How much information can we get?

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1. Introduction

Assuming that real return rate is equal to discount rates, household consumption, which follows PIH, is changeable by prediction error between expectation of period t and its of t-1. For example, when we change our expectation in every 3-month, we can get more information about the next period's income fluctuation than 10 years after income during the 3-month. In this paper, I will investigate how much information we get.

Our common method to get predicted income is time series analysis, which is represented by AR model. In this model, even in AR(1) model (though non-stationary), we can explain more than 98% of fluctuation of next period's income by present income and more than 90% of income fluctuation of 6-year later. In contrast to this result, we cannot predict our income so well. This paper tries to explain the difference between ordinary model's prediction and our intuition.

Campbell (1987) showed that saving movements explain future income changes. This analysis is based on the idea that consumption function is defined by predictable future income. Kiley (1998) used this insight to show that consumption movements predict changes in future tax rates. In this paper, I will examine the power of consumption movement to predict income. To compare the length of time difference, we use two types of consumption data, 3-month prior consumption and 1-year prior consumption.

2. Consumption Function

Consider the standard intertemporal optimization problem. A consumption decision is assumed to follow from the maximization of the expected lifetime value of utility from consumption subject to an intertemporal budget constraint that reflects the intertemporal allocation possibilities available. Assuming that lifetime utility displays additive separability, the maximization problem can be written as follows:

$$max \quad U = E_t \sum_{i=0}^{T-t} (1+d)^{-i} u \ (c_{t+i}) \mid \tag{1}$$

$$s.t. \quad a_{t+i+1} = (1+r)(a_{t+i} + y_{t+i} - c_{t+i}) \tag{2}$$

where u is utility function, c_t is consumption , y_t is labor income, a_t is non-human asset in period t. d is the time discount rate and r is the rate of return.

First order condition for this problem is

$$\frac{1+r}{1+d} \left| E_t \left[u'(c_{t+1}) \right] = u'(c_t) \right. \tag{3}$$

where u' is marginal utility with consumption. Assuming utility function is constant relative risk aversion ($(c^{1-\sigma}-1)/1-\sigma$), optimal consumption path is

$$\frac{1+r}{1+d} E_t \left[\frac{c_{t+1}}{c_t} \right]^{-\sigma} = 1 \qquad (\sigma > 0) \tag{4}$$

where σ is relative risk aversion and is the reciprocal of the intertemporal substitution of elasticity.

Summing the single period constraints over time yields:

$$\sum_{i=0}^{\infty}(1+r)^{-i} E_t[c_{t+i}] = (1+r)a_t + \sum_{i=0}^{\infty}(1+r)^{-i} E_t[y_{t+i}] \tag{5}$$

$E_t[c_{t+i}]$ are determined by equation(4). Then consumption function is:

$$c_t = \kappa[a_t + \sum_{i=0}(1+r)^{-i} y_{t+i}] \tag{6}$$

where $\kappa = \kappa$ (r,d σ)

Assuming that discount rate is equal to the rate of return,

$$\sum_{i=0}^{\infty}(1+r)^{-i} c_t = (1+r)a_t + \sum_{i=0}^{\infty}(1+r)^{-i} E[y_{t+i}] \tag{7}$$

Using equation (7), we get the change of consumption are[i]:

$$\Delta c_t = (\frac{r}{1+r})\sum_{i=0}^{\infty}(1+r)^{-i}[E_t(y_{t+i}) - E_{t-1}(y_{t+i})] \tag{8}$$

Therefore, the changes of consumption depend on unpredictable income shocks and relating factors that affect the prediction of future income.

Simplifying the above equation, we can get well known relationship,

$$c_t = c_{t-1} + u_t \tag{9}$$

where $u_t = (\frac{r}{1+r})\sum_{i=0}^{\infty}(1+r)^{-i}[E_t(y_{t+i}) - E_{t-1}(y_{t+i})]$

Generalizing the equation(9) (assuming non-equality between rate of return and discount rate),

$$c_t = a + bc_{t-1} + u_t' \tag{10}$$

Equation (10) is our basic model estimation to be estimated.

To get unpredictable income shock, we use a multiple regression model as following[ii].

$$c_t = b_0 + b_1 y_t + b_2 c_{t-1} + u^b{}_t \tag{11}$$

In multiple regression, the coefficients show the partial effects that is after eliminating the effect of the other variables. Thus b1 in the equation (11) is to be interpreted as measuring the effect of present income to consumption after eliminating the effect of prior consumption, a function of predictable income, on present income. Therefore b1 measures the unpredictable shock of present income effect on present consumption.

To normalize, we use another regression as:

$$c_t = b_0^y + b_1^y y_t + u^y{}_t \qquad (12)$$

Using b_1^y, we can get the ratio of unpredictable income to total income shock.

$$ID = \frac{b_1}{b_1^y} \qquad (13)$$

Moreover, we enumerate equation (13) with different future income.

$$c_t = d_{0i} + d_{1i} y_{t+i} + d_{2i}\, c_{t-1} \qquad (\text{ j=1,}\cdots\text{,25 }) \qquad (14)$$

3. Evidence

The data of non-durable consumption expenditure, which is from "Annual Report on National Accounts" is not seasonally adjusted. We use web Decomp[iii] to adjust the series and implicit deflator to get real income. Each data are divided average population in the periods. Sample periods are from 1970:2 to 1999:1.

【Figure1】

Figure 1 shows ID defined in equation (13). From period t to period t+7, unpredictable income shocks are significant at 5% level, and are not significant for the remainder periods. And the ratio of unpredictable income shock to total income shock decreases in far future. This result suggests that unpredictable income shock composes stationary factor in 3-month prediction error.

To compare the quantity of information, we use consumption in period t-4 as a prior consumption data.

$$c_t = d_{0i} + d_{1i} y_{t+i} + d_{2i}\, c_{t-4} \qquad (\text{ j=1,}\cdots\text{,25 }) \qquad (15)$$

Figure 2 shows the results.

【Figure 2】

In this case, the coefficients decrease in far future. But all coefficients are significant at 5% level. It means the prediction error in a year includes permanent shock. And the degree is about 2 times of 3-month case.

What factor do we use and how much use.

As Killey (1998) said, consumption movements predict all factors constructing our income expectation. In this section, I investigate which variable construct our income expectation. We use some macro variables, which are GDP, government expenditure, investment, and export. All are per capita real value to eliminate non-stationary effect of inflation and the growth of population.

Figure 3-a shows the result in GDE.

【Figure 3-a】

In this case, the difference between 3-month information and 1-year information are very similar with the model, which uses non-durable data.

【Figure 3-b】

Figure 3-b shows the results in government expenditure. In both 3-month and 1-year model, all unpredictable shocks are insignificant at 5% level. This suggests that we cannot get information of government expenditure when we construct our expectation.

【Figure 3-c】

Figure 3-c shows the results in INVESTMENT. In 3-month model, from period t to period t+17, unpredictable shocks are significant at 5% level, and are not significant for the remainder periods. And in 1-year model, from period t to period t+19, unpredictable shocks are significant at 5% level and are not significant for the remainder periods.

【Figure 3-d】

Figure 3-d shows the results in EXPORT. In 3-month model, from period t+2 to period t+11, unpredictable shocks are significant at 5% level, and are not significant for the remainder periods. And in 1-year model, all periods are significant at 5% level.

Comparing with USA

In this section, to compare the consumption behavior between USA and Japan, I estimated the model using similar data in USA with the above section. We use seasonally adjusted total personal consumption expenditures and GDP from NIPA. Both are per capita real value. Sample periods are from 1947:1 to 2000:1.

【Figure 4】

Figure 4 shows ID defined in equation (13). In 3-month model, from period t to period t+20, unpredictable income shocks are significant at 5% level, and are not significant for the remainder periods. And the ratio of unpredictable income shock to total income shock decrease in far future. And in 1-year model, all periods are significant at 5% level. This results suggest that we can get more information for 1-year than for 3-month. And in 3-month we cannot get new information about 5 years after GDP but can get in 1-year.

4. Concluding

In this paper, we investigate the power of consumption movement to predict income. To compare the length of time difference, we use two types of consumption data, 3-month prior consumption and 1-year prior consumption.

Our result suggests that unpredictable income shock clearly include permanent income shock for 1-year information but does not for 3-month information. And the degree of taken information for 1-year is about twice of 3-month's case.

Moreover, we predict about 65% of fluctuation of next period's (3-month) income. This result is largely different from AR model's one.

References

Campbell, J. Y. (1987), ”Does Saving Anticipate Declining Labor Income? An Alternative Test of the Permanent Income Hypothesis,” Econometrica, Vol.55, No.6, pp.1249-1273.

Cochrane,J.H.(1988),"How Big Is the Random Walk in GNP?", Journal of Political Economy, vol.96,pp.893-920.

Cochrane,J.H.(1994),"Permanent and Transitory Components of GNP,” Quarterly Journal of Economics, Vol.109, pp.241-65.

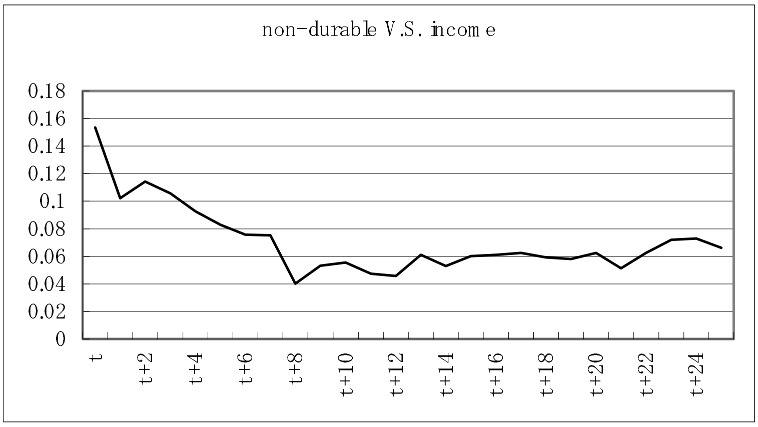
Deaton, A. (1992), “ Understanding Consumption”, Oxford Press

Elwood,S.K.(1997), “Estimating Permanent and Transitory Components of GNP Using Consumption Information,” Southern Economic Journal, vol.64, No.2, pp.567-575.

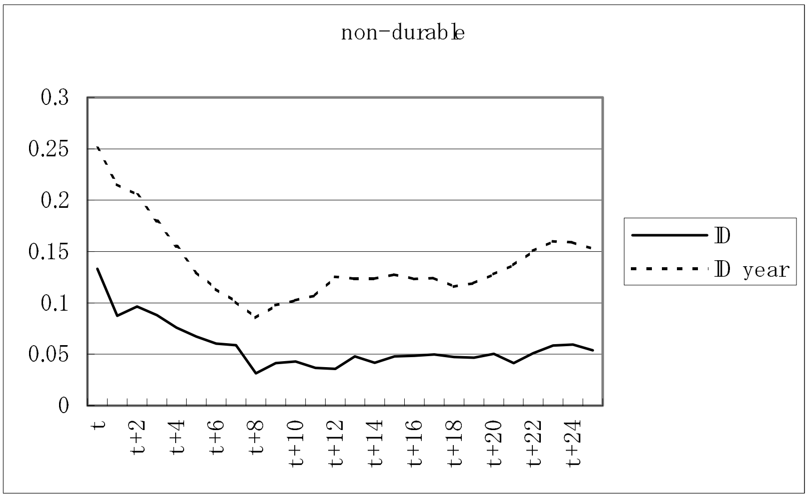
Kiley, M. T. (1998), “Predicting Tax Rate Changes: Insights from the Permanent Income Hypothesis,” Journal of Macroeconomics, Vol.20, No.1, pp.153-167.

Pistoresi,B.(1997), “Using a VECM to characterize the relative importance of permanent and transitory components of U.S. total disposable income and total consumption,” Research in Economics, Vol.51, pp.131-155.

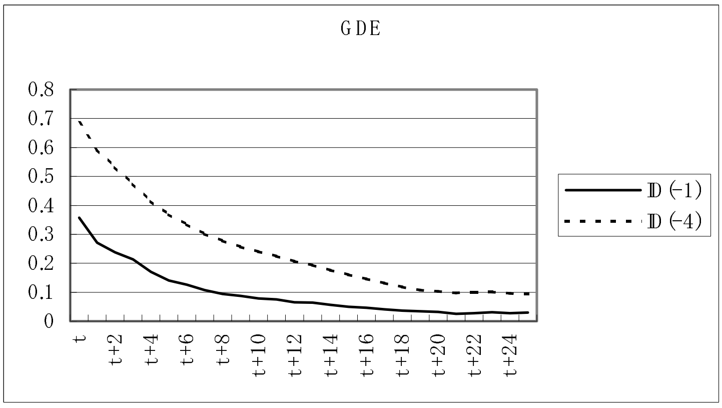
【figure1】



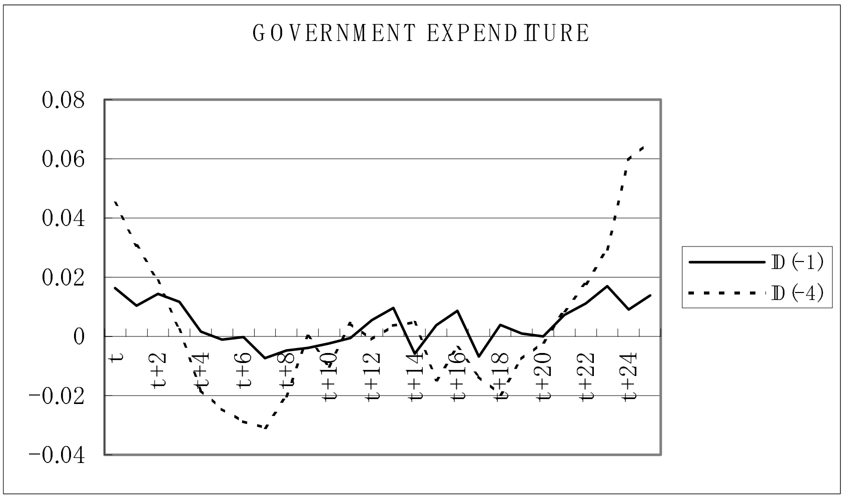
【figure 2】



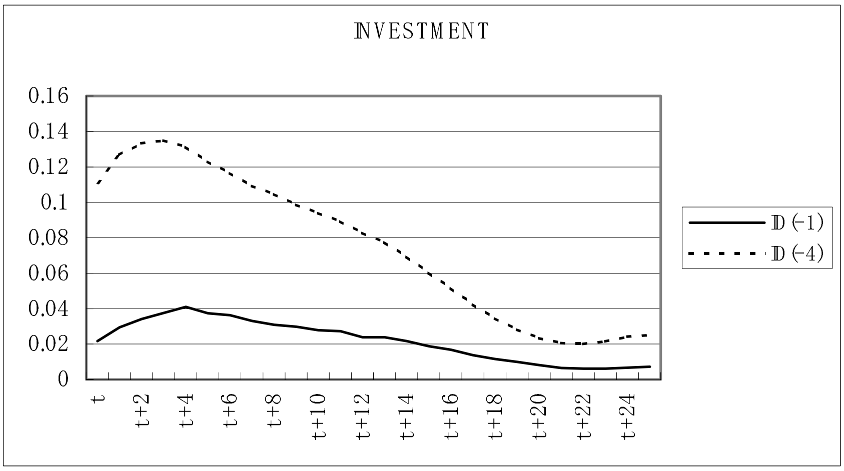
【Figure 3-a】



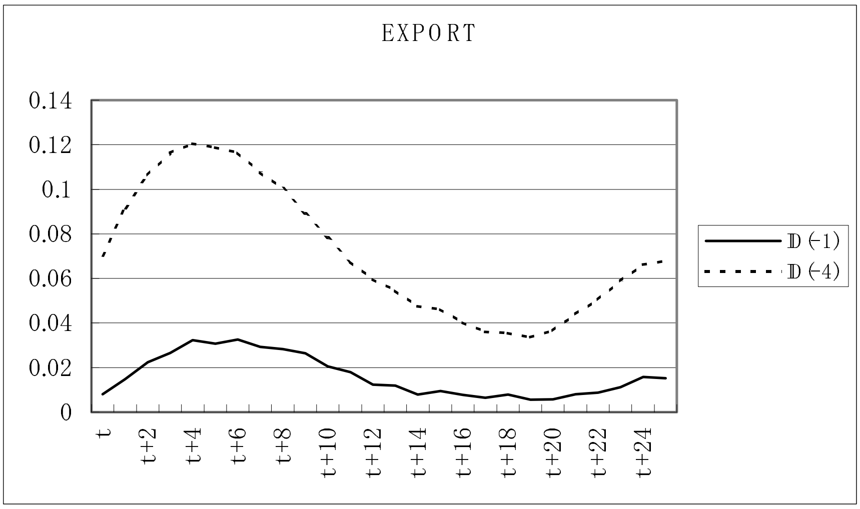
【Figure 3-b】



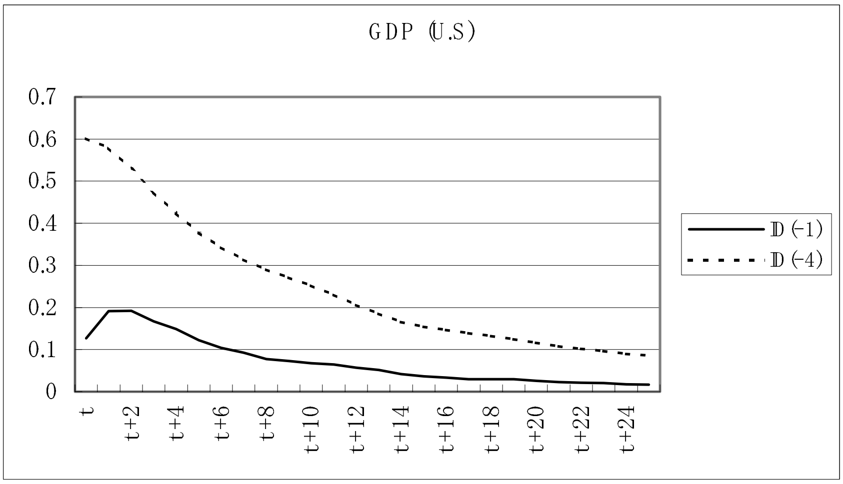
【Figure 3-c】



【Figure 3-d】



【Figure 4】



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i See Deaton (1992).

ii However, it is likely to be multicollinearity in our estimation. Therefore we also estimate using redefined variables which are divided by prior consumption. And confirming if there are multicollinearity or not. This regression is unbiased. But it dose not have efficiency. For all estimations, we do not have apparently different coefficients with this estimation.

$$cc_t = d_{0i} cs_t + d_{1i} cy_{t+i} + d_{2i}$$

where

$$cc_t = c_t / c_{t-1}$$

$$cs_t = 1 / c_{t-1}$$
$$cy_t = y_t / c_{t-1}$$

[iii] This is provided at http://www.ism.ac.jp/~sato/