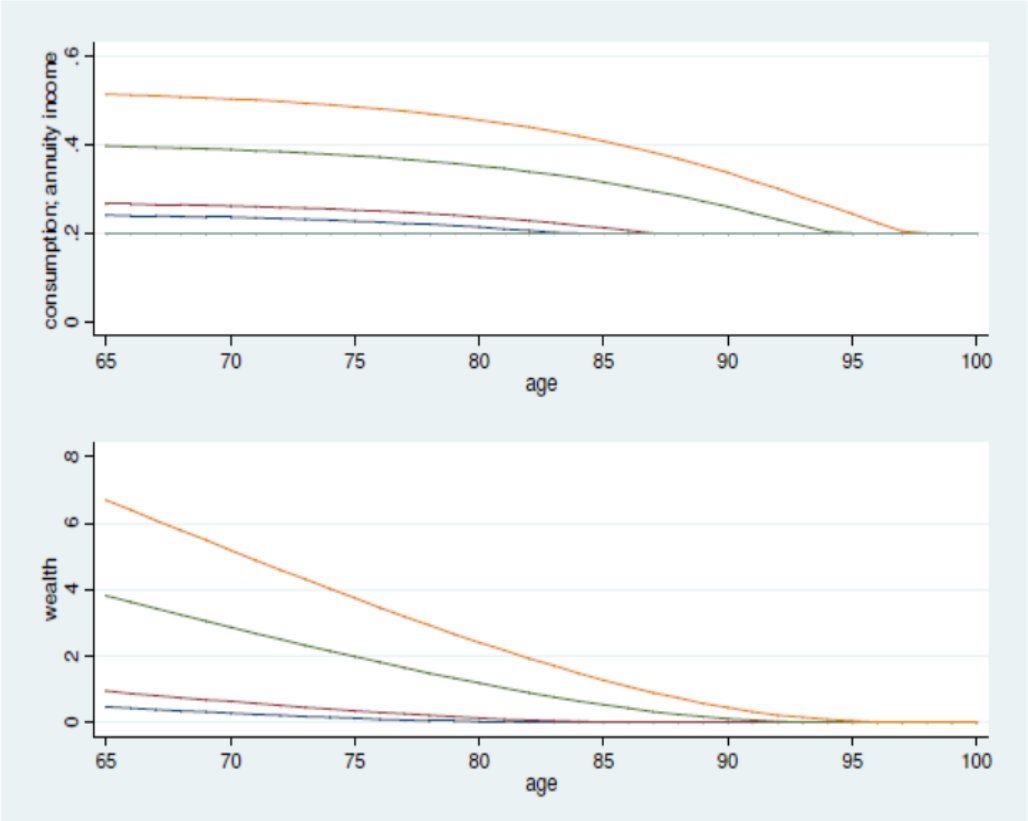

Figure 1: Consumption and wealth in a model without bequest: variation in A_0 y=0.2, r=0.001, $\rho = 0.001$, $\gamma = 4$

The Couples Model (Hurd 1999)

The couple maximizes the following expected utility function:

$$\sum_{\tau=t}^{L_{\min}}(1+\rho)^{t-\tau}\, a_\tau^t u(C_\tau)+\sum_{\tau=t}^{L_m}(1+\rho)^{t-1-\tau}\, pm_{\tau+1}^t M\left((1+r)A_\tau\right)+$$

$$\sum_{\tau=t}^{L_f}(1+\rho)^{t-1-\tau}\, pf_{\tau+1}^t F\left((1+r)A_\tau\right)+\sum_{\tau=t}^{L_{\max}}(1+\rho)^{t-1-\tau}\, h_{\tau+1}^t V\left((1+r)A_\tau\right)$$

s.t.

$$A_\tau=(1+r)A_{\tau-1}+y-c_\tau \qquad \tau=t,\ldots,L_{\max}$$

$$A_\tau \geq 0$$

The solution of this problem depends on the widower's marginal utility of wealth, $M'\left((1+r)A_\tau\right)$ and the widow's marginal utility of wealth, $F'\left((1+r)A_\tau\right)$.

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The Couples Model (Hurd 1999)

- In this paper, we derive a unitary model for the couple.

$$\sum_{\tau=t}^{L_{\min}}(1+\rho)^{t-\tau}\, a_\tau^t u\left(\frac{c_\tau}{\sqrt{2}}\right)+\sum_{\tau=t}^{L_m}(1+\rho)^{t-1-\tau}\; pm_{\tau+1}^t M\left((1+r)A_\tau\right)+$$

$$\sum_{\tau=t}^{L_f}(1+\rho)^{t-1-\tau}\; pf_{\tau+1}^t F\left((1+r)A_\tau\right)+\sum_{\tau=t}^{L_{\max}}(1+\rho)^{t-1-\tau}\; h_{\tau+1}^t V\left((1+r)A_\tau\right)$$

$u\left(\frac{c_\tau}{\sqrt{2}}\right)$:couple's utility from consumption divided by an equivalent scale

$$M\left((1+r)A_\tau\right)=\sum_{\tau=t+1}^{L_m}(1+\rho)^{t+1-\tau}\, a_\tau^{m,t+1}u(c_\tau)$$

$$F\left((1+r)A_\tau\right)=\sum_{\tau=t+1}^{L_f}(1+\rho)^{t+1-\tau}\, a_\tau^{f,t+1}u(c_\tau)$$

And the same asset accumulation and liquidity constraints as before

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The Couples Model (Hurd 1999)

In case of no bequest motive to the children or others, no liquidity constraints, and a CRRA utility function, the Euler equation is derived as:

$$\Delta \ln c_{t+1} = \frac{1}{\gamma}\ln\left(\frac{1+r}{1+\rho}\right) + \frac{1}{\gamma}\ln\left[1-\left(cm_{t+1}^{t} - \sqrt{2}^{1-\gamma}\left(pm_{t+1}^{t} + pf_{t+1}^{t}\right)\right)\right]$$

cm_{t+1}^{t} : instantaneous mortality rate of the couple,

pm_{t+1}^{t} : the probability that the husband becomes a widower at the beginning of period t+1

pf_{t+1}^{t} : the probability that the wife becomes a widow at the beginning of period t+1,

$cm_{t+1}^{t} - \sqrt{2}^{1-\gamma}\left(pm_{t+1}^{t} + pf_{t+1}^{t}\right)$: the couple's adjusted mortality rate, it is positive as long as $\gamma > 1$. $cm_{t+1}^{t} - \sqrt{2}^{1-\gamma}\left(pm_{t+1}^{t} + pf_{t+1}^{t}\right) = \frac{1}{2}\left(mw_{t+1}^{t} + mh_{t+1}^{t}\right)$ when $\gamma = 3$

Consumption growth is negatively associated with the couple's adjusted mortality rate.

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Data

- 5 waves of the Health and Retirement Study (HRS) supplemented with the Consumption Activities and Mail Survey (CAMS) for the period 2001-2009.
- The HRS survey is biennial panel survey of Americans over age 50 and their spouses and it started to collect data in 1992.
- In 2001, the CAMS survey interviewed a subsample of the households who were in the HRS 2000 core survey.
- The CAMS has information on household spending in 26 categories of nondurables and 6 categories of durables.
- Information on subjective survival probabilities (SSPs), annuity income, wealth, health status is obtained from the HRS survey.

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Definitions

- Annuity income after taxes is calculated by deducting total taxes paid (federal taxes, states taxes, and the Federal Insurance Contributions Act (FICA) tax) from before-tax annuity income (NBER tax calculator, TAXSIM)
- Annual subjective mortality rates for each respondent and his/her spouse(if present) as calculated using individuals' SSPs following Gan et al. (2003) and Salm(2010):

$$m_{i,\tau}^{\tau-1} = \xi_i m_{0,\tau}^{\tau-1} \qquad \tau = t+1, t+2, \ldots, L+1$$

Assuming that subjective mortality rate is proportionate to the life table mortality rate.

$$s_{i,t,T} = \prod_{\tau=t-1}^{T-1}(1-m_{i,\tau+1}^{\tau}) = \prod_{\tau=t-1}^{T-1}(1-\xi_i m_{0,\tau+1}^{\tau})$$

$s_{i,t,T}$:Subjective probability of individual i to survive from age t to age T.

ξ_i :Individual mortality factor.

Sample Selection

- An unbalanced panel sample of 5,402 households who participated in the CAMS survey at least one year between 2001-2009.
- 3,264 households in which the respondent and, if present, his/her spouse are aged 65 and over and do not earn any wage income.
- 3,033 households with positive wealth earnings in the first year they entered the survey.
- 2,428 single-person or two-person households.
- 1,154 households with non-missing information on the variables used and provided consumption data in at least two consecutive waves.

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Descriptive Statistics

Table 1: Summary statistics (one-person or two-person households)

	mean	median	std. deviation
Total consumption (in 2003 dollars)	23380	18950	17240
Annuity income (in 2003 dollars)	18330	16090	13120
Wealth (in 2003 dollars)	289240	156730	590680
Financial wealth (in 2003 dollars)	151010	47510	356180
Total health expenditures (in 2003 dollars)	3510	2610	4100
Wealth/Annuity income	17.243	8.370	41.474
Financial wealth/Annuity income	8.974	2.418	27.982
Total consumption/Annuity income	1.632	1.133	2.119
Total consumption minus annuity income	0.498	0.206	2.017
Dummy (total consumption>=annuity income)	0.587	1	0.492
Age [a]	74.827	75	6.426
Male	0.324	0	0.468
Number of observations (households)	3,692 (1,154)		

[a] Age stands for the age of the respondent who answered the questions about the household consumption. For two-person households one of the spouses is chosen randomly to answer these questions. The variables measured at the household level are divided by the OECD-modified equivalence scale.

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Descriptive Statistics

Table 2: The mean of the dummy (consumption>=annuity income) by age groups and years

2001			2003	
age class	mean	No. obs.	mean	No. obs.
65-69	0.649	154	0.606	158
70-74	0.673	141	0.639	177
75-79	0.630	156	0.582	175
80-83	0.649	102	0.686	162
85+	0.657	30	0.723	75
2005			2007	
age class	mean	No. obs.	mean	No. obs.
65-69	0.528	178	0.543	180
70-74	0.453	203	0.548	215
75-79	0.610	187	0.600	215
80-83	0.603	164	0.596	157
85+	0.638	94	0.622	105
2009				
age class	mean	No. obs.		
65-69	0.426	89		
70-74	0.503	165		
75-79	0.516	180		
80-83	0.592	135		
85+	0.600	95		

Income and expenditures are is in 2003 dollars and divided by the OECD-modified equivalence scale. Age stands for the age of the respondent who answered the questions about the household consumption. For two-person households one of the spouses is chosen randomly to answer these questions.

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Estimation Results

Table 3: Estimation results based on the OLS (one-person households)

	(1) Log total consumption minus log annuity income	(2) Log total consumption minus log annuity income	(3) Log total consumption (excluding health exp.) minus log annuity income	(4) Log total health expenditures
Year of birth	-0.023***	-0.022***	-0.016***	-0.051***
	(0.005)	(0.005)	(0.005)	(0.009)
Age	-0.019***	-0.018***	-0.015**	-0.032***
	(0.005)	(0.006)	(0.006)	(0.009)
Wealth (in $10,000)	0.003***		0.004***	0.003***
	(0.001)		(0.001)	(0.001)
CES-D score	0.014	0.016	0.015	0.012
	(0.011)	(0.011)	(0.011)	(0.016)
Poor health	0.110**	0.079*	0.069	0.167**
	(0.045)	(0.047)	(0.050)	(0.079)
Good health	0.016	0.044	0.070	-0.088
	(0.041)	(0.043)	(0.043)	(0.061)
Any ADL limitations	0.008	0.019	0.002	0.046
	(0.049)	(0.050)	(0.051)	(0.085)
Any IADL limitations	0.040	-0.012	-0.020	-0.011
	(0.041)	(0.042)	(0.042)	(0.066)
Years of education	0.023***			0.066***
	(0.008)			(0.015)
Constant	47.29***	44.63***	41.70***	108.3***
	(11.58)	(11.72)	(11.88)	(18.12)
Number of observations (households)	1995(646)	1995(646)	1995(646)	1941(645)
p-value Wald test: all health variables	0.015	0.320	0.214	0.017

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Table 4: Estimation results based on the OLS (two-person households)

	(1) Log total consumption minus log annuity income	(2) Log total consumption minus log annuity income	(3) Log total consumption (excluding health exp.) minus log annuity income	(4) Log total health expenditures
Year of birth_husband	0.001	0.014	0.030	-0.057
Year of birth_wife	-0.016	-0.028	-0.055*	0.038
Age_husband	-0.001	0.013	0.028	-0.056
Age_wife	-0.010	-0.024	-0.053*	0.046
Wealth (in $10,000)	0.004***		0.006***	0.002***
Cesd score_husband	0.003	0.003	0.006	-0.022
Cesd score_wife	-0.008	-0.014	-0.015	-0.029
Any IADL limitations_husband	0.021	-0.013	-0.013	-0.031
Any IADL limitations_wife	-0.051	-0.116**	-0.106**	-0.049
Poor health_husband	0.053	0.023	0.0011	0.138**
Poor health_wife	0.010	-0.006	-0.012	-0.042
Good health_husband	-0.024	-0.001	0.007	-0.030
Good health_wife	-0.002	0.051	0.076*	-0.066
Any ADL limitations_husband	0.115*	0.096	0.089	0.010
Any ADL limitations_wife	0.072	0.098	0.106	0.027
Years of education_husband	0.010			0.027**
Years of education_wife	0.011			0.018
Constant	29.90**	28.89**	38.45***	43.70**
	(12.73)	(13.57)	(13.77)	(18.45)
Number of observations (households)	1617(524)	1617(524)	1617(524)	1606(524)
p-value Wald test: all health variables	0.342	0.427	0.612	0.351
p-value Wald test: age	0.579	0.528	0.300	0.257

Table 5: Estimation results of the Euler Equation by OLS (one-person households)

	(1) Consumption growth (All categories)	(2) Consumption growth (All categories)	(3) Consumption growth (Salm (2010, sub-categories)	(4) Consumption growth (Salm (2010, sub-categories)
	$\Delta \ln c_{t+1}$	$\Delta \ln c_{t+1}$	$\Delta \ln c_{t+1}$	$\Delta \ln c_{t+1}$
$\ln(1-m_{i,t}^{t-1})$	0.119	0.170	0.294	0.343*
	(0.119)	(0.123)	(0.190)	(0.200)
Change in self-rated health	-0.005		-0.005	
	(0.009)		(0.013)	
Change in any ADL	0.027		0.019	
	(0.020)		(0.028)	
Change in any IADL	0.019		-0.022	
	(0.016)		(0.025)	
Change in CES-D	0.003		0.001	
	(0.004)		(0.006)	
Years of education	0.0003	0.001	-0.002	-0.001
	(0.003)	(0.003)	(0.004)	(0.004)
Poor health		0.023		-0.001
		(0.021)		(0.030)
Good health		0.001		-0.001
		(0.017)		(0.023)
Any IADL limitations		0.003		-0.033
		(0.016)		(0.024)
Any ADL limitations		0.015		0.078**
		(0.023)		(0.034)
CES-D score		0.003		0.009
		(0.004)		(0.006)
Constant	-0.020	-0.046	0.006	-0.014
	(0.045)	(0.047)	(0.064)	(0.064)
Number of observations (households)	1306(641)	1323(646)	1306(641)	1323(646)
p-value Wald test: all health variables	0.327	0.501	0.847	0.084

Table 6: Estimation results of the Euler Equation by OLS (two-person households), $\gamma = 3$

	(1) Consumption growth (All categories)	(2) Consumption growth (All categories)	(3) Consumption growth (Salm (2010, sub-categories)	(4) Consumption growth (Salm (2010, sub-categories)
	$\Delta \ln c_{t+1}$	$\Delta \ln c_{t+1}$	$\Delta \ln c_{t+1}$	$\Delta \ln c_{t+1}$
$\ln\left[1-\frac{1}{2}\left(mw_t^{t-1}+mh_t^{t-1}\right)\right]$	0.263	0.267	-0.064	-0.122
Change in self health_husband	0.011		0.018	
Change in self health_wife	0.011		0.009	
Change in any ADL_husband	0.023		-0.014	
Change in any ADL_wife	0.013		-0.033	
Change in any IADL_husband	0.0001		0.034*	
Change in any IADL_wife	-0.009		-0.010	
Change in CES-D_husband	-0.0004		0.003	
Change in CES-D_wife	-0.001		0.002	
Years of education_husband	-0.0004	0.001	-0.002	-0.002
Years of education_wife	-0.001	-0.002	-0.005	-0.006
Poor health_husband		0.006		0.015
Poor health_wife		0.002		-0.022
Good health_husband		-0.026		0.004
Good health_wife		-0.009		-0.017
Any IADL limitations _husband		-0.003		0.030
Any IADL limitations _wife		-0.011		-0.012
Any ADL limitations _husband		-0.018		-0.042
Any ADL limitations _wife		0.011		-0.024
CES-D score_husband		-0.003		-0.005
CES-D score_wife		-0.001		0.002
Constant	-0.011	0.017	0.049	0.060
	(0.048)	(0.055)	(0.073)	(0.078)
Number of observations (households)	1004(506)	1061(524)	1004(506)	1061(524)
p-value Wald test: all health variables	0.845	0.921	0.460	0.802

Table 7: IV Estimation of the Euler Equation (one-person households)

	(1) Consumption growth (Salm (2010, sub-categories) IV $\Delta \ln c_{t+1}$	(2) $\ln(1-m_{i,t}^{t-1})$ First Stage	(3) Consumption growth (Salm (2010, sub-categories) IV $\Delta \ln c_{t+1}$	(4) $\ln(1-m_{i,t}^{t-1})$ First Stage
$\ln(1-m_{i,t}^{t-1})$	0.760*		0.873*	
	(0.434)		(0.470)	
Change in self-rated health	-0.005	-0.0003		
	(0.013)	(0.001)		
Change in any ADL	0.030	-0.013***		
	(0.028)	(0.004)		
Change in any IADL	-0.015	0.001		
	(0.023)	(0.003)		
Change in CES-D	0.001	0.0002		
	(0.005)	(0.001)		
Years of education	-0.003	0.001**	-0.002	0.001
	(0.004)	(0.000)	(0.004)	(0.001)
$\ln(1-m_{0,t}^{t-1})$		0.705***		0.659***
		(0.060)		(0.060)
Mother is still alive (ref.)		-		-
Mother's age at death<= 76		-0.020**		-0.017*
		(0.009)		(0.009)
77<=Mother's age at death<=84		-0.009		-0.007
		(0.009)		(0.009)
Mother's age at death>= 85		-0.0005		0.001
		(0.009)		(0.009)
Poor health			0.019	-0.023***
			(0.031)	(0.004)
Good health			-0.007	0.010***
			(0.023)	(0.003)
Any IADL limitations			-0.030	0.002
			(0.023)	(0.003)
Any ADL limitations			0.085**	-0.005
			(0.034)	(0.004)
CES-D score			0.008	0.0003
			(0.007)	(0.001)
Constant	0.050	-0.039***	0.022	-0.031***
	(0.073)	(0.012)	(0.072)	(0.012)
Number of obs.(households)	1290(630)	1290(630)	1307(635)	1307(635)
F test (p-value)		47.296 (0.00)		41.77 (0.00)
Hansen's J test(p-value)		0.795 (0.85)		1.012(0.798)
Test of exogeneity χ_1^2 *(p-value)*		1.242 (0.265)		1.279(0.257)

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Table 8: IV Estimation of the Euler Equation (two-person households), $\gamma = 3$

	(1) Consumption growth (All categories) IV $\Delta \ln c_{t+1}$	(2) First Stage	(3) Consumption growth (All categories) IV $\Delta \ln c_{t+1}$	(4) First Stage
$\ln\left[1-\frac{1}{2}\left(mw_t^{t-1}+mh_t^{t-1}\right)\right]$	0.427		0.241	
Change in self health_husband	0.011	-0.001		
Change in self health_wife	0.011	-0.002		
Change in any ADL_husband	0.023	0.001		
Change in any ADL_wife	0.013	-0.002		
Change in any IADL_husband	0.0003	-0.0003		
Change in any IADL_wife	-0.009	0.001		
Change in CES-D_husband	0.0000	-0.002**		
Change in CES-D_wife	-0.001	0.0003		
Years of education_husband	-0.001	0.001**	0.001	0.0001
Years of education_wife	-0.001	0.0006	-0.002	0.00001
$\ln\left[1-\frac{1}{2}\left(mw_{0,t}^{t-1}+mh_{0,t}^{t-1}\right)\right]$		0.833***		0.765***
Poor health_husband			0.006	-0.010***
Poor health_wife			0.002	-0.006*
Good health_husband			-0.026	0.004*
Good health_wife			-0.009	0.008***
Any IADL limitations _husband			-0.003	0.001
Any IADL limitations _wife			-0.011	-0.001
Any ADL limitations _husband			-0.018	-0.006*
Any ADL limitations _wife			0.011	-0.002
CES-D score_husband			-0.003	-0.003***
CES-D score_wife			-0.001	-0.0004
Constant	0.0002	-0.036***	0.016	-0.017**
Number of observations (households)	1004(506)	1004(506)	1061(524)	1061(524)
Test of exogeneity- χ_1^2 (p-value)		0.159 (0.689)		0.003 (0.954)

Conclusions

- This study finds some evidence in favor of wealth decumulation by elderly after retirement.
- More than half of the households in our sample spend more than their annuity income after retirement.
- The difference between total consumption and annuity income increases with the level of wealth for both elderly singles and couples.

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Conclusions

- In single households, the growth rate of consumption expenditures on sub-categories (but not all categories) of nondurables is lower for individuals with higher subjective mortality rates.
- This is probably because some categories such as home insurance, property tax, rent electricity etc. are not adjusted in response to changes in the mortality risk.

- In couple households, the growth rate of consumption does not depend on the couple's adjusted mortality risk.

- Model assumption may not hold: women tend to be more risk averse then men in financial decision making.

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Further Research

- A different coefficient of risk aversion for the husband and the wife.
- Uncertainty about out-of-pocket medical expenses.

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