Precautionary Savings and Income Uncertainty: Evidence from Japanese Micro Data

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This paper tests the existence of precautionary savings using subjective or self-reported measures of income uncertainty drawn from Japanese household data (primarily from those in their 30s). Two subjective measures are tested: one concerning labor earnings and the other concerning public pension benefits. The results show that, among either nuclear-family households or households that do not receive income transfers from parents, there exist precautionary savings due to uncertainty concerning public pension benefits. As the respondents are primarily in their 30s, we find that those households start to save based on precautionary motives early in their lives. The finding that the effect of public pension uncertainty concerning savings is manifested in nuclear-family households suggests that intergenerational risk-sharing reduces risk and therefore wealth accumulation. Precautionary savings are found to take the form of relatively low-risk assets; no precautionary savings are found in securities. No evidence has been found for precautionary savings being motivated by uncertainty over labor earnings when economic prospects are utilized as the measure of labor income uncertainty.

Keywords: Precautionary savings; Uncertainty; Income risks; Uncertainty over public pension benefits; Risk-sharing; Individual data; Longitudinal data
JEL Classification: E21, D91

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This research was done while the author was Senior Economist at the Institute for Monetary and Economic Studies (IMES) of the Bank of Japan. The author is grateful to Charles Yuji Horioka, Yukinobu Kitamura, Makoto Saito, Miki Kohara, Toshitaka Sekine, and the staff at IMES for their helpful comments. The author would also like to thank the Institute for Research on Household Economics for permitting us to use longitudinal data from the *Japanese Panel Survey of Consumers*. The views expressed and any errors contained herein are solely those of the author, and do not necessarily reflect those of the Bank of Japan, the Economic and Social Research Institute, or the Cabinet Office.

I. Introduction

Models of precautionary savings imply that households will hold more assets when they are faced with greater income uncertainty. Since the late 1980s, many empirical studies on precautionary savings have been conducted in both the United States and Europe.[1] In Japan, analyses of precautionary savings using the aggregate time-series have been conducted by Ogawa (1991), Nakagawa (1999), Doi (2001), and Saito and Shiratsuka (2003).[2] Their conclusions support the existence of precautionary savings; however, primarily due to the lack of available data sources, analyses using Japanese micro data have thus far been rather limited.

This study uses Japanese micro data to test the existence of precautionary savings. As uncertainty measures, subjective or self-reported measures regarding labor earnings and public pension benefits are applied. The precautionary-saving model is estimated using the cross-sectional data, while earnings figures from the longitudinal data are also utilized to derive the permanent income variable in that model.

We find that there is a positive relationship between public pension uncertainty and wealth accumulation, which supports the theory of precautionary savings for nuclear-family households and households that do not receive income transfers from parents.[3] No such relationship is found between households' asset accumulation and uncertainty over labor earnings when economic prospects are utilized as the measure of such uncertainty.

The paper is organized as follows. Section II provides a brief review of the related empirical literature on precautionary savings. Section III discusses the model. Section IV describes the data and the subjective measures of uncertainty. Sections V and VI present empirical results and some extensions. Section VII offers conclusions and discusses some remaining issues.

II. Previous Empirical Studies on Precautionary Savings

Although many empirical studies on precautionary savings have been conducted in the United States and Europe, they have provided only mixed conclusions. Dardanoni (1991), using data on British households, found the average consumption across occupation and industry groups to be significantly lower when income variance is greater; he estimates that more than 60 percent of saving is due to precautionary motives. Carroll and Samwick (1998) used the *Panel Study of Income Dynamics* (PSID) and found that income risk has positive effects on wealth accumulation,

1. Deaton (1992) and Browning and Lusardi (1996) provide reviews of empirical literature.
2. Ogawa (1991) finds that there is a positive relationship between the saving rate and income uncertainty, using the variance of income growth expectations computed from a survey of Japanese households. Nakagawa (1999) applies the same methodology to semi-aggregated data on households by income level, and concludes that precautionary savings tend to be found in low- and middle-income households. Doi (2001) also finds precautionary saving behavior based on employment prospects rather than income prospects obtained from the same survey. On the other hand, Saito and Shiratsuka (2003) investigated precautionary saving as well as "saving as waiting options," and find that during the 1990s, saving as waiting options was more dominant in Japan.
3. In this paper, a nuclear family is defined as a married couple with or without children. If the children live with their parents, the family is called an extended family.

applying proxies for income risks across occupation and education. They further conducted simulation studies using the parameters obtained from empirical results, and found that approximately 50 percent of financial wealth and 45 percent of total net worth can be attributed to precautionary motives. Kazarosian (1997), using the *National Longitudinal Survey* (NLS), applied a similar methodology and concluded that the financial wealth/permanent income ratio would increase by approximately 30 percentage points if income risk is doubled. Engen and Gruber (2001), using the *Survey of Income and Program Participation* (SIPP), found that reducing the unemployment-insurance payment benefit replacement rate by 50 percent would increase gross financial asset holdings by 14 percent for the average worker.

Dynan (1993), on the other hand, found that the coefficient of relative prudence, proposed by Kimball (1990), is not statistically different from zero in the *Consumer Expenditure Survey* (CEX), suggesting that there is no precautionary saving. Guiso *et al.* (1992), using individual data on Italian households, found that consumption is only slightly lower and wealth accumulation only slightly higher (approximately 2 percent of total net worth) for households indicating a greater subjective variance for their next year's earnings. Lusardi (1998), using the *Health Retirement Survey* (HRS), the respondents for which are 51–61 years of age, found precautionary wealth accumulation to be small (2–4.5 percent in financial wealth and 1–3.5 percent in total net worth), applying a subjective next year's income risk, which is calculated by income multiplied by the subjective possibility of job loss during the next year. Starr-McCluer (1996) focused on uncertainty related to spending in medical service, rather than earnings; she found no evidence that wealth accumulation is lower for health-insured households in the *Survey of Consumer Finances* (SCF).

There has been little empirical research on precautionary savings using Japanese micro data. Zhou (2003) applied the methodology of Dardanoni (1991) to the 1996 *Financial Asset Choice of Households*, published by the Ministry of Public Management, Home Affairs, Posts and Telecommunications. She found that consumption is significantly lower when income variance is greater; the result implies that 5.6 percent of total saving is due to precautionary motives for salaried-worker households, while such motive accounts for 64.3 percent of total saving for agricultural, forestry, fishery, or self-employed households. Horioka *et al.* (2002), using the *Japanese Panel Survey of Consumers* (JPSC) conducted by the Institute for Research on Household Economics (IRHE), noted the possibility of the existence of precautionary saving, referring to the fact that households which have experienced unforeseen contingencies such as unemployment, bankruptcy, or traffic accidents reduce their savings.

Shimizutani (2002), on the other hand, in accordance with Dynan (1993), found that the coefficient of relative prudence is not significantly different from zero through 1995–97, although it is positive and significant in 1998 in the *Household Savings Survey* conducted by the Ministry of Public Management, Home Affairs, Posts and Telecommunications.

A central difficulty in empirical analyses of precautionary savings is how to obtain a good measure of individual risk. As discussed by Browning and Lusardi (1996), it should be observable, exogenous, and vary significantly across the population.

Concerning observability, they demonstrate possible problems in the use of some proxy of risk, such as measurement errors, implying that direct measures of subjective measures are more attractive if questionnaires are fully understandable for respondents and replied to accurately.

This research tests the existence of precautionary savings using subjective measures of income uncertainty drawn from the JPSC. To measure individual risk, two dummy variables are used: one concerning labor earnings and the other concerning public pension benefits. The questions are simple and straightforward, avoiding the problem of questions being misunderstood by respondents, as stressed by Browning and Lusardi (1996). The uncertainty of public pension benefits is examined, as public pension benefits play an important role, representing approximately 80 percent of income,[4] among retired households, and because approximately 80 percent of young or middle-aged households worry about their public pension benefits in Japan. These facts raise the question of whether uncertainty over public pension benefits affects the saving behavior of Japanese households. Higo *et al.* (2001) indicated the existence of precautionary savings due to uncertainty concerning public pensions, without offering direct empirical evidence.

III. Empirical Model

The theory of precautionary saving specifies that households facing uncertainty save more if the third derivative of the utility function is positive (Leland [1968] and Sandmo [1970]). One problem with this framework is that it is generally impossible to obtain closed-form solutions.[5] We therefore estimate a reduced-form wealth/permanent-income equation based on the life-cycle permanent income model, which has been used by many authors including Engen and Gruber (2001), Lusardi (1998), Kazarosian (1997), Starr-McCluer (1996), and Guiso *et al.* (1992):

$$\frac{W_i}{Y_i^p} = f(age_i, \sigma_i, \boldsymbol{X}_i). \tag{1}$$

W_i is wealth held by the household i; Y_i^p is the permanent non-property disposable income (hereinafter referred to as permanent income); age_i is the age of the head of the household; σ_i is the uncertainty measure for future income; $\boldsymbol{X}_i$ is the variable vector representing the household characteristics affecting utility. If preference is not homothetic, $\boldsymbol{X}_i$ includes Y_i^p (King and Dicks-Mireaux [1982]). Note that there is a positive relationship between uncertainty and wealth, in accordance with the precautionary-saving model.

4. According to the 1996 *Family Income and Expenditure Survey* published by the Ministry of Public Management, Home Affairs, Posts and Telecommunications, among households with household heads aged over 59 and retired, approximately 80 percent of income is from public pension benefits. The remaining 20 percent is primarily from labor earnings of other household members. In addition, they dissave their financial assets, which correspond to only approximately 10 percent of their income.
5. See the theoretical review of precautionary savings in Browning and Lusardi (1996) and Deaton (1992).

IV. Data and Subjective Measures of Uncertainty

A. Data

The JPSC covered 1,500 single and married women aged 24–34 in 1993, when it was first conducted. The sample was selected on the basis of a stratified two-stage random sampling method throughout the country. Respondents have been followed up regularly in October of each year since then, and six-year panels (1993–98) are currently available (upon application to the IRHE). The survey contains major economic series such as consumption, saving, annual income, wealth, and a series of demographic and economic characteristics including age, martial status, employment conditions, education, and number of children. Although males are excluded from the survey population, the survey does include the information on the husband of females in the sample who are married.

It should be noted that, as the survey is conducted using young or middle-aged women, this paper focuses primarily on the behavior of younger and middle-aged households, and excludes the elderly.

Table 1 indicates the sample characteristics used in equation (3), which is discussed in Section V. We deleted the sample respondents with missing values for regression, and obtained 784 observations in the 1996 JPSC. In the process of estimating permanent income, we exclude single respondents, respondents (wives) who work full-time, and respondents who earn more than ¥1 million per year. We also exclude households in which husbands are either agricultural workers or

Table 1 Descriptive Statistics

Variables	Number of observations	Average	Standard deviation	Minimum	Maximum
Husband's age	279	35.1	4.6	23	45
Wife's age	279	32.5	3.1	27	37
Age difference between husband and wife	279	2.6	3.4	–7	17
Wife's education (translated into years)	279	12.9	1.7	9	16
Number of children	279	1.85	0.87	0	5
Owner-occupier dummy	279	0.48	0.50	0	1
Extended-family dummy	279	0.23	0.42	0	1
Permanent income (real, million yen)	279	5.06	1.73	1.45	12.67
Financial assets/permanent income	279	1.11	0.89	0	5.6
Deposits/permanent income	279	0.59	0.68	0	4.8
Personal insurance (savings-type)/ permanent income	279	0.47	0.41	0	2.5
Securities/permanent income	279	0.05	0.23	0	3.2
Total net worth/permanent income	254	1.46	2.14	–2.4	13.8

Notes: 1. For the owner-occupier dummy, owned house = 1 and others = 0. For the extended-family dummy, living with parents = 1 and others = 0.
2. Personal insurance (savings-type) indicates the total premiums paid thus far for savings-type policies (postal insurance, postal annuity pensions, life insurance, personal pension insurance, reserve-type liability insurance, etc.).

self-employed, as well as those in which the husband and/or wife obtains income from his or her own business.[6] The remaining samples contain few households with heads over 45 years of age, which are accordingly excluded (six observations). Finally, those holding an extreme amount of wealth are dropped (three observations),[7] leaving us with 279 observations to regress the model.

The average age of wives is 32.5 years, while that of husbands is 35.1 years, as shown in Table 1. Education is translated into years in school: junior high school graduate = 9 years; senior high school graduate = 12 years; technical or junior college graduate = 14 years; and university/graduate school graduate = 16 years. Incomes and assets are deflated by the household consumption expenditure deflator obtained from the System of National Accounts published by the Cabinet Office (for assets, the third-quarter seasonally adjusted figure is used). Average permanent income is estimated at ¥5.06 million. The average financial asset/permanent income ratio is 1.11, with financial assets including deposits, securities, and total premium payments already made for the funding of insurance policies, which exclude term insurance without maturity refund.[8]

In addition to the figures given in Table 1, the average annual income before tax (earned in the previous year) and financial assets are ¥5.86 million and ¥5.89 million, respectively (both nominal). In comparison, according to the *Family Savings Survey* (for 1995 and 1996) published by the Ministry of Public Management, Home Affairs, Posts and Telecommunications, workers' households in which the heads are 30–34 years of age hold ¥6.68 million in financial assets and earn ¥5.97 million (¥5.84 million in the 1995 survey); the figures are ¥9.16 million and ¥6.94 million (¥6.58 million in the 1995 survey), respectively, for households in which the heads are 35–39 years of age. Both financial assets and annual incomes in the households covered by our analyses are slightly lower than those in the *Family Savings Survey*.[9]

B. Subjective Measures of Uncertainty

In estimating equation (1), a major problem is what should be chosen as the uncertainty measures. Many previous studies use some proxies for income uncertainty, such as income variance. However, as the JPSC currently provides only a six-year panel, it is difficult to formulate proxies for income uncertainty by computing income variance.[10] In addition, the JPSC asks no direct question concerning households' income uncertainty, such as the probability distribution of their labor earnings or the probability of losing their jobs. Fortunately, however, related to income uncertainty, the JPSC asked a question concerning economic prospects in the second panel (1994)

6. See Appendix 1 for the procedure used in constructing a measure of permanent income.
7. The asset/permanent income ratio is regressed by age and age-squared. Observations for which the equation residuals are four times larger or smaller than the equation standard errors are eliminated (three samples).
8. Appendix 2 explains the definitions of each asset.
9. One possible reason for the discrepancies is that we have eliminated households in which wives work full-time or earn more than ¥1 million per year. The JPSC itself reported the following characteristics of respondents to the survey: (1) there are slightly more couples who live with their parents; (2) there are slightly fewer couples who have no children; (3) the educational background is relatively higher; and (4) household incomes are slightly lower (Institute for Research on Household Economics [1995]).
10. Among the samples used for the estimation of permanent income (2,622 observations, 683 households; see Appendix 1), those in which income data is available for all six years are limited to 149 households (894 samples).

and one concerning the uncertainty of public pension benefits in the fourth panel (1996); those we employ in the regression model.

The question regarding economic prospects is "Do you think that Japan's business conditions will be better in the near future?" Each respondent selected her response from among the following:

1. Much better
2. Slightly better
3. No change
4. Slightly worse
5. Much worse

As companies or enterprises normally take into account their current and future revenues in determining employees' wages, households' economic prospects could generally affect the probability distribution of their expected labor earnings. We assume that the uncertainty over labor earnings for the next year for respondents who selected "no change" is lower than that of those who replied "worse" or "better," all other factors being equal.

Table 2 shows that those who responded "slightly better" and "no change" each account for approximately 40 percent, and that approximately 15 percent of the respondents anticipated that the situation would be "slightly worse." As annual incomes rise, as wives' education levels increase, or as the number of children decreases, the percentage of those anticipating that the situation would be "better" increases. The percentage is also higher for those in which wives (respondents) work compared to those in which wives do not.

The question concerning uncertainty regarding public pension benefits is "Do you think the public pension system is a reliable economic resource for your life after retirement?" The response was selected from among the following:

1. Relying on a public pension, as the public pension will be the primary source of personal income
2. Wish to rely on a public pension, but worried that the amount currently expected is unlikely to be fulfilled
3. Feel uneasy, as the public pension system itself may become unsustainable due to the rapidly aging society
4. Not relying on a public pension
5. Other (please specify)

One could reasonably assume that the respondents who selected replies 2 or 3 would evaluate the uncertainty of future public pension benefits more cautiously or pessimistically than those who selected reply 1. This reasoning suggests an empirically testable implication for our reduced-form model equation (1).[11]

The ratio of those who selected reply 1 is 12.8 percent (Table 3). Almost 80 percent of all respondents indicated that they have some misgivings concerning the public pension system, including 38.5 percent who indicated concern about the decrease in pension benefits and 40.9 percent who indicated concern about the sustainability of the system itself. The ratio of those who do not rely on a pension is 7.9 percent.

11. One potential problem with this specification is that it assumes the expected value of future public pension benefits to be independent of its uncertainty. This problem will be tested in Section VI.

Table 2 Prospects for Business Conditions

Percent

	Number of observations	1	2	3	4	5	Total
All samples	728	0.5	41.6	40.9	14.7	2.2	100
Age group							
25–27	161	0.6	44.1	37.3	15.5	2.5	100
28–32	345	0.9	44.6	40.9	12.8	0.9	100
33–35	222	0.0	35.1	43.7	17.1	4.1	100
Education							
Junior high school graduate	50	0.0	20.0	60.0	12.0	8.0	100
Senior high school graduate	346	0.6	40.5	41.0	16.2	1.7	100
Technical/junior college graduate	266	0.8	45.5	37.6	14.3	1.9	100
University/graduate school graduate	66	0.0	48.5	39.4	10.6	1.5	100
Number of workers							
One	422	0.9	44.3	39.6	12.6	2.6	100
Two	306	0.0	37.9	42.8	17.6	1.6	100
Whether wife works full-time							
Full-time	148	0.0	35.8	43.2	18.9	2.0	100
Part-time	129	0.0	41.1	41.1	16.3	1.6	100
Husband's age							
Younger than 30	72	1.4	44.4	37.5	15.3	1.4	100
30–34	248	0.4	48.8	39.1	10.9	0.8	100
35–39	252	0.4	38.1	42.9	16.3	2.4	100
40–44	124	0.8	32.3	43.5	18.5	4.8	100
45 or older	32	0.0	43.8	37.5	15.6	3.1	100
Annual income							
Less than ¥4 million	28	0.0	25.0	42.9	21.4	10.7	100
¥4 million ≤ income < ¥6 million	270	1.1	41.9	40.0	14.8	2.2	100
¥6 million ≤ income < ¥8 million	264	0.0	41.7	40.5	15.9	1.9	100
¥8 million ≤ income < ¥10 million	111	0.9	43.2	41.4	13.5	0.9	100
¥10 million or more	55	0.0	45.5	45.5	7.3	1.8	100
Number of children							
None	102	0.0	50.0	42.2	5.9	2.0	100
One	212	0.5	46.7	38.7	12.3	1.9	100
Two	315	1.0	37.8	41.3	18.1	1.9	100
Three	88	0.0	36.4	42.0	17.0	4.5	100
Four or more	11	0.0	18.2	54.5	27.3	0.0	100
Privately owned house or not							
Privately owned house	373	0.3	41.8	41.8	14.2	1.9	100
Rented house	355	0.8	41.4	40.0	15.2	2.5	100
Living with parents or not							
Living with parents	260	1.2	39.2	40.8	16.9	1.9	100
Not living with parents	468	0.2	42.9	41.0	13.5	2.4	100

Note: Excluding single households and those in which husbands are farmers or self-employed.

Table 3 Uncertainty over Future Public Pensions

Percent

	Number of observations	1	2	3	4	Total
All samples	736	12.8	38.5	40.9	7.9	100
Age group						
27–29	183	9.8	42.6	39.3	8.2	100
30–34	345	13.9	35.9	40.9	9.3	100
35–37	208	13.5	38.9	42.3	5.3	100
Education						
Junior high school graduate	44	22.7	25.0	25.0	27.3	100
Senior high school graduate	325	14.5	40.3	39.1	6.2	100
Technical/junior college graduate	280	10.4	39.6	43.9	6.1	100
University/graduate school graduate	87	9.2	34.5	46.0	10.3	100
Number of workers						
One	394	12.2	38.8	40.6	8.4	100
Two	342	13.5	38.0	41.2	7.3	100
Whether wife works full-time						
Full-time	149	14.1	38.3	40.9	6.7	100
Part-time	165	13.9	35.2	41.8	9.1	100
Husband's age						
Younger than 30	99	8.1	33.3	45.5	13.1	100
30–34	251	11.6	36.7	43.0	8.8	100
35–39	251	12.7	40.2	40.2	6.8	100
40–44	109	18.3	42.2	35.8	3.7	100
45 or older	26	19.2	42.3	30.8	7.7	100
Annual income						
Less than ¥4 million	104	14.4	28.8	47.1	9.6	100
¥4 million ≤ income < ¥6 million	277	11.2	41.5	37.9	9.4	100
¥6 million ≤ income < ¥8 million	222	14.4	35.6	44.1	5.9	100
¥8 million ≤ income < ¥10 million	84	13.1	42.9	39.3	4.8	100
¥10 million or more	49	10.2	46.9	32.7	10.2	100
Number of children						
None	93	10.8	38.7	41.9	8.6	100
One	178	9.0	32.6	46.1	12.4	100
Two	334	13.2	39.8	39.8	7.2	100
Three	120	17.5	41.7	38.3	2.5	100
Four or more	11	27.3	54.5	9.1	9.1	100
Privately owned house or not						
Privately owned house	402	12.9	40.0	40.3	6.7	100
Rented house	334	12.6	36.5	41.6	9.3	100
Living with parents or not						
Living with parents	257	13.6	38.1	40.5	7.8	100
Not living with parents	479	12.3	38.6	41.1	7.9	100

Note: As in Table 2.

The higher the wife's education level and the younger the husband, the higher the percentage of respondents indicating stronger uncertainty regarding pensions. The ages of respondents and wives' working status makes no significant difference.

V. Empirical Results

Prior to the regression, probit estimations are conducted to examine possible factors that may be correlated with both wealth accumulation and uncertainty measures; those variables should be included in the model, as the obtained parameters will otherwise be biased. Some variables are found to be correlated with both the wealth/permanent-income ratio and future uncertainty: for economic prospects, wives' education, double- or single-income household dummy, current income, and number of children; for uncertainty regarding public pension benefits, wives' education, number of children, and age differences between husbands and wives (see Appendix 3 for more details). Thus, based on equation (1), the following equations (2) and (3) have been estimated, including the above factors as explanatory variables.

$$\frac{W_i}{Y_i^p} = a_0 + a_{11}FDUM1_i + a_{12}FDUM2_i + a_2 Y_i^p + a_{31}Age_i + a_{32}Age_i^2 + a_4 Fedu_i + a_5 Children_i + a_6 Nem_i + a_7 Income_i + e_i. \quad (2)$$

$$\frac{W_i}{Y_i^p} = a'_0 + a'_{11}IDUM2_i + a'_{12}IDUM3_i + a'_{13}IDUM4_i + a'_2 Y_i^p + a'_{31}Age_i + a'_{32}Age_i^2 + a'_4 Fedu_i + a'_5 Children_i + a'_6 Agap + e'_i. \quad (3)$$

The variables are defined as follows.

W: Wealth
FDUM1: Reply to economic prospects = 1 for 1 or 2, and 0 dummy for the others
FDUM2: Reply to economic prospects = 1 for 4 or 5, and 0 dummy for the others
IDUM2: Reply to uncertainty regarding public pensions = 1 for 2, and 0 dummy for the others
IDUM3: Reply to uncertainty regarding public pensions = 1 for 3, and 0 dummy for the others
IDUM4: Reply to uncertainty regarding public pensions = 1 for 4, and 0 dummy for the others
Y^p: Permanent income
Age: Age of husband
Fedu: Educational background of wife (respondent)
Children: Number of children
Nem: Double income = 1; 0 dummy for the others
Income: Annual income for the previous year
Agap: Age difference between husband and wife (husband's age – wife's age)

Permanent income, Y_i^p, is estimated using longitudinal data from the JPSC (see Appendix 1).

The theory demonstrates that households with a utility function, for which the third derivative is positive, consume less in the current period if they are uncertain about their prospects for future income. Therefore, parameters a_{11}, a_{12}, a'_{11}, a'_{12} are expected to satisfy the following conditions:

$$\begin{aligned} &a_{11} > 0,\ a_{12} > 0 \\ &a'_{11} > 0,\ a'_{12} > 0. \end{aligned} \tag{4}$$

Furthermore, precautionary saving effects against the uncertainty over future public pension benefits would not exceed the amount of life-cycle savings supplementarily accumulated by respondents who are not dependent on a public pension:

$$\max(a'_{11},\ a'_{12}) \leq a'_{13}. \tag{5}$$

In accordance with the age effects, if we assume a finite model, the wealth/age profile becomes hump-shaped. As this study covers households with heads under 45 years of age, the age effects are expected to be positive:

$$\begin{aligned} &a_{31} + 2\ a_{32} age > 0 \\ &a'_{31} + 2\ a'_{32} age > 0. \end{aligned} \tag{6}$$

Table 4 highlights the results. Neither dummy of those who responded that business conditions would be "better" nor "worse" is statistically significant at all.[12] As for uncertainty regarding public pension benefits, the *p*-value becomes closer to zero but not statistically significant either. However, when extended-family (three-generation) households are excluded, the dummies for pension uncertainty become significant. Those with misgivings regarding public pensions possess more financial assets, by approximately 40 percentage points in terms of the permanent-income ratio, compared with those who selected reply 1. This result implies that, among nuclear-family households, households with uncertainty concerning public pensions accumulate more financial assets by approximately ¥2.1 million, which corresponds to approximately one-third of the average financial assets held.[13] There is no difference in the effects between "uncertainty about reduced pension benefits" (reply 2) and "uncertainty about the system" (reply 3).

12. The results do not change even if extended families are excluded (the *p*-value of the dummy of those who responded "worse" was 0.277; the number of observations for the equation was 228).
13. The average permanent income and financial wealth for the sample reported in Table 5 [2] are ¥5.069 million and ¥5.849 million, respectively. The estimated parameters may be underestimated due to the exclusion of expected pension benefits from permanent income.

Table 4 Effects of Uncertainty on Wealth Accumulation

	Financial assets		
	Coefficient	s.e.	*p*-value
Economic prospects			
FDUM1	–0.028	(0.101)	0.785
FDUM2	0.068	(0.146)	0.639
Uncertainty concerning public pensions			
(1) All samples			
IDUM2	0.202	(0.139)	0.147
IDUM3	0.254	(0.149)	0.088
IDUM4	0.299	(0.286)	0.297
(2) Nuclear families			
IDUM2	0.394	(0.144)	0.007
IDUM3	0.381	(0.152)	0.013
IDUM4	0.695	(0.357)	0.053

Note: The estimation method is OLS. For economic prospects, those who responded "no change" are regarded as standard. The number of observations on the equation is 296. For uncertainty concerning public pensions, those who responded "relying" are regarded as standard. The number of observations for all samples and for nuclear families is 296 and 228, respectively. Heteroscedasticity-robust standard errors are given in parentheses. Economic prospects were surveyed in 1994. Uncertainty over public pensions was surveyed in 1996. For more detailed estimation results for the latter, refer to Table 5.

More detailed results for uncertainty regarding public pensions are given in Table 5 [1], together with the results for total net worth. The pension uncertainty dummy is not significant for the total net worth, even when extended-family households are excluded. This is probably due to the fact that, in Japan, where physical assets such as housing and land are commonly owned not for investment but for living purposes, it is more rational to accumulate financial assets for future living expenses as a precautionary behavior.

In Table 5 [2], financial wealth is divided into three categories: deposits, the accumulated amount for personal insurance, and securities. Public pension uncertainty dummies have no effects on securities. On the other hand, the estimated coefficients show positive values both in deposits and in the accumulated amount for personal insurance. Although neither is statistically significant at the 5 percent level, the coefficient becomes highly significant if those assets are aggregated. Thus, households accumulate more wealth in deposits and/or personal insurance for precautionary motives, but not in securities.

Those who responded "not relying on pension" (reply 4) have more financial assets by approximately 70 percentage points in terms of the permanent-income ratio, compared to those depending on public pensions, although the *p*-value of the coefficient is marginally lower than the 5 percent level. This broadly confirms that public pensions and life-cycle savings are substituted for each other (equation [5] holds).

Table 5 Uncertainty over Public Pension Benefits and Wealth Accumulation

[1] Financial Wealth and Total Net Worth

	Financial assets		Total net worth	
	All samples	Nuclear families	All samples	Nuclear families
IDUM2	0.202 (0.139)	0.394 (0.144)***	–0.603 (0.668)	–0.040 (0.665)
IDUM3	0.254 (0.149)*	0.381 (0.152)**	–1.092 (0.639)	–0.668 (0.626)
IDUM4	0.299 (0.286)	0.695 (0.357)*	0.119 (0.943)	0.309 (0.991)
Age	–0.039 (0.133)	–0.208 (0.172)	–0.485 (0.367)	–0.639 (0.533)
Age^2	0.002 (0.002)	0.005 (0.003)*	0.009 (0.006)	0.011 (0.008)
Y^p	0.006 (0.028)	0.019 (0.032)	0.041 (0.073)	0.084 (0.081)
Fedu	0.117 (0.033)***	0.124 (0.035)***	0.196 (0.072)***	0.221 (0.077)***
Children	–0.125 (0.064)*	–0.142 (0.071)**	–0.253 (0.183)	–0.276 (0.202)
Agap	–0.051 (0.020)**	–0.066 (0.023)***	–0.039 (0.074)	–0.016 (0.086)
Constant	–1.036 (2.141)	1.112 (2.773)	5.577 (5.896)	7.080 (8.492)
Number of observations	279	214	254	203

[2] Deposits, Personal Insurance, and Securities (Nuclear Families)

	Deposits	Personal insurance (Tobit)	Securities (Tobit)	Financial assets excluding securities
IDUM2	0.187 (0.114)	0.220 (0.113)*	0.155 (0.330)	0.358 (0.135)***
IDUM3	0.212 (0.114)*	0.194 (0.113)*	–0.084 (0.333)	0.383 (0.144)***
IDUM4	0.528 (0.264)**	0.050 (0.162)	0.265 (0.478)	0.597 (0.306)*
Age	–0.291 (0.155)	0.101 (0.084)	0.378 (0.300)	–0.227 (0.154)
Age^2	0.005 (0.002)**	–0.001 (0.001)	–0.005 (0.004)	0.005 (0.002)**
Y^p	0.036 (0.027)	–0.026 (0.019)	0.144 (0.057)**	0.004 (0.030)
Fedu	0.093 (0.029)***	0.019 (0.019)	0.156 (0.065)**	0.105 (0.031)***
Children	–0.125 (0.052)**	–0.020 (0.039)	–0.020 (0.118)	–0.134 (0.066)**
Agap	–0.033 (0.020)	–0.038 (0.014)***	–0.040 (0.044)	–0.065 (0.023)***
Constant	3.178 (2.365)	–2.297 (1.443)	–10.465 (5.500)*	1.730 (2.488)
Number of observations	214	214	214	214
Log likelihood		–137.1	–85.55	

Notes: 1. The estimation method is OLS or otherwise shown in the table. Heteroscedasticity-robust standard errors are given in parentheses. ***, **, and * indicate the statistical significance of independent variables, at the 1 percent, 5 percent, and 10 percent levels, respectively.
2. Personal insurance indicates the total premiums paid thus far for savings-type policies (postal insurance, postal annuity pensions, life insurance, personal pension insurance, reserve-type liability insurance, etc.).
3. Financial assets = deposits + personal insurance + securities.

The age effect in financial wealth excluding securities is found to be positive for nuclear families and therefore consistent with equation (6).

One possible reason for the effect of uncertainty regarding pensions being significant only for nuclear families is that intergenerational risk-sharing reduces the effect of precautionary savings. To investigate this problem, we further regress the model by dividing the observations into two groups according to whether they receive any income transfer from parents, the response to which is available from the

JPSC.[14] The results are given in Table 6. Among households that do not receive income transfers from parents, the effect of uncertainty regarding pensions is significant; however, among those that do receive such income transfers, the effect is insignificant. The coefficients of public pension uncertainty dummies are approximately 30 percent among the former, implying that households with uncertainties concerning public pensions accumulate more wealth by ¥1.5 million (approximately one-fourth of financial wealth held).

The other possible reason is the "demonstration effect" proposed by Stark (1995). Stark's model assumes that children simply imitate their parents' actions with a certain probability, and that parents are aware that their own children may be imitators. In this model, the higher the probability of imitation, the more "productive" the transfers to one's parents. The children must be close to their parents so that they can imitate their parents' behaviors. Thus, if parents live with grandparents, the possibility of their children living with them in the future increases, as does the possibility of them making some transfers to their parents as their parents did for their grandparents. If Stark's model can be applied to Japanese households, households who live with their parents might anticipate co-residence with their children in the future, which has the effect of reducing their current precautionary savings.

Lastly, the possible reasons for the effects of economic prospects on wealth not being significant are as follows. First, our analyses are based on the hypothesis, as mentioned earlier, that respondents replying that the economic prospects would be "better" or "worse" recognize a larger risk in labor earnings than those who responded that there would be "no change." It is likely, however, that a substantial number of

Table 6 Uncertainty over Public Pension Benefits and Wealth Accumulation (Comparison Based on Whether Economic Transfers Are Received from Parents)

	Financial assets	
	With transfers	Without transfers
IDUM2	–0.358 (0.438)	0.290 (0.143)**
IDUM3	–0.290 (0.481)	0.317 (0.150)**
IDUM4	–0.762 (0.467)	0.555 (0.337)
Age	0.313 (0.185)*	–0.156 (0.156)
Age^2	–0.004 (0.003)	0.003 (0.002)
Y^p	–0.065 (0.096)	0.023 (0.029)
Fedu	0.067 (0.053)	0.126 (0.036)***
Children	–0.139 (0.127)	–0.137 (0.075)*
Agap	–0.032 (0.042)	–0.054 (0.024)**
Constant	–5.029 (3.260)	0.507 (2.549)
Number of observations	67	212

Note: As in Table 5.

14. Households that receive economic transfers from parents are those that responded "yes" to the question concerning whether they receive any funds for the repayment of housing loans, rent, living expenses, or the like from either set of parents. Those that responded "no" are designated as households that do not receive economic transfers from parents.

households recognize only limited effects of the deteriorating economic conditions on their own labor earnings, particularly in consideration of the fact that the survey was conducted in 1994, when the stagnant economic conditions in Japan were not perceived to be as severe as they are today. Second, if the economic prospects are recognized as transitory and thus not affecting uncertainty regarding permanent income, the effects on precautionary savings may become too weak to allow sufficient verification. Third, it is also possible that the economic prospects accurately indicate income uncertainty, and that the results therefore indicate no precautionary savings due to uncertainty over labor earnings.

To investigate the above possible causes, it is worthwhile to refer to another survey. According to *The Bank's Opinion Survey on Lifestyle and Financial Behavior, No. 2*, published by the Bank of Japan in 1994, the ratio that replied that business conditions were "bad" or "fairly bad" amounted to 86.6 percent in 1994 (Table 7). As for the next year's business conditions, the ratio that replied "worse" or "slightly worse" was 16.9 percent, while that for "no change" was 55.8 percent. Regarding the average economic growth rate in the coming five to 10 years, more than 70 percent of respondents replied that the Japanese economy growth rate would continue to be low, including 21.6 percent of those who expected the growth rate to be possibly negative. As for their own income, on the other hand, 33.5 percent of respondents replied that their income had decreased compared to the previous year in 1994. However, only 21.2 percent expected their income to fall the next year. Concerning their income in the coming five to 10 years, 41.5 percent of those expected their income to increase, while 26.7 percent expected their income to decrease. Meanwhile, the inflation rate was expected to be no more than 1–3 percent by approximately 70 percent of respondents for the next year, as well as for the coming five to 10 years.

It should be noted that this survey does not ask questions concerning income uncertainty, but does ask questions concerning income growth. Furthermore, the income prospects do not exclude the effect of deterministic factors, including age effects. Thus, as the next step, we compare equation residuals and their variance obtained from equation (A.4) in Appendix 1 for each reply to the economic prospects (Table 8). The variance tends to be marginally higher for respondents who selected "better" or "worse," compared to those who selected "no change" in 1994. However, in the following year it reverses, and there is no clear relationship between the variance and the economic prospects.

Thus, the reason that the economic-prospect dummies are not significant is that there may have been little relationship between income uncertainty and economic prospects, rather than because there are no precautionary-saving motives.

VI. Precautionary Savings or Life-Cycle Savings?

The results given in the previous section imply that one-third of financial wealth can be attributed to uncertainty over future pensions among nuclear-family households. In the previous section, we assumed that uncertainty over public pension benefits is

Table 7 Assessments of Business Conditions, Income, and Prices

Percent

Economic prospects (business conditions)							
	Good	Fairly good	Normal	Fairly bad	Bad		
Current situation	0.3	1.7	11.4	39.7	46.9		
	Better	Slightly better	No change	Slightly worse	Worse		
Next year	1.1	26.1	55.8	11.2	5.7		
	High	Low	Low, possibly negative	No idea			
Average economic growth rate for the next 5–10 years	3.5	50.7	21.6	24.2			
Income							
	Increased	Increased slightly	No change	Decreased slightly	Decreased		
Change from last year	2.2	17.8	46.3	18.9	14.6		
	Increase	Increase slightly	No change	Decrease slightly	Decrease	No idea	
Next year	1.7	20.7	56.3	13.2	8.0	—	
For the next 5–10 years	7.3	34.2	24.8	13.2	13.5	6.8	
Prices							
	Fall 7 percent–	Fall 4–6 percent	Fall 1–3 percent	Almost the same	Rise 1–3 percent	Rise 4–6 percent	Rise 7 percent–
Change from last year	3.6	2.9	5.3	28.9	29.3	19.3	10.3
Next year	1.6	1.1	2.8	30.6	35.1	17.1	11.3
Average inflation rate for the next 5–10 years	1.7	1.1	4.1	15.1	47.8	20.4	9.0

Notes: 1. The figures are obtained from *The Results of the Bank's Opinion Survey on Lifestyle and Financial Behavior, No. 2,* published by the Bank of Japan. The survey covered 3,407 respondents among a total of 4,000 representative consumers from across the nation who were older than 19 years of age.

2. Concerning economic prospects, the questions were "What is your assessment of current business conditions?" and "What is your assessment of the prospects for business conditions next year?" As for the growth rate for the next 5–10 years, the question was "What do you expect the overall average economic growth rate of the Japanese economy to be over the next 5–10 years?" Respondents selected a reply from among the following:
   "1. Will be a high growth rate as in the past."
   "2. Will continue to be low."
   "3. Will continue to be low, and possibly negative."
   "4. No idea."

3. As for income, the questions were "Has your (and your spouse's) income increased or decreased since last year?" and "What do you expect your (and your spouse's) income to be next year?" As for the income for the next 5–10 years, the question was "What do you expect your (and your spouse's) income to be over the next 5–10 years?" Respondents selected a reply from among the following:
   "1. Will increase compared to income this year."
   "2. Will increase slightly compared to income this year."
   "3. No change."
   "4. Will decrease slightly compared to income this year."
   "5. Will decrease compared to income this year."
   "6. No idea."

4. As for prices, the questions were "What is your assessment of the price level compared to last year?" and "What do you expect the price level to be next year compared to this year?" As for the price for the next 5–10 years, the question was "What do you think the average inflation rate will be over the next 5–10 years in Japan?"

Table 8 Equation Residuals by Economic Prospect

	Better			No change			Worse		
	Number of observations	Average	Variance	Number of observations	Average	Variance	Number of observations	Average	Variance
e_{it} (previous year)	123	–0.008	0.018	88	0.006	0.020	38	–0.035	0.013
e_{it+1} (this year)	123	–0.009	0.021	88	0.021	0.010	38	0.010	0.012
e_{it+2} (next year)	123	0.006	0.013	88	0.004	0.017	38	0.030	0.014
e_{it+3} (two years in the future)	123	0.010	0.022	88	0.007	0.010	38	0.008	0.023

Note: This table reports the average and variance of equation residuals obtained from the earning equation shown in Appendix Table 1. The observations are those for which equation residuals are available for the second- to fifth-year panel, and for which a reply concerning economic prospects is available.

independent of the expected value of households' public pension benefits. If there is a correlation between those, however, the effect may include life-cycle savings due to the differences in expected pension benefits. This is important particularly in terms of policy implications. If households accumulate more wealth due to uncertainty, policies for reducing uncertainty would reduce precautionary savings and stimulate consumption, all other factors being equal. If households accumulate more assets for life-cycle motives, however, policies should affect the expected pension benefits of such households if those policies are to have any influence on consumption.

To investigate this problem, the most direct approach is to test the correlation between the public pension benefits expected by households and the reply regarding public pension uncertainty. If households with higher public pension uncertainty accumulate more wealth for life-cycle motives rather than precautionary motives, the expected value of public pension benefits should be lower than that for those without public pension uncertainty, all other factors being equal. Regrettably, however, such a question is not posed in the JPSC. Thus, we employ the target savings amount for retirement, which is available in the JPSC. If households with public pension uncertainty accumulate more wealth for life-cycle motives, the expected target savings amount for retirement should be higher than that for households without public pension uncertainty, all other factors being equal. We also regress the wealth/income equation including the target savings amount to control possible biases due to the correlation between the target savings amount and uncertainty over public pension benefits.

A. Data

The JPSC asks two types of questions concerning target savings amounts. One involves target savings amounts by different objectives. The question consists of two stages. First, savings objectives must be selected in "For what purposes do you and your spouse accumulate wealth? Please select your primary objective, secondary objective, and the third most important objective from among the following." As examples of savings objectives, 12 items are listed, including "for retired life," "for unexpected expenses due to sickness, disasters, and others," "for children's education," "for children's marriages,"

and "for housing loans."[15] Then, for each of the three objectives selected, respondents indicate the target amount and planned fulfillment year (how many years from now). The other question simply asks the total target savings amount: "What is the total target savings you and your spouse are trying to achieve?" This may be problematic in the sense that savings objectives are not limited to life-cycle savings for life after retirement, but can be employed as a reference measure, as more respondents provided answers compared with the first question.[16]

B. Uncertainty Concerning Public Pensions and Target Savings Amounts

Table 9 summarizes the above two target savings amounts for each reply concerning public pensions.[17] The target savings amounts for those who selected reply 1 and those who selected replies 2 or 3 are similar in terms of both average and standard deviation for "target savings amounts for retired life"; for nuclear families, the average is somewhat higher. These findings are overall the same as for "total target savings amounts." Thus, no good argument can be made for those who selected replies 2 or 3 having higher target savings amounts. In addition, the sum of the planned fulfillment time and husbands' ages is found to be 59.7 years on average, implying that households prepare to achieve their life-cycle savings by around age 60; this does not differ among replies concerning public pension uncertainty.

However, the above findings do not control factors other than uncertainty concerning public pensions, which may affect target savings amounts. The following two models are thus estimated as the next step.

According to the life-cycle permanent-income theory, households' target savings amounts for retired life equal the expected assets held at the time of retirement. Incorporating uncertainty, we obtain

$$\frac{W_i^*}{Y_i^p} = h(\sigma_i, \boldsymbol{X}_i), \tag{7}$$

where W^* is the target savings amount for retired life. Thus, equation (3) is modified as follows:

$$\frac{W_i^*}{Y_i^p} = b_0 + b_{11}IDUM2_i + b_{12}IDUM3_i + b_{13}IDUM4_i + b_2 Y_i^p + b_3 Fedu_i + b_4 Children_i + b_5 Agap + \eta_i. \tag{8}$$

15. The other motives are "for purchasing durable goods," "for leisure activities," "for paying taxes," "for funds to perform independent business operations," "no particular reason but simply for peace of mind," "for inheritance to children," and "others."
16. In "savings for retired life," target savings amounts are unavailable unless the objective is ranked third or higher as a savings motive. Of the 718 married respondents who replied to the question concerning pensions, 335 of those ranked "savings for retired life" third or higher (46.7 percent), while "target total savings amounts" are available for 714 observations.
17. For "savings for retired life," if no reply was obtained in the 1996 survey, target amounts are drawn from the 1995, 1994, or 1993 surveys (with available data from the year closest to 1996 being preferred). The results remained the same when the samples were restricted to those in which replies were obtained in 1996 only.

Table 9 Target Savings Amounts and Uncertainty over Public Pensions

	Response to question concerning uncertainty over pension	Number of observations (subtotal)	Target savings amount (¥ millions)			
			Average	Standard deviation	Minimum	Maximum
1. All samples						
For retired life	1	66	11.89	12.19	2.00	60.00
	2	186	11.74	10.90	1.00	70.00
	3	189	11.79	13.21	0.50	100.00
	4	36	18.03	24.76	1.00	100.00
		(477)				
Total target amount currently planned	1	90	24.56	23.35	1.00	100.00
	2	277	20.67	18.43	1.00	100.00
	3	292	21.50	21.95	1.00	160.00
	4	55	26.33	40.07	1.00	200.00
		(714)				
2. Nuclear families						
For retired life	1	38	14.25	14.86	2.00	60.00
	2	114	9.91	7.79	1.00	40.00
	3	110	12.26	11.14	1.00	50.00
	4	23	23.30	29.62	1.00	100.00
		(285)				
Total target amount currently planned	1	56	25.36	26.38	2.00	100.00
	2	181	18.55	17.00	1.00	100.00
	3	191	21.83	21.67	1.00	105.00
	4	37	31.35	47.21	1.00	200.00
		(465)				
3. Nuclear families (Samples used in Table 5)						
For retired life	1	11	11.64	8.73	3.00	3.00
	2	49	10.52	7.82	1.00	30.00
	3	50	12.54	14.94	1.00	50.00
	4	8	26.63	33.36	3.00	100.00
		(118)				
Total target amount currently planned	1	20	17.65	15.99	2.00	50.00
	2	83	19.08	16.68	1.00	90.00
	3	92	18.75	18.20	1.00	105.00
	4	13	34.46	48.86	3.00	170.00
		(208)				

Notes: 1. Item 1 covers all samples from which necessary data (target savings amounts or total targets, and responses to questions concerning uncertainty over pensions) can be obtained. Item 2 indicates those not living with parents among 1; and item 3 represents samples used for estimation of financial assets in Table 5, among those in 2. All exclude single households and those in which husbands are farmers or self-employed.

2. For data on target savings amounts, if no reply was obtained in the 1996 survey, the target amounts from the 1993, 1994, or 1995 survey are used (with available data from the year closest to 1996 being preferred; 155 out of 477 samples). In addition, households with extremely high target savings amounts (¥500 million or more; two samples for target savings amounts and one sample for total targets) are excluded.

If households with uncertainty concerning public pensions have a higher target savings amount, b_{11} and b_{12} will be positive.

The second model is simply to add the target savings amount to equation (3). Although the observation is reduced to half, by adding the target savings amount as an explanatory variable, possible biases caused by the correlation between the expected value and the uncertainty of public pension benefits can be controlled.

The results are given in Tables 10 and 11. Neither b_{11} nor b_{12} is significant at all (Table 10). The third column of Table 11 demonstrates that adding the target savings amount has little effect on the coefficients of public pension uncertainty dummies, namely *IDUM2* and *IDUM3*, for nuclear families. The effects are not statistically different from those given in the second column of Table 5 [2]. These results indicate that the positive effect of public pension uncertainty on wealth accumulation is due to precautionary rather than life-cycle motives.[18]

Another finding supporting the existence of precautionary savings is that uncertainty for future public pension benefits increases deposits and/or personal insurance, but not securities. As Kimball (1993) discussed, the theory of portfolio choice demonstrates that uninsurable risk may induce prudent investors to reduce their holdings of risky assets in order to lower their overall exposure to risk. Our empirical results presented in Table 5 [2] are consistent with this argument.

Thus, from the two points concerning the target savings amount and the possession of risk assets, no evidence is found to reject the existence of precautionary savings caused by uncertainty over future public pension benefits.

VII. Conclusions

The main contribution of this paper to the literature on precautionary savings is testing of a theory using subjective or self-reported measures of uncertainty concerning income, using micro data on Japanese households (primarily from those in their 30s). The longitudinal data are utilized in estimating earning functions for the calculation of permanent income. The following conclusions have been reached.

First, nuclear-family households and households that do not receive income transfers from parents accumulate more wealth if they recognize public pension uncertainties. The effect is 30–40 percentage points in the financial-asset/permanent-income ratio. On average, ¥1.5–2.1 million in financial assets (one-third or one-fourth of the total financial assets held) is due to uncertainty regarding public pensions. As the respondents are primarily in their 30s, we find that households start to save due to uncertainty early in their lives, even if they will not start to receive their pension benefits at least until they become 60 years old. The effect may not totally exclude life-cycle savings; however, the acquired data have not confirmed any effects due to life-cycle motives.

18. It is assumed in this paper that the uncertainty over public pension benefits is independent of the rate of time preference and the degree of risk aversion of households. The effects of public pension uncertainty dummies do not alter when the planned fulfillment age (the sum of planned fulfillment time and husbands' ages) is included as an explanatory variable in equation (3), although the number of observations is reduced to 92.

Table 10 Uncertainty over Public Pension Benefits and Target Savings Amounts

	All samples		Nuclear families	
	For retired life	Total amount currently planned	For retired life	Total amount currently planned
IDUM2	–0.429 (0.605)	–0.612 (0.796)	–0.785 (0.698)	–0.716 (0.978)
IDUM3	0.144 (0.684)	–0.885 (0.792)	–0.587 (0.768)	–1.043 (0.964)
IDUM4	2.101 (1.273)	1.863 (1.863)	2.978 (1.742)*	3.410 (2.551)
Y^P	–0.245 (0.115)**	–0.318 (0.131)**	–0.064 (0.094)	–0.343 (0.159)**
Fedu	0.316 (0.138)**	0.591 (0.191)***	0.290 (0.122)**	0.733 (0.207)***
Children	0.070 (0.268)	–0.013 (0.431)	–0.067 (0.255)	0.160 (0.504)
Agap	0.150 (0.108)	0.018 (0.079)	–0.021 (0.069)	–0.006 (0.083)
Constant	–0.816 (2.000)	–1.298 (2.41)	–0.448 (1.677)	–3.286 (2.613)
Number of observations	166	273	121	209

Note: The estimation method is OLS. Heteroscedasticity-robust standard errors are given in parentheses. ***, **, and * indicate the statistical significance of independent variables, at the 1 percent, 5 percent, and 10 percent levels, respectively.

Table 11 Effects of Uncertainty over Public Pension Benefits on Financial Assets, Including Target Savings Amounts as an Explanatory Variable

	All samples		Nuclear families	
	For retired life	Total amount currently planned	For retired life	Total amount currently planned
IDUM2	0.116 (0.179)	0.242 (0.127)*	0.432 (0.168)**	0.426 (0.130)***
IDUM3	0.268 (0.200)	0.334 (0.139)**	0.506 (0.195)**	0.471 (0.141)***
IDUM4	0.295 (0.336)	0.205 (0.209)	0.759 (0.437)*	0.531 (0.269)**
Target savings amount	0.065 (0.037)*	0.076 (0.018)***	0.078 (0.055)	0.073 (0.018)***
Age	–0.280 (0.219)	–0.005 (0.118)	–0.607 (0.261)**	–0.145 (0.147)
Age^2	0.005 (0.003)	0.001 (0.002)	0.010 (0.004)***	0.003 (0.002)
Y^P	0.005 (0.037)	0.026 (0.026)	0.001 (0.041)	0.039 (0.030)
Fedu	0.086 (0.041)**	0.075 (0.029)***	0.090 (0.042)**	0.076 (0.032)**
Children	–0.166 (0.085)*	–0.112 (0.062)*	–0.129 (0.095)	–0.135 (0.069)*
Agap	–0.072 (0.031)**	–0.042 (0.019)**	–0.066 (0.031)**	–0.054 (0.020)***
Constant	3.505 (3.785)	–1.463 (1.987)	8.273 (4.538)*	0.346 (2.429)
Number of observations	166	273	121	209

Note: As in Table 5.

Second, the finding that the effect of public pension uncertainty on savings is significant for nuclear families but not for extended families suggests that intergenerational risk-sharing reduces risk and therefore wealth accumulation.

Third, precautionary savings due to public pension uncertainty are found to take the form of relatively low-risk assets such as deposits and private personal insurance; no precautionary savings are found in securities.

Finally, there is no evidence for precautionary savings when economic prospects are utilized as the measure of labor income uncertainty. This is partly due to the fact that the survey was conducted in 1994, when a considerable number of households did not recognize a relationship between economic prospects and their own risk in labor earnings. The result may differ if more recent data are applied (as well as data acquired by directly asking individuals about their income risk).

APPENDIX 1: THE CONSTRUCTION OF PERMANENT INCOME

A. Estimation of Permanent Income

In accordance with King and Dicks-Mireaux (1982), the permanent income (defined as normal age-adjusted annual earnings) is given by

$$\ln y_i^p = \boldsymbol{Z}_i\boldsymbol{\gamma} + u_i - c(age_i), \tag{A.1}$$

where y_i^p is the permanent income of individual i, $\boldsymbol{Z}_i$ is the observable variable vector (such as education and occupation), $\boldsymbol{\gamma}$ is the associated coefficient vector, age_i is his or her age in the sample year, and u_i is the unobserved variable measurement characteristics such as skill, willingness, or luck constructed such that its mean value in the population is zero and its variance is σ_u^2. The final term, $c(age_i)$, indicates a cohort effect, which reflects the fact that younger generations are better off than their elders due to technological progress and capital accumulation.

Current earnings differ from permanent income for two reasons. One is the existence of an age-earnings profile over the life-cycle, and the other is the transitory component of earnings. Therefore, current income in year t, y_{it}, is expressed as follows:

$$\ln y_{it} = \ln y_i^p + h(age_{it} - \overline{age}) + e_{it}, \tag{A.2}$$

where h measures the age-earnings profile. The transitory component of income, denoted by e_{it} (average = 0; variance = σ_e^2), is assumed to be uncorrelated with u_i. Combining equations (A.1) and (A.2) gives the following equation:

$$\begin{aligned} &\ln y_{it} = \boldsymbol{Z}_i\boldsymbol{\gamma} + g(age_{it}) + u_i + e_{it} \\ &g(age_{it}) = h(age_{it} - \overline{age}) - c(age_{it}). \end{aligned} \tag{A.3}$$

In equation (A.3), the age-earnings profile is assumed to be constant across the population. In applying this to Japan, we modify the equation to allow for different age-earnings for each combination of education and the economic nature of an occupation (such as occupation, industry, and firm size). Hence, current earnings are expressed as

$$\ln y_{it} = \boldsymbol{Z}_i\boldsymbol{\gamma}_1 + \boldsymbol{Z}_i\boldsymbol{\gamma}_2 age_{it} + \boldsymbol{Z}_i\boldsymbol{\gamma}_3 age_{it}^2 + u_i + e_{it}. \tag{A.4}$$

The third term is found to be insignificant in the estimation, and the permanent income is computed for each household using $\boldsymbol{\gamma}_1$, $\boldsymbol{\gamma}_2$, and u_i.[19]

19. The cohort effect is not accounted for, as the JPSC covers primarily households of those in their 30s. In King and Dicks-Mireaux (1982), permanent income at a certain age (45) is calculated by substituting equation (A.3) for equation (A.1). In this paper, permanent income is computed based on the years of estimation (1996 for pension uncertainty and 1994 for economic forecasts), to allow age-earnings profiles to vary among education, occupation, and firm size.

1. Estimation of equation (A.4)

The husband's non-property disposable income is deflated by the household consumption expenditure deflator. For $\boldsymbol{Z}_i$, the husband's education as well as occupation, firm size, and industry are incorporated.[20] As noted above, the third term in equation (A.4) is first included, but is found to be insignificant and is therefore excluded from the model (Appendix Table 1, to be explained below).

2. Calculation of permanent income

a. Husband's income

Husbands are assumed to retire at the age of 60. Income up to the age of 50 is computed using the parameters obtained from the regression. Income from the age of 51 to 60 is calculated by applying another source of data, assuming that the ratios of incomes and wages are equal. More precisely, income up to the age of 60 is calculated by the following equation.

$$y_{i,age} = \frac{w_{j,age}}{w_{j,50}} y_{i,50}, \quad j\text{: group by firm size and education,} \quad j = 1, \ldots, 20, \tag{A.5}$$

where w_j indicates the annual wage classified by the education level and company size of households' heads, drawn from the 1993 *Basic Survey on Wage Structure* conducted by the Ministry of Public Management, Home Affairs, Posts and Telecommunications.[21] The husband's permanent income is then computed as

$$y_i^p = \frac{1}{61 - age - N} \sum_{n=-N}^{61-age-N} \frac{y_{i,age+n}}{(1+r)^n}, \quad N\text{: Working years at present.} \tag{A.6}$$

b. Wife's income

It is assumed that wives working part-time continue to work at the same wage until the age of 54,[22] and that housewives maintain their current status.

Appendix Table 1 gives the regression results. Both the random-effect model and the fixed-effect model are applied, and the fixed-effect model is supported by the Hausman test. This indicates that labor earnings (of male employees) are affected by unobservable factors, and that panel data are useful in estimating the model. The age effect (including growth effects) is found to be 2.5 percent for clerical workers in small enterprises (fewer than 10 employees) who have graduated from junior high

20. As the JPSC requests the disclosure of annual incomes in the previous year, the explanatory variables are replaced by those obtained in the previous year. For the first year of the panel (1993), those other than age are assumed to be the same in 1992 and 1993. Data for years in which job transfers or losses occur are eliminated (108 samples and one sample, respectively). Even if these samples are not excluded and the job-transfer dummy and job-loss dummy are added to the explanatory variables, the central empirical results do not change.
21. The *Basic Survey on Wage Structure* does not include enterprises having fewer than 10 workers. Thus, for households in which the husband works for such small enterprises, it is assumed that $W_{j,age}/W_{j,50} = 1$ (leveling off at 50). Note that retirement allowances are not included.
22. This refers to the fact that the part-time-employment ratios (employment of fewer than 35 hours per week) of married women fall by half after 55 years of age; the ratios are 15.4 percent for those aged 23–34, 22.3 percent for those aged 35–44, 20.2 percent for those aged 45–54, 10.9 percent for those aged 55–64, and 3.5 percent for those aged 65 or older, according to the *Report on the Special Survey on the Labor Force Survey, February 1993* conducted by the Ministry of Public Management, Home Affairs, Posts and Telecommunications.

Appendix Table 1 Estimated Earnings Functions for the Calculation of Permanent Income

	Fixed effect		Random effect	
	Coefficient	s.e.	Coefficient	s.e.
Husband's age (*age*)	0.022	(0.011)**	0.013	(0.007)*
Husband's education				
Senior high school graduate	—	—	–0.132	(0.182)
Technical/junior college graduate	—	—	–0.397	(0.236)*
University/graduate school graduate	—	—	–0.131	(0.216)
Husband's education × *age*				
Senior high school graduate × *age*	0.011	(0.010)	0.007	(0.005)
Technical/junior college graduate × *age*	0.010	(0.012)	0.015	(0.007)
University/graduate school graduate × *age*	0.011	(0.010)	0.011	(0.006)**
Size of husband's employer				
10–99 workers	–0.169	(0.164)	–0.127	(0.133)
100–999 workers	–0.393	(0.192)**	–0.292	(0.150)*
1,000 or more workers	–0.456	(0.217)**	–0.403	(0.170)**
Public office	–0.365	(0.347)	–0.510	(0.256)**
Size of husbands employer × *age*				
10–99 workers × *age*	0.005	(0.005)	0.004	(0.004)
100–999 workers × *age*	0.011	(0.006)**	0.010	(0.004)**
1,000 or more workers × *age*	0.014	(0.006)**	0.016	(0.005)***
Public office × *age*	0.021	(0.010)**	0.020	(0.007)***
Husband's occupation				
Management/professional	–0.169	(0.247)	–0.005	(0.215)
Technical/educational	–0.130	(0.167)	–0.062	(0.140)
Skilled worker	–0.093	(0.157)	0.092	(0.130)
Service	–0.092	(0.179)	–0.050	(0.154)
Husbands occupation × *age*				
Management/professional × *age*	0.004	(0.007)	0.001	(0.006)
Technical/educational × *age*	0.003	(0.005)	0.001	(0.004)
Skilled worker × *age*	0.001	(0.004)	–0.004	(0.004)
Service × *age*	0.002	(0.005)	0.001	(0.004)
Husband's employer's business category				
Agricultural/fishery/marine/mining	–1.019	(0.902)	–0.831	(0.648)
Construction	0.118	(0.239)	0.248	(0.160)
Wholesale/retail	0.374	(0.212)*	0.289	(0.160)*
Financial/insurance/real estate	0.140	(0.309)	0.188	(0.226)
Transportation/communication	0.477	(0.267)*	0.441	(0.195)**
Electricity/gas/water supply	0.040	(0.447)	0.052	(0.331)
Service	0.385	(0.205)*	0.304	(0.153)**
Husband's employer's business category × *age*				
Agricultural/fishery/marine/mining × *age*	0.033	(0.027)	0.026	(0.019)
Construction × *age*	–0.002	(0.007)	–0.006	(0.005)
Wholesale/retail × *age*	–0.009	(0.006)	–0.008	(0.005)*
Financial/insurance/real estate × *age*	0.001	(0.009)	0.000	(0.007)
Transportation/communication × *age*	–0.012	(0.007)	–0.011	(0.006)**
Electricity/gas/water supply × *age*	0.002	(0.012)	0.002	(0.010)
Service × *age*	–0.009	(0.006)*	–0.008	(0.004)*
Constant	4.929	(0.229)***	5.357	(0.240)***
Number of observations	2,434		2,434	
Number of groups	682		682	
R-squared				
Within	0.141		0.113	
Between	0.207		0.389	
Overall	0.197		0.347	

Notes: 1. Standard errors are given in parentheses. ***, **, and * indicate the statistical significance of independent variables, at the 1 percent, 5 percent, and 10 percent levels, respectively.

2. In the fixed-effect model, the F-test for all $u_i = 0$ is F(681, 1,728) = 5.46 (p-value = 0.0000). In the random-effect model, the Breusch and Pagan Lagrangian multiplier test is $\chi^2(2) = 949.87$ (p-value = 0.0000) and the Hausman specification test is $\chi^2(34) = 115.13$ (p-value = 0.0000).

3. For the education dummy, the standard is junior high school graduate; for the husband's job category, the standard is clerical work; for the size of the husband's employer, the standard is small-scale (1–9); and for the husband's employer's business category, the standard is manufacturing.

school. This is reasonable, considering that the average growth rate of earnings for the covered period (1993–98) is 0.2 percent, and that the age effect calculated from the wages of junior high graduates working for small enterprises (10–99 workers) from 20–24 to 45–49 years of age, as specified in the *Basic Survey on Wage Structure*, is 2.2 percent (for 1993).[23] Furthermore, the cross-effects of age and higher education or those of age and larger enterprises tend to be positive, which is also consistent with the characteristics obtained from other statistics on Japanese employees.

In computing permanent income, the discount rate is assumed to be 0.0286, which is derived from 2.76 percent (the rate for long-term government bonds [10 years] in 1996) minus –0.1 percent (the household consumption expenditure deflator).[24] For the income of wives with part-time jobs and that of husbands from 50 to 60 years of age, the growth rate is assumed to equal the discount rate. Applying these rates, the average permanent income in 1996 is calculated as ¥5.02 million (standard deviation of ¥1.68 million; 417 observations).

B. Income Data and Sample Selection

1. Sample selection

(1) Farm and self-employed workers as well as family workers are excluded due to the fact that their permanent incomes are difficult to estimate. For the same reason, employees with additional business earnings are also excluded. Households in which husbands are students are excluded as well.

(2) Households in which husbands are 51 years of age or older are excluded, due to a limited number of observations.

(3) Households in which wives work full-time are excluded. This is due to the fact that the lifetime earnings of married women working full-time vary substantially and are difficult to estimate in Japan; some of them continue to work as men normally do, some retire after having children, and some start working again as their children grow up.

(4) Households in which wives work part-time and their income exceeds ¥1 million are excluded. This is due to the fact that wives' annual earnings amounting to ¥1 million or less will not affect husbands' tax exemptions, nor will income taxes or residential taxes be levied on the wives' earnings.

(5) Households in which husbands or wives perform piecework at home are excluded.

As a result, the remaining households are those in which husbands are aged 50 years or younger and are employed, and wives either work part-time and earn ¥1 million or less per year or have no jobs.

2. Income data

As the JPSC asks questions concerning the payment of taxes and social security insurance as well as income, non-property disposable income can be calculated as follows:

23. The annual earnings for 1993 (including bonuses) were calculated from the *Basic Survey on Wage Structure* for 1993 and 1994.

24. Discount rates of 1 percent or 2 percent are also applied, and do not change the main implications obtained in Section V.

Husband's income (non-property disposable income)
= earnings from husband's employer + husband's social security benefits
– husband's tax/social security payments.
Wife's income (non-property disposable income)
= earnings from wife's employer + wife's social security benefits
– wife's tax/social security payments.

It is found that in more than 80 percent of households, husbands receive no social security benefits; among those who receive such benefits, it is observed that the allowance for dependent children (¥5,000 each, ¥10,000 each from the third child, both per month) is a major source. More precisely, the number of households that receive social security benefits is 580 out of 2,622 observations. Among the 580 observations, 275 households receive ¥60,000 annually, while 70 households receive ¥12,000. Households that receive more than ¥24,000 account for only 1.4 percent. These findings suggest that the social security benefits received by such households are due primarily to the allowance for dependent children, which will terminate when children reach six years of age. Thus, social security benefits are calculated as zero except for households for which social security benefits are apparently classified as an unemployment allowance (21 observations). As for social security benefits for wives, the ratio of households in which wives receive such benefits is less than 10 percent. Thus, social security benefits are assumed to be zero, as it is not clear whether wives will work again in the future.

For respondents from which annually based replies are not obtained concerning tax/social security payments, they are calculated in accordance with the following procedure:[25] the tax allowances and social insurance premiums are calculated from annual incomes to determine taxable incomes, which are then multiplied by the corresponding tax rates (income and residential taxes) to calculate incomes.

Income (= non-property disposable income) = taxable income × (1 – tax rate).
Taxable income = annual earnings – tax allowance – social insurance premiums.
Tax allowance = exemption for spouse + special exemption for spouse
+ allowance for dependent
= ¥380,000 × (2 + number of children).
Social insurance premiums = social insurance premium ratio × annual earnings for previous year × (1 – bonus ratio for previous year).
Bonus ratio = bonus/annual earnings.

25. In the JPSC, annual incomes for the previous year are surveyed; tax/social security payments are taken from either the annual payments for the previous year or those paid in September of the current year (integrated into the former from the 1999 survey). Thus, for households responding with the latter payment data and those that did not specify tax/social security payments, disposable incomes are calculated in accordance with the procedures explained here.

As for tax rates, based on the taxable-income figures obtained above, they are determined through the application of corresponding income tax rates (0.1–0.5) and residential tax rates (0.05–0.15). Note that social security insurance premiums are calculated in accordance with standard monthly remuneration, which does not take bonuses into account. As bonuses are not covered by the JPSC, bonus ratios for male workers are investigated using the *Basic Survey on Wage Structure*. As it is found that the ratio apparently varies depending on firm size, the ratio is assumed to be 0.26 for enterprises employing 1,000 or more workers, 0.22 for those employing 100 or more but fewer than 1,000, 0.17 for those employing 10 or more but fewer than 100, and 0.14 for those employing fewer than 10. For public officials, the ratio is determined as 0.25. The social security insurance premium ratio is determined for each household by referring to the table matching the amount of standard monthly remuneration and annual earnings without the bonus obtained above.[26] For employment insurance, the ratio is 0.006 (0.007 for construction industries). The ratio of tax/social security payments to annual income, acquired from the above, is a maximum of 59.1 percent (covering the 2,917 households from which the data required for calculation could be obtained). On the other hand, as there are few households in which the ratios exceeded 0.6 (11 samples among 1,255) in the data indicated by household, they are excluded from the sample.

APPENDIX 2: WEALTH DATA

A. Financial Wealth

The JPSC requests specification of the amount of financial assets of three types, proposing the following as examples:

1. Deposits

Includes fixed-rate deposits, term deposits, installment savings, and ordinary savings at post offices; term deposits, installment savings, and ordinary deposits at banks and credit associations (such as *shinkin* banks); deposits at companies, gold investment accounts, gold savings accounts, medium-term government securities funds, etc.

2. Securities

Includes stocks (market value), debentures (face value), stock investment trusts (market value), bond investment trusts (market value), loan trusts/money trusts (face value).

3. Personal insurance and others

Includes postal insurance, postal annuity pensions, life insurance, personal pension insurance, reserve-type liability insurance, educational insurance, etc.

Concerning insurance, the JSPC requests specification of the amount of any premiums paid in the previous year, together with the total premium amount paid in past years if the insurance is not term insurance but offers a maturity refund. Thus, the following definition has been adopted for financial assets:

26. To simplify calculations, for households to which the first and highest grades of the standard monthly remuneration are not applied, the figures acquired from the conversion of annual incomes excluding bonuses to a monthly basis are determined as the standard monthly remuneration.

Financial assets
= deposits + securities held + total paid-up amounts for savings-type insurance policies.

To determine the total paid-up insurance premiums, the saved-up portions should be subtracted and evaluated at the present values. However, as the paid-up amounts for each year are not available, the total paid-up amounts are used.

B. Physical Assets

The JPSC asks questions concerning residences currently occupied, specifically (1) whether they are owned by the respondents; (2) the market values of land and residences (among those who own their houses); and (3) under whose names they are registered (husband, wife, common property of husband and wife, common property with a parent, husband's parent, or wife's parent). As for liabilities, any housing or other loans (housing loans, automobile loans, consumer loans, cash advances, etc.) are determined. Based on that information, total net worth is defined as follows:

Total net worth = financial assets + present market values of privately owned land and residences – outstanding liabilities.

If privately owned residences are registered under parents' names, the physical assets are set at zero. Cases in which the owners of the residences are registered in common with the parents are excluded from the samples, as the ownership ratios are not available in the JPSC. In the case of rented residences, the physical assets are also set at zero.

APPENDIX 3: FACTORS AFFECTING FUTURE UNCERTAINTY

Prior to the estimation of wealth/income regressions, probit estimations are conducted to examine possible factors affecting both wealth accumulation and prospects concerning business conditions or uncertainty over pubic pensions. For economic prospects, ordered probit estimations are employed using dummies such as "conditions will be better (much better + slightly better)" = 1, "no change" = 2, and "worse (much worse + slightly worse)" = 3. For uncertainty over public pensions, regressions are formulated in two steps. First, probit estimation is conducted in which those who have selected reply 4 are denoted as one and the others as zero. In the second step, ordered-probit estimation is conducted for those who did not select reply 4, with "relying" (reply 1) = 1, "worried about reductions" (reply 2) = 2, and "worried about the system itself" (reply 3) = 3.[27]

27. If the ordered probit estimations are conducted only for those who selected replies 1, 2, or 3, with those who selected reply 4 excluded, the results may be biased due to sample selection problems. Thus, prior to this estimation, for all samples, for (1) those who selected replies 1, 2, or 3 and (2) those who selected replies 2 or 3 among those who selected replies 1, 2, or 3, Heckman's maximum-likelihood probit estimation with selection was conducted. The results indicate that the sample selections are not significant (p = 0.2809).

Examining the results presented in Appendix Table 2, it can be seen that the lower the level of wives' education, the lower the income, and that those in double-income households tend to have more pessimistic prospects. As for reliance on public pensions, households with fewer children tend to rely less on such pensions. The reasons for this remain to be determined, but considering that the number of children is an endogenous variable, reverse-causal relationships may be a plausible explanation (as children are less likely to care for parents in their old age, those relying on pensions tend to have more children; however, those who do not rely on pensions tend to have fewer children).[28] The younger the husband, the higher the wives' education levels, and the fewer the children, the more uncertainty there tends to be concerning pensions. One important finding is that the husbands' age has a negative effect. The younger the husband, the longer the period until he starts receiving his pension benefits in the future, which intensifies his uncertainty concerning public pensions, as does the aging of Japanese society.

Based on the above estimation results, the wife's education, number of children, double-income dummy, and current income are added to the regression, including the economic-prospect dummy; the wife's education, number of children, and the age difference between husband and wife are incorporated into the equation concerning uncertainty over public pensions.

Appendix Table 2 Factors Affecting Economic Prospects and Uncertainty over Public Pension Benefits

	Economic prospects[1]	Uncertainty over public pension	
	Ordered probit	Probit[2]	Ordered probit[3]
Husband's age	0.017 (0.011)	–0.015 (0.022)	–0.027 (0.014)**
Wife's age	0.030 (0.019)	0.020 (0.032)	0.037 (0.021)*
Wife's education	–0.052 (0.025)**	–0.092 (0.049)*	0.066 (0.031)**
Double-income dummy	0.252 (0.084)***	–0.101 (0.147)	–0.014 (0.093)
Annual income	–0.355 (0.135)***	–0.164 (0.216)	–0.194 (0.140)
Number of children	0.085 (0.049)*	–0.222 (0.084)***	–0.107 (0.054)**
Extended-family dummy	–0.013 (0.100)	0.128 (0.175)	0.008 (0.112)
Owner-occupier dummy	0.050 (0.095)	0.177 (0.169)	–0.011 (0.109)
Constant	—	0.951 (1.433)	—
Number of observations	728	736	678
Log likelihood	–798.99	–195.24	–667.21

Notes: 1. Ordered probit estimation on answers concerning economic prospects.
2. Probit estimation on answers concerning public pension uncertainty; 1 for households that selected reply 4 and 0 for others (that selected reply 1, 2, or 3).
3. Ordered probit estimation among those who answered 1, 2, or 3 for public pension benefits.
4. Heteroscedasticity-robust standard errors are given in parentheses. ***, **, and * indicate the statistical significance of independent variables, at the 1 percent, 5 percent, and 10 percent levels, respectively.

28. However, considering that the targets of our survey are primarily young females, some households expect to have more children in the future. In this regard, this explanation may not be valid.

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