An Empirical Evidence of Consumption Planning

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Abstract

We use the hyperbolic discounting model as the model that saving of each household varies in the steady state. In this model, there is a trade off that consumers will decrease future consumption and saving because of their temptation of current consumption. Therefore the degree of commitment technologies fixes consumption and saving paths. In this paper, we consider data of life planning as the commitment period of consumption and make an empirical analysis using the data about life planning of Public Opinion Survey on Household Financial Assets and Liabilities. We use the Tobit TSLS. We get the result that there exists the short-run trade off between consumption and saving, therefore consumers can increase their future consumption and saving by life planning. This result supports the hyperbolic discounting theory.

We use the data in Public Opinion Survey on Household Financial Assets and Liabilities with the permission of the central council for financial services information (secretariat: public relations department, bank of Japan). All the remaining error and opinions in this paper is due to the author and not to the bank of Japan.
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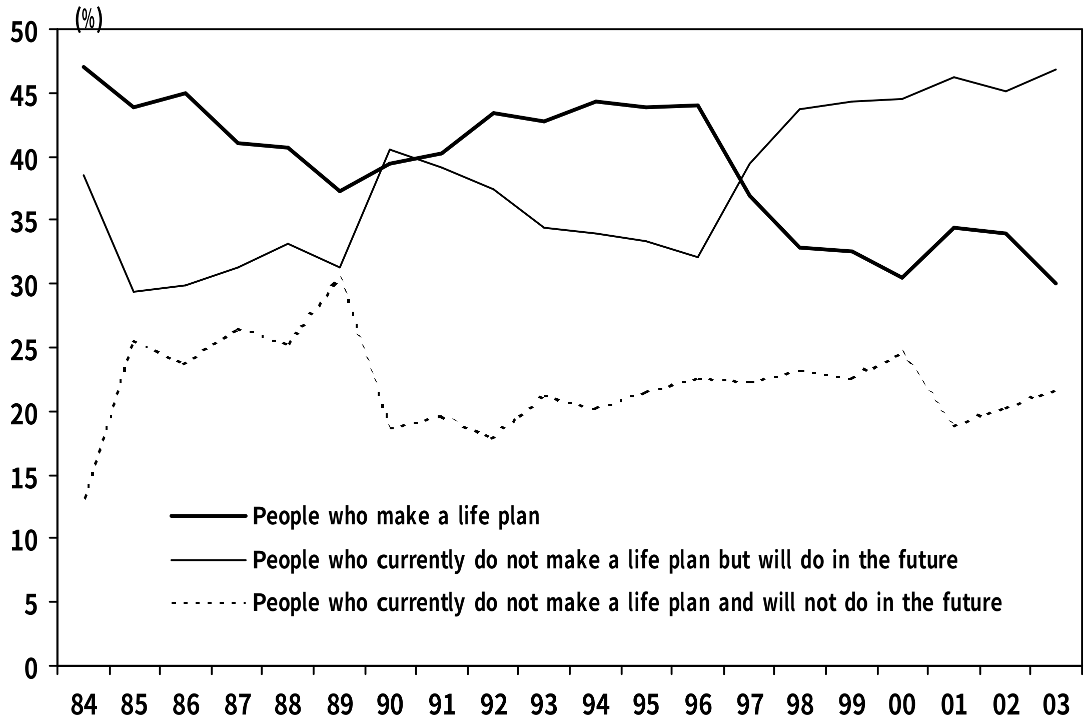
1. Introduction

Saving of household follows the lifecycle and permanent income hypothesis. Particularly, variables such as assets and consumption which decide saving rate are dependent on whether households make life planning or not, how long they consider the life planning period. They are choice variables of each household. In short, each household can achieve the desirable combination of higher consumption and saving by suppressing the wasteful consumption.



For analyzing thrift, we assume the hyperbolic discounting growth model (Strotz(1956), Phelps & Pollak（1968）, Barro（1999）, Laibson（2003）). In this model, the time preference rate varies with the time distance from consumption planning date. So, if consumers have commitment technologies to withhold consumption they can increase their saving (see Barro(1999)). The commitment technology has two cases; partial and full. They are distinguished by T, the period consumers can commit. If the period is infinite, commitment is full. If not, commitment is partial. The full commitment case is asymptotically equivalent to the Ramsey model with a constant time preference rate. The commitment period of each household is determined by saving motives and the existence of illiquid assets, children and other commitment technologies.

In this paper, we use the Tobit TSLS framework with saving and life planning. In this model, the life planning period is endogenously determined by saving, dummy variables that is the determinants of saving, saving motives and illiquid assets. Using

Tobit means that there is some “desirable life planning period” different from using Probit which means that whether consumers make life planning depends on 1-0 index function. Asymptotically, estimators of Tobit have a consistency (Lee et al.(1980)).

Our result supports the hyperbolic discounting theory that life planning, i.e., commitment makes saving higher to the optimal in the steady state.

2.The Model

2.1. Consumer

The following model is explained in Barro(1999). We set the consumer’s utility function as follows.

$$(1)\quad U(\tau)=\int_{\tau}^{\infty} u[c(t)]\exp\{-(\rho(t-\tau)+\phi(t-\tau))\}dt$$

τ means the current time and we assume that the felicity function has the property $u'(c)>0$, $u''(c)<0$. The ordinal time preference rate is $\rho>0$. We assume CRRA as the felicity function.

$$u(c)=\frac{c^{1-\theta}}{1-\theta}$$

The time preference rate at t depends on not only the time distance t-τ but also $\phi(t-\tau)\geqq 0$. The latter term shows the term which are not defined in the exponential time preference rate $\exp(-\rho(t-\tau))$, $\phi(0)=0$. The time distance is $v=t-\tau\geqq 0$. $\phi'(v)\geq 0$, $\phi''(v)\leq 0$, and if $v\to\infty$ then $\phi'(v)\to 0$. Therefore, the time preference rate is high in the near future and stays the low constant rate ρ in the long run.

(i) The complete solution in the no commitment case

Using the above utility function, consumption is given by c(t)=λ[k(t)+present value of wage] for $t\geqq\tau+\varepsilon$ for small constant $\lambda>0$. In $t\geqq\tau+\varepsilon$, consumption c(t) grows at the rate of r(t)-λ.

$$(2)\quad \frac{dc/dt}{c}=\frac{1}{\theta}[r(t)-\lambda(\tau)]\quad \text{for } t>\tau$$

λ is the instantaneous time preference rate. In the case of Ramsey model, $\lambda=\rho$ ($\phi(v)=0$, for any v). λ is given as;

$$(3)\quad \lambda=\frac{\int_0^{\infty}-\{\rho v+\phi'(v)\}\exp[-\{\rho v+\phi(v)\}]dv}{\int_0^{\infty}\exp[-\{\rho v+\phi(v)\}]dv}$$

$\rho\leqq\lambda\leqq\rho+\phi'(0)$ means that λ is between the long-term time preference rate ρ and the short-run instantaneous time preference rate $\rho+\phi'(0)$.

(ii) The role of commitment

When the time preference rate is constant as in the Ramsey model, the commitment has no difference in the result, but has a large difference in the result when the time preference rate is time varying.

(Full commitment case)

In the Steady State, $\lambda \geqq \rho$ if there is no commitment and asymptotically constant time preference rate ρ if there is full commitment. If there is no commitment, λ is the average of the current and future instantaneous time preference rate. If there is commitment, the time preference rate is not λ but $\rho + \phi'(0)$, it decreases to ρ over time. In the full commitment case, the result is low r* and high k* and c*. Consumption varies as in the below equation.

$$(4)\quad \frac{dc/dt}{c} = \frac{1}{\theta}[r(t) - \rho - \phi'(t-\tau)] \quad \text{for } t > \tau$$

(Partial commitment case)

Households can choose the consumption path at time τ in the interval T≧0, [τ , τ +T]. λ_T depends on T.

$$(5)\quad \lambda_T = \frac{\exp[-\rho T + \phi(\tau)]}{\Omega_T}、\quad \Omega_T = \int_T^{\infty} \exp[-\{\rho v + \phi(v)\}]dv$$

$$\text{For T=0,}\quad \lambda_T = \frac{1}{\Omega}、\quad \Omega_T = \int_0^{\infty} \exp[-\{\rho v + \phi(v)\}]dv$$

$\lambda_0 \geqq \rho$.

λ_T decreases monotonically from λ_0 to ρ as T increases from 0 to infinity. Households with better commitment technology have the more valuable T and accumulate capital with low and efficient time preference rate, low consumption propensity, high saving propensity. The difference of commitment ability is modeled as changes of T and produces the transition period.

At first, assuming T=0, in the interval [τ,τ+T], $\rho \leqq \lambda_0 \leqq \rho + \phi'(0)$。

$$(6)\quad \frac{dc/dt}{c} = \frac{1}{\theta}[r(t) - \rho - \phi'(t-\tau)] \quad \text{for } \tau \leqq t \leqq \tau + T$$

At time τ , λ_0 is equal to $\rho + \phi'(0)$ and gradually reduces to $\rho + \phi'(T)$ at time T. Therefore, $\lambda_T \leqq \lambda_0$. Consumption varies as the above equation and experiences the discrete shift.

3. Data and Empirical Analysis

3.1. Data

In Public Opinion Survey on Household Financial Assets and Liabilities, we can use the annual cross section data in Japan. We interpret the financial asset into saving. In this data, we should care that saving is a financial asset and does not include real assets like land, houses. One of the dependent variables is answer to how long you consider as the life planning period in your future. As independent variables, we use answers to (i) whether saving rate to the current income increased or not and why, (ii) what are saving motives. These answers are converted into dummy variables

3.2. Estimation

In an empirical analysis, there are 2 regimes; case 1 of consumption planning and case 2 of no consumption planning. Under these regimes, households accumulate savings. These 2 regimes are represented in the following estimation equations.

(1) (Regime 1) $y_{1i} = \beta_1 ' X_{1i} + \varepsilon_{1i}$

(2) (Regime 2) $y_{2i} = \beta_2 ' X_{2i} + \varepsilon_{2i}$

X is an independent variable. y_{1i} and y_{2i} are savings of households. These 2 regimes are divided by the next criterion function.

(3) $C_i = \gamma ' Z_i + \delta (y_{1i} - y_{2i}) - \varepsilon_i$

Either one of y_{1i} and y_{2i} is observed from data. It depends on Ci≧0 or Ci<0. But, you should notice that the criterion function includes y_{1i}-y_{2i}. To estimate δ which represents saving changes to consumption planning, we need y_{1i} and y_{2i} for all the households. At first, we substitute (3) into (1) and (2), we get the following estimation equation.

(4) $C_i = \gamma ' Z_i + \delta (\beta_1 ' X_{1i} - \beta_2 ' X_{2i}) + \delta (\varepsilon_{1i} - \varepsilon_{2i}) - \varepsilon_i$

This is rewritten as;

(5) $C_i = \gamma^* ' Z^*{}_i - \varepsilon_i$

For 2SLS, we define as follows;

(6) Ii=1 if C>0, Ii=0 otherwise

Using this definition, we estimate γ*' by Tobit. Next, to estimate β_1 and β_2, we estimate the next equation.

(7) $E(u_{2i} \mid u_i \geq \gamma ' Z_i) = E(\sigma_{2u} \mid u_i \geq \gamma ' Z_i) = \sigma \dfrac{\phi(\gamma ' Z_i)}{1 - \Phi(\gamma ' Z_i)}$

where $W_{1i} = \dfrac{\phi(\gamma ' Z_i)}{\Phi(\gamma ' Z_i)}$、 $W_{2i} = \dfrac{\phi(\gamma ' Z_i)}{1 - \Phi(\gamma ' Z_i)}$.

From (1), (2), using the result of (7), we rewrite them as follows. We consider households that have no saving and we do not take a logarithm of saving in the estimation.

(8) $y_{1i} = \beta_1' X_{1i} - \sigma_{1u} W_{1i} + u_{1i}$

(9) $y_{2i} = \beta_2' X_{2i} + \sigma_{2u} W_{2i} + u_{2i}$

Estimating these equations, we get the computed value for every observation.

(10) $\hat{y}_{1i} = \hat{\beta}_1' X_{1i}, \hat{y}_{2i} = \hat{\beta}_2' X_{2i}$

Using them, we estimate (3) again and get δ. This is the value we need. Judging whether this value is significant or not can test whether commitment, which is equal to the life planning period, increases saving or not. The estimation result is in the next section.

3.2.3. Result

We use Tobit considering that the time span of each household for life planning is different among households, since, data shows that the shortest period is "1 or 2 years" and the largest period is "more than 20 years."

From the final results of table 1, δ (coefficient of Q3AC) is significant and the life planning period means important. In table 1, in saving objectives, "For education of children," "For buying a house (including land) or extension or reconstruction of house," "For a life of old age," "For travel, leisure" and "For taxes" are significant and particularly "For a life of old age" has the largest coefficient. These are intuitively right motives from the result of LCH/PIH hypothesis. A child is a kind of durable goods and "For education of children" confirms that. The result shows that saving motives are themselves important as deciding the life planning period.

In table 3, debt (Q12X) is not significant. Households are more myopic when households get older and that existence of owning houses (Q16) has a positive effect. The significance of housing is a kind of commitment technology since it is not a liquid asset. The household income is significant. This is because other variables have common effects on the dependent variable as household income. The number of household is also negative and significant. That is intuitive result that the probability of temptation of current consumption increases as the number of people in household increases.

Last, the theory predicts that it takes a long time to have an effect of thrift on saving (Barro(1999)). Since the difference of saving is not always significant in the younger generation, we may estimate by cohort. Actually, in Public Opinion Survey on Household Financial Assets and Liabilities(2004), the cohort distribution is as follows;

Age of head of household	20's	30's	40's	50's	60's	60～64	65～69	More than 70
Share	3.6	13.1	20.6	28.4	21.5	13.1	8.5	12.8

Clearly from the table, the share of younger generation is small. It means that the difference of saving tend to be significant in estimation and helps to support the theory.

Appendix Data

Question: What is your purpose for saving? (you can choose up to 3 choices)

Variable	Dummy	Choices
Q901	1 or 0	For diseases or untimely disasters
Q902	1 or 0	For education of children
Q903	1 or 0	For marriage of children
Q904	1 or 0	For buying a house (including land) or extension or reconstruction of house
Q905	1 or 0	For a life of old age
Q906	1 or 0	For durable goods (cars, furniture, home electronic appliances)
Q907	1 or 0	For travel, leisure
Q908	1 or 0	For taxes
Q909	1 or 0	For a bequest
Q910	1 or 0	For a peace of mind (no motive)
Q911	1 or 0	Others

Other questions used for independent variables in estimation are "In your household, does your current saving increase or decrease compared to one in the last year? (Choose one), (a) What is the reason of increase? (You can choose any number of them.), (b) What is the reason of decrease? (You can choose any number of them.)," "Household attributes." They are used for TSLS and not used in final estimate of the criterion function.

(References)

1. Barro, Robert, "Laibson meets Ramsey in the Neoclassical Growth Model," Quarterly Journal of Economics, vol.114, pp.1125-1152, 1999.

2. Harris, Chirstpher, David Laibson, "Hyperbolic Discounting and Consumption," Advances in Economics and Econometrics Theory and Applications, Eighth World Congress, volume 1, Ed: Mathias Dewatrippont, Lars Peter Hansen, and Stephen J.Turnovsky, Econometric Society Monographs No.35, pp.258-297, 2003.
3. Lee, Lung-Fei, G.S. Maddala and R.P. Trost, "Asymptotic Covariance Matrices of Two-Stage Probit and Two-Stage Tobit Methods for Simultaneous Equations Models with Selectivity," Econometrica, Vol.48, No.2, pp.491-504, 1980.
4. Maddala, G.S., Limited Dependent and Qualitative Variables in Econometrics, Econometric Society Monographs No.3, Cambridge University Press, 1983.
5. Phelps, E.S., R.A.Pollak, "On Second-Best National Saving and Game-Equilibrium Growth," Review of Economic Studies, vol.35, No.2, pp.185-199, 1968.
6. Strotz, R.H., "Myopia and Inconsistency in Dynamic Utility Maximization," Review of Economic Studies, vol.23, No.3, pp.165-180, 1956.
7. Willis, Robert J., Sherwin Rosen, "Education and Self-Selection," Journal of Political Economy, vol.87, No.5, Part 2: Education and Income Distribution, pp.7-36, 1979.

(Table 1)

Dependent Variable: Life planning period			
Sample: 1 4520	Included observations: 4520		
Left censoring (value) at zero			
	Coefficient	Std. Error	Prob.
debt	-1.13	0.70	0.105
Q3AC	0.01	0.00	0.002
Q901	1.01	0.69	0.142
Q902	2.91	0.84	0.001
Q903	2.21	1.17	0.059
Q904	2.80	0.89	0.002
Q905	6.48	0.78	0.000
Q906	1.60	1.07	0.135
Q907	3.07	1.02	0.003
Q908	4.63	1.66	0.005
Q909	3.83	1.98	0.053
Q910	-1.40	0.80	0.078
Q911	1.18	2.08	0.568
Num. of people in household	-0.99	0.24	0.000
Age	-1.64	0.26	0.000
Job	-0.56	0.17	0.001
Annual total income	0.17	0.20	0.411
Dstrict	-0.55	0.13	0.000
City scale	-0.35	0.22	0.115
Q16	3.99	0.82	0.000
Error Distribution			
SCALE	17.25	0.37	0.000
Log likelihood	-7,574.6	Hannan-Quinn crite	3.371405
Avg. log likelihood	-1.676		
Left censored obs	3,103.000	Right censored obs	0
Uncensored obs	1,417.000	Total obs	4520