Peer Effects on COVID-19 Vaccine Uptake

Ao Liu[a] Yohei Mitani[b]

Abstract

Promoting vaccine uptake has become a major challenge for authorities worldwide in the COVID-19 era. A better understanding of the determinants of vaccine uptake is pivotal for improving policymaking in public health. This paper examines the role of peer effects in vaccination behavior. We use a structural model to identify peer effects on COVID-19 booster uptake among 1800 adults in Japan. We find statistically significant endogenous peer effects on booster uptake. The result indicates that a one-peer increment among five peers increases the individual's probability by 7.6% point. Other significant determinants of booster uptake are age, education, subjective evaluation of health, health conditions, and prosociality measured in an incentivized donation experiment.

Keywords: Peer effects, Vaccine uptake, COVID-19, Structural estimation, Prosociality
JEL classification: H41, I11, I12

[a] Division of Natural Resource Economics, Graduate School of Agriculture, Kyoto University, Kyoto 606-8501 Japan. E-mail: liu.ao.72w@st.kyoto-u.ac.jp
[b] Division of Natural Resource Economics, Graduate School of Agriculture, Kyoto University, Kyoto 606-8501 Japan. E-mail: mitani.yohei.7w@kyoto-u.ac.jp

1. Introduction

COVID-19 vaccines have proven to be safe, effective, and life-saving. For better disease control, it is essential to understand what drives vaccination behavior and why. One potential driver is the peer effects. Several studies have examined individual vaccination behavior and support that peer effects are an important determinant of the behavior. However, according to Manski (1993), peer effects may contain three distinct effects: In a social group, a person's choice can be either influenced by the choices (endogenous effects) or the characteristics (contextual effects) of the group members, as well as the effects of common unobserved factors (correlated effects). These factors include simultaneity, nonrandom group selection, and common shocks. Thus, the results from survey studies with a simple reduced-form method may not be interpreted as causal.

Generally, the causal identification of peer effects on individual behavior is still challenging. In the context of COVID-19 vaccination behavior, the selection of the relevant peer group is not straightforward and extremely challenging for researchers, especially when compared with those of workers' productivity in workplaces and students' performances in schools. We tackle this issue by eliciting individuals' subjective beliefs about their peers' behavior in a survey. This approach also bypasses the issue of group data availability. However, this comes with the price of the potential correlated effects magnified by endogenous group formation, in which the correlated unobserved determinants account for the observed correlation in outcomes among peers. Correlated effects emerge from self-selection into groups, common shocks, or simultaneity. To this end, we use a structural model and corresponding estimation method developed by Krauth (2006) to identify the endogenous peer effects. The model enables observable characteristics and unobservable error terms to be correlated across group members to deal with nonrandom group selection and common shocks. It accounts for simultaneity by treating peer behavior as an endogenous variable. The nonparametric identification of correlated effects is made by restricting the between-peer correlations in unobservable to equal these in observables. Then, we employ an equilibrium selection rule to deal with the existence of multiple equilibria and simulate the likelihood.

2. Methods

Data are gathered from a representative survey experiment in Japan. The survey was self-administrated in July 2022 on Qualtrics' online platform, and 1825 respondents completed the survey. The vaccine take-up variable is based on the survey item: "Have you been vaccinated for COVID-19?". Respondents were asked to answer whether they received a booster shot (the third dose) or not, and we use this information as the dependent variable. To identify peer effects on vaccine take-up, we use the following survey item: “How many of the five closest adults to you do you think have received three doses of the COVID-19 vaccine?” The answer can be any integer between 0 and 5.

Subsequently, we follow Falk et al. (2018), Hanaki et al. (2022) to include a full version of the Global Preference Survey (GPS). We measure the economic preferences: patience, risk-taking, positive reciprocity, negative reciprocity, altruism, and trust in the fourth part. For most preferences, the optimization procedure results in a combination of two survey items, involving one qualitative item, which is more abstract, and one quantitative item, which puts the respondent into a precisely defined hypothetical choice scenario.

Then, we also asked about several sociodemographic and household factors. Finally, we use the simulated maximum likelihood (SML) estimator developed by Krauth (2006) for estimation. The descriptive statistics are shown in Table 1.

Table 1 Descriptive Statistics

Variables	Description	Mean	S.D.	N
Booster[a]	1 if the respondent has got a booster (third) shot	.712	.453	1825
Peer Average	The average choice of the five peers who have got a booster stated by the respondent ($\sum_1^5 \frac{y_{gi}}{5}$)	.712	.311	1825
Male[a]	1 if the gender of the respondent is male	.500	.500	1825
Age	Age of the respondent	50.7	15.0	1825
Spouse	1 if the respondent has a spouse	.619	.486	1825
N household	The number of household members	2.58	1.23	1825
Education	The education years	14.8	1.94	1825
Income	Annual income level of the respondent (15-scale, 1: lowest; 15: highest)	3.11	2.77	1825
Medical worker[a]	1 if the respondent is a medical worker	.062	.241	1825
Medical worker N/A[a]	1 if the respondent has chosen “Refused” or “I don’t know” for the above item	.012	.109	1825

Subjective current health	Current subjective health conditions (6-scale, 1: worst; 6: best)	3.95	.878	1825
Subjective relative health	Subjective health conditions compared to a year ago (5-scale, -2: much worse; 2: much better)	-.050	.647	1825
Subjective life expectancy	Probability to live 10 more years (5-ccale: 0, 0.25, 0.5, 0.75, 1)	.740	.227	1825
Subjective life expectancy N/A[a]	1 if the respondent has chosen "Refused" or "I don't know" for the above item	.011	.104	1825
Underlying health conditions[a]	1 if the respondent does not have underlying health conditions	.730	.444	1825
Underlying health conditions N/A[a]	1 if the respondent has chosen "Refused" or "I don't know" for the above item	.059	.236	1825
Patience[b]	The weighted patience measured from the GPS items	0	.808	1825
Risk taking[b]	The weighted risk taking measured from the GPS items	0	0.801	1825
Positive reciprocity[b]	The weighted positive reciprocity measured from the GPS items	0	0.830	1796
Negative reciprocity[b]	The weighted negative reciprocity measured from the GPS items	0	0.860	1739
Altruism[b]	The weighted altruism measured from the GPS items	0	0.835	1759
Trust[b]	The weighted trust measured from the GPS items	0	1	1734
Donation[a]	1 if the respondent has chosen to donate in an incentivized experiment	.613	.487	1825

CRT score	The number of correct answers for the cognitive reflection test (4-scale: 0, 1, 2, 3)	1.03	1.05	1825

[a] Dummy variable.

[b] See Falk et al. (2018) for more details of the weights and weighted method.

3. Main findings

Table 2 shows the main estimation results. We find strong and significant effects of the share of closest adults out of five on the choice to complete three doses of COVID-19 vaccination in a peer group. The naive probit model (the first column), the naive probit model with controls for various factors (the second column), and the structural model (the third column) present similar results.

Table 2 Estimation results for vaccine take-up

	Model 1	Model 2	Model 3	AME
Variables	Naive Probit	Naive Probit	Structural	
Peer Average	2.36***	2.30***	1.40***	.379***
	(.118)	(.132)	(.320)	(.087)
Peer Correlation			.034	.009
			(.127)	(.034)
Male		.209**	.132	.036
		(.090)	(.082)	(.022)
Age		.018***	.019***	.005***
		(.003)	(.004)	(.001)
Spouse		.201**	.186**	.050**
		(.097)	(.086)	(.023)
N household		-.009	-.014	-.004
		(.036)	(.030)	(.008)
Education		.052**	.051***	.014***
		(.021)	(.020)	(.005)
Income		.010	.008	.002
		(.016)	(.011)	(.003)
Donation		.153*	.165**	.045**
		(.087)	(.075)	(.020)
Health Conditions	Uncontrolled	Controlled	Controlled	
Economic Preferences	Uncontrolled	Controlled	Controlled	

Constant		-3.22***	-2.50***
		(.446)	(.403)
Number of observations	1825	1681	1681
Log-likelihood	-850	-710	-3368

*Note. *** p<.01, ** p<.05, * p<.1.* Standard errors are in parentheses. Standard errors for SML estimates are estimated from 300 bootstrap replications. The random-activity selection rule is applied in the third column. The average marginal effects are estimated based on the structural estimation results.

4. Conclusions

This study uses the data from a survey experiment on vaccine uptake in Japan to explore the relationship between peer effects and COVID-19 booster vaccine uptake. Based on the theoretical and econometric models developed by Krauth (2006), combined with a game-theoretical framework, we are able to identify the endogenous peer effects and correlated effects on vaccine uptake. Across different equilibrium restrictions, there are some common results. First, endogenous peer effects are significant and have a strong positive influence on the vaccine uptake. In our sample, one increment in the respondent's closest adults to get vaccinated will increase about 7.6% of the respondent's chance of getting vaccinated. Second, age, education level, subjective current health, subjective relative health, underlying health conditions, and donation decision significantly influence vaccine uptake.

Reference

Falk, A., Becker, A., Dohmen, T., Enke, B., Huffman, D., and Sunde, U, 2018. Global evidence on economic preferences. Quarterly Journal of Economics, 133 (4), 1645–1692.

Hanaki, N., Inukai, K., Masuda, T., and Shimodaira, Y, 2022. Comparing behavior between a large sample of smart students and a representative sample of Japanese adults. ISER DP, (1160).

Krauth, B. V, 2006. Simulation-based estimation of peer effects. Journal of Econometrics, 133(1), 243-271.

Manski, C. F, 1993. Identification of endogenous social effects: The reflection problem. Review of Economic Studies 60 (3): 531–42