Macroeconomics Seminar

Income Shock, Partial Insurance and Welfare Effect: Differece between Chinese Urban and Rural Consumption

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Motivation

- inequality become more and more important issue since China come into new normal economy.
- comparing income inequality, consumption inequality reveals welfare better.
- income and consumption joint dynamic reveals much deep information

This Paper

- estimate income shock, partial insurance, and estimate preference parameter based life cycle model and simulated moment method
- calculate welfare effect for income shock, partial insurance, and stochastic shock.

Compare the Existing Research

- Rigorously calculate welfare effect of income shock and partial insurance between Chinese rural and urban household via structural estimation
- Rigorously handle unbalanced panel data and calculate variance for estimated parameter with unbalanced panel data

Life Cycle Model

- Consider a life cycle model, individual i maximize his life cycle utility

$$u(C_{it}) + E_t\{\sum_{j=t+1}^{T} \beta^{j-t} u(C_{ij})\} \quad (1)$$

- subject to the budget constraint

$$A_{i,t+1} = R(A_{i,t} - C_{i,t}) + Y_{i,t+1} \quad (2)$$

Income Dynamic

- The log residual income y_{it} consist of permanent component z_{it}, and transitory component ϵ_t

$$y_{it} = z_{it} + \epsilon_{it}$$

$$z_{it} = g_t^y + z_{it-1} + \eta_{it}$$

- where g_t^y is log income growth in age t, η_{it} and ϵ_{it} are both independently and identically normally distributed, $\eta_{it} \sim N(0, \sigma_u^2)$, $\epsilon_{it} \sim N(0, \sigma_n^2)$
- So income growth is

$$\boxed{\Delta y_{it} = g_t^y + \eta_{it} + \Delta\epsilon_{it}} \tag{3}$$

Consumption Dynamic

- Following Blundell et al. (2008), if preferences are of the CRRA form, we can drive an apprpoximation of the Euler equation to describe the log consumption growth Δc_{it}

$$\Delta c_{it} = g_t^c + \phi \eta_{it} + \psi \epsilon_{it} + v_{it} \tag{4}$$

- where g_t^c is log consumption growth in age t, ϕ is partial insurance of permanent income shock, ψ is partial insurance of transitory income shock, v_{it} is the stochastic shock.

Consumption Dynamic

- consider the existence of the measurement error in consumption, the measured log consumption growth is

$$\Delta c_{it}^{*} = g_t^c + \phi\eta_{it} + \psi\epsilon_{it} + v_{it} + \Delta u_{it}^c \quad (5)$$

- where u_{it} is the measurement errors in consumption

Minimum Distance Estimator

- combine (3) and (5), we can construct the following moment condition

$$
\begin{aligned}
var(\Delta y_{it}) &= \sigma_\eta^2 + 2\sigma_\epsilon^2 \\
cov(\Delta y_{it}, \Delta y_{it+1}) &= -\sigma_\epsilon^2 \\
var(\Delta c_{it}) &= \phi^2\sigma_\eta^2 + \psi^2\sigma_\epsilon^2 + 2\sigma_u^2 + \sigma_v^2 \\
cov(\Delta c_{it}, \Delta c_{it+1}) &= -\sigma_u^2 \\
cov(\Delta c_{it}, \Delta y_{it}) &= \phi\sigma_\eta^2 + \psi\sigma_\epsilon^2 \\
cov(\Delta c_{it}, \Delta y_{it+1}) &= -\psi\sigma_\epsilon^2 \\
cov(\Delta c_{it+1}, \Delta y_{it}) &= 0
\end{aligned}
\tag{6}
$$

Minimum Distance Estimator

- to do minimum distance estimator, we should handle the problems of unbalanced panel data.
- we define

$$\Delta c_i = \begin{pmatrix} \Delta c_{i,1} \\ \Delta c_{i,2} \end{pmatrix} \text{ and } \Delta y_i = \begin{pmatrix} \Delta y_{i,1} \\ \Delta y_{i,2} \end{pmatrix}$$

- and define

$$\Delta d_i^c = \begin{pmatrix} \Delta d_{i,1}^c \\ \Delta d_{i,2}^c \end{pmatrix} \text{ and } \Delta d_i^y = \begin{pmatrix} \Delta d_{i,1}^y \\ \Delta d_{i,2}^y \end{pmatrix}$$

- we obtain the vector

$$x_i = \begin{pmatrix} \Delta c_i \\ \Delta y_i \end{pmatrix} \text{ and } d_i = \begin{pmatrix} \Delta d_i^c \\ \Delta d_i^t \end{pmatrix}$$

Minimum Distance Estimator

- we can drive

$$m = vech\left\{\left(\sum_{i=1}^{N} x_i x_i') \oslash (\sum_{i=1}^{N} d_i d_i'\right)\right\}$$

- define with m the individual vector, $m_i = vech\{x_i x_i'\}$. The variance-covariance matrix of m is

$$V = \left[\sum_{i=1}^{N}((m_i - m)(m_i - m)') \circledast (D_i D_i')\right] \oslash \left(\sum_{i=1}^{N} D_i D_i'\right)$$

- where $D_i = vech\{d_i d_i{}'\}$

Minimum Distance Estimator

- we estimate the model for m:

$$m = f(\Lambda) + \Upsilon$$

- we solve the problem of estimating Λ by minimizing

$$\min_{\Lambda}(m - f(\Lambda))'W(m - f(\Lambda))$$

- we use diagonally weighted minimum distance requires W is a diagonal matrix with the elements in the main diagonal given by $diag(V^{-1})$
- the variance-covariance matrix of Λ is

$$var(\hat{\Lambda}) = (G'WG)^{-1}G'W(V \oslash \left(\sum_{i=1}^{N} D_i D_i'\right))WG(G'WG)^{-1}$$

Preferences

- The within-period utility function is of the form

$$u(C_{it}) = \frac{C_{it}^{1-\rho}}{1-\rho}$$

- a retirement value function that summarizes the consumers problem at retirement time

$$V(A_{i,T_w+1}, P_{i,T_w+1}) = \theta \frac{(A_{i,T_w+1} + k \cdot P_{i,T_w+1})^{1-\rho}}{1-\rho}$$

Simulated Moment Method

- To calculate welfare effect of income shock and partial insurance, we need know preference parameter,
- to estimate preference parameter $\chi = \{\rho, \beta, \theta, \kappa\}$, we employ simulated moment method. Given χ, we can solve numerically for the age-dependent optimal consumption rules.
- For a given set of consumption rules, we can numerically simulate the associated expected consumption as a function of age only.
- The estimation procedure then minimizes the distance between the simulated consumption profiles and empirical consumption profiles

Estimation

- by making the simulated moments as close as possible to theoretical meMents

$$g_t(\chi) = \frac{1}{N_s}\sum_{i=1}^{N_s} ln\hat{C}^s_{i,t}(\chi) - \frac{1}{N_t}\sum_{i=1}^{N_t} ln\hat{C}_{i,t}$$

- then simulated moments method (SMM) that minimizes over χ:

$$\hat{\chi} = argmin\ g(\chi)'Wg(\chi)$$

Asymptotic Variance Covariance Matrix

- the variance-covariance matrix of χ is:

$$var(\hat{\chi}) = (G'_\chi W G_\chi)^{-1} G'_\chi W (V/N_s + V \oslash N_t) W G_\chi (G'_\chi W G_\chi)^{-1}$$

- And the statistic is distributed asymptotically as Chi-squared with $T_w - 4$ degrees of freedom:

$$\chi_{T_w-4} = g(\hat{\chi})'(V/N_s + V \oslash N_t)^{-1} g(\hat{\chi})$$

Welfare Calculations

- by (4), we can get consumption C_{it} in age t:

$$C_{it} = exp\left\{c_0 + \sum_{\tau=1}^{t} g^c_\tau + \phi \sum_{\tau=1}^{t} \eta_{it} + \psi \sum_{\tau=1}^{t} \epsilon_{it} + \sum_{\tau=1}^{t} v_{it}\right\}$$
$$= \tilde{C}_t exp\left\{\phi \sum_{\tau=1}^{t} \eta_{it} + \psi \sum_{\tau=1}^{t} \epsilon_{it} + \sum_{\tau=1}^{t} v_{it}\right\}$$

- the ex ante welfare of living in for working periods T_w is:

$$E \sum_{t=1}^{T_w} \beta^t u(C_{it}) = \sum_{t=1}^{T_w} \beta^t u(\tilde{C}_t) exp\left(\frac{1}{2}(1-\rho)^2(\phi^2\sigma^2_\eta + \psi^2\sigma^2_\epsilon + \sigma^2_v)t\right)$$
$$= E \sum_{t=1}^{T_w} \beta^t u(C_{it}; \tilde{C}_t, \beta, \rho, \eta, \epsilon, \phi, \psi, v)$$

Welfare Calculations

- for rural consumer, we can define the total effect on welfare in consumption equivalent variation, $1+\omega$, from moving from rural environment A to urban enviroment B for as

$$E\sum_{t=1}^{T_w}\beta^t u((1+\omega)C_{it};\eta_A,\epsilon_A,\phi_A,\psi_A,\upsilon_A)$$
$$=E\sum_{t=1}^{T_w}\beta^t u(C_{it};\eta_B,\epsilon_B,\phi_B,\psi_B,\upsilon_B)$$

- we can get close solution for ω:

$$(1+\omega)^{1-\rho}U_A=U_B$$

Welfare Calculations

- We can decompose the total risk effect, $1+\omega$, into a income shock effect $1+\omega_1$, a partial insurance effect $1+\omega_2$ and an stochastic shock effect $1+\omega_3$.
- income shock effect:

$$
\begin{aligned}
& E\sum_{t=1}^{T_w}\beta^t u((1+\omega_1)C_{it};\eta_A,\epsilon_A,\phi_A,\psi_A,v_A) \\
& = E\sum_{t=1}^{T_w}\beta^t u(C_{it};\eta_B,\epsilon_B,\phi_A,\psi_A,v_A)
\end{aligned}
$$

Welfare Calculations

- income shock effect: comparing $(\eta_A, \epsilon_A, \phi_A, \psi_A, \upsilon_A)$ to $(\eta_B, \epsilon_B, \phi_A, \psi_A, \upsilon_A)$
- partial insurance effect: comparing $(\eta_B, \epsilon_B, \phi_A, \psi_A, \upsilon_A)$ to $(\eta_B, \epsilon_B, \phi_B, \psi_B, \upsilon_A)$
- stochastic shock effect: comparing $(\eta_B, \epsilon_B, \phi_B, \psi_B, \upsilon_A)$ to $(\eta_B, \epsilon_B, \phi_B, \psi_B, \upsilon_B)$
- we can get:

$$1 + \omega = (1 + \omega_1)(1 + \omega_2)(1 + \omega_3)$$

Data

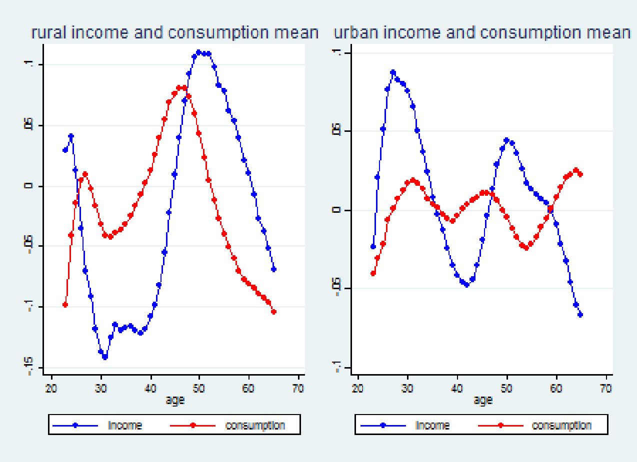
- CFPS 2010-2012-2014 panel data
- household comsunption C: keep consumption large than zero
- household income Y: drop if income small than 120 or large than one million
- keep $25 \leqslant age \leqslant 60$

Descriptive Statistics

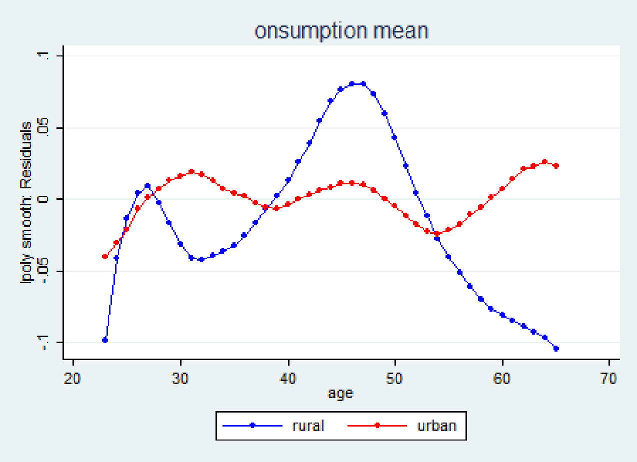
Table 1

	rural			urban		
variable	N	mean	sd	N	mean	sd
income	11860	31772	33402	9580	43665	46279
consumption	10665	31540	36183	8571	47791	53637
education	11857	2.311	1.010	9575	3.110	1.313
family size	11860	4.512	1.753	9580	3.766	1.496
age	11860	48.09	9.026	9580	47.62	9.514
gender	11860	0.824	0.381	9580	0.700	0.458

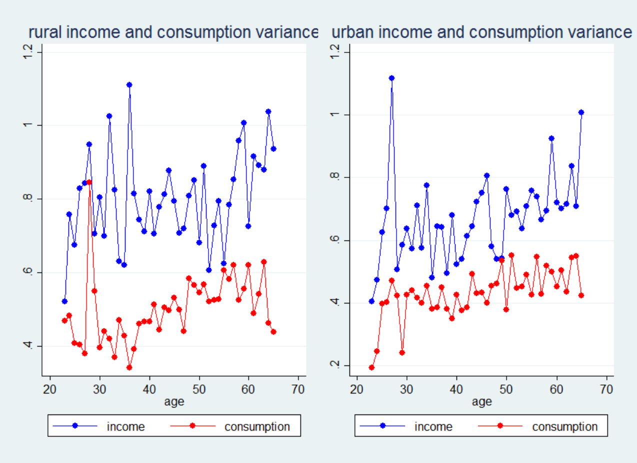
Income and Consumption Mean



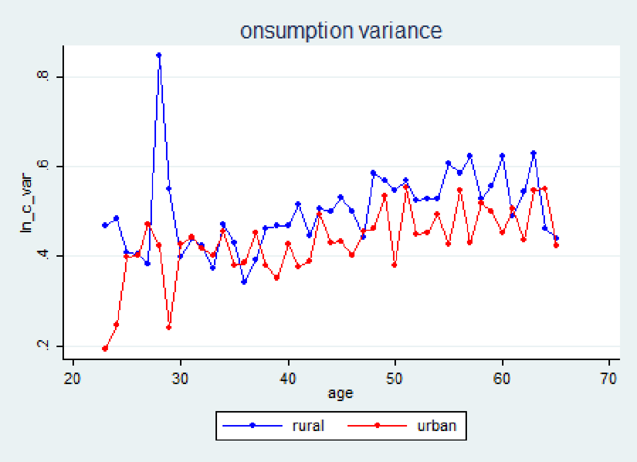
Consumption Mean



Income and Consumption Variance



Consumption Variance



Income and Consumption Covariance Matrix

Table 2

	rural		urban	
Year	2012	2014	2012	2014
$var(\Delta_2 y_t)$	1.10623	1.10994	0.884592	0.965979
$cov(\Delta_2 y_t, \Delta_2 y_{t+2})$	-0.5106	NA	-0.530256	NA
$var(\Delta_2 c_t)$	0.695127	0.761096	0.539513	0.573568
$cov(\Delta_2 c_t, \Delta_2 c_{t+2})$	-0.339865	NA	-0.291344	NA
$cov(\Delta_2 c_t, \Delta_2 y_t)$	.039093	.041942	0.047823	0.038155
$cov(\Delta_2 c_t, \Delta_2 y_{t+2})$	-0.004035	NA	-0.006885	NA
$cov(\Delta_2 c_{t+2}, \Delta_2 y_t)$	0.021302	NA	0.002756	NA

Minimum Distance Estimator

Table 3

Parameter	Rural	Urban
σ_η^2	0.0495	0.0262
	(0.0216)	(0.0195)
σ_ε^2	0.5145	0.4708
	(0.0324)	(0.0343)
ϕ	0.3799	0.5940
	(0.2148)	(0.4665)
ψ	0.0056	0.0723
	(0.0373)	(0.0376)
σ_u^2	0.3392	0.2464
	(0.0225)	(0.0190)
σ_υ^2	0.0258	0.0384
	(0.0153)	(0.0141)

Standard errors in parentheses

Simulated Moment Method

Table 4

MSM Estimation	Rural	Urban
β	0.9466	0.9653
	(0.0046)	(0.0022)
ρ	1.3838	1.3819
	(0.0177)	(0.0074)
θ	65.0230	57.9545
	(1.6346)	(0.4339)
κ	0.2119	0.1696
	(0.0119)	(0.0009)
$\chi^2(32)$	68.2009	60.9930

Standard errors in parentheses

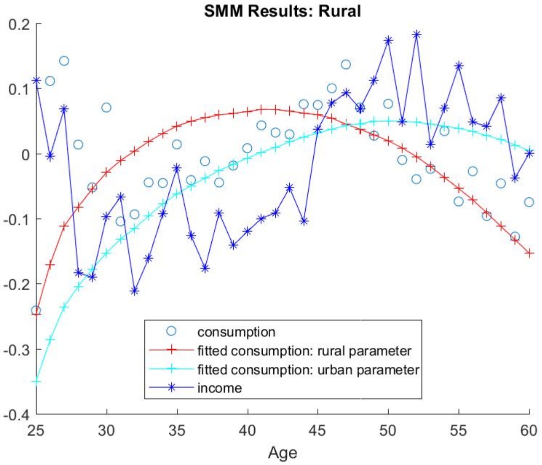
Simulated Moment Method: Identification

Table 5

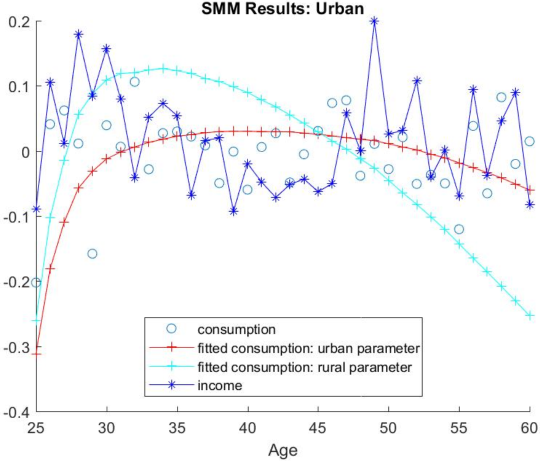
Object Function	Rural	Urban
rual parameter	0.6255	0.5071
	(0.0142)	(0.0086)
urban parameter	1.1648	1.2454
	(0.0298)	(0.0210)

Standard errors in parentheses

Simulated Moment Method: Identification



Simulated Moment Method: Identification



Welfare Calculation

Table 6

Welfare Calculation	Rural	Urban
income shock effect	0.85%	-2.42%
partial insurance effect	-1.97%	3.83%
stachastic shock effect	-3.14%	3.69%
total effect	-4.24%	5.06%

Conclusion

- rural consumer have bigger income risk, better risk insurance
- rural consumer have lower discount factor, slight higher risk aversion
- for rural consumer, income shock effect is about 0.85%, partial insurance effect is about -1.97%, stachastic shock effect is about -3.14%.
- for urban consumer, income shock effect is about -2.42%, partial insurance effect is about 3.83%, stachastic shock effect is about 3.69%.

Partial Insurance

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