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Habit formation in household consumption: evidence from Japanese panel data

Koichiro Iwamoto
College of Contemporary Management, Aichi Gakusen University

Abstract

Habit formation in consumption has important implications for the effects of macroeconomic policies. Using micro data from the Japanese Panel Survey of Consumers (JPSC) for the period 1998-2004, an Euler equation à la Dynan (2000) allowing for time-nonseparablity in consumer preferences is estimated. In contrast to previous, macro data-based studies on consumption in Japan, the estimates yield no evidence of habit formation and appear consistent with durability in consumption.

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Contact: Koichiro Iwamoto - iwamoto@gakusen.ac.jp.
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1. Introduction

In recent decades, there has been growing interest in the implications of preferences that are not time-separable. Incorporating habit formation in consumption,[1] a form of time-nonseparable preferences, has come to play an important role in making responses to shocks in modern macroeconometric models, such as dynamic stochastic general equilibrium (DSGE) models, more realistic. In such models, habit formation is used as an additional friction that is necessary to capture the empirical persistence observed in macroeconomic data (see, e.g., Smets and Wouters, 2003; Christiano et al., 2005). In contrast to habit formation, which induces positive autocorrelation in consumption growth, consumption durability, another source of time-nonseparable preferences, induces negative autocorrelation and provides a rational explanation for the well-known excess sensitivity puzzle.

Given the importance of the issue, numerous empirical studies have been conducted to provide evidence for time-nonseparable preferences. Early empirical studies based on aggregate time-series data generally produced evidence in support of habit formation in consumption (e.g., Ferson and Constantinides, 1991; Braun et al., 1993). However, since the early 2000s, when micro/panel data-based studies became increasingly popular among empirical economists, these findings have been challenged on the grounds that they suffer from aggregation bias. One of the pioneering studies highlighting this issue is that by Dynan (2000), who examined household-level data on food expenditures in the United States using the *Panel Study of Income Dynamics* (*PSID*). She found almost no evidence of habit formation in consumption by US households. Similarly, Kuismanen and Pistaferri (2006) calculated a dynamic consumption function also using the *PSID* and found no evidence of habit formation. While there are a few micro data analyses that report results consistent with habit formation for some expenditure items (e.g., Carrasco et al., 2005; Browning and Collado, 2007), the inconsistency between findings based on macro and on micro data presents a puzzle that is yet to be explained in the literature.

The issue of habit formation has also been the subject of several empirical studies using Japanese consumption data. However, no similar macro–micro inconsistency has yet emerged, because almost all of the studies on Japan used macro data and produced results largely consistent with habit formation (e.g., Iwata and Shimotsu, 1996; Pagano, 2004).[2] The lack of micro data-based studies on Japan is due to the fact that until recently the panel data required for this kind of analysis was unavailable. However, this has now changed thanks to the *Japanese Panel Survey of Consumers* (*JPSC*), an annual panel survey on Japanese households.

Against this background, the purpose of this study is to empirically investigate whether time-nonseparability in preferences can be found for Japanese consumers, using micro-level expenditure data for individual households in Japan from the *JPSC* for the period 1998–2004 by estimating a Dynan-type Euler equation. The estimated parameter for time-nonseparable preferences provides significant support for the durability of consumption expenditure rather than habit formation. Therefore, the puzzle,

[1] The habit formation considered in this paper is a rational (and internal) one. In the framework of rational habit formation, the level of current consumption influences the marginal utility of future consumption.

[2] Notable exceptions are the micro data-based studies by Hayashi (1985, 1986), which, however, focused on the durability of consumption.

that is, the macro–micro inconsistency, appears to hold true also for Japanese consumption, justifying further study of this issue.

The remainder of this study is organized as follows. Section 2 describes Dynan's empirical model, on which the analysis here is based. Next, Section 3 discusses the *JPSC* data used in this study, while Section 4 reports the results of the estimation. Section 5 concludes.

2. Applying Dynan's model

Following the study by Dynan (2000), the empirical analysis here relies on the Euler equation approach allowing for time-nonseparability in consumer preferences. Specifically, household i's consumption at time t, C_{it}, is defined as follows:

$$C_{it} = CE_{it} - a\,CE_{it-1}, \tag{1}$$

where CE_{it} represents the household's (consumption) expenditure. Dynan (2000) treated a as the habit formation parameter, which measures the strength of habit formation. The household's utility function takes the following isoelastic form:

$$u(C_{it};T_{it}) = T_{it}\frac{C_{it}^{1-\rho}}{1-\rho}, \tag{2}$$

where T_{it} denotes the taste shifters of the utility function and $-\rho$ denotes the elasticity of marginal utility of consumption. This expression shows that part of past consumption expenditure is habitual and is expended preferentially at the current time (in other words, consumption is committed) but has no influence on current utility. From the household's utility maximization problem, Dynan derives the log-linearized Euler equation for her estimation.[3] Her model is as follows:

$$\Delta\ln CE_{it} = a_0 + a_1\Delta\ln CE_{it-1} + a_2\Delta\ln T_{it} + e_{it}, \tag{3}$$

where e_{it} represents a stochastic error term with mean zero and constant variance, and a_0, a_1, and a_2 are parameters to be estimated. Equation (3) will be referred to as the Dynan Euler equation.

The key parameter of interest in this study is a_1, which corresponds to Dynan's habit formation parameter a in equation (1). However, as Ferson and Constantinides (1991) pointed out, if there is durability in consumption, the parameter estimate on lagged consumption expenditure will be affected not only by habit formation, but also by durability. The time-nonseparability parameter a_1 will be positive if habit formation dominates, while it will be negative if durability dominates.

As for a_0 in equation (3), this will be treated as a constant in the baseline estimation, following Dynan (2000) and many other studies. However, a_0 potentially can be a function of the real interest rate, which is a proxy of the rate of return to savings available to each household, the time discount factor, and forecast error variance, as footnote 6 in Dynan (2000) points out. Therefore, to check the robustness of the results, a number of alternative specifications with the personal real interest rate

[3] See Dynan's (2000) Section I and Appendix A for details of how the log-linearized Euler equation is derived.

and/or dummy variables capturing the education stage of the eldest child in the household will be estimated.

3. Data

The dataset used in this paper consists of micro data from the *JPSC* conducted by the Institute for Research on Household Economics. The *JPSC* was originally designed as an in-home questionnaire survey implemented over multiple periods to track a random sample of 1,500 single and married women aged 24–35, who were selected from all over Japan in 1993. To compensate for attrition over time, a supplementary sample of 500 women aged 24–27 was added in 1997, and another 1,000 women aged 24–29 were added in 2003. Respondents are surveyed once a year in October. Since 1998, the *JPSC* has collected data regarding household expenditures by category for the month preceding the survey, i.e., September. The expenditure categories roughly correspond to the ten expenditure categories of the *Family Income and Expenditure Survey* (*FIES*), the main source of information on household consumption in Japan, which is published by the government.

For the analysis below, *JPSC* data for the period from 1998 to 2004 is used. To improve the reliability of the estimates, the following observations are removed from the dataset as outliers: (1) respondents that reported zero expenditure on food for the entire month; (2) respondents that reported spending more than 170,000 yen on food for the month;[4] (3) respondents that reported that their family income in the previous year was less than one million yen, which is the 1 percentile value of the family income distribution; (4) respondents that reported that their annual family income was more than 22.8 million yen, which is the 99 percentile value. In addition, observations for unmarried respondents were also omitted, because the *JPSC* does not include questions about the expenditure of cohabitating family members of such respondents. Following these adjustments, we are left with a dataset containing 6,640 observations.

[4] 170,000 yen corresponds to the 99 percentile value of the food expenditure distribution.

Table 1. Basic Statistics

Variables	Obs.	Mean	S.D.	Min.	Max.
Real Total Monthly Expenditure	6,353	274.7	149.78	40.0	3,060.0
Durable and Semidurable Expenditure	6,640	15.8	23.89	0.0	630.0
Nondurable and Service Expenditure	6,640	106.5	58.40	2.0	1,074.0
Age of Survey Respondent	6,640	35.2	4.74	25.0	45.0
Number of Family Members	6,640	4.3	1.45	1.0	11.0
Average Real Interest Rate for Each Prefecture (%)	6,628	0.729	0.48	0.03	1.70
Dummy for the Education Stage of the Eldest Child (Before School Age=1)	6,640	0.163	0.37	0	1
Dummy for the Education Stage of the Eldest Child (Elementary School=1)	6,640	0.204	0.40	0	1
Dummy for the Education Stage of the Eldest Child (Junior High School and Above=1)	6,640	0.110	0.31	0	1

Notes: All expenditure variables are in nominal terms (thousand yen). Average real interest rates are obtained by converting nominal ones using the rate of change in the CPI. Average nominal interest rates are the average values for each prefecture of regional banks' interest rates (= interest paid / deposit), which are disclosed on the web site of the Japanese Bankers Association.

Table 1 reports the basic statistics of selected variables that are used in the regression analysis. Total expenditure in the *JPSC* consists of the following 14 categories:[5] (1) food; (2) house rent, land rent, and home repairs; (3) utilities; (4) furniture and housekeeping equipment; (5) clothing and shoes; (6) healthcare; (7) transportation; (8) communication; (9) education; (10) culture and entertainment; (11) social expenses; (12) pocket money for family members; (13) allowance for wife's and husband's parents; and (14) other expenses. All expenditure categories include all family members and denote the expenditure incurred in September. Based on information regarding the durability of items in the different expenditure categories gleaned from the "Income and Expenditure Classification Table" in the *FIES*, two variables representing expenditure on items of different durability are constructed. The first variable is defined as the sum of (4) and (5) and is a proxy for durable and semi-durable expenditures. The second variable is the sum of (1), (3), and (9) and is a proxy for nondurable and service expenditures. In the following analysis, all these (semi-)aggregated expenditures as well as food expenditure are deflated by the consumer price index. As taste shifters in the baseline model, family size and the age of survey respondents are selected.[6] Moreover, in the alternative estimation to check the robustness of the results, the average real interest rate,[7] which is used in place of the personal real interest rate since the *JPSC* provides no information on personal interest rates, and dummies for the education stage of the eldest child are employed as

[5] Based on the 2004 questionnaire of the *JPSC*.
[6] Dynan (2000) used family size and the age of the household head as taste shifters. See column (1) of Dynan's Table 2.
[7] Details of how the average real interest rate is obtained are provided in the notes for Table 1.

additional control variables.

4. Estimation Results

A. Basic Results

Turning to the empirical analysis, Table 2 shows the basic results of the estimation of the Dynan Euler equation, equation (3) in Section 2. The dependent variable is the log difference in real total monthly expenditure. Independent variables in the baseline estimation shown in column (i), which is estimated using ordinary least squares (OLS), are the first lagged dependent variable, the respondent's age, age squared, the log difference in household size, year dummies, and a constant term. The p-value of the F-test to examine whether all estimated parameters are zero is almost equal to zero, indicating that the null hypothesis can be rejected at the 5% level. The parameter of key interest, a_1 on the $\Delta \ln CE_{t-1}$ term, is negative and significant.[8] This result implies a time-nonseparable component in the preferences (or the utility function) of Japanese consumers. Moreover, the negative coefficient is consistent with consumption durability rather than with habit formation.

Although this "first shot" result looks convincing, the OLS estimate of the autoregressive coefficient could be biased, because it does not control for heterogeneity among households, measurement errors, or potential endogeneity of the lagged dependent variable. To control for these contaminating factors, two additional regressions are conducted using different estimation methods. The first of these is a fixed effects model that considers household-specific factors. The result is shown in column (ii). The key parameter a_1 is still significantly negative, suggesting that durability is dominant. The second approach employs the system GMM estimation procedure, which controls for measurement errors and potential endogeneity of the lagged dependent variable. The results are shown in column (iii). Three tests (the Wald test, the Arellano−Bond test, and the Hansen test) all produce the desired results, suggesting that the model specified in column (iii) is valid. Finally, the key parameter a_1 is significantly negative. Therefore, although the size of the parameter estimate is slightly smaller (in absolute terms) than in columns (i) and (ii), the conclusions are the same as before.

Next, columns (iv), (v), and (vi) report the results when using additional regressors for robustness checks. In column (iv), the real interest is added as a regressor, implying that the assumption of a constant interest rate across households and time periods is dropped. Further, in column (v), dummies representing the education stage of the eldest child, which are proxies for the family life-stage, are included as additional control variables for remaining heterogeneity among households. Finally, in column (vi), all regressors are used. In all columns, the key parameter a_1 is negative and statistically significant. Therefore, the results of the extended models are also consistent with the finding that there exist time-nonseparable components in consumer preferences in Japan and that durability appears to be dominant over habit formation.

[8] In all estimations, standard errors are transformed to heteroskedasticity robust standard errors.

Table 2. Basic Results: Log Difference in Real Total Monthly Expenditure

	(i) OLS	(ii) Fixed Effects Model	(iii) System GMM Baseline	(iv) System GMM (iii)+ Interest Rate	(v) System GMM (iii)+ Life Stage Dummies	(vi) System GMM (iii)+ Interest Rate + Life Stage Dummies
$\Delta \ln CE_{t-1}$ (a_1)	–0.4562 ***	–0.4997 ***	–0.3312 ***	–0.3203 ***	–0.3412 ***	–0.3787 **
	(0.022)	(0.017)	(0.045)	(0.071)	(0.091)	(0.178)
Age	–0.0101	–0.0034	–1.297	–1.854	–2.856	–2.451
	(0.022)	(0.071)	(1.694)	(2.713)	(3.243)	(5.061)
Age^2/1,000	0.1532	0.365	18.226	26.914	41.198	35.390
	(0.30)	(0.49)	(23.46)	(37.573)	(43.29)	(68.398)
$\Delta \ln$ *Family Size*	–0.0465	–0.0280	4.845	8.755	8.575	14.935
	(0.059)	(0.076)	(3.58)	(6.806)	(6.264)	(18.013)
Average Real Interst Rate for Each Prefecture				–20.962		–54.193
				(27.471)		(125.35)
Dummy for the Education Stage of the Eldest Child (Before School Age)					43.245	–21.915
					(227.1)	(405.19)
Dummy for the Education Stage of the Eldest Child (Elementary School)					11.960	–3.916
					(74.659)	(123.36)
Dummy for the Education Stage of the Eldest Child (Junior High School and Above)					11.126	–2.620
					(49.74)	(86.374)
F-Test (P-Value)	0.000	0.000				
R Squared	0.223	0.272				
Wald Test (P-Value)			0.000	0.000	0.000	0.141
Arellano–Bond Test for AR(2) in First Differences (P-Value)			0.065	0.597	0.846	0.640
Hansen Test of Overidentifying Restrictions (P-Value)			0.617	0.982	0.941	0.996
Number of Observations	3,992	3,992	3,992	3,988	3,992	3,988

Notes: *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively. Δ denotes the first difference.
Standard errors are denoted in parentheses. A constant term and year dummies are included in all estimations.
In columns (iii) to (vi), the instrument for the log difference equation is $\Delta \ln CE_{t-2}$, and the instruments for the level equation are $\Delta\Delta \ln CE_{t-1}$ and the constant term.

B. Results for Semi-Aggregated Categories of Different Durability

The estimated parameter on total expenditure appears to be consistent with durability in consumption. To examine the issue further, the next step of the analysis is to conduct the same analysis, but for semi-aggregated expenditure categories of different durability. Concretely, the same specifications and estimation methods as in columns (iii) to (vi) in Table 2 are employed for the two variables representing expenditure categories of different durability, that is, the proxy for durable and semi-durable expenditures and the proxy for nondurable and service expenditures.

The results for durable and semi-durable expenditures are shown in columns (i) to (iv) of Table 3 and indicate that the estimates of a_1 are statistically significant and larger (in absolute terms) than in the total expenditure estimations in Table 2. This finding appears consistent with the interpretation that the parameter estimates of time-nonseparable preferences are influenced by the durability of consumption expenditure, because the proxy variable is constructed such that it is more slanted toward durable components than total expenditure. Next, regarding nondurable and

service expenditures (columns (v) to (viii)), the estimates of the key parameter, as expected are smaller (in absolute terms) than those for durable and semi-durable expenditures, but they remain negative.[9] Although the reason for these negative parameters for nondurable expenditures is not quite clear, comparing the estimates of a_1 in columns (i) to (iv) and (v) to (viii) suggests that the durability of consumption goods plays a role and that habit formation, if it exists, is offset by this durability.

[9] In column (viii), although a_1 is insignificant, the sign is still negative. A possible reason why a_1 is insignificant is multicollinearity, as suggested by the large standard error.

Table 3. Alternative Results for Expenditure Categories of Different Durability

Estimation Results by System GMM

	Durables and Semidurables				Nondurables and Services			
	(i) Baseline	(ii) (i)+ Interest Rate	(iii) (i)+ Life Stage Dummies	(iv) (i)+ Interest Rate + Life Stage Dummies	(v) Baseline	(vi) (i)+ Interest Rate	(vii) (i)+ Life Stage Dummies	(viii) (i)+ Interest Rate + Life Stage Dummies
$\Delta \ln CE_{t-1}$ (a_1)	–0.4039 ***	–0.3954 ***	–0.4144 ***	–0.4061 ***	–0.2349 ***	–0.2399 ***	–0.3438 ***	–0.3949
	(0.069)	(0.087)	(0.043)	(0.047)	(0.045)	(0.046)	(0.134)	(0.486)
Age	–9.208	–14.337	1.650	–6.569	2.162	1.994	–2.447	–1.315
	(15.60)	(35.68)	(8.59)	(12.99)	(2.283)	(2.349)	(6.238)	(53.46)
Age^2/1,000	114.047	178.896	–25.249	79.315	–30.203	–28.148	31.044	48.239
	(192.92)	(450.2)	(108.4)	(163.1)	(31.75)	(32.75)	(88.95)	(548.3)
$\Delta \ln$ *Family Size*	13.085	11.930	8.048	4.988	2.898 *	2.936 *	7.541	7.333
	(11.93)	(19.83)	(9.70)	(12.86)	(1.529)	(1.554)	(5.301)	(6.209)
Average Real Interest Rate for Each Prefecture		–36.265		–58.953		–5.369		95.657
		(201.1)		(117.0)		(11.29)		(662.7)
Dummy for the Education Stage of the Eldest Child (Before School Age)			–9.950	–8.622			–26.556	1.000
			(21.6)	(36.3)			(62.89)	(396.1)
Dummy for the Education Stage of the Eldest Child (Elementary School)			–13.996	–11.119			–21.293	113.443
			(27.7)	(44.0)			(53.62)	(868.2)
Dummy for the Education Stage of the Eldest Child (Junior High School and Above)			–9.617	–3.816			–26.844	2.762
			(40.4)	(58.2)			(52.89)	(329.8)
Wald Test (P-Value)	0.000	0.000	0.000	0.000	0.000	0.000	0.526	0.752
Arellano–Bond Test for AR(2) First Differences (P-Value)	0.268	0.604	0.635	0.806	0.579	0.794	0.351	0.865
Hansen Test of Overidentifying Restrictions (P-Value)	0.975	0.957	0.746	0.750	0.314	0.195	0.934	0.977
Number of Observations	2,520	2,518	2,520	2,518	4,270	4,265	4,270	4,265

Notes: *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively. Δ denotes the first difference. Standard errors are denoted in parentheses. A constant term and year dummies are included in all estimations. In all columns, the instrument for the log difference equation is $\Delta \ln CE_{t-2}$, and the instruments for the level equations are $\Delta\Delta \ln CE_{t-1}$ and the constant term.

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5. Conclusion

Using annual household panel data for Japan, which has become available for public use only recently, the present paper, following the example of Dynan (2000), estimated an Euler equation allowing for time-nonseparable preferences. The results yielded no evidence of habit formation and appear consistent with durability in consumption. (This durability may have offset the effect of habit formation). This finding contradicts the results reported in previous Japanese studies based on aggregate data.

It would be premature at this point to claim that the results obtained in this paper unambiguously show that we should assume durability rather than habit formation in macroeconomic models. However, the evidence presented here suggests that the puzzle mentioned at the outset, that is, the macro−micro inconsistency, holds true also for Japanese consumers, justifying further study of this issue.

There are a number of potential candidates that may help to explain the macro−micro inconsistency and that warrant further investigation: (1) measurement errors in the data; (2) the durability of consumption goods; (3) heterogeneity among households; and (4) self-selection bias in the survey data. More research is necessary to examine each of these. While it is not easy to simultaneously control for all of these factors in an analysis of household consumption, many researchers are trying to address this problem.[10] Given the importance of the issue for government policy, further research is needed.

[10] As mentioned in the introduction, micro data-based studies by Carrasco et al. (2005) and Browning and Collado (2007) obtained results that are consistent with habit formation, after controlling for contaminating factors.

References

Braun, P. A., G. M. Constantinides and W. E. Ferson (1993) "Time Non-Separability in Aggregate Consumption: International Evidence," *European Economic Review* 37, 897-920.

Browning, M. and M. D. Collado (2007) "Habits and Heterogeneity in Demands: A Panel Data Analysis," *Journal of Applied Econometrics* 22(3), 625-640.

Carrasco, R., J. M. Labeaga and J. D. Lopez-Salido (2005) "Consumption and Habits: Evidence from Panel Data," *Economic Journal* 115(500), 144-165.

Christiano, L. J., M. Eichenbaum and C. L. Evans (2005) "Nominal Rigidities and the Dynamic Effects of a Shock to Monetary Policy," *Journal of Political Economy* 113(1), 1-45.

Dynan, K. E. (2000) "Habit Formation in Consumer Preferences: Evidence from Panel Data," *American Economic Review* 90(3), 391-406.

Ferson, W. E. and G. M. Constantinides (1991) "Habit Persistence and Durability in Aggregate Consumption: Empirical Tests," *Journal of Financial Economics* 29(2), 199-240.

Hayashi, F. (1985) "The Permanent Income Hypothesis and Consumption Durability: Analysis Based on Japanese Panel Data," *Quarterly Journal of Economics* 100(4), 1083-1113.

Hayashi, F. (1986) "Kojo Shotoku Kasetsu no Kakucho to Kensho (The Extension and Test for LCPIH)," *Keizai Bunseki* (*Economic Analysis)* 101, 1-23 (in Japanese).

Iwata, K. and K. Shimotsu (1996) "Shisan Kakaku to Shohi (Asset Pricing and Consumption: Durability/Habits and Multi Goods)," *Kikan Jutaku Tochi Keizai* (*Quarterly Journal of Housing and Land Economics)*, 1996 (spring), 9-20 (in Japanese).

Kuismanen, M. and L. Pistaferri (2006) "Information, Habits, and Consumption Behavior: Evidence from Micro Data," *Working Paper Series 572*, European Central Bank.

Pagano, P. (2004) "Habit Persistence and the Marginal Propensity to Consume in Japan," *Journal of the Japanese and International Economies* 18(3), 316-329.

Smets, F. and R. Wouters (2003) "An Estimated Dynamic Stochastic General Equilibrium Model of the Euro Area," *Journal of the European Economic Association* 1(5), 1123-1175.