CONSUMPTION BEHAVIOR, ASSET RETURNS, AND THE RISK AVERSION: EVIDENCE FROM JAPANESE HOUSEHOLD SURVEY*,†

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Abstract

We investigate the consumption based asset pricing model for Japan using monthly Family Income and Expenditure Survey income-decile data. We expect that a risk aversion coefficient for each income cohort is different. We focus on the consumption behavior of higher income-decile groups because they hold more stock. We find that the risk aversion coefficients for all deciles vary as originally expected. We also find the risk aversion coefficients for higher income level households are much smaller than that for the representative consumer. We find that Euler conditions are overall rejected and conclude that the equity premium puzzle exists in Japan.

JEL Classification: E32; G11; G12

Keywords: Euler Equations; Family Income and Expenditure Survey; Decile Consumption Data; Asset Returns

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1. Introduction

Mehra and Prescott (1985) pointed out that the historical risk premium in the U.S. during the last century was too high to be consistent with a standard equilibrium asset pricing model. Since then, many researchers have tried to solve the equity premium puzzle. In a typical model it is assumed that there is a representative agent and that the markets are complete.

There are several theoretical solutions for this puzzle. First, as Mehra and Prescott (1985) inferred, the assumption of complete markets is too stringent. Heaton and Lucas (1995) and Constantinides and Duffie (1996) tried to incorporate the effect of incomplete markets into asset prices. Brav et al. (2002) tested Euler equations using the model in Constantinides and Duffie (1996) and found that the existence of uninsurable labor income risk resolves the equity premium puzzle.[1] Second, the assumption of a representative agent is too restrictive. For example, Mankiw and Zeldes (1991) investigated the difference in consumption behavior between stock-holders and non stock-holders using Consumer Expenditure Survey (CEX) data.

In this paper, we relax the assumptions of both the existence of a representative agent and the complete markets discussed above. For relaxation of the first assumption, we compare results estimated from aggregate consumption data with those estimated from income-decile consumption data. For relaxation of the second assumption, we again compare results from a standard Euler equation which holds under the complete markets with those from the Euler equation modeled by Constantinides and Duffie (1996). Since we have income-decile ranked consumption data for consumers, we allow for the heterogeneity of investors as well as for non stock-holding of less wealthy investor groups. The estimation and the test of an Euler equation that explicitly incorporate both the

[1] For a thorough survey on equity premium issue, see Kocherlakota (1996), for instance. For a survey on Japanese empirical results Iwaisako (2001) is most extensive.

heterogeneity of investors and the existence of incomplete markets have never been undertaken in the field, using Japanese income-decile consumption survey data.

Hamori (1992) is one of the first studies which tested Euler conditions for Japanese asset returns data. He claims that the equity premium puzzle does not exist in Japan and accepts the null hypothesis with the standard Euler condition tests. On the contrary, Roy (1995) rejects Euler equations using several different set of instruments, and Nakano and Saito (1998) also rejected Euler equations with a different utility function. All of these three studies above, however, employ aggregate consumption data. As far as the authors know, this paper is the first extensive study that considers the heterogeneity of Japanese investors by utilizing income-decile consumption survey data.

The Japanese income-decile consumption data has never been used in any empirical research in finance. There are a few papers that used the income-quintile consumption data. Ogawa (1987), for example, used older annual income-quintile consumption data between 1969 and 1984, which were surveyed during that time every five year only and tested the Consumption CAPM. Shintani (1996) employed only quarterly income-quintile consumption data to investigate excess consumption smoothness puzzle in Japan. Accordingly, one of the contributions of our paper is to use the decile consumption data which was recently released and test Euler conditions with considerations discussed above.

Section two discusses our estimation and testing method. Section three explains the basic sample statistics of our data. Section four reports our main empirical results and Section five concludes the paper.

2. Estimation and Test of Euler Equations

2.1. Euler Equations at the Aggregate and the Decile Levels

Our estimation and testing strategy is as follows. We estimate and test Euler equations by GMM for both monthly raw and excess asset returns. Our data is from Family Income and Expenditure Survey income-decile monthly consumption data, and the detail of our data is explained in Appendix A. We do not have individual level consumption data on stockholders and non-holders like the ones in Mankiw and Zeldes (1991), but we observe that the higher income group tends to invest more into risky assets (see Fig. 1). The income-decile cohort is indexed by i for i = 0, …, 10. For example, the subscript 0 denotes the aggregate consumption, the subscript 1 denotes the consumption of the lowest income cohort (rank1), the subscript 2 denotes the consumption of the second lowest income cohort (rank2), and so forth. For each cohort i, $c_{i,t}$ is the (monthly) real per capita seasonally adjusted consumption level (see Appendix B for consumption data construction), $R_{s,t}$ is the real stock index return, $R_{b,t}$ is the real bond index return, $R_{f,t}$ is the real risk free rate. Also, α_i is the coefficient of the relative risk aversion and, β_i is the coefficient of a time preference parameter for cohort i. Finally, Z_t is a set of the instruments such as a constant, lagged stock and bond returns, lagged consumption series, and lagged labor income growth.[2]

Suppose each investor has a standard time-additive power utility function. Under the assumption of the existence of a representative agent, we obtain the following Euler conditions as the first order condition for the representative agent (i=0) in each period t. We only use Euler equations in an unconditional form. We use index k to denote s for stock, b for bonds, and f for risk free asset. Our Euler equation in a raw return form for a representative agent (i=0) is given by the following equation for each asset:

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[2] The labor income variable is used because this variable is strongly related to the cross-sectional stock returns for Japan (Jagannathan et al., 1998). The theoretical justification that the labor income influences asset returns is given in Basak (1999) and Viceira (1999). Also labor-income shock cannot be insured in the incomplete market models (Aiyagari and Gertler, 1991).

$$\mathrm{E}\left[\beta_0\left(\frac{c_{0,t+1}}{c_{0,t}}\right)^{-\alpha_0} R_{k,t+1}\middle| Z_t\right]=1, \quad \text{for } \forall\, t \text{ and } k=s,b,f, \tag{1}$$

and, in an excess return form, it is

$$\mathrm{E}\left[\left(\frac{c_{0,t+1}}{c_{0,t}}\right)^{-\alpha_0}\left(R_{k,t+1}-R_{f,t+1}\right)\middle| Z_t\right]=0, \quad \text{for } \forall\, t \text{ and } k=s,b. \tag{2}$$

In our paper, we also employ the following Euler equation (3) for heterogeneous cohorts, which should hold under less stringent conditions than those for equation (1):

$$\mathrm{E}\left[\beta_i\left(\frac{c_{0,t+1}}{c_{0,t}}\right)^{-\alpha_i} R_{k,t+1}\middle| Z_t\right]=1, \quad \text{for } \forall\, t, i=1,\ldots,10, \text{ and } k=s,b,f. \tag{3}$$

Accordingly, we also employ the following Euler equation (4) for each cohort which once again holds for less stringent assumptions than those for equation (2):

$$\mathrm{E}\left[\left(\frac{c_{i,t+1}}{c_{i,t}}\right)^{-\alpha_i}\left(R_{k,t+1}-R_{f,t+1}\right)\middle| Z_t\right]=0, \quad \text{for } \forall\, t, i=1,\ldots,10, \text{ and } k=s,b. \tag{4}$$

2.2. Euler Equation under Incomplete Markets

So far, we have discussed the heterogeneity of investors in terms of their income levels. If we furthermore introduce the incompleteness in the capital market, we obtain the following Euler equation (5) derived by Constantinides and Duffie (1996) for each individual. In this equation (5), y_{t+1}^2 is the variance of a cross-section of log real consumption growth rates for each individual investor at t+1.

$$\mathrm{E}\left[\beta\left(\frac{c_{0,t+1}}{c_{0,t}}\right)^{-\alpha} R_{k,t+1}\exp\left\{\frac{\alpha(\alpha+1)}{2} y_{t+1}^2\right\}\middle| Z_t\right]=1, \quad \text{for } \forall t \text{ and } k=s,b,f, \tag{5}$$

where

$$y_{t+1}^2 = \mathrm{Var}\left(\ln\left\{ \frac{\delta_{l,t+1} / c_{0,t+1}}{\delta_{l,t} / c_{0,t}} \right\} \right). \tag{6}$$

Similarly, the excess return form is given as follows.

$$\mathrm{E}\left[\left(\frac{c_{0,t+1}}{c_{0,t}} \right)^{-\alpha} \left(R_{k,t+1} - R_{f,t+1} \right) \exp\left\{ \frac{\alpha(\alpha+1)}{2} y_{t+1}^2 \right\} \middle| Z_t \right] = 0, \quad \text{for } \forall t \text{ and } k = s, b. \tag{7}$$

The symbol in equation (6), $\delta_{l,t}$, l=1, ..., L, in which L is the total number of all the individuals in the economy denotes individual level consumption data.

However, because the consumption data $\delta_{l,t}$ at individual level is not available in our data, we cannot estimate directly (6) from our data.[3] Thus, we impose additional assumptions on the cross-sectional property of individual consumption data and estimate Euler equations similar to (5) that hold at a decile-cohort level. These necessary assumptions are as follows: 1) mean consumption growth rates for all individuals within the same cohort are the same, 2) consumption growth rates for all different individuals within the same cohort are uncorrelated, and 3) there are equal numbers of individuals within each cohort and these numbers are invariant over time.[4] In this case the same Euler equation (5) and (7) hold for our decile data. However, in these Euler equations, we need to estimate the correct variance by multiplying the variance estimated from decile data by the number of households in each decile and correct for the unobservable individual level data, wherein n is equal to L/10 and 10 is the number of cohorts in our data. [5]

$$y_{t+1}^2 = n \ \mathrm{Var}\left(\ln\left\{ \frac{c_{i,t+1} / c_{0,t+1}}{c_{i,t} / c_{0,t}} \right\} \right). \tag{8}$$

[3] The author appreciates an anonymous referee for pointing out the necessity to make this correction.
[4] The sampling design adopted in the Family Income and Expenditure Survey indeed satisfies this assumption 3.
[5] The derivations are available from the authors upon request.

3. Data Descriptions

3.1. The Consumption and Asset Return Data

Our sample period is from January 1986 to December 1998 and we have 167 monthly observations. As for consumption, we use eleven series: ten series for income-decile data and one series for the aggregate data. We construct seasonally-adjusted, real per-capita consumption growth rates. As for the asset returns, we use three series. The overnight call rate is taken as a proxy for the risk free rate. The bond index return is computed from the holding returns of long-term government bonds. The value-weighted return is based on the index returns of all listed stocks in the first section of the Tokyo Stock Exchange adjusted for dividend yield. All three series are from Ibbotson Associates Japan, Inc. In order to deflate nominal asset return series, we use aggregate CPI index as reported by Ibbotson and Associates, because the equilibrium asset demand is an aggregated measure. The labor income data are from the monthly Japanese Ministry of Health, Labour, and Welfare survey and the particular series we have chosen is the "C" series in which the total payments per worker for regular wage and overtime wages are included.

3.2. Sample Statistics

We report the sample statistics for consumption growth rates and asset returns in Table 1 It shows the summary statistics for nominal consumption series. From Panel A of Table 1 we find that the aggregate consumption growth rate is 1.209 per cent per month. The consumption growth rate for the lowest income group is 1.033 per cent, and that for the highest is 1.692 per cent. The standard deviation is also higher for the higher income groups. From Panel B of Table 1, we notice that the magnitude of autocorrelations is all negative for lag one and they are significant. Besides, the Box-Pierce Q statistics for lags 6 and 12 are significant. The ratios of the yen amount of the stock investment over the yen amount of net worth are depicted in Fig. 1 for years 1986, 1991, and 1996. It shows that the higher income groups own much larger fraction of stock in their portfolio than lower income deciles.

After applying the above mentioned seasonal adjustments and deflating, the results are shown in Table 2. In Table 2, we find that the aggregate consumption growth rate is 0.110 per cent per month. The consumption growth rate for the lowest income group is 0.191 per cent, and that for the highest is 0.242 per cent. The standard deviation is 1.713 per cent for the aggregate consumption growth rate and it is 4.993 per cent for the consumption growth rate for highest income quintile. This is almost three times as large as that from the aggregate consumption growth rate. We conjecture that the risk aversion coefficient estimated from Euler equations based on the decile consumption should be much smaller than that estimated from the one based on the aggregate consumption. Our empirical observations in the next section verify this conjecture.

Moreover, the magnitude of autocorrelations becomes much smaller in this case, even though they are still significant at lag one and the Box-Pierce statistics are still significant. Ferson and Harvey (1992) report a similar result for US data, but they employ quarterly consumption data at the aggregate level which are not seasonally adjusted. Accordingly, we cannot directly compare our result with theirs.

Table 3 presents similar sample statistics for real returns for stock, bonds, and risk-free assets. Note that our sample period is from February 1986 to December 1998. This period covers the pre-bubble era, the bubble-era and the post-bubble era in Japan. The real cumulative returns are depicted in Fig. 2 and we notice that stock returns are much lower than bond returns for the total period. The average real stock return is 0.185 per cent per month and smaller than the bond return of 0.480 per cent, and it is almost equal to the risk free rate of 0.178 per cent. From Panel B of the same table we note that the magnitude of autocorrelations of all real return series is positive at lag one but they are not significantly different from zero for stock and bond returns. So are the *Q* statistics.

Table 4 shows correlation coefficients for real asset returns and real seasonally adjusted consumption growth rates. Remarkable is the fact that we find low correlations of consumption growth rates among different income decile groups. For instance, the correlation between the 10th income quintile and the 9th income quintile is only 2 per cent and that between the 10th quintile and the 8th quintile is also only 2 per cent. The largest correlation is only 27 per cent and it is between the 10th quintile and the 7th quintile. As correlations among the income cohorts are quite small, it is not surprising that the aggregate consumption growth rate is much less volatile than that of each income quintile.

If we look at the correlation between stock raw returns and consumption growth rates, the highest correlation is 13 per cent and it is with the 10th income quintile. The highest correlation between stock excess return and consumption growth rates is 14 per cent and it is also with the 10th income quintile. These results strongly suggest that the equity premium in Japan depends on the correlation between the stock excess returns and the wealthiest individuals who own major fraction of the stocks. This goes in line with the discussion by Ait-Sahaila et al. (2004).[6]

This rationalizes the motivation of our study to distinguishing the consumption and investment behavior of different income groups. Since previous studies on Japanese capital markets and consumers' asset choice behavior have used only this aggregate consumption series, we point out the possibility that there might have been a lot of important information lost in the empirical results of the previous studies.[7]

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[6] The authors appreciate an anonymous referee for pointing this out.

[7] In an earlier version of the paper we used quintile data, and with our cross-examining the decile data and the quintile data, the result seems is robust. We thank an anonymous referee for showing concerns on this point.

4. Empirical Result

4.1. Euler Equation Estimation from the Entire Period

Table 5 reports the estimation results of Euler equations (2) and (4). Although we tested Euler equations with many different combinations of the instruments, we only report results from a typical case.[8]

The instruments are a constant, one-lagged excess bond return, one-lagged excess stork return, one-lagged consumption and two-lagged labor income. The risk aversion coefficient from the aggregate consumption series is quite high at 14.474, while those from the highest, second highest and the third highest income groups are 0.875, 2.335 and 1.978, respectively. For the income groups 3 and 4, they are very high at 19.235 and 7.541. Unfortunately, the coefficients from the 5th and the 6th income groups are negative. As for the estimation and test of the incomplete market model of Constantinides and Duffie (1996), the coefficient is also negative at -0.495.[9] We finally note that Euler conditions are rejected for all but one case and the evidence strongly supports the existence of equity premium puzzle.

Our observation is consistent and robust among various excess return tests. The result for the aggregate data is in conformity with the previous studies with US data which pointed out an unusually high level of risk aversion coefficients and the model rejection. We have successfully demonstrated that the puzzle of unreasonable higher risk aversion coefficients is resolved by focusing on the consumption behavior of higher income groups.

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[8] The results based on other sets of instruments are available from the authors upon request.

[9] Brav et al. (2002) find the estimated relative risk aversion coefficients are quite unstable over three different cohorts sampled over three consecutive starting months. We estimated the coefficient by allowing for cross-variations of the different cohorts. We thank an anonymous referee for clarifying this point.

Table 6 reports results using the equation (1) and (3).[10] The instruments are a constant, one-lagged and two-lagged stock returns, one-lagged consumption, and two-lagged labor income. The standard errors are reported in parenthesis. We find that time preference parameters are uniformly 0.998 and are significant. The risk aversion coefficients are uniformly smaller than one and they are not significant.[11] As for the estimation and test of the incomplete market model of Constantinides and Duffie (1996), the coefficient of risk aversion is 0.007 and insignificant. Finally, the Euler equations from all income cohorts are rejected at 10% significance level.

Overall, these results refute the findings by Hamori (1992) who failed to reject Euler equations. Hamori (1992) tested an Euler equation similar to equation (1) using raw stock return and aggregate consumption series only. The observation period is between January 1980 and December 1988 and the instruments are a constant, one-period lagged consumption growth rates, and one period lagged asset returns. Although the sample period is different between Hamori (1992) and ours, the difference in the findings is clear. When we estimate two or more Euler equations at the same time with exactly the same set of instruments for the average household, the model is, for a large part, rejected, which is in par with our results in previous section. Thus, it seems the result of Hamori (1992) is due to the fact that a single equation Euler test is predominantly used.

The tendency we found is again confirmed when we construct partially aggregated data from higher income groups as shown in Table 7. Specifically, we construct the following three set of aggregate groups: 1) group one formed from rank 7, 8, 9 and 10, 2) group two formed from rank 8, 9 and 10 and 3) group 3 formed from rank 9 and 10. For instance, for group one, we follow the following procedure. First, we add the nominal

[10] See footnote 8.
[11] This seems to be a common observation obtained from estimating this type of nonlinear Euler equations. The authors thank George Constantinides for pointing this out.

non-durables of rank 7 to 10 deciles. Second, we add the nominal services of rank 7 to 10 deciles. Third, we deflate non-durables by the non-durables deflator and services by the services deflator. Finally, we add these two real consumption series and apply the X-11 seasonal adjustment method.

Table 7 reports results for the excess return Euler conditions test. The model is rejected. Not surprisingly, the magnitude of the risk aversion coefficients decreases almost uniformly, as the partially-aggregated income decile groups contain higher income consumer groups. This result is consistent with the low correlation among higher income deciles as previously shown in Table 2. Note the difference between this result and the result for the total aggregated group denoted as "aggregate." The radical differences of these risk aversion coefficients warn us not to use the aggregated data under the assumption of homogenous consumers in testing the equity premium puzzle, and the result strongly recommends that one should use the limited participation model. This result has never been found elsewhere and it justifies our use of disaggregated or partially aggregated consumption data.

4.2. Euler Equation Estimation from the Sub-Periods

Since the return for risky asset was low during our sampling period, we have also split the sample period into two sub-periods in order to investigate the difference of the result between the first sub-period and the second sub-period.[12] In the first sub-period, the stock market was booming and in the second, the tendency was the opposite. From an excess return Euler equation, the risk aversion coefficient from the aggregate consumption growth series estimated from the first period is high at 16.689, while that from the second period is also high at 9.460. The risk aversion coefficients from the consumption growth

[12] The detailed demonstration of the results is skipped by the recommendation of an anonymous referee and they are once again available upon request from the authors.

rate of rank 5 to rank 10 are much lower and they are between -2.617 and 3.248 from the first period and they are again much lower and they are between -4.670 and 5.220 from the second period. In the total sample period, we find that the risk aversion coefficient from the aggregate data is much higher than those from the higher income group. We also find similar tendency in each sub-period. Thus, our results are robust to the choice of the sample period as well.

For a raw return Euler equation, the time preference parameters from the first period are 0.997 and they are highly significant. Also those from the second period are between 0.998 and 0.999 and they are also highly significant. Risk aversion coefficients from the first period are all less than 0.1 and all of them are not statistically different from zero. Those from the second period are again less than 0.1 except for the 14.750 for the rank 5. The coefficient for rank 1, 3, 5, and 9 are significant. Once again, our results are robust with respect to the choice of a sample period.

5. Conclusions

In this paper we investigated the consumption based asset pricing model using Japanese household income decile consumption data from February 1986 through December 1998. This decile survey data has never been used previously and we add new evidence to the literature. Only a small percentage of Japanese households own common stock, and lower-income decile households invest more into the bank deposit, postal savings, the Japanese government bonds, and long-term bank notes. Hence, we expect to find systematically different risk aversion coefficients for each income cohort. From the excess return Euler equation tests, we find that it is indeed the case and that the risk aversion coefficients for higher income decile households are much smaller than those estimated from the aggregate consumption data. Throughout the test of our various forms of

Euler equation tests we find that the Euler equations are mostly rejected. We conclude that the equity premium puzzle exists for Japan.

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Appendix A: Description of the Japanese Household Survey

Our consumption data is based on the Family Income and Expenditure Survey, which is administered by the Minister of the Management and Coordination Agency and conducted at each prefecture level by the board of governors. We collected these data at the Statistical Bureau of the Minister of the Management and Coordination Agency, because these detailed items are not published in their monthly statistics book. The selected items are publicly reported both monthly and annually. It also forms the base for the Gross National Expenditure statistics and the Consumer Price Index. Workers' Households refer to households whose heads are employed as workers in enterprises or establishment, private or government, such as government offices, private companies, factories, schools, hospitals, shops, etc. The following households are, however, excluded as inappropriate households. (a) Households engaged in agriculture and cultivating 10 acres of land or more (in Hokkaido 30 acres or more), (b) Households engaged in forestry, (c) Households engaged in fishery, (d) One-person households, (e) Households which manage restaurants, hotels, boarding houses or dormitories, using their dwellings, (f) Households which serve meals to boarders even though not managing boarding houses as business, (g) Households with 4 or more living-in employees, (h) Households whose heads are absent for a long time, and (i) Foreigner households.

The survey uses a stratified random sampling. Approximately 8,000 households are selected. Each household is surveyed for six months and then is replaced by a new one. That is, every month one-sixth of the sample is replaced. However, this replacement is designed so that the continuity of the sample is kept. The replacement is conducted across unit areas defined within the same block area so that the continuity of the pseudo-panel type sampling will be kept. The older survey was based on quintile income group and the survey with new classification scheme composed of the decile income group was

Annual Income for Each Decile Group (unit: 10,000 yen)

	rank1	rank2	rank3	rank4	rank5	rank6	rank7	rank8	rank9	rank10
1987	244	337	397	448	503	561	630	720	842	1,163
1988	254	349	412	470	525	587	655	745	872	1,208
1989	264	366	431	491	548	610	680	768	905	1,239
1990	278	387	452	513	577	644	716	812	951	1,308
1991	288	404	475	541	605	679	758	850	1,003	1,402
1992	301	426	502	570	636	708	788	894	1,057	1,441
1993	314	442	518	586	656	727	812	913	1,071	1,477
1994	326	450	522	592	662	735	821	931	1,084	1,511
1995	316	444	518	591	665	741	828	939	1,094	1,524
1996	313	446	524	595	669	748	838	946	1,104	1,499
1997	313	450	532	603	678	756	844	954	1,113	1,552
1998	316	451	533	609	684	765	856	976	1,141	1,555

introduced from 1981. The monthly consumption data necessary for our analysis can go back only up to January 1986, from which time our analysis starts. Average values within each income group in the data are the arithmetic averages, and so is the aggregate consumption. Classification of the sample into decile income group is done every month based on the households' previous twelve-month income level and the equal number of sample point is allotted to each decile. Since only one-sixth of the sample changes every month after designating the sample points within the well-defined area, there exists time series continuity in this decile data survey to some extent, even though it is not a perfect panel data. The annual income for each decile group during the sample period is shown in the above table. There are more than 300 separate items to be recorded as consumption expense in the survey. These are decomposed into service consumption, non-durable, semi-durable, and durable. The semi-durable items include the consumption of sporting shoes, kettles, or TV games the data series. After carefully analyzing the time series of above four series, we decide to use only the service consumption and the non-durable consumption in our monthly consumption series to match against monthly stock returns. We thank Narayana Kocherlakota for discussing this observation.

Appendix B: The Seasonal Adjustment of Consumption Data

The original household-level consumption data is a nominal number and is not seasonally adjusted. In order to generate the real per-capita, seasonally adjusted decile consumption series from the original data, we take the following steps for each decile. First, we deflate both the nominal non-durable consumption series and the nominal service consumption series by the non-durable consumption deflator and the service consumption deflator, respectively. Second, we add real non-durable consumption series and real service consumption series. Third, we divide the consumption series obtained above by the number of the people in each decile. Finally, we seasonally adjust these final real per capita decile consumption series by X-11 using RATS. In our first version of the paper we used monthly dummy regression method to seasonally adjust the series. It can reduce the seasonal variations of the data better, but the results for Euler condition tests were not remarkably different. Hence, we use only the standard X-11 method. Bell and Hillmer (1984) discuss in detail how to seasonally adjust the mixed series. Based on what they advocate, we employ our method of seasonally adjusting our mixed series.

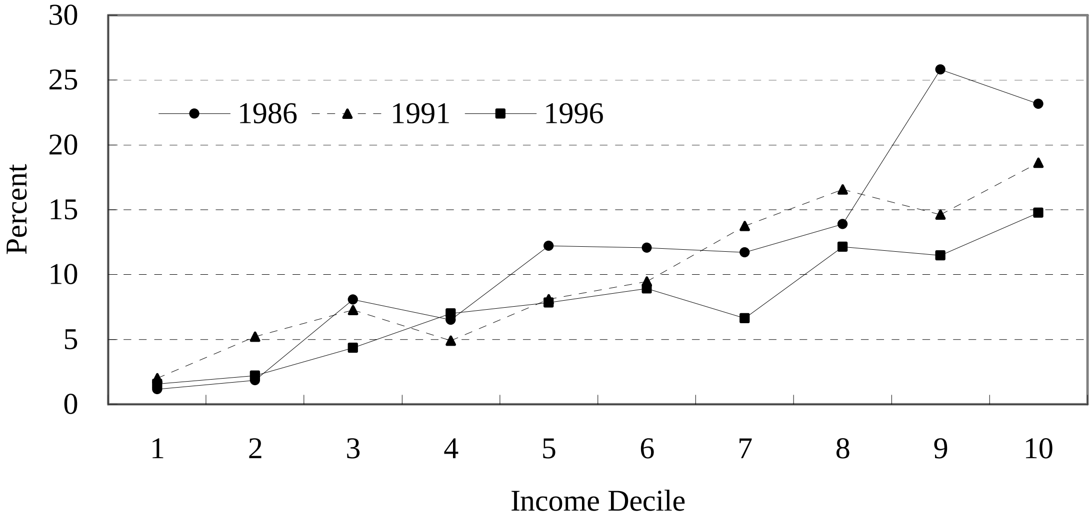

Fig. 1. The ratios of the yen amount of the stock investment over the yen amount of net worth

The graph shows the ratio of household's stock holding to their net worth for each decile for year 1986, 1991 and 1996, in which years survey is conducted for the asset holdings. The decile 1 is the lowest income-decile and the decile 10 is the highest.

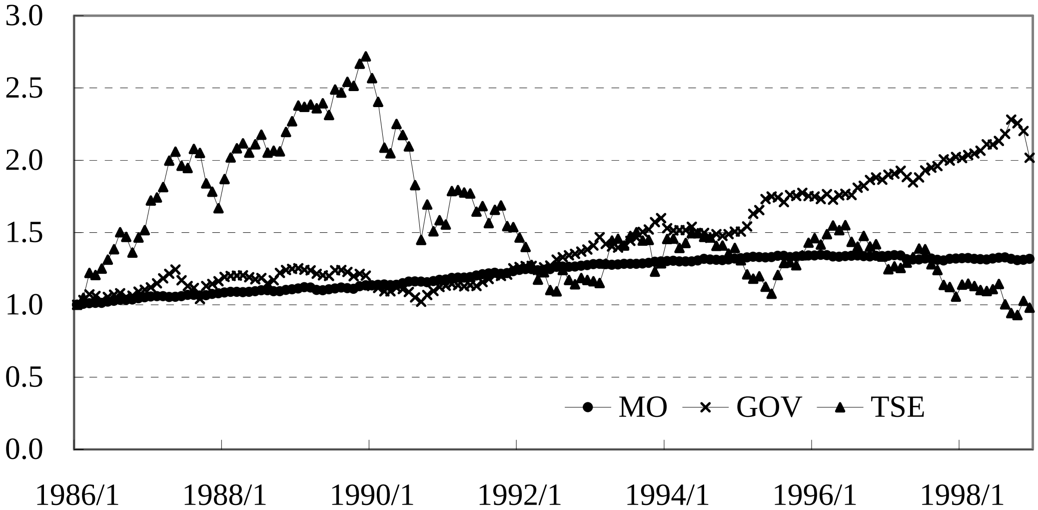

Fig. 2. Cumulative Real Rate of Returns for Stock, Bond and Risk Free Asset
Monthly returns are cumulated. Stock returns are the value weighted total return on all the stocks listed at the Tokyo Stock Exchange 1st section, the bond return is the long-term Japanese government bond return, and the risk free rate is overnight call rate. The initial value starts from one. "MO" is the rate of return on risk free asset, "GOV" is the rate of return on bond and "TSE" is the rate of return on stock.

Table 1
Summary Statistics for Seaonally Unadjusted Nominal Consumption Growth Rate

Panel A

consumption growth	Mean (%)	Std Dev (%)	Skewness	Excess Kurtosis
aggregate	1.209	13.068	0.426	1.333
rank 1	1.033	11.618	0.102	1.178
rank 2	1.133	12.465	0.235	1.319
rank 3	1.141	12.232	0.019	1.025
rank 4	1.101	12.558	0.376	1.771
rank 5	1.132	12.908	0.379	1.482
rank 6	1.428	14.806	0.304	0.490
rank 7	1.474	14.786	0.539	1.242
rank 8	1.355	14.323	0.521	0.960
rank 9	1.453	15.015	0.594	0.897
rank 10	1.692	16.227	0.622	0.629

Panel B

consumption	autocorrelation											
growth	lag = 1		2		3		4		5		$Q(6)$	$Q(12)$
aggregate	-0.483	*	-0.162	*	0.067		0.148		0.186	*	84.99	279.20
rank 1	-0.521	*	-0.001		-0.078		0.163	*	0.118		65.30	211.55
rank 2	-0.489	*	-0.109		0.011		0.123		0.210	*	83.60	246.58
rank 3	-0.452	*	-0.155	*	-0.016		0.164	*	0.245	*	90.11	240.45
rank 4	-0.487	*	-0.127		0.042		0.130		0.158	*	71.24	238.38
rank 5	-0.493	*	-0.109		0.068		0.041		0.246	*	84.82	253.22
rank 6	-0.489	*	-0.140		0.086		0.044		0.284	*	94.99	259.84
rank 7	-0.539	*	-0.042		0.063		0.045		0.158	*	68.04	215.73
rank 8	-0.475	*	-0.143		0.058		0.123		0.176	*	76.11	234.88
rank 9	-0.434	*	-0.247	*	0.109		0.214	*	0.007		58.58	206.50
rank 10	-0.420	*	-0.243	*	0.107		0.160	*	0.145		78.10	234.70

The nominal consumption data is composed of non-durable and services. The caption "aggregate" is aggregate consumption growth, "rank 1" is the consumption growth for the lowest income decile, and "rank 10" is that for the highest income decile. Q is Box-Pierce statistics. * indicates significance at the 5% level.

Table 2

Summary Statistics for Seasonally Adjusted Real Consumption Growth Rate

Panel A

consumption growth	Mean (%)	Std Dev (%)	Skewness	Excess Kurtosis
aggregate	0.110	1.713	-0.073	0.713
rank 1	0.191	4.158	-0.192	0.634
rank 2	0.176	3.975	0.182	0.498
rank 3	0.194	4.272	0.307	1.818
rank 4	0.154	3.587	0.163	0.562
rank 5	0.090	3.665	0.235	0.715
rank 6	0.133	4.790	0.205	1.110
rank 7	0.264	5.237	-0.091	0.525
rank 8	0.211	4.840	0.497	0.676
rank 9	0.226	5.263	0.646	1.390
rank 10	0.242	4.993	0.071	0.044

Panel B

consumption	autocorrelation						
growth	lag = 1	2	3	4	5	$Q(6)$	$Q(12)$
aggregate	-0.495 *	0.071	-0.064	0.098	-0.031	41.75	79.59
rank 1	-0.547 *	0.191 *	-0.105	-0.017	0.082	55.16	62.83
rank 2	-0.537 *	0.188 *	-0.218 *	0.240 *	-0.284 *	82.51	93.64
rank 3	-0.515 *	0.079	-0.106	0.069	-0.049	46.29	65.52
rank 4	-0.463 *	0.023	0.020	0.048	-0.050	34.43	55.29
rank 5	-0.303 *	-0.109	0.048	-0.039	-0.005	17.19	36.58
rank 6	-0.434 *	-0.065	0.051	-0.145	0.305 *	52.81	75.31
rank 7	-0.521 *	0.038	0.007	-0.074	0.131	47.06	69.24
rank 8	-0.382 *	-0.095	-0.009	-0.078	0.131	27.69	35.65
rank 9	-0.383 *	-0.180 *	0.064	0.052	0.042	30.63	63.31
rank 10	-0.395 *	-0.089	0.039	-0.049	0.008	26.10	38.33

The real consumption data is composed of non-durable and services in which the corresponding deflators are used to deflate the series. We used X-11 to seasonally adjust the real series. The caption "aggregate" is aggregate consumption growth, "rank 1" is the consumption growth for the lowest income decile, and "rank 10" is that for the highest income decile. Q is Box-Pierce statistics. * indicates significance at the 5% level.

Table 3
Summary Statistics for Real Asset Returns

Panel A

	Mean (%)	Std (%)	Skewness	Excess Kurtosis
MO	0.178	0.462	-0.744	2.697
GOV	0.480	2.307	-0.570	2.250
TSE	0.185	6.302	0.062	0.651
GOV - MO	0.302	2.274	-0.521	2.585
TSE - MO	0.007	6.301	0.040	0.651

Panel B

	autocorrelation						
	lag = 1	2	3	4	5	*Q* (6)	*Q* (12)
MO	0.286 *	-0.259 *	-0.253 *	-0.022	0.257 *	62.63	145.90
GOV	0.142	0.040	-0.108	-0.187 *	-0.021	10.90	14.92
TSE	0.038	-0.016	-0.025	0.047	0.124	4.40	8.34
GOV - MO	0.151	0.045	-0.123	-0.209 *	0.005	13.07	16.52
TSE - MO	0.036	-0.018	-0.021	0.048	0.118	4.55	8.60

The caption "MO" is the overnight call rate, "GOV" is the long-term government bond return, and "TSE" is the value weighted total return on all the stocks listed at the Tokyo Stock Exchange 1st section. All the asset returns are deflated by CPI. *Q* is Box-Pierce statistics. * indicates significance at the 5% level.

Table 4
Correlations between Real Consumption Growth and Real Asset Returns

	aggregate	rank 1	rank 2	rank 3	rank 4	rank 5	rank 6	rank 7	rank 8	rank 9	rank 10	MO	GOV	TSE	GOV-MO
rank 1	0.31														
rank 2	0.40	0.12													
rank 3	0.30	0.22	0.19												
rank 4	0.37	0.11	0.10	0.18											
rank 5	0.26	0.20	0.18	0.08	0.17										
rank 6	0.30	0.00	-0.04	-0.01	0.04	0.02									
rank 7	0.42	0.01	0.09	-0.01	0.07	-0.06	0.19								
rank 8	0.29	0.11	0.00	0.14	0.08	-0.08	-0.10	-0.05							
rank 9	0.33	-0.04	0.15	-0.01	0.03	-0.03	-0.12	-0.11	0.01						
rank 10	0.59	0.07	0.15	0.00	0.07	0.06	0.07	0.27	0.02	0.02					
MO	0.09	0.11	0.11	0.13	0.17	0.10	-0.06	0.04	0.01	0.00	-0.01				
GOV	0.17	0.02	0.03	0.05	0.15	0.05	-0.04	0.13	0.19	0.07	0.01	0.17			
TSE	0.10	-0.04	-0.01	0.00	0.12	0.11	0.00	0.06	0.02	-0.07	0.13	0.04	0.08		
GOV-MO	0.15	0.00	0.00	0.03	0.12	0.03	-0.03	0.13	0.19	0.07	0.02	-0.03	0.98	0.07	
TSE-MO	0.09	-0.05	-0.02	-0.01	0.11	0.10	0.00	0.06	0.02	-0.07	0.14	-0.03	0.06	1.00	0.07

Consumption series are deflated by corresponding deflators and then seasonally adjusted by X-11. All asset returns are deflated by CPI. The caption "aggregate" is aggregate consumption growth and "rank1" is the consumption growth for the lowest income decile. The caption MO is overnight call rate, GOV is the government bond return, and TSE is the value weighted total return on all the stocks listed at the Tokyo Stock Exchange 1st section.

Table 5

Results of Excess Return Euler Equation Tests with Aggregate Data, Decile Data and Heterogeneous Data

label	i	α			χ^2	p-value
aggregate	0	14.474	(17.44)		18.88	0.026
rank1	1	2.816	(7.72)		22.17	0.008
rank2	2	7.471	(7.07)		18.80	0.027
rank3	3	19.235	(6.51)	*	10.98	0.277
rank4	4	7.541	(8.71)		20.61	0.014
rank5	5	-4.728	(10.54)		23.21	0.006
rank6	6	-3.277	(7.42)		22.05	0.009
rank7	7	1.925	(5.14)		22.40	0.008
rank8	8	1.978	(7.66)		21.86	0.009
rank9	9	2.335	(7.79)		22.09	0.009
rank10	10	0.875	(5.79)		22.66	0.007
CD		-0.495	(15.97)		22.81	0.007

The Euler equation test for excess returns: stock returns over risk-free assets and bond returns over risk-free assets. The rows from "aggregate" to "rank 10" are results from standard Euler equation test and "CD" is the result from Constantinides and Duffie type Euler equation test. The coefficient "α" is the risk aversion coefficient and chi-squares statistics are as in Hansen (1982). The instruments are a constant, one-lagged excess bond return, one-lagged excess stork return, one lagged consumption and two-lagged labor income. Standard errors are reported in parenthesis. * indicates significance at the 5% level.

Table 6
Results of Raw Return Euler Equation Tests with Aggregate Data, Decile Data and Heterogeneous Data

label	i	β			α		χ^2	p-value
aggregate	0	0.998	(0.00)	*	0.069	(0.05)	20.78	0.077
rank 1	1	0.998	(0.00)	*	0.024	(0.04)	21.08	0.071
rank 2	2	0.998	(0.00)	*	0.064	(0.05)	20.59	0.081
rank 3	3	0.998	(0.00)	*	0.043	(0.06)	21.35	0.066
rank 4	4	0.998	(0.00)	*	0.037	(0.03)	20.51	0.083
rank 5	5	0.998	(0.00)	*	0.075	(0.06)	20.54	0.082
rank 6	6	0.998	(0.00)	*	0.016	(0.03)	21.40	0.065
rank 7	7	0.998	(0.00)	*	0.024	(0.03)	21.43	0.065
rank 8	8	0.998	(0.00)	*	-0.040	(0.07)	21.16	0.070
rank 9	9	0.998	(0.00)	*	0.057	(0.04)	21.01	0.073
rank 10	10	0.998	(0.00)	*	0.035	(0.03)	21.06	0.072
CD		0.995	(0.00)	*	0.007	(0.01)	21.41	0.065

Euler equation tests for raw returns: stock, bond, and risk-free returns. The rows from "aggreagte" to "rank 10" are results from standard Euler equation tests and "CD" is the result from Constantinides and Duffie type Euler equation test. The coefficient "α" is the risk aversion coefficient, "β" is the discount factor, and chi-squares statistics are as in Hansen (1982). The instruments are a constant, one-lagged and two-lagged stock returns, one-lagged consumption, and two-lagged labor income. Standard errors are reported in parenthesis. * indicates significance at the 5% level.

Table 7
Results of Excess Return Euler Equation Tests with Aggregated Decile Data

label	i	α		χ^2	p -value
aggregate	0	14.474	(17.44)	18.88	0.026
rank 7:10	7:10	6.323	(9.16)	20.16	0.017
rank 8:10	8:10	2.551	(10.61)	21.81	0.009
rank 9:10	9:10	2.151	(8.47)	22.05	0.009
rank 10	10	0.876	(5.79)	22.66	0.007

The Euler equation tests for excess returns: stock returns over risk-free rate and bond returns over risk-free rate. We have aggregated decile data for higher income group. The coefficient "α" is the risk aversion coefficient and chi-square statistics are as in Hansen (1982). The instruments are a constant, one-lagged excess bond return, one-lagged excess stork return, one lagged consumption and two-lagged labor income. Standard errors are reported in parenthesis.