Changes in Subjective Mortality Due to COVID-19 and Its Vaccination:

The Influence on Saving Behavior in Japan

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Abstract

When the COVID-19 pandemic spread in 2020, many people were afraid of infections, and may have feared death. Some may also have felt less likely to die from the infection if vaccines became available in 2021. This study explored how COVID-19 and vaccination influenced subjective mortality and saving behavior. Referring to the life cycle model, we hypothesized that an increase in subjective mortality due to COVID-19 negatively affects and a decrease in mortality due to vaccination positively affects saving. In January 2022, we conducted an online survey in Japan with 3500 individuals aged 20–79 years who were working or whose spouses were working. We analyzed the determinants of the share of savings in income. Considering the endogeneity of subjective mortality, we estimated the savings equation using the instrumental variable method. According to our empirical results, those who felt that their mortality increased owing to the spread of COVID-19 saved less, and those who felt that their mortality decreased after vaccination saved more. However, vaccination alone does not significantly affect savings.

1. Introduction

This study explores the effect of changes in subjective mortality due to COVID-19 and its vaccination on saving. Saving is a source for capital accumulation, and saving for retirement is essential for aging society like Japan, thus it is important to analyze the determinant of saving. Changes in consumption and saving behavior during COVID-19 have received much attention. However, the changes have not been analyzed in relation to subjective mortality. As COVID-19 spread in 2020, many feared infections and may have thought that their mortality rate had gone up.[1] Some may also have felt somewhat less likely to die from infection when vaccines became available.

Previous studies tend to discuss the demographic determinant of saving based on life cycle model, which suggests that individuals decide save and consumption maximizing lifetime utility. Many of them applied life cycle model and indicated that mortality has a negative effect on saving for old age (Yaari, 1967; Blanchard, 1985; Lee et al., 2001; Yakita, 2001; Bloom et al., 2003; Lee, Mason and Miller, 2001; Kinugasa and Mason, 2007).

Changes in saving behavior associated with changes in subjective mortality due to events have also been applied to earthquake and diseases. Filipski et al. (2019) insist that a "no tomorrow" tendency can occur after a disaster. According to the authors, after experiencing a large disaster, people come to think they may die soon and tend to consume more. The authors found evidence of this after an earthquake in Sichuan Province, China. In addition, previous studies stressed that epidemics such as malaria and AIDS decreased saving (e.g., Baranov and Kohlera, 2018). We suggest that the COVID-19 pandemic increased subjective mortality and decreased saving.

The effect of COVID-19 on saving has also been investigated in several studies such as Jin et al. (2021), Lhaopadchan et al. (2024) and Peng et al. (2024) but not in relation to subjective mortality. Few previous studies have discussed the impact of COVID-19 on savings in relation to subjective mortality. Kinugasa et al. (2024) took an online survey in Japan in January 2021 found

[1] Cai et al. (2021) and Shiina et al. (2021) discussed anxiety during COVID-19.

that an increase in subjective mortality due to COVID-19 pandemic had a significant negative effect on saving, but vaccination for COVID-19 was not considered because it was not available yet in Japan. Ren and Zheng (2023) conducted empirical analysis using the county data and showed that the vaccine decreased precautionary saving but did not consider the change in subjective mortality.

In this study, we hypothesize that an increase in subjective mortality due to COVID-19 decreased saving and a decrease in subjective mortality due to vaccination for it increased saving. Our study is new in that we consider the change in subjective mortality due to vaccination for COVID-19. We conducted an online questionnaire survey in Japan in January 2022 and analyzed the determinant of the share of saving in income.

The rest of this paper is organized as follows. Section 2 describes the model and data of this study. Section 3 describes empirical results and Section 4 concludes.

2. Model and Data

2.1 Theoretical Focus

Our model is based on the life cycle hypothesis, which argues that individuals consider their lifetime income to decide on consumption and saving.[2] Individuals who retire at a certain age save when young and consume what they have saved after retirement. Applying the life cycle hypothesis without bequest motive, higher life expectancy will lead higher saving; moreover, higher mortality will decrease saving (Yaari, 1967; Blanchard, 1985; Lee et al., 2001; Yakita, 2001; Bloom et al., 2003; Lee, Mason and Miller, 2001; Kinugasa and Mason, 2007). The COVID-19 pandemic may have increased individuals' mortality expectations, which reduces the incentive to save (Kinugasa et al., 2024). Moreover, widespread use of vaccines for COVID-19 could reduce subjective mortality and increase savings. In addition, the availability of the vaccine

[2] Basic model of the life cycle hypothesis is described in Modigliani and Brumberg (1954).

could decrease subjective mortality and increase saving.

We therefore hypothesize the following.

1.Those who felt that their own mortality increased due to COVID-19 tended to have a lower share of saving in income.

2. Those who felt that their mortality decreased due to the vaccine for COVID-19 tended to have a higher share of saving in income.

2.2 Model

Using the data from the online survey described in the following subsection, we estimate the following equation:

$$S_i = \beta_0 + \beta_1 DMortality_i + \beta_2 DVaccine_i + \beta_3 Income_i + \beta_4 Education_i$$
$$+\beta_5 Age_i + \beta_6 {Age^2}_i + \beta_7 Family_i + \beta_8 Timepreference_i$$
$$+\beta_9 DBequest_i + \sum_k \beta_k \, DOccupation_{k,i} + \varepsilon_i,$$

where S_i is the share of household savings in household income in 2021. $DMortality$ is the dummy variable for the subjective mortality change due to COVID-19 pandemic. The variable is the answer to the statement "You feel that the probability of dying in a few years increased after the COVID-19 pandemic" in the matrix questions selected from strongly disagree, disagree, agree, and strongly agree. $DMortality$ is set to 1 if a respondent selects strongly agree or agree.

$DVaccine$ is a dummy variable related to the vaccine. We consider two cases. The first case is the dummy variable for those who felt their mortality decreased after taking the COVID-19 vaccine. The second case is the dummy variable for taking vaccine at least once.

$Income$ refers to the household income in 2021 and we hypothesize that income has a positive effect on saving because individuals with higher income can cover their necessities more easily, allowing excess income to be saved. $Education$ indicates educational attainment and we expect that it has a positive effect on saving because more educated individuals could tend to have better understanding of financial concepts. Age is the age of the respondent and Age^2 is the value of age squared. Many individuals tend to remain single during early adulthood and accumulate savings in anticipation of future marriage. As they age and begin raising children, household expenses typically rise, making it harder to save. However, once their children complete their education, people often shift focus to saving for retirement. As a result, the relationship between age and savings is expected to follow a U-shaped (quadratic) pattern and the coefficient of Age and d Age^2 is hypothesized to be negative and positive, respectively.

$Family$ is the number of family members. A larger household size generally implies a greater number of individuals consuming resources, which may lead to reduce savings. Therefore, we expect the coefficient of this variable to be negative. $Timepreference$ represents patience and higher value implies that the respondent is more patient. We asked the following question: "If you can exchange a gift certificate of 10,000 yen with that of 15,000 yen after a while, how many days can you wait?"[3] For less patient individuals, the utility of current consumption will be higher and savings will be lower. More patient individuals will prefer saving. Thus, we expect the coefficient of this variable to be positive.

$DBequest$ represents the bequest motive for saving, which equals 1 for respondents who want to leave a bequest for children and 0 otherwise. Those who wish to leave a bequest to their children are expected to tend to save more. $DOccupation$ is the dummy variables for controlling occupations.[4]

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[3] This question is quoted from Osaka University Institute of Social and Economic Research (2020).

[4] For options of occupation, we consider the following: 1. Agriculture, 2. Fishery and forestry, 3. Mining, 4. Construction, 5. Manufacturing, 6. Wholesale/Retail, 7. Restaurant/hotel, 8. Finance/Insurance, 9. Real estate, 10. Transportation, 11. Research and information services, 12. Information and Communications, except research and information services (e.g., telecommunications, broadcasting, Internet-based services), 13. Electricity, gas, heat supply and

We must also consider the endogeneity of change in subjective mortality due to COVID-19 pandemic. A change in subjective mortality could be influenced by the share of saving: if the respondents have saved less money, they may expect poorer treatment or insufficient nutrition in case of infection. We estimate the equation based on the instrumental variable method. As instrumental variables, we consider dummy variables for those who have had illnesses because they will be more seriously affected by the infection of COVID-19, those living in an urban area, and those in occupations where teleworking is not possible.

2.3 Data

We conducted an online survey, "Questionnaire about your life before and after the COVID-19 pandemic" on a web-based platform in January 2022 through Rakuten Insight, a research company with a survey monitor for about 2.2 million people in Japan. We sent questionnaires to monitors aged 20 to 79. Since those who do not work are unlikely to be able to afford to save, screening questions were used to survey only those who work or whose spouse work. We received 3,500 responses. In analyzing the data, we omitted respondents who took too much or too little time to respond to eliminate dishonest responses. Consequently, we analyze in the data of 3,350 respondents.

Descriptive statistics of the data used are described in Table 1. According to Table 1, share of saving in income was 9.8% on average. In Japan, household saving rate was 7.1% in Japan and the respondents had higher saving than national average, but it would be reasonable since the sample includes only workers or spouses of workers. The statistics of *DMortaoity* indicates 19% of respondents felt that he probability of dying in a few years increased after the COVID-19

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water, 14. Medical, health care and welfare, 15. Education and learning support, 16. Miscellaneous services, 17. Government, and 18. Other.

pandemic. Those who felt that their mortality increased due to COVID-19 was less than half, but the value would not be negligible. *DVaccine:*1 is the dummy variable for those who felt their mortality decreased after taking the COVID-19 vaccine. The statistic of this variable indicates that 38% of respondents felt that their mortality decreased after taking vaccine. The statistic of the variable *DVaccine:*2 shows that 91% of respondents took vaccine of COVID-19 at least once.

3. Findings

Estimated results for equation (1) are presented in Table 2. The coefficient of the variable for an increase in mortality due to COVID-19 is significantly negative in Table 2(1) and (2). This result implies that those whose mortality increased due to COVID-19 pandemic tend to have lower share of saving in income. In Table 1 (1), the coefficient of the dummy the variable for those who felt their mortality decreased after taking vaccine is significantly positive. Conversely, the coefficients for those who took the COVID-19 vaccine is not significant in Table 1 (2). Model (3) of Table 2 is the results for the sub-sample of the respondents who took vaccine for COVID-19 at least once. Similar to Model (1), an increase in subjective mortality due to the COVID-19 pandemic has a negative effect on saving and those who felt their mortality decreased after taking the vaccine tend to have a higher saving share in income.

The empirical results imply that an increase in subjective mortality due to COVID-19 can lower the share of saving in income but a decrease in subjective mortality due to vaccination can raise the share of saving. However, vaccination alone does not have a significant effect on saving. As for the results of the other variables, income had a significantly positive effect on saving, which is consistent with our hypothesis.

Empirical results show household income has a significant positive effect on savings, suggesting that lower-income households may face financial constraints that limit their capacity to save. Education also has a significantly positive effect on saving. Across all three model specifications, the coefficient on age is significantly negative, whereas the squared term of age shows a significantly positive coefficient. This implies a nonlinear, U-shaped relationship between age and the proportion of income devoted to savings. In early adulthood, individuals often allocate a relatively larger share of their income to savings, possibly due to fewer financial obligations and in preparation for future life events such as marriage or childbearing. As they move into middle age, rising expenses—particularly those associated with raising children—can lead to a decline in saving rates. However, as individuals near retirement, the incentive to accumulate savings strengthens, leading to an upward trend in savings behavior. The turning points in this relationship, where the savings-to-income ratio is minimized, are estimated at ages 65, 64, and 66 in Models 1, 2, and 3, respectively. After these ages, the proportion of income saved generally increases with age.

The coefficient of family members is negative but not significant. The coefficient of time preference variable is positive and it is consistent with our hypothesis. Bequest motive does not have significant effect on saving. The Wu-Hausman test rejects the null hypothesis that an increase in subjective mortality due to COVID-19 is exogenous, thus the variable *DMortality* is considered to be endogenous in all three specifications. The results of overidentification test implies that instrument variables are selected appropriately.

4. Conclusion

This study empirically showed that an increase in subjective morality due to COVID-19 has a negative effect and a decrease in it due to vaccination of COVID-19 has a positive effect on saving. Not everyone felt his or her mortality changed due to COVID-19 and its vaccination, but a certain percentage of people felt that way. This indicates that changes in people's subjective mortality rates can affect their saving behavior. Especially in an aging society, it is important for each individual to save for their own retirement. An event that could lead one to believe that his or her mortality rate has increased could reduce the incentive to save.

A high self-assessment of risk of death from infection may lead to pessimism and discourage saving. Particularly, excessive anxiety during periods of infection spread risks reducing the willingness to save effectively for the future. Although COVID-19 has now subsided, the findings of this study can be applied and considered in the event of a future epidemic. Moreover, our study showed that vaccination itself did not have a significant effect on saving behavior but a decrease in subjective mortality due to vaccination can increase saving. Not only the efficacy of the vaccine itself, but how people perceive it, is important to the economy.

In future research, it would be important to accumulate studies on obtaining data on subjective mortality and its impact on the economy. No macro data for subjective mortality is available and even the publicly available micro-data does not include that item. As Kinugasa et al. (2024) indicate, there would be more issues that can influence subjective mortality such as disaster, accident and various kind of diseases. It would be useful to examine in detail which factors affect subjective mortality more and which affect savings more, as well as comparisons with other countries.

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Table 1 Descriptive Statistics

Variable	Obs	Mean	Std. dev.	Min	Max
Saving	3,059	9.83	18.47	-100	100
DMortality	3,059	0.19	0.39	0	1
*DVaccine:*1	3,059	0.38	0.49	0	1
DVaccine:2	3,059	0.91	0.29	0	1
Income (10,000JPI)	3,059	383.80	353.70	0	4000
Education	3,059	4.92	1.42	1	7
Age	3,059	49.70	15.59	20	79
Age2	3,059	2713.41	1563.19	400	6241
Family	3,059	2.66	1.24	1	10
Timepreference	3,059	144.94	316.46	0	5000
DBequest	3,059	0.46	0.50	0	1

Table 2 Estimated results for the determinants of saving by the instrumental variable method

	(1)		(2)		(3)	
	Full sample		Full sample		Vaccinee only	
DMortality	-18.221	***	-17.210	***	-16.549	***
	(6.749)		(6.571)		(6.774)	
*DVaccine:*1	3.692	***			3.389	***
	(0.978)				(0.991)	
DVaccine:2			2.105			
			(1.332)			
Income	0.00938	***	0.0095	***	0.00939	***
	(0.00143)		(0.00142)		(0.00150)	
Education	1.021	***	1.023	***	0.980	***
	(0.265)		(0.263)		(0.267)	
Age	-0.746	***	-0.786	***	-0.760	***
	(0.183)		(0.187)		(0.184)	
Age2	0.00570	***	0.00618	***	0.00578	***
	(0.00175)		(0.00179)		(0.00177)	
Family	-0.235		-0.287		-0.271	
	(0.329)		(0.325)		(0.353)	
Timepreference	0.00495	***	0.00488	***	0.00560	***
	(0.00166)		(0.00164)		(0.00175)	
DBequest	0.259		0.267		0.208	
	(0.852)		(0.853)		(0.885)	
Constant	24.015	***	24.133	***	24.365	***
	(4.791)		(5.071)		(4.686)	
Wu-Hausman Test (p-value)	0.0075		0.0084		0.0184	
Overidentification Test (p-value)	0.231		0.2688		0.1913	
Observations	3,059		3,059		2,781	
Adjusted R-squared	0.079		0.0584		0.0879	

Note: The dependent variable is the percentage of household savings in the household income of the respondent's household. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. Robust standard errors are reported in parentheses. The estimation includes dummy variables for occupation but are not reported.