Inferring Labor Income Risk and Partial Insurance from Economic Choices

By Fatih Guvenen And Anthony Smith, Jr.

Presented by James Zou

School of Economics (HUST)

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This Paper

- use individuals' consumption-savings decisions to learn about the uninsurable labor-income risks
- build a life-cycle consumptionsavings model with constant relative risk aversion (CRRA) utility, potentially binding borrowing constraints, partial insurance, and a realistic retirement pension system
- the slopes of individuals labor income profiles (i.e., their income growth rates) vary in the population but that individuals have imperfect information about their own growth rates. Each individual enters the labor market with a prior belief about his own growth rate and then updates his beliefs over time in a Bayesian fashion.

Methodology: indirect inference

- indirect inference focuses instead on the parameters of an auxiliary model that plays the role of a reduced form for the structural model
- use an auxiliary model that approximates the joint dynamics of income and consumption implied by the structural consumption-savings model

Main Conclusion

- the amount of uninsurable income risk perceived by individuals upon entering the labor market is substantially smaller than what is typically assumed in calibrated incomplete markets models

Related Literature

- uses panel data to study the transmission of income shocks to consumption when markets are incomplete. Important examples include Hall and Mishkin (1982) and, more recently, Blundell, Pistaferri, and Preston (2008), Kauffmann and Pistaferri (2009), Krueger and Perri (2009), Kaplan and Violante (2010), and Heathcote, Storesletten, and Violante (2014).
- Guvenen (2007), HIP Model vs RIP Model
- Gourinchas and Parker (2002), who estimate a life-cycle consumption-savings model using the method of simulated moments.

Labor Income Process

- log labor income

$$y_t^i = \underbrace{g(t, observables, ...)}_{\text{common life-cycle component}} + \underbrace{[\alpha^i + \beta^i t]}_{\text{profile heterogeneity}} + \underbrace{[z_t^i + \varepsilon_t^i]}_{\text{stochastic component}}$$

where $z_t^i = \rho z_{t-1}^i + \eta_t^i$

Time 0: Prior Beliefs and Variance

- The income growth rate is given by $\beta^i = \beta^i_k + \beta^i_u$, implying $\sigma^2_\beta = \sigma^2_{\beta_k} + \sigma^2_{\beta_u}$
- Then the prior mean is $\hat{\beta}^i_{1|0} = \beta^i_k$, and the prior variance is $\sigma^2_{\beta,0} = \sigma^2_{\beta_u}$
- define

$$\lambda = \frac{\sigma^2_{\beta,0}}{\sigma^2_\beta}$$

  which represents uncertainty
  - When $\lambda = 1$, individuals do not have any private prior information about their income growth rate.
  - When $\lambda = 0$, i is revealed completely at time zero

Updating Beliefs Over the Life Cycle

- The state equation describes the evolution of the vector of state variables

$$\underbrace{\begin{bmatrix} \beta^i \\ z^i_{t+1} \end{bmatrix}}_{S^i_{t+1}} = \underbrace{\begin{bmatrix} 1 & 0 \\ 0 & \rho \end{bmatrix}}_{F} \underbrace{\begin{bmatrix} \beta^i \\ z^i_t \end{bmatrix}}_{S^i_t} + \underbrace{\begin{bmatrix} 0 \\ \eta^i_{t+1} \end{bmatrix}}_{v^i_{t+1}}$$

- log income net of the fixed effect

$$\tilde{y}^i_t = y^i_t - \alpha^i = \begin{bmatrix} t & 1 \end{bmatrix} \begin{bmatrix} \beta^i \\ z^i_t \end{bmatrix} = H'_t S^i_t + \varepsilon^i_t$$

- Each individuals prior belief over (β^i, z^i_1): mean $\hat{S}^i_{1|0} = (\hat{\beta}^i_{1|0}, \hat{z}^i_{1|0})$ and covariance matrix

$$P_{1|0} = \begin{bmatrix} \sigma^2_{\beta,0} & 0 \\ 0 & \sigma^2_{z,0} \end{bmatrix}$$

Updating Beliefs Over the Life Cycle

- the perceived innovation to (log) income

$$\hat{\xi}_t^i = \tilde{y}_t^i - E_{t-1}(\tilde{y}_t^i) = \tilde{y}_t^i - (\hat{\beta}_{t|t-1}^i t + \hat{z}_{t|t-1}^i)$$

- The recursive Kalman updating formulas are given by

$$\hat{S}_t^i = \hat{S}_{t|t-1}^i + K_t \times \hat{\xi}_t^i$$

$$P_t = (I - K_t H_t') \times P_{t|t-1}$$

- next periods log income (net of i) is normally distributed as

$$\tilde{y}_t^i | \hat{S}_t^i \sim N(H_t' \hat{S}_{t|t-1}^i, H_t' P_{t|t-1} H_t + \sigma_\varepsilon^2)$$

a stylized life-cycle model

- a simpler form of the income process

$$Y_t^i = \alpha^i + \beta^i t + z_t^i$$

  where the income level (instead of its logarithm) is linear in the underlying components, and we set $\varepsilon_t^i = 0$
- the consumption-savings problem can be written as

$$\begin{aligned} & V_t^i(\omega_t^i, \hat{\beta}_t^i, \hat{z}_t^i) \\ & = \max_{C_t^i, a_{t+1}^i} \left\{ -(C_t^i - C^*)^2 + \frac{1}{1+r} E_t[V_{t+1}^i(\omega_{t+1}^i, \hat{\beta}_{t+1}^i, \hat{z}_{t+1}^i)] \right\} \\ s.t. \quad & C_t^i + a_{t+1}^i = \omega_t^i \\ & \omega_t^i = (1+r)a_t^i + Y_t^{disp,i} \end{aligned}$$

Partial Insurance

- It seems plausible to assume that the informal risk-sharing mechanisms available in the society (which allow partial insurance) are subject to the same informational constraints faced by the individuals themselves
- we specify disposable income as

$$Y_t^{disp,i} = Y_t^i - \theta \hat{\xi}_t^i$$

HIP vs RIP

- HIP: without any further restrictions imposed, the framework has a heterogeneous-income-profiles (HIP; following Guvenen (2007)) process with Bayesian learning about individual income slopes
- RIP: when $\sigma_\beta = 0$, in which case there is no heterogeneity in profiles and no Bayesian learning

Information in Consumption Growth

- abstract from partial insurance by setting $\theta = 0$,
- optimal consumption choice satisfies

$$\Delta C_t^i = \varphi_t \left[\sum_{s=0}^{T-t} \gamma^s (E_t - E_{t-1}) Y_{t+s}^i \right]$$

- yields a key structural equation in this framework

$$\Delta C_t^i = \Pi_t \times \hat{\xi}_t^i$$

- by setting $\sigma_\beta = 0$, the resulting (RIP) model implies

$$\Delta C_t^i = \Psi_t \times \eta_t^i$$

EXAMPLE 1: Consumption Growth Depends Negatively on Past Income Growth

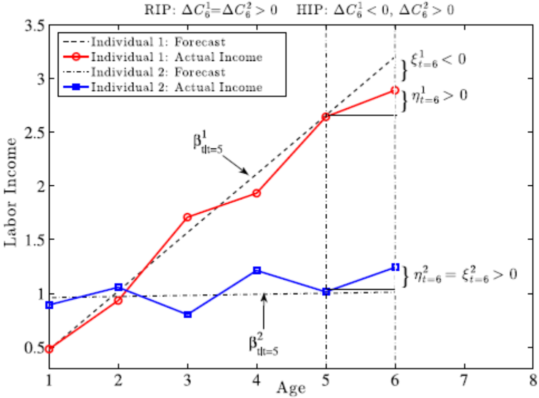


FIGURE 1.—Information about σ_β and λ in consumption changes.

PROPOSITION 1: Information in Consumption Growth

- define $\Delta\overline{C}_t^i = E(\Delta C_t^i | \beta^i, \Delta Y_t^i)$
  - Controlling for current income growth, consumption growth will, on average, be a decreasing function of an individuals β^i: $\frac{\partial \Delta\overline{C}_t^i}{\partial \beta^i} < 0$ for all t
  - the relationship becomes stronger as λ rises: $\frac{\partial^2 \Delta\overline{C}_t^i}{\partial \beta^i \partial \lambda} < 0$ for all t
  - the response of consumption growth to income growth becomes stronger as λ increases: $\frac{\partial^2 \Delta\overline{C}_t^i}{\partial \Delta Y_t^i \partial \lambda} < 0$

Information in Consumption Levels

- The consumption decision rule

$$C_t^i = \varphi_t \omega_t^i + r\Phi_{t+1}\hat{\beta}_t^i + r\rho\Psi_{t+1}\hat{z}_t^i$$

EXAMPLE 2: Past Income Growth Affects Current Consumption Level

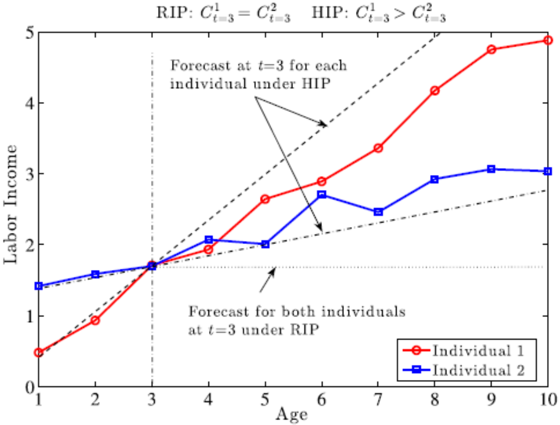


FIGURE 2.—Information about σ_β in consumption levels.

EXAMPLE 3: Dependence of Consumption Level on Future Income Growth Reveals Prior Information

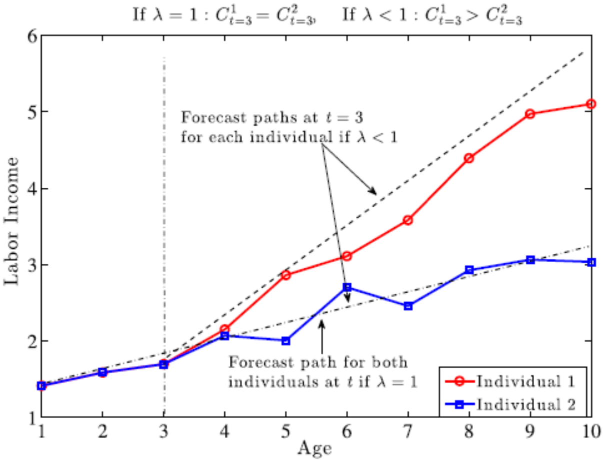


FIGURE 3.—Information about prior uncertainty.

Reintroducing Partial Insurance

- With partial insurance, optimal consumption growth is given by

$$\Delta C_t^i = (\mathit{\Pi}_t - \theta \varphi_t) \times \hat{\xi}_t^i$$

Partial Insurance versus Advance Information

- consider a two-period model with quadratic utility, no time discounting, no borrowing constraints, and a zero net interest rate,

$$\max_{C_1, C_2} [-(C_1 - C^*)^2 - E(C_2 - C^*)^2]$$
$$s.t. \quad C_1 + C_2 = Y_1 + Y_2^{disp}$$

- model advance information: Suppose that at time 1, the individual receives a signal about his future income,

$$E^{AI}(Y_2) = (1-\alpha)Y_2 + \alpha Y_1$$

- When $\alpha = 1$, there is no advance information, and when $\alpha = 0$, the signal is fully revealing,

Partial Insurance versus Advance Information

- disposable income is given by

$$
\begin{aligned}
Y_2^{disp} &= Y_2 - \theta(Y_2 - E^{AI}(Y_2)) \\
&= (1-\theta)Y_2 + \theta E^{AI}(Y_2) \\
&= Y_2 - \alpha\theta(Y_1 - Y_2)
\end{aligned}
$$

Partial Insurance versus Advance Information

- Optimal consumption choices can be shown to be

$$C_1 = \frac{(1+\alpha)Y_1 + (1-\alpha)Y_2}{2}$$

$$C_2 = \left[\frac{1}{2} - \alpha(\frac{1}{2} - \theta)\right] Y_1 + \left[\frac{1}{2} + \alpha(\frac{1}{2} - \theta)\right] Y_2$$

- compute the consumption change:

$$C_2 - C_1 = \alpha(1-\theta)(Y_2 - Y_1)$$

dynamic program

- the dynamic program is

$$
\begin{aligned}
& V_t^i(\omega_t^i, \hat{\beta}_t^i, \hat{z}_t^i; \alpha^i) \\
& = \max_{C_t^i, a_{t+1}^i} \left\{ \frac{(C_t^i)^{1-\phi}}{1-\phi} + \delta_{t+1} E_t[V_{t+1}^i(\omega_{t+1}^i, \hat{\beta}_{t+1}^i, \hat{z}_{t+1}^i; \alpha^i)] \right\} \\
s.t. \quad & C_t^i + a_{t+1}^i = \omega_t^i \\
& \omega_t^i = (1+r)a_t^i + Y_t^{disp,i} \\
& a_{t+1} \geqslant \underline{a}_t, \text{and Kalman recursions}
\end{aligned}
$$

dynamic program

- Partial Insurance: disposable income as

$$Y_t^{disp,i} = Y_t^i - \theta\hat{\xi}_t^i = (1-\theta)y_t^i + \theta E_{t-1}(y_t^i)$$

- The level of disposable income is

$$Y_t^{disp,i} = \underline{Y} + exp(y_t^{disp,i})$$

- Borrowing Constraints

$$\underline{a}_t = \underline{Y}\left[\sum_{\tau=1}^{R-t}(\psi\gamma)^\tau + \psi^{R-t+1}\sum_{\tau=R-t+1}^{T-t}\gamma^\tau\right]$$

Retirement Period

- During retirement

$$V_t^i(\omega_t^i; Y) = \max_{C_t^i, a_{t+1}^i} \left\{ \frac{(C_t^i)^{1-\phi}}{1-\phi} + \delta_{t+1} V_{t+1}^i(\omega_{t+1}^i; Y) \right\}$$

$$s.t. \quad Y^i = Y(Y_R^i; \overline{Y})$$

- Social Security System

Constructing a Panel of Imputed Consumption

- The Panel Study of Income Dynamics (PSID) has a long panel dimension but covers limited categories of consumption expenditures, whereas the Consumer Expenditure Survey (CE) has detailed expenditures over a short period of time (four quarters)
- Blundell, Pistaferri, and Preston (2008) developed a structural method that imputes consumption expenditures for PSID households using information from the CE survey

FigureS1: Constructing a Panel of (Imputed) Consumption

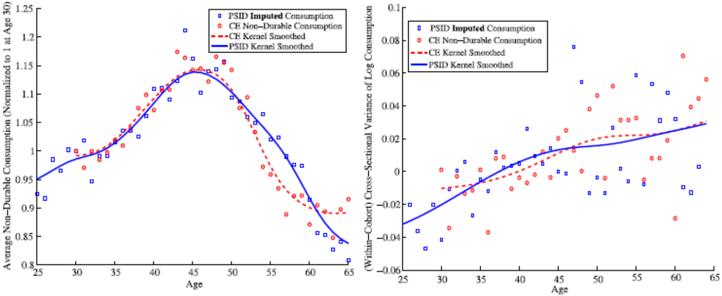
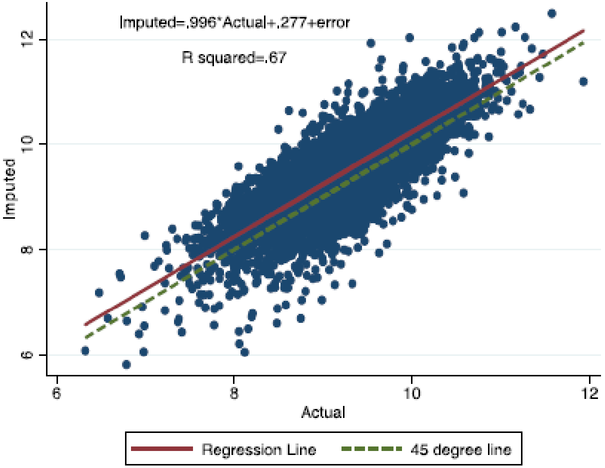


FIGURE S.1.—Mean and variance profile of log consumption over the life cycle.

FigureS2: Constructing a Panel of (Imputed) Consumption



FigureS3: Constructing a Panel of (Imputed) Consumption

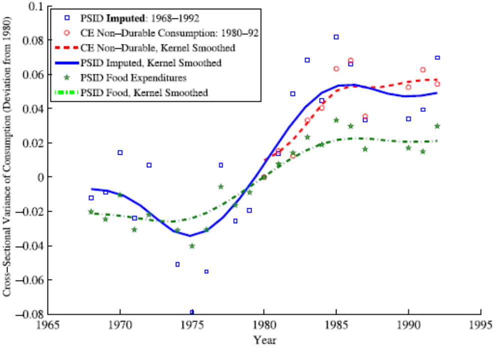


FIGURE S.3.—Cross-sectional variance of log consumption in CE and imputed PSID data: 1968–1992.

Identifying Risk Aversion and Borrowing Constraints

- suppose that the income process is the sum of a permanent and a transitory shock, which implies $\Delta Y_t = \eta_t + \Delta \varepsilon_t$
- Here, it can be shown that $\Delta C_t = \eta_t + \varphi_t \Delta \varepsilon_t$
- These two equations can be jointly used to estimate the ratio of shock variances $(\sigma_\eta^2 / \sigma_\varepsilon^2)$

$$\Delta C_t = \pi \times \Delta Y_t + error, \quad where \quad \pi = \frac{1 + \varphi_t (\sigma_\varepsilon^2 / \sigma_\eta^2)}{1 + 2(\sigma_\varepsilon^2 / \sigma_\eta^2)}$$

the example

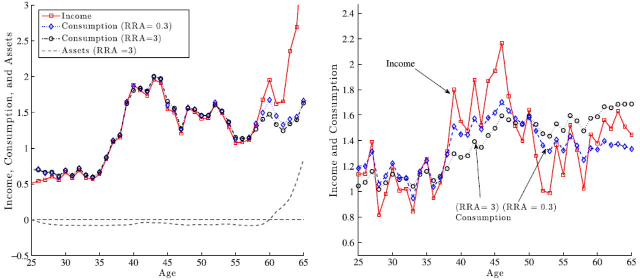


FIGURE 4.—Inferring persistence of shocks using generalized method of moments (GMM) moment conditions.

A Parsimonious and Feasible Auxiliary Model

- an auxiliary model is following equation

$$\begin{aligned} c_t =& a' X_{c,t} + \epsilon_t^c \\ =& a_0 + a_1 y_{t-1} + a_2 y_{t-2} + a_3 y_{t+1} + a_4 y_{t+2} \\ &+ a_5 \overline{y}_{1,t-3} + a_6 \overline{y}_{t+3,R} + a_7 \Delta y_{1,t-3} + + a_8 \Delta y_{t+3,R} \\ &+ a_9 c_{t-1} + a_{10} c_{t-2} + a_{11} c_{t+1} + a_{12} c_{t+2} + \epsilon_t^c \end{aligned}$$

- add a second equation

$$\begin{aligned} y_t =& b' X_{y,t} + \epsilon_t^y \\ =& b_0 + b_1 y_{t-1} + b_2 y_{t-2} + b_3 y_{t+1} + b_4 y_{t+2} \\ &+ b_5 \overline{y}_{1,t-3} + b_6 \overline{y}_{t+3,R} + b_7 \Delta y_{1,t-3} + + b_8 \Delta y_{t+3,R} + \epsilon_t^y \end{aligned}$$

Empirical Preliminaries

- Working life is R = 41 years, and the retirement duration is 15 years (T = 80). an interest rate of $r \approx 5.26\%$. The income floor, Y, is set to 5% of average income in this economy
- fix ϕ at 2 and estimate $\overline{\delta}$
- Measurement Error

$$y_t^{i,*} = y_t^i + u_t^{i,y}$$

$$c_t^{i,*} = c_t^i + \overline{u}^{i,c} + u_t^{i,c}$$

- Matching the Wealth-to-Income Ratio

Missing Observations

- For missing values of regressors, we simply use values that are constructed or filled in using a reasonable procedure.
- a strength of the indirect inference method is that the particular filling-in method is not critical for the estimation as long as the same procedure is applied consistently to real and simulated data

TableS1: A Monte Carlo Study

TABLE S.I

MONTE CARLO ANALYSIS

	Using **Y**+**C** Data			Using **Y** Data		Using **Y** Data		
		Estimates		Estimates			Estimates	
	True Value 1	Mean	Std. Err.	Mean	Std. Err.	True Value 2	Mean	Std. Err.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Income Processes Parameters								
σ_α	0.288	0.293	0.017	0.285	0.031	0.298	0.301	0.038
σ_β	1.764	1.735	0.137	1.834	0.220	1.343	1.377	0.271
$\text{corr}_{\alpha\beta}$	−0.127	−0.106	0.102	−0.161	0.173	0.558	0.531	0.289
ρ	0.756	0.755	0.023	0.754	0.027	0.783	0.780	0.022
σ_η	0.227	0.227	0.007	0.196	0.005	0.200	0.199	0.005
σ_ϵ	0.100	0.105	0.016	–	–	–		
Economic Model Parameters								
λ	0.438	0.410	0.045					
$\bar{\delta}$	0.953	0.952	0.001					
ψ	0.582	0.610	0.040					
θ	0.451	0.447	0.028					
Measurement Errors								
σ_y	0.165	0.163	0.006	0.147	0.005	0.147[a]	0.146	0.005
σ_c	0.355	0.356	0.007	–		–		
σ_{c_0}	0.430	0.428	0.011	–		–		

TableS2: A Monte Carlo Study

TABLE S.II

MONTE CARLO ANALYSIS: ALTERNATIVE AUXILIARY MODELS

Auxiliary Model:		Baseline		No *WY* Moment		Drop Regressors With t-Stats < 2.0		Drop Regressors With t-Stats < 2.0	
Number of Age Groups:[a]		Three		Two		Two		One	
		Estimates		Estimates		Estimates		Estimates	
	"True" Value 1 (1)	Mean (2)	Std. Err. (3)	Mean (4)	Std. Err. (5)	Mean (6)	Std. Err. (7)	Mean (8)	Std. Err. (9)
Income Processes Parameters									
σ_α	0.284	0.292	0.023	0.284	0.025	0.284	0.024	0.284	0.024
σ_β	1.852	2.000	0.163	1.814	0.193	1.821	0.207	1.758	0.397
$\text{corr}_{\alpha\beta}$	−0.162	−0.211	0.143	−0.162	0.189	−0.170	0.205	−0.09	0.228
ρ	0.754	0.765	0.027	0.756	0.025	0.760	0.029	0.757	0.038
σ_η	0.196	0.201	0.005	0.196	0.005	0.194	0.005	0.195	0.005
σ_ε	0.004	0.041	0.031	0.026	0.025	0.036	0.023	0.039	0.022
λ	0.345	0.320	0.110	0.291	0.110	0.310	0.094	0.272	0.114
δ	0.950	0.950	0.002	0.949	0.003	0.951	0.002	0.951	0.002
ψ	0.874	0.949	0.041	0.886	0.082	0.882	0.083	0.797	0.148
σ_y	0.147	0.146	0.010	0.142	0.008	0.142	0.007	0.141	0.007
σ_c	0.356	0.371	0.002	0.356	0.003	0.356	0.002	0.356	0.002
σ_{c_0}	0.428	0.439	0.010	0.421	0.010	0.420	0.010	0.418	0.010

[a]The baseline estimation uses two age groups in the auxiliary model.

Structural Parameters

- The parameter estimates are reported in Table1.
- using only the income regression, reported in column 4.
- Partial Insurance: An Alternative Specification:

$$y_t^{disp,i} = y_t^i - \theta \hat{z}_t^i$$

  Column 2 in Table1 reports the results from this specification
- Self-Insurance Model: Shutting Down Partial Insurance. Restricting $\theta = 0$. Column 3 of Table1 reports the results.

Table1

TABLE I

ESTIMATING THE FULL CONSUMPTION–SAVINGS MODEL[a]

Data:	Income and Consumption			Income
Partial Insurance?	*Benchmark* Insure $\hat{\xi}$ (1)	Yes Insure $\hat{z}$ (2)	Self-Insurance ($\theta \equiv 0$) (3)	(4)
Income Processes Parameters (can be identified with income data alone)				
σ_α	0.288	0.286	0.265	0.298
	(0.017)	(0.017)	(0.022)	(0.038)
σ_β	1.764	1.881	1.660	1.343
	(0.137)	(0.131)	(0.118)	(0.271)
$\text{corr}_{\alpha\beta}$	−0.127	−0.140	−0.112	0.558
	(0.102)	(0.090)	(0.121)	(0.289)
ρ	0.756	0.755	0.768	0.783
	(0.023)	(0.021)	(0.025)	(0.022)
σ_η	0.227	0.427	0.196	0.200
	(0.007)	(0.012)	(0.005)	(0.005)
σ_ε	0.100	0.004	0.008	0.147
	(0.016)	(0.018)	(0.021)	(0.005)

Table1

Economic Model Parameters (need consumption data)				
λ (prior uncertainty)	0.438	0.429	0.345	–
	(0.045)	(0.042)	(0.074)	–
θ (partial insurance)	0.451	0.552	0.00*	–
	(0.028)	(0.031)	–	
ψ (borrowing constraint)	0.582	0.859	0.855	–
	(0.040)	(0.048)	(0.083)	
$\overline{\delta}$ (subjective time discount factor)	0.953	0.955	0.956	–
	(0.001)	(0.001)	(0.001)	–
Measurement Error and Transitory Shocks (need consumption data)				
σ_y	0.165	0.146	0.148	–
	(0.006)	(0.005)	(0.007)	–
σ_c	0.355	0.356	0.356	–
	(0.007)	(0.006)	(0.002)	–
σ_{c_0}	0.430	0.429	0.427	–
	(0.011)	(0.011)	(0.009)	
Max % constrained…	17.4%	21.8%	19.5%	
…at age	29	27	27	
$\underline{a}_{25}/\mathbb{E}(Y^i)$	0.08	0.13	0.11	–
$\underline{a}_{55}/\mathbb{E}(Y^i)$	0.06	0.11	0.09	–

[a]Standard errors (in parentheses) are obtained via parametric bootstrap with 140 repetitions. * θ is restricted to be zero.

Model-Data Comparison: Life-Cycle Profiles of Income and Consumption

- Figure 5 plots the variance of log income and consumption using our PSID estimation sample
- Figure 6 plots the average life-cycle profile of consumption
- Figure 7 plots the forecast variance of predicted log income at different horizons

Figure5

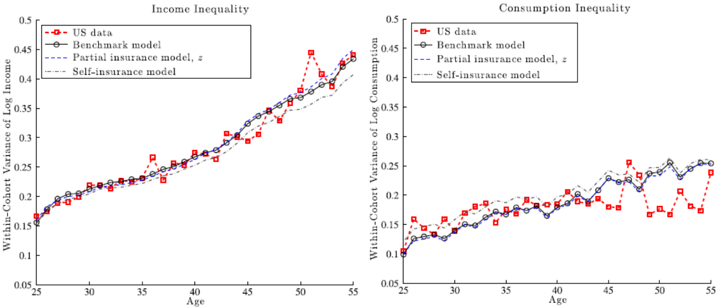


FIGURE 5.—Within-cohort income and consumption inequality: data versus estimated models.

Figure6

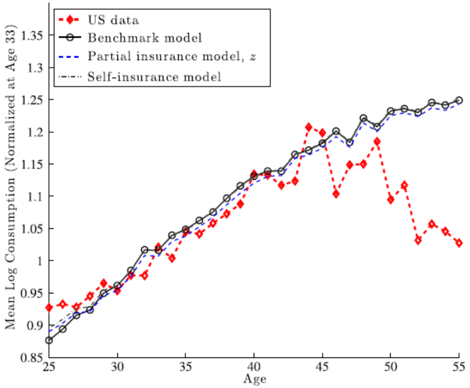


FIGURE 6.—Mean log consumption profile over the life cycle: model versus U.S. data.

Figure7

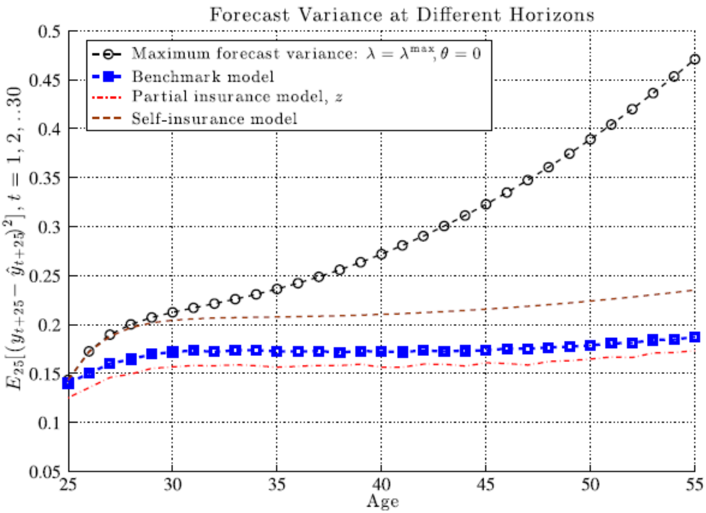


FIGURE 7.—Uninsurable income uncertainty.

Inspecting the Response of Consumption to Income

- Figure 8 plots six figures in two columns. Each column corresponds to a different household and plots (from top to bottom) the simulated paths of income, annual consumption growth, and wealth over the life cycle. Household 1 has a fairly high income.

Figure8

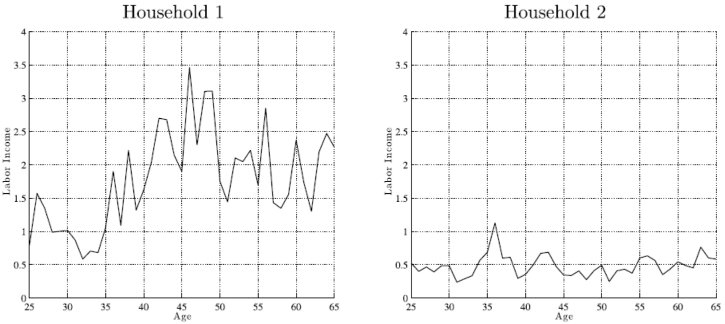
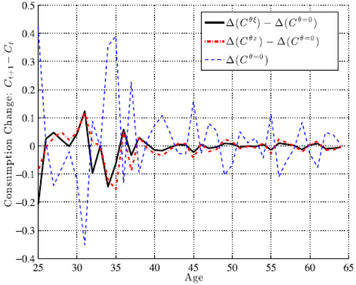
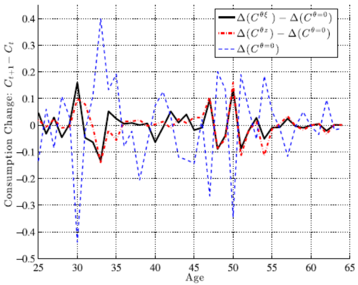


Figure8



Consumption Change: $C_{t+1} - C_t$
0.5
0.4
0.3
0.2
0.1
0
−0.1
−0.2
−0.3
−0.4
25 30 35 40 45 50 55 60 65
Age
$\Delta(C^{\theta\xi}) - \Delta(C^{\theta=0})$
$\Delta(C^{\theta z}) - \Delta(C^{\theta=0})$
$\Delta(C^{\theta=0})$



Consumption Change: $C_{t+1} - C_t$
0.4
0.3
0.2
0.1
0
−0.1
−0.2
−0.3
−0.4
−0.5
25 30 35 40 45 50 55 60 65
Age
$\Delta(C^{\theta\xi}) - \Delta(C^{\theta=0})$
$\Delta(C^{\theta z}) - \Delta(C^{\theta=0})$
$\Delta(C^{\theta=0})$

Figure8

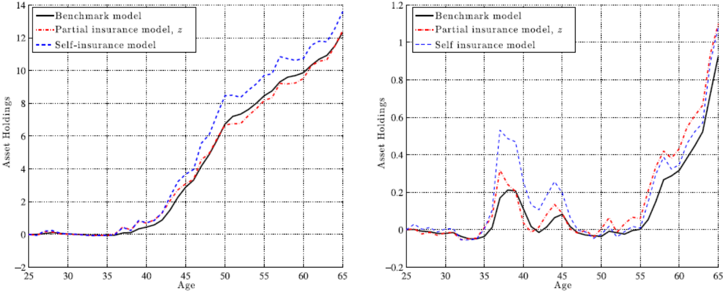


FIGURE 8.—Consumption response to income shocks: two sample paths.

Inspecting the Auxiliary Model

- Table II displays the 50 coefficients of interest for the benchmark model (44 regression coefficients and 6 elements of the covariance matrix)
- the estimated structural model matches several very significant coefficients of the auxiliary model quite well, but also falls short in matching the coefficients on lagged and future consumption

Table2

TABLE II

COEFFICIENTS OF THE AUXILIARY MODEL: BENCHMARK ESTIMATED MODEL VERSUS U.S. DATA

		Constant	y_{t-1}	y_{t-2}	y_{t+1}	y_{t+2}	$\overline{y}_{1,t-3}$	$\overline{y}_{t+3,T}$	$\Delta y_{1,t-3}$	$\Delta y_{t+3,T}$	c_{t-1}	c_{t-2}	c_{t+1}	c_{t+2}
PANEL A: INCOME EQUATION														
Young Group														
(1)	Data	**−0.036**[a]	**0.346**	**0.360**	**0.077**	**0.097**	**−0.098**	**0.150**	0.037	−0.022				
(2)	Model	−0.024††[b]	0.359	0.381	0.086	0.092	−0.088	0.107††	−0.022††	−0.011				
Middle-Age Group														
(3)	Data	0.006**	**0.418**	**0.358**	**0.111**	**0.093**	−0.027	0.043**	0.031	0.028				
(4)	Model	−0.002††	0.429	0.399	0.109	0.095	−0.055	0.007††	−0.005	0.052				
PANEL B: CONSUMPTION EQUATION														
Young Group														
(5)	Data	−0.007	**0.108**	0.042*	−0.023	−0.005	−0.045*	−0.017	0.030	−0.002	**0.248**	**0.262**	**0.178**	**0.175**
(6)	Model	−0.021††	0.092	0.124††	−0.025	−0.034	−0.088	0.004	0.006	0.015	0.211††	0.205†††	0.247†††	0.228†††
Middle-Age Group														
(7)	Data	−0.004	**0.136**	0.046**	−0.014	−0.040*	−0.082**	0.012	0.030	0.028	**0.270**	**0.260**	**0.177**	**0.187**
(8)	Model	0.007††	0.097	0.083	0.008	−0.054	0.041†††	−0.059††	0.025	0.037	0.201†††	0.210††	0.224††	0.256†††

PANEL C: RESIDUAL VARIANCES AND CORRELATIONS

		Young Group			*Middle-Age Group*		
		$\sigma^2(\epsilon_i^y)$	$\sigma^2(\epsilon_i^c)$	$\rho(\epsilon_i^y, \epsilon_i^c)$	$\sigma^2(\epsilon_i^y)$	$\sigma^2(\epsilon_i^c)$	$\rho(\epsilon_i^y, \epsilon_i^c)$
(9)	Data	**0.222**	**0.396**	**0.117**	**0.235**	**0.379**	**0.114**
(10)	Model	0.216	0.390	0.121	0.223††	0.388	0.108

Robustness

- an alternative method for filling in missing observations
- considering a higher income floor $\underline{Y}$
- a lower interest rate
- fixing (rather than estimating) the borrowing constraints
- using all data available up to age 65

TableS3: Robustness

SENSITIVITY ANALYSIS: ALTERNATIVE ASSUMPTIONS

	Low Interest Rate $\gamma = 0.97$ (1)	Alternative Filling-in Method (2)	Doubling Minimum Income $\underline{Y} = 0.10$ (3)	Use Data Up to Age 65 (4)	No Prior Uncertainty $\lambda = 0$ (5)	Maximum Prior Uncertainty $\lambda = \lambda^{max}$ (6)
Income Processes Parameters (can be identified with income data alone)						
σ_α	0.284	0.220	0.293	0.228	0.268	0.248
σ_β	1.856	1.916	1.886	1.088	1.756	1.04
$\text{corr}_{\alpha\beta}$	−0.164	0.003	−0.166	−0.161	−0.086	0.751
ρ	0.755	0.760	0.759	0.801	0.777	0.806
σ_η	0.196	0.200	0.208	0.200	0.195	0.196
σ_ε	0.005	0.006	0.007	0.003	0.006	0.010
Economic Model Parameters (need consumption data)						
λ	0.380	0.327	0.374	0.520	0.0 (fixed)	0.656[a]
δ	0.964	0.950	0.951	0.943	0.954	0.951
ψ	0.790	0.921	0.757	0.992	0.761	0.895
Measurement Error and Transitory Shocks (need consumption data)						
σ_y	0.147	0.145	0.156	0.152	0.148	0.151
σ_c	0.356	0.356	0.356	0.356	0.355	0.356
σ_ϖ	0.429	0.414	0.427	0.432	0.424	0.433
Max % constrained...	16.1%	10.2%	12.5%	9.1%	14.1%	13.2%
...at age	30	31	30	35	30	33
$\underline{a}_{25}$/mean income	0.35	0.44	0.41	0.93	0.21	0.37
$\underline{a}_{55}$/mean income	0.60	0.59	0.87	0.73	0.44	0.55

TableS4: Robustness

SENSITIVITY OF STRUCTURAL ESTIMATES TO RESTRICTIONS ON ECONOMIC MODEL PARAMETERS[a]

	Role of Preference Parameters						Borrowing Limit	
	Low RRA	*High RRA*	*δ Fixed*	*δ Fixed*	δ Estim.	*δ Fixed*	$\psi = 1$	$\underline{a}_t = 0$
Preset Parameters↓	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ϕ (risk aversion)	1	3	1	1	1	1	2	2
δ (time discount factor)	Estim.	Estim.	0.94	0.94	Estim.	0.953	Estim.	Estim.
Weight on *WY* moment	10.0	10.0	1.0	0.0	0.0	0.0	10.0	10.0
Income Processes Parameters (can be identified with income data alone)								
σ_α	0.283	0.282	0.339	0.326	0.332	0.281	0.333	0.272
σ_β	1.838	1.841	3.997	2.165	2.093	1.850	2.129	1.747
$\text{corr}_{\alpha\beta}$	−0.161	−0.161	0.660	−0.243	−0.162	−0.161	−0.139	−0.101
ρ	0.756	0.756	0.821	0.724	0.738	0.760	0.750	0.765
σ_η	0.196	0.196	0.238	0.194	0.196	0.195	0.195	0.194
σ_ε	0.005	0.005	0.007	0.001	0.0124	0.005	0.029	0.005
Economic Model Parameters (need consumption data)								
λ	0.368	0.330	0.998	0.001	0.035	0.343	0.360	0.283
δ	0.953	0.942	0.94*	0.94*	0.938	0.953*	0.951	0.949
ψ	0.877	0.871	0.002	0.997	0.998	0.923	0.99*	$\underline{a}_t = 0$
Max % constrained	13.9%	10.5%	52.2%	21.7%	14.3%	12.2%	7.2%	38.1%
Max constrained age	31	33	25	35	35	33	35	25
Wealth-to-income ratio	1.08	1.08	0.94	−0.03	0.15	1.03	1.08	1.07
$\underline{a}_{25}$/mean income	0.33	0.32	0.07	0.90	0.90	0.44	0.83	0.0
$\underline{a}_{55}$/mean income	0.53	0.53	0.31	0.73	0.73	0.59	0.71	0.0

Conclusions

- The joint dynamics of consumption and labor income contain rich information about the economic environment that individuals inhabit
- We have studied how such information can be extracted from choice data to shed light on different aspects of lifetime income risk

Conclusions

- the estimation method we use is general enough to accommodate a variety of other static or intertemporal decisions. Economic decisions that involve large fixed costs (and, hence, are made infrequently, such as fertility choice, house purchases, etc.) are likely to be especially forward-looking and, therefore, are useful for inferring the nature and amount of risk

Reference

- BLUNDELL, R., L. PISTAFERRI, AND I. PRESTON (2008): Consumption Inequality and Partial Insurance, American Economic Review, 98 (5), 18871921. [2087,2094,2105,2113,2124,2126]
- GOURINCHAS, P.-O., AND J. A. PARKER (2002): Consumption Over the Life Cycle, Econometrica, 70 (1), 4789. [2088,2126]
- GUVENEN, F. (2007): Learning Your Earning: Are Labor Income Shocks Really Very Persistent? American Economic Review, 97 (3), 687712. [2086-2090,2093,2119,2120,2122,2126]