SEASONAL INCOME AND CONSUMPTION IN JAPAN AND THE UNITED STATES, 1961/4 to 1969/1

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Economists have for some time debated the question of whether seasonal income in Japan is treated by consumers as part of their permanent or transitory income. This question is of more than academic interest, because it suggests a possible explanation of the high personal savings rate observed in the postwar years. Miyohei Shinohara (pp. 235-37) has suggested that the large biannual bonuses paid to Japanese workers, which explain a major part of seasonal income, are perceived as essentially transitory in nature.[1] Toshiyuki Mizoguchi has agreed with this view: "(regular income of the household head) is considered as the main index on consumption planning, because this portion is the most stable and easiest to forecast among the various types of income," and Tuvia Blumenthal has found supporting evidence in the parallel movements of family saving and temporary income.[2] On the other hand, Ryūtaro Komiya suggests that seasonal income, in so far as it depends on the seasonal bonuses, is seen as permanent income because the timing of the bonuses is known and their magnitude largely foreseen.

This paper describes an attempt to resolve the issue empirically for the 1960s, and to make a comparison with seasonal consumption behavior in the United States. A consumption function based on the permanent income hypothesis is specified a priori and used to obtain measures of the seasonal marginal and average propensities to consume in each country. The magnitudes and seasonal behavior of these parameters suggest the inference that seasonal income was largely treated as transitory income in Japan and as permanent income in the United States.

The structural equation chosen is based on an equation from the Wharton-EFU model of the United States by Michael K. Evans and Lawrence R. Klein:

$$(1)\qquad \frac{C}{Y}=a_1-b_1\sum_{i=0}^{3}\left(\frac{4-i}{4}\right)\left(\frac{dY}{Y}\right)_{-i}+\tfrac{1}{4}d\sum_{i=1}^{4}\left(\frac{C}{Y}\right)_{-i}$$

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[1] Another important component of seasonal income arises from seasonal fluctuations in farm income. These fluctuations lead to a low propensity to consume out of seasonal income, because of income/consumption smoothing behavior, and, partly because of risk aversion, to a low propensity to consume out of average income.

[2] Mizoguchi, (1970) has reiterated this position in a recent book while pointing out the dangers of attempts to explain international differences in the propensity to save based on this factor. I am grateful to a referee for a reminder of this work.

This equation is based on a PI model suggested by Jacob Mincer,

$$(2) \qquad C=kZ+hY$$

where Z, Y, are the levels of permanent and measured disposable income, and k, h, are constants. We allow for the presence of money illusion or price expectation effects by specifying the consumption function in terms of income and expenditures at current prices, y^n, c^n, and assume that the average and marginal propensities to consume are seasonal parameters. Equation (2) becomes:

$$C^n=(\tilde{k}'\tilde{Q})Z^n+(\tilde{h}'\tilde{Q})Y^n$$

where $\tilde{k}$, $\tilde{h}$, are four element column vectors with elements $k_1, k_2, \ldots . h$, and $\tilde{Q}$ is a vector of seasonal dummies with elements 1, $Q2$, $Q3$, $Q4$, After a little manipulation and the addition of a homoskadastic disturbance term u we obtain:

$$(3) \qquad \frac{C}{Y}=\frac{C^n}{Y^n}=\tilde{g}'\tilde{Q}-(\tilde{k}'\tilde{Q})\frac{Y^n-Z^n}{Y^n}+u$$

where Y^n-Z^n is the level of transitory income, and $\tilde{g}=(\tilde{k}+\tilde{h})$.

Suppose now that we make the approximation

$$(\tilde{k}'\tilde{Q})(Y^n-Z^n)=(\tilde{k}'\tilde{Q})\sum_{i=0}^{\infty}(dY^n-dZ^n)_{-i}$$

$$\cong\sum_{i=0}^{\infty}(\tilde{b}'\tilde{Q})_{-i}(dY^n-dZ^n)_{-i}$$

This transformation is asymptotically exact for the case where incomes grow exponentially and the rate of growth tends to infinity. We may now write:

$$(\tilde{k}'\tilde{Q})\left(\frac{Y^n-Z^n}{Y^n}\right)=\frac{1}{Y^n}\sum_{i=0}^{\infty}Y^n_{-i}(\tilde{b}'\tilde{Q})_{-i}\left(\frac{dY^n}{Y^n}-\frac{dZ^n}{Z^n}\right)_{-i}$$

$$=\sum_{i=0}^{\infty}\lambda^i(\tilde{b}'\tilde{Q})_{-i}\left(\frac{dY^n}{Y^n}-\frac{dZ^n}{Z^n}\right)_{-i}$$

in the neighbourhood of a steady state growth path on which $dY^n=\lambda Y^n$, $0<\lambda<1$, if Z^n approximately equals Y^n (i.e. expectations are realized). Equation (3) now becomes:

$$(4) \qquad \frac{C}{Y}=\tilde{g}'\tilde{Q}+\sum_{i=0}^{\infty}\lambda^i(\tilde{b}'\tilde{Q})_{-i}\left(\frac{dZ^n}{Z^n}\right)_{-i}-\sum_{i=0}^{\infty}\lambda^i(\tilde{b}'\tilde{Q})_{-i}\left(\frac{dY^n}{Y^n}\right)_{-i}+u$$

We assume, as is implied in the work of Evans and Klein, that the disturbance term u is autocorrelated and of the form

$$u-\frac{1}{N}\sum_{i=1}^{N}\lambda^i u_{-i}=e$$

where e is normally and independently distributed. For $N=4$, a four stage Koyck transformation on (4) leads to the result:

$$(5) \qquad \frac{C}{Y}=\sum_{i=0}^{3}\left(\frac{4-i}{4}\right)(\tilde{a}'\tilde{Q})_{-i}-\sum_{i=0}^{3}\left(\frac{4-i}{4}\right)(\tilde{b}'\tilde{Q})_{-i}\left(\frac{dY^n}{Y^n}\right)_{-i}+\tfrac{1}{4}d\sum_{i=1}^{4}\left(\frac{C}{Y}\right)_{-i}+e$$

assuming $\lambda\cong1$ and $\frac{dZ^n}{Z^n}$ is constant.

Finally, we assume that the rates of change of real income and prices are both small, so that we may write:

$$\frac{dY^n}{Y^n}=\frac{dY}{Y}+\frac{dP}{P}$$

and also provide independent estimated coefficients for the income and price terms. The equation to be estimated is:

$$(6)\qquad \frac{C}{Y}=\sum_{i=0}^{3}\left(\frac{4-i}{4}\right)(\tilde{a}'\tilde{Q})_{-i}-\sum_{i=0}^{3}\left(\frac{4-i}{4}\right)(\tilde{b}'\tilde{Q})_{-i}\left(\frac{dY}{Y}\right)_{-i}$$

$$-\sum_{i=0}^{3}\left(\frac{4-i}{4}\right)(\tilde{c}'\tilde{Q})_{-i}\left(\frac{dP}{P}\right)_{-i}+\tfrac{1}{4}d\sum_{i=1}^{4}\left(\frac{C}{Y}\right)_{-i}$$

The Marginal and Average Propensities to Consume

If incomes and prices are assumed to grow at constant rates GY and GP, then equation 6 reduces to

$$\frac{C}{Y}=\text{APC}=(\tilde{a}-GY\tilde{b}-GP\tilde{c})'\tilde{A}'\tilde{Q}+\tfrac{1}{4}d\sum_{i=1}^{4}\text{APC}_{-i}$$

$$(7)\text{ or}\qquad \text{APC}=\tilde{e}'\tilde{A}'\tilde{Q}+d\overline{\text{APC}}$$

since the APC varies seasonally about some mean value $\overline{\text{APC}}$. The vectors $\tilde{a}$, $\tilde{b}$, $\tilde{c}$, and $\tilde{Q}$ have been defined earlier, the term $\tilde{A}'\tilde{Q}$ replaces the weighted averages of lagged quarterly dummies in equation 6, and $\tilde{A}$ is defined by:

$$\tilde{A}=\begin{bmatrix}2.5 & 0.25 & 0.50 & 0.75\\ 0.0 & 0.75 & -0.25 & -0.25\\ 0.0 & 0.50 & 0.50 & -0.50\\ 0.0 & 0.25 & 0.25 & 0.25\end{bmatrix}$$

$$(8)\text{ Hence,}\qquad \overline{\text{APC}}=\tilde{e}'\tilde{A}'\tilde{QA}/(1-d)$$

where $\tilde{QA}$ is the vector $\left(1\,\frac{1}{4}\,\frac{1}{4}\,\frac{1}{4}\right)'$, representing the four quarter average of $\tilde{Q}$.

The marginal propensity to consume may be derived from equation 7 by following the method used by Evans (pp. 70-71) for the basic Wharton equation. One finds that:

$$(9)\qquad \text{MPC}=\text{APC}-(1-GY)\tilde{b}'\tilde{Q}$$

and hence

$$(10)\qquad \overline{\text{MPC}}=\overline{\text{APC}}-(1-GY)\tilde{b}'\tilde{QA}$$

The Revealed Seasonal Behavior

The estimates of equation 6, made on both seasonally unadjusted (NAS) and adjusted (SA) data for each country, are shown in Table 1.[3] The average and marginal propensities to consume, derived from equations 7 through 10 on the assumption that incomes and prices continue to grow at their actual average rates over the sample period, are given in Table 2.[4]

Where the consumption function has been estimated with NSA data we would generally expect to find seasonal variations in the APC; but with SA data, barring inadequate

[3] The sources of data are given in Appendix 1. Estimates were made on both NSA and SA series as a crosscheck since constructed series were needed to complete the United States NSA and Japanese SA data sets. Ordinary least squares regression was used throughout since the specification in terms of the average propensity to consume would be expected to reduce simultaneous equations bias substantially.

[4] For Japan, the rates of growth of incomes and prices were 2.19 and 1.33 per cent per quarter respectively over the sample period. The corresponding figures for the United States were 1.15 and 0.53 per cent.

TABLE 1. REGRESSION COEFFICIENTS AND SUMMARY STATISTICS

	S. A.		N. S. A.	
	Japan	US	Japan	US
a_1[a]	0.4628 (0.1868)[b]	0.3940 (0.2962)	0.0065 (0.7279)	0.4267 (0.3451)
a_2	−0.0012 (0.0101)	−0.0079 (0.0123)	−0.0163 (0.2256)	0.0556 (0.0228)
a_3	−0.0053 (0.0125)	0.0123 (0.0102)	0.0773 (0.2144)	−0.0134 (0.0251)
a_4	−0.0014 (0.0092)	0.0080 (0.0133)	0.1205 (0.2300)	0.0305 (0.0323)
b_1	0.8385 (0.2185)	0.4825 (0.3271)	0.5896 (0.3246)	0.2479 (0.1676)
b_2	−0.4158 (0.2236)	−0.2788 (0.4940)	−0.1797 (0.3992)	0.0274 (0.3107)
b_3	0.3959 (0.3275)	0.0521 (0.4240)	0.5088 (0.3474)	0.2518 (0.3018)
b_4	−0.1083 (0.2415)	0.3207 (0.5922)	0.0827 (0.3748)	−0.1628 (0.2079)
c_1	0.3271 (0.2801)	−1.0135 (0.9926)	0.4271 (0.3325)	−0.7625 (0.9716)
c_2	0.2485 (0.5645)	0.4405 (1.4282)	−0.0941 (0.5163)	0.6212 (1.3189)
c_3	−1.1688 (0.6979)	2.9604 (1.3395)	−0.3549 (0.6838)	1.2607 (1.4461)
c_4	0.2193 (0.3671)	2.5037 (1.3975)	−0.1270 (0.3628)	1.6150 (1.8756)
d	0.4994 (0.2292)	0.5839 (0.3165)	0.8196 (0.3086)	0.4946 (0.3894)
$\bar{R}^2$	0.671	0.623	0.9961	0.913
SER	0.00721	0.00539	0.00755	0.00766
DW	1.52	1.78	1.93	1.56

a. Coefficients of the estimated regressions.
b. Standard errors in parentheses.

adjustment procedures, the APC should be constant. The absence of seasonal variations from the APC based on NSA data implies that seasonal fluctuations of consumption and income are highly correlated——as if seasonal income is treated as permanent income—— and their presence implies that seasonal income is treated differently from regular income ——as if it is at least partly transitory in nature.

Seasonal variations in the APC imply corresponding variations in the MPC. The magnitudes and signs of the quarterly values of the MPC depend on the relative magnitudes and direction of movement relative to the trend of the increments to income and consumption: the MPC will be positive if both move in the same direction, but if in any given quarter consumption and income are negatively correlated when measured relative to the trends, the MPC will be negative. Further, a small seasonal variation of the APC may accompany large variations of the MPC, where, for example, the estimated parameters are based on

TABLE 2. SEASONAL VALUES OF THE APC AND MPC

	NSA		SA	
	Japan	U. S.	Japan	U. S.
MPCA (1)[a]	0.195	0.657	−0.005	0.441
MPCA (2)	0.315	0.669	0.405	0.715
MPCA (3)	−0.333	0.411	−0.389	0.389
MPCA (4)	0.159	0.831	0.102	0.119
$\overline{\text{MPCA}}$	0.084	0.642	0.028	0.416
$\overline{\text{APCA}}$	0.841	0.917	0.817	0.917
MPCB (1)	−0.164	0.657	−0.006	0.441
MPCB (2)	−0.044	0.668	0.404	0.714
MPCB (3)	−0.692	0.410	−0.389	0.388
MPCB (4)	−0.200	0.831	0.101	0.119
$\overline{\text{MPCB}}$	−0.275	0.641	0.028	0.416
APCB (1)	0.413	0.902	0.814	0.918
APCB (2)	0.356	0.940	0.818	0.915
APCB (3)	0.383	0.904	0.818	0.916
APCB (4)	0.458	0.915	0.815	0.913
$\overline{\text{APCB}}$	0.403	0.915	0.816	0.916

a. MPCA denotes values of the MPC computed using the actual mean value, $\overline{\text{APCA}}$, of the APC. MPCB represents values derived from the computed mean average propensity to consume $\overline{\text{APCB}}$.

SA data, if the adjustment procedures are not consistent in the sense discussed by Michael C. Lovell.

The SA data leads to rather constant values of the computed APC, close in magnitude to the actual mean APC, for both countries, but the MPC values fluctuate over a fairly wide range. It appears that small seasonal components (of magnitude or phase) still remain in one or both of the income and consumption series for each country, however the seasonal fluctuations may not be statistically significant.

The computed values of the APC based on U.S. unajusted data capture about fifty per cent of the actual variation in the APC. The MPCs for the U.S. are relatively large and positive, and average about two thirds of the magnitude of the APC; we conclude that the seasonal components of income and consumption are highly correlated in the United States and behavior is as if seasonal fluctuations of income are at least partly anticipated and absorbed into permanent income.

The NSA results for Japan are less satisfactory than those for the U.S. and show a large (though not necessarily significant) discrepancy between the actual and computed mean values of the APC. As a consequence, all values of MPCB (i.e. those calculated from the computed APC) are negative. Further, although the percentage seasonal variation of the computed APCs has the same magnitude as actually observed, its pattern is different, in contrast with the results for the United States. The low computed APCs, and hence the negative MPCs derived from them, appear to be caused by an error in d, the coefficient of the average of lagged APCs in equation 6. If the value of d is increased by approximately one third of its standard error, the computed APCs and the MPCs derived from them (MPCB) approximately equal the actual APCs and derived MPCs (MPCA). A corresponding adjustment would be needed for the coefficient a_1, since a_1 and d are inversely correlated. The low value of d and high value of a_1 may be the result of the very regular pattern of seasonal consumption in Japan during the 1960s.

The Japanese MPCs, after allowance for these adjustments, are generally small in magnitude and vary in sign, with the average MPC over the year close to zero. These results are consistent with the proposition that seasonal income in Japan is treated as if it is transitory.

Conclusions

The responses of consumers in Japan and the United States to seasonal fluctuations of income have been compared through estimates of the parameters of a consumption function with an a priori specified structural form. The estimates on seasonally unadjusted data allow the seasonal patterns of variation of the average and marginal propensities to consume in the two countries to be compared. The results suggest that seasonal income in the United States is largely treated as permanent income, but in Japan it is treated as transitory. The proportion of income received in the form of bonuses or other seasonal payments is also much greater in Japan than in the United States, so the important question arises as to whether the behavioral differences are caused by this institutional factor. The results support the hypothesis that Japan's greater saving rate is partly related to its response to seasonal income; they also suggest, if this response is indeed partly induced by the income structure, a means of adjusting the savings rate in the United States and other countries by differential tax rates for profit related bonus income and regular income.

APPENDIX 1

Date Sources

Aggregate personal consumption expenditures at constant prices

U.S. data are from the *Survey of Current Business* (SCB), July issues, Tables 1.1, 1.2 (SA values in current and 1958 dollars) line 2, and Table 1.19 (NSA values in current dollars) line 2. An unadjusted series for consumption expenditures at constant prices was constructed from the series at current prices and the NSA price index discussed below. The series was normalized to make annual totals agree with the national income accounts. Japanese data are from the *Annual Report on National Income Statistics* (ARNIS), 1970 edition, Tables 3 (NSA and SA values at current prices) and 4 (NSA and SA values at 1965 prices) line 1: Private Consumption Expenditures.

Personal Disposable income at constant prices

The adjusted series for the U.S. are form *SCB* Table 2.1 line 28. Unadjusted values at current prices were obtained via the methodology of Albert Ando and Stephen M. Goldfeld, and were deflated with the constructed NSA price index. Annual totals were reconciled with the national income accounts. Japanese personal disposable income, NSA at current prices, was taken from ARNIS, Account 3: Households and Private Non-profit Institutions: the constant price series was computed with the aid of the NSA consumption expenditure deflator. An adjusted series was obtained by linear regression of the difference between actual observations and a five-quarter trapezoidal moving average (weights: $\frac{1}{2}$, 1, 1, 1, $\frac{1}{2}$) on the moving average with seasonal slope and intercept dummies. The adjusted series was deflated by means of the SA private consumption deflator, and annual totals reconciled with the national accounts. A spectral analysis of the adjusted series showed no detectable peaks at seasonal frequencies.

Price deflator for private consumption expenditures

The implicit price deflator was used for both Japanese regressions and for the U.S. regressions on SA data. An unadjusted series for the U.S. was constructed from quarterly averages of the Consumer Price Index (Bureau of Labor Statistics).

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