

Inflation Expectations and the COVID-19 Pandemic: A Japanese Experience in 2020*

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ABSTRACT

The aim of our study is to determine the characteristics of inflation expectations during the early period of the coronavirus disease 2019 (COVID-19) pandemic in Japan based on panel data. We examined this main hypothesis: vulnerable people tend to have higher inflation expectations as shown by two points. First, the finding that women who are seen as vulnerable have higher inflation expectations is strongly robust. Second, vulnerable people who have a negative perception of their standard of living and the socioeconomic environment also have higher inflation expectations.

Key words: Inflation expectations, Perception, Vulnerable

JEL Classification: D1, D63, D84, E31

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1. Introduction

The coronavirus disease 2019 (COVID-19) pandemic greatly influenced the Japanese economy and society. In its early stage, the uncertainty was quite high and Japanese people were in high-alert mode. People changed their lifestyles significantly, trying to stay home as much as possible. At the aggregate level, the demand shock first seemed so large that the production and price level declined. Many businesses faced substantially lower sales and the anxiety regarding job losses rose among workers. In response, both fiscal and monetary policy were expanded substantially. However, as the pandemic continued, the aggregate supply shock turned out to be large and persistent, so the price level started to rise significantly.

This paper focuses on examining the characteristics of Japan's inflation expectations during the pandemic. We conducted an online survey about inflation expectations in December 2019 and in December 2020, so that we collected the panel data for the year before the pandemic and its first year. Thus, we can examine the pandemic's impacts on inflation expectations in its first phase. In order to do so, we added questions concerning the respondents' perceptions under the pandemic, such as their outlook for their standard of living and job security in the second survey¹.

Based on the literature and the pandemic situation, we hypothesize that vulnerable people tend to expect higher inflation. We found that among the respondents' objective characteristics, this hypothesis applies to females. Moreover, several perception factors significantly influence inflation expectations. People who perceive their standard of living as worse-off compared to their friends or parents, people whose relative outlook for their standard of living compared to the social average is poor, and people with a poor outlook on their own standard of living tend to have higher inflation expectations.

The remainder of this paper is organized as follows. The next section surveys the literature and explains our main hypothesis. The third section explains the survey questionnaire and provides the basic descriptive statistics of the results. The fourth section explains the baseline model and its estimation results. The fifth section demonstrates the alternative specification model and its estimation results. The final section concludes.

2. Literature review and hypothesis development

There are many studies on the characteristics of inflation expectations based on the characteristics of the survey respondents. We may summarize the main findings as follows: People with the following characteristics tend to expect higher inflation: 1. female, 2. young and senior, 3. low-income, 4. less educated, and 5. unemployed.

Many previous studies have demonstrated that women and young people tend to have higher

inflation expectations. Analyzing a Swedish household survey in 1977, Jonung (1981) reported that women tend to recognize the rise in prices more quickly than men and attributed that to the difference in their shopping frequency. Bryan and Venkatu (2001) analyzed Michigan survey data and discovered female's higher inflation expectations after controlling for race, educational background, marriage, income, and age. Palmqvist and Stronberg (2004) reported that female, less educated, and lower-income people tend to expect higher inflation in Sweden. They also found that among the age cohorts, younger people tend to have the highest inflation expectations and that older people in their 80s also expected higher inflation.

There are some studies that less educated or lower-income people tend to have high inflation expectations. Blanchflower and MacCoile (2009) showed the following based on the BOE's Inflation Attitudes Survey in the 2000s. People who had a lower educational background, lower-income, and who were tenants tended to have pessimistic expectation about future price levels, so their inflation expectations tended to be higher. Second, people with a higher educational background tend to believe the inflation targets of monetary policy but do not emphasize their own recognition of past inflation. Based on a Michigan survey from 1975 to 2005, Pfajfar and Santoro (2013) reported that more educated, older, males tended to expect less inflation. Bruine de Bruin et al. (2010) pointed out that people with higher inflation expectations tend to focus on their own expenditure and purchase prices in making their inflation expectations. In particular, that tendency is stronger for those with a shorter horizon for asset management and less financial literacy. Johannsen (2014) posited the possibility that volatile consumption expenditures make lower-income families have peculiar inflation expectations.

Other studies have reported that the frequency of purchases affects inflation expectations. Georganas, Healy, and Li (2014) conducted an experiment on heterogenous inflation recognition and expectations and reported the influence of the prices of frequently purchased goods on inflation recognition. Coibion and Gorodnichenko (2015) showed that households with frequent purchases of gasoline tended to adjust their inflation expectations. Cavallo, Cruces, and Perez-Truglia (2017) showed that purchase prices at grocery stores influenced inflation expectations. Based on the European commission's consumer survey data from 2003 to 2005, Linden (2005) showed that consumers with an incentive for collecting information on future inflation tended to have more precise inflation expectations.

We show the recent related studies about Japan where the economic stagnation and the mild deflation continued for more than two decades. As related studies which use the online survey data, Diamond et al. (2020) examined the *experience* hypothesis proposed by Malmendier and Nagel (2016) and reported that inflation expectations increase with age. Kikuchi and Nakazono (2022) found that consumers have their own frequency for reviewing prices.

Unlike our survey, using the traditional expectations data from the Monthly Consumer Confidence Survey, Hori and Kawagoe (2013) showed that the expectation formation of households was irrational. Niizeki (2021) documented the rise in expected inflation caused a short-run increase in total expenditure using three micro dataset provided by the Japanese government. Ahn and Tsuchiya (2022) estimated how the bias of perceived and expected inflation is upward based on the BOJ's Opinion Survey on the General Public's Views and Behavior.

Some studies have presented the characteristics of the macroeconomic outlook, inflation in particular, during the pandemic. Binder (2020) showed that consumers were greatly concerned high inflation in March 2020. Weber, Gorodnichenko, and Coibion (2022) reported that the dispersion in the inflation rates experienced by U.S. households might be one possible source for disagreements about inflation expectations.

According to the literature review, our study proposes this hypothesis:

Main hypothesis: Vulnerable people tend to have higher inflation expectations

There is no academic definition of “vulnerable people” to the best of our knowledge. We do not intend to suggest a specific definition. Using online surveys, we consider the following people as vulnerable: when the respondents answered that they are low-income, female, young/old, not regularly employed, and have other typical vulnerability-related characteristics. In addition, we later introduce survey questions about respondents' perceptions on their living standard and society so that negative answers may suggest their vulnerabilities.

3. Survey and results

3.1. Construction of the survey

Our panel data on inflation expectations were acquired through an online survey in two consecutive years. In December of 2019, the first year, we received 4,000 answers. In December of 2020, the second year, we sent survey questionnaires to the same 4,000 respondents and received 2,764 answers. Therefore, this is the size of our panel data. The demographic structure of the 2,764 answers is reasonably close to that of Japan's total population (see Table 1)².

We repeated the exact same question on inflation expectations as follows:

“How much the CPI inflation rate will be in the coming 1 year?”

1: Goes down by 5% or more

2: Goes down by 3% or more but less than 5%

3: Goes down by 1% or more but less than 3%

Table 1. Demographic structure of the sample and the population

Male	20s	30s	40s	50s	60s	Total
sample	7.00%	10.60%	11.50%	11.10%	11.30%	51.50%
actual	8.60%	9.20%	11.80%	11.00%	9.80%	50.40%
Female	20s	30s	40s	50s	60s	Total
sample	7.00%	9.70%	10.40%	10.60%	10.80%	48.50%
actual	8.00%	8.90%	11.60%	10.90%	10.30%	49.60%

Data Source: Authors' original surveys in 2019 and 2020 and Japan census in 2015.

4: Stay about the same (i.e., 0%)

5: Goes up by 1% or more but less than 3%

6: Goes up by 3% or more but less than 5%

7: Goes up by 5% or more”

The two surveys were designed to understand the influence of the respondents' characteristics on their inflation expectations. The first survey focused on the respondents' working status in addition to their other characteristics, which previous studies have emphasized, such as gender, age, education, price review frequency, monetary policy recognition, etc³. We considered non-regular employment status to be an important influencing factor on respondents' vulnerability, so it might influence their inflation expectations. The survey also asked about other basic characteristics like prefecture of residence, marital status, category of industry, number of children, number of persons in the household, income, assets, and debt.

The second survey adopted the major questions from the first but added questions on the respondents' perceptions about their standard of living, job, and society. Those questions were designed to reveal the respondents' self-perceptions about their anxiety and dissatisfaction, which is subjective information about their vulnerability⁴. We considered that kind of subjective information might be as important as objective information like working status, levels and changes in income/assets so that it can influence on the respondents' inflation expectations.

In fact, we introduce the following perception questions⁵:

1. Compared to friends or parents, do you think that your living standard is worse-off? Do you think if it is unfair?
2. What do you think about the prospects for your own living standard? How do you compare them with those of the average Japanese?
3. Do you feel anxious concerning your employment under the COVID-19 pandemic?
4. How dissatisfied are you with your job and income?

Table 2. Summary statistics of inflation expectations in 2019 and 2020

	Current	3-months forecast	1-year forecast	5-year forecast
actual 2019	0.80	-0.20	-1.19	
actual 2020	-1.19	0.60	0.81	
average 2019	1.02	0.77	1.21	1.75
average 2020	0.32	0.40	0.76	1.13
standard deviation 2019	2.84	2.66	2.95	3.38
standard deviation 2020	2.07	2.04	2.20	2.51
1stQ 2019	0.00	0.00	0.00	0.00
1stQ 2020	0.00	0.00	0.00	0.00
median2019	0.00	0.00	0.00	2.00
median2020	0.00	0.00	0.00	0.00
3rdQ 2019	2.00	2.00	4.00	4.00
3rdQ 2020	2.00	2.00	2.00	2.00

Data source: Authors' original surveys in 2019 and 2020.

3.2. Survey results on the inflation expectations

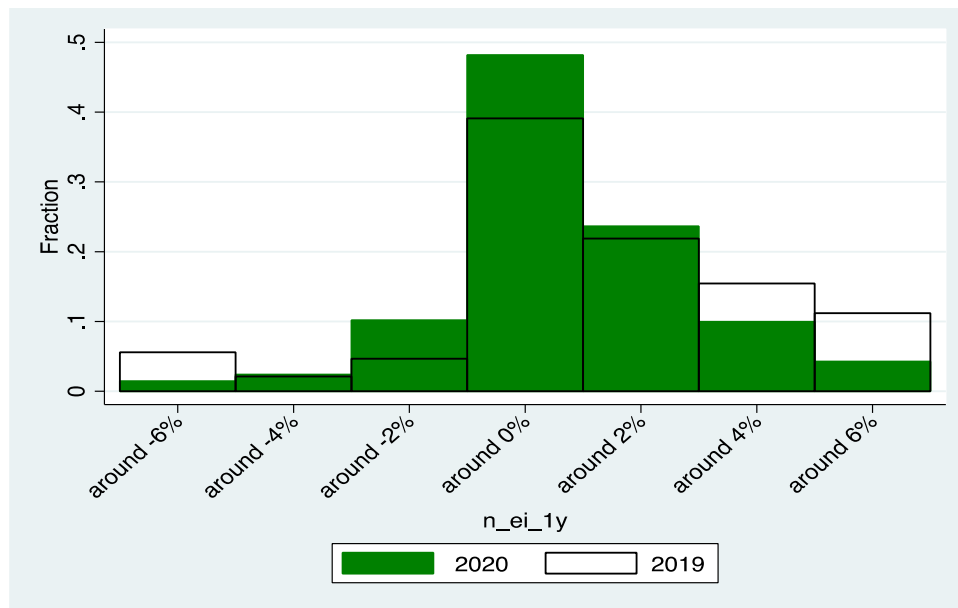
The actual inflation rate in the two survey periods was quite different. Around the first survey period, inflation from 1 year ago was positive and increasing from +0.50% in November to +0.80% in December in 2019, and +0.80% in January 2020. On the contrary, around the second survey period, it was negative and falling from -1.00% in November to -1.19% in December in 2020, and it then rose to -0.70% in January 2022.

The distribution of inflation expectations from the two surveys is summarized in Table 2. We can examine the changes in inflation expectations between the two surveys. It could be considered to mainly reflect the impact of the pandemic. Of course, the pandemic influences people in many diverse ways.

First, as to the location of the survey answer distribution, the medians are zero over most of the time span, the current observations, 3-month forecast, and 1-year forecast in both survey periods. The current observations of 0% shows that typical people view the current inflation more or less correctly. Since 0% in our survey represents an inflation rate in the range of between -1% to +1%, the actual inflation rate around the survey period was within that range in 2019 and almost so in 2020.

The 5-year forecast in 2020 was also 0%, but it was 2% in 2019, the only exception. This difference in the 5-year forecasts may reflect the actual inflation dynamics in the two survey periods. In addition, 2% is equal to the Bank of Japan's (BOJ's) inflation goal; this might indicate that longer-run inflation expectations were anchored by the BOJ's inflation goal before the pandemic.

When we examine the average value of inflation expectations, they were positive over all time spans in both survey periods. They were mostly greater than 1% in 2019, but mostly less than



Data source: Authors' original surveys in 2019 and 2020.

Fig. 1. The distribution of 1-year inflation expectations in two surveys

1% in 2020. This fall in inflation expectations between the two periods is in accordance with the actual change in the inflation rate. However, the current observation in 2020 is positive +0.32%, against the actual negative value of -1.19%. This overestimate might reflect the well-known tendency for people to expect positive inflation while actual inflation is negative⁶.

We mainly focus on the 1-year forecasts in the following analysis. Figure 1 shows their distribution in histogram form. Comparing the two distributions, we can observe the following.

1. There is a significant reduction in extreme value expectations on both tails.
2. There is a significant increase in the three categories near zero.
3. The distributions are skewed toward the right, but the degree of skewness decreased because of the significant reduction in the two categories on the right end.

The first two points contribute to a reduction in the standard error, and the third point contributes to a reduction in the average.

4. Estimation

4.1. Baseline models

We estimate the baseline model as follows:

$$E_{2020}\pi_{2021,i} = \theta * E_{2019}\pi_{2020,i} + \Gamma * Z_{2020,i} + u_{2020,i}.$$

$E_{2020}\pi_{2021,i}$ and $E_{2019}\pi_{2020,i}$, respectively, depict the 1-year inflation forecasts for 2020 and 2019. $Z_{2020,i}$ stands for the group of explanatory variables⁷. As we explained in the survey design, $Z_{2020,i}$ includes the following variables—household income, changes in financial assets and debts, the non-regular employment dummy, the regular employment dummy, the respondents' view on business conditions, the recognition dummy on current monetary policy, the recognition dummy on the inflation target, the regional COVID-19 variable, price review frequency on 11 expenditure items, the respondents' characteristics, and the respondents' perceptions of themselves and society. As the regional COVID-19 variable, we use the number of prefectural infections per 100,000 people the week right before our 2020 survey, which began on December 16, 2020⁸.

We now estimate the two variants of the baseline model, the economic model and the perception model. The latter contains all the explanatory variables explained above and the former does not contain the respondents' perceptions.

In the following analysis, we apply a weighted least squares regression as well as an interval regression. In our survey, respondents were asked to choose the interval that included their inflation expectation. The interval regression applies directly to this situation⁹. We also adopted another approach for using numbers in the center of those intervals. We applied the weighted least squares regression to this case to accommodate for heteroscedasticity¹⁰.

4.2. Estimation results of the baseline economic model

Tables 3-1, 3-2, and 3-3 show the estimation results for the two variants of the baseline model. We first examine the results for the economic model and then move on to the perception model.

In Table 3-1, the variable “Inflation expectations in 2019” has a significantly positive influence on inflation expectations in 2020. This means that people's inflation forecasts have some inertia. People who had a higher inflation forecast 1 year ago tend to expect higher inflation again now.

Next, we examine the influence of the vulnerability-related variables. Neither household income nor a change in assets/debts influence inflation expectations significantly. However, this may not reject our hypothesis that vulnerable people tend to have larger inflation expectations. For example, If the non-regularly employed persons have regularly employed family members, they may not belong to the vulnerable. This might explain that the job status dummy did not influence inflation expectations¹¹.

Then, we examine the other variables' influence. The view on business conditions had a significantly positive influence. This result seems to be in accord with normal economic understanding. Both the recognition of current monetary policy and the correct inflation target had a significantly positive influence. If people did not have accurate information about

Table 3-1. Estimation results on typical explanatory variables

VARIABLES	economic model		perception model	
	Interval Regression	Regression	Interval Regression	Regression
Inflation expectations in 2019	0.148*** (0.0145)	0.159*** (0.0144)	0.142*** (0.0146)	0.153*** (0.0145)
Household income	-0.00570 (0.0197)	-0.0177 (0.0231)	0.00310 (0.0201)	-0.0106 (0.0235)
Change in financial assets	-0.0507 (0.0784)	-0.0257 (0.0848)	0.00641 (0.0800)	0.0251 (0.0872)
Change in debt	-0.159 (0.138)	-0.150 (0.137)	-0.175 (0.137)	-0.166 (0.137)
Non-regular employment dummy	-0.0610 (0.0967)	-0.0272 (0.124)	-0.0605 (0.0975)	-0.0225 (0.125)
Regular employment dummy	0.0320 (0.0959)	0.0853 (0.124)	0.0571 (0.0962)	0.117 (0.124)
Views on business condition	0.111*** (0.0416)	0.111*** (0.0421)	0.0187 (0.0467)	0.0158 (0.0489)
Recognition of the current monetary policy	-0.444*** (0.0948)	-0.517*** (0.112)	-0.448*** (0.0947)	-0.524*** (0.112)
Recognition of the inflation target level	-0.133* (0.0738)	-0.0705 (0.0873)	-0.152** (0.0735)	-0.0918 (0.0873)
Prefectural COVID-19 infection Rate	-0.000153 (0.00450)	0.000155 (0.00513)	-0.000490 (0.00449)	-0.000399 (0.00511)

Standard errors appear in parentheses.

*** p < 0.01, ** p < 0.05, * p < 0.1.

Table 3-2. Estimation results on price review frequencies

VARIABLES	economic model		perception model	
	Interval Regression	Weighted LS	Interval Regression	Weighted LS
Food	0.0991** (0.0432)	0.128*** (0.0479)	0.0900** (0.0431)	0.120** (0.0479)
Rent and housing	-0.0919 (0.0911)	-0.130 (0.0937)	-0.0903 (0.0906)	-0.130 (0.0935)
Utility	0.0913 (0.0811)	0.0694 (0.0819)	0.0808 (0.0805)	0.0544 (0.0817)
Furniture	0.00442 (0.0956)	-0.00910 (0.109)	-0.00649 (0.0946)	-0.0161 (0.108)
Clothing	0.107 (0.0796)	0.0915 (0.0925)	0.121 (0.0792)	0.106 (0.0924)
Health	-0.0275 (0.0927)	-1.92e-05 (0.0915)	-0.0270 (0.0924)	-0.000176 (0.0913)
Transportation	0.0416 (0.0805)	0.0808 (0.0852)	0.0396 (0.0793)	0.0745 (0.0851)
Communication	0.0856 (0.0935)	0.0706 (0.0934)	0.0820 (0.0927)	0.0714 (0.0932)
Education	-0.154 (0.107)	-0.166 (0.111)	-0.125 (0.106)	-0.133 (0.112)
Culture	0.0329 (0.108)	0.0404 (0.108)	0.0182 (0.108)	0.0249 (0.108)
Social Relation	-0.166* (0.0887)	-0.166* (0.0921)	-0.158* (0.0885)	-0.158* (0.0919)

Standard errors appear in parentheses.

*** p < 0.01, ** p < 0.05, * p < 0.1.

Table 3-3. Estimation results on attributes and perceptions

VARIABLES	economic model		perception model	
	Interval Regression	Weighted LS	Interval Regression	Weighted LS
Youth dummy	-0.0332 (0.0986)	-0.0223 (0.124)	-0.00117 (0.0985)	0.00945 (0.124)
Senior dummy	0.137 (0.0965)	0.119 (0.103)	0.170* (0.0975)	0.149 (0.105)
Without-college-degree dummy	-0.0129 (0.0761)	-0.0164 (0.0869)	-0.00996 (0.0757)	-0.0118 (0.0867)
Female dummy	0.139* (0.0746)	0.204** (0.0852)	0.150** (0.0740)	0.211** (0.0853)
No-marriage dummy	0.0980 (0.0903)	0.0768 (0.100)	0.0633 (0.0915)	0.0387 (0.101)
Single living dummy	0.000606 (0.0957)	-0.0474 (0.112)	0.0182 (0.0959)	-0.0318 (0.112)
Job insecurity dummy			0.0826 (0.0875)	0.0942 (0.0940)
Job and income Dissatisfaction			-0.0151 (0.0597)	-0.0531 (0.0616)
Worse-off compared to friends and parents			0.146*** (0.0509)	0.187*** (0.0587)
Unfair compared to friends and parents			-0.0238 (0.0430)	-0.0276 (0.0507)
Relative decline of the living level			0.133* (0.0699)	0.152* (0.0784)
Prospects for current and future standard of living			0.154*** (0.0509)	0.150*** (0.0537)
Constant	yes	yes	yes	yes
Observations		2,724		

Standard errors appear in parentheses.

*** p < 0.01, ** p < 0.05, * p < 0.1.

monetary policy, their inflation expectations tended to skew lower.

Finally, the prefectural variable on the COVID-19 pandemic had no statistically significant influence on inflation expectations. In the period surrounding our 2020 survey, there were some regionally high infection rates, so the variation between the prefectures was large¹². However, the results show that inflation expectations do not reflect the regional rise in COVID-19 cases.

In Table 3-2, we examine the price review frequency of 11 expenditure items (see Table 3-2). Those of two expense items have a statistically significant influence. As in D’Acunto et al. (2019) and D’Acunto et al. (2021a, 2021b), people who reviewed food prices frequently tended to have higher inflation expectations. We believe that if one frequently updates price information at the grocery store, they tend to responsively incorporate newer information into their inflation expectations. In fact, food prices rose by 1.4% annually in 2020 under the conditions of the pandemic. Thus, we suppose that those who carefully observed food prices might answer higher inflation expectations.

People, who reexamined social expenses at a lower frequency also tended to have higher inflation expectations. Aside from the actual association during the pandemic, the respondents

who frequently watched restaurant prices looking for dining opportunities might lower their inflation expectations in accordance with business conditions in the restaurant industry.

Finally, in Table 3-3, we examine the influence of the respondents' basic characteristics. First, female respondents tended to have significantly higher inflation expectations. This is in accordance with existing research, like Bryan and Venkatu (2001). Kikuchi and Nakazono (2022) also showed that the female inflation expectation is higher than the male expectation asking their expectations on the CPI as we do so here. While they focused on the irrationality of the female expectation formation, we do not examine the irrationality in this paper. Therefore, we infer that female expectation formation have more distortion than male one.

Second, unlike prior studies, young people in their 20s and older people in their 60s and above do not have statistically different inflation expectations than others. We do not have any conjecture for this difference, so this might apply only to the special conditions in 2020 during the pandemic. Third, the variables that might lead to vulnerability, like the without a college degree dummy, the no-marriage dummy, and the single living dummy, did not have a statistically significant influence on inflation expectations.

4.3. Estimation results of the baseline perception model

In this section, we report the estimation results of the baseline perception model, which additionally incorporates the respondents' perception about themselves and society (see Tables 3-1, 3-2, and 3-3).

The addition of the perception variables did not alter the estimation results for almost all of the other explanatory variables. However, only the view on business conditions lost its statistical significance. This might be caused by its similarity to some perception variables such as the perception about job insecurity, income insecurity, and prospects on the standard of living. By incorporating seven alternative perception variables that express respondents' anxiety or dissatisfaction, we were able to estimate the effect of their perception in detail.

The people who felt worse-off compared to friends and/or parents, the people who had poor prospects on their future standard of living, and the people who anticipated a relative decline in their standard of living compared to the Japanese average level, had significantly higher inflation expectations. These results seem to conform to our hypothesis that vulnerable people tend to have higher inflation expectations.

However, inflation expectations are not statistically influenced by either job insecurity or job and income dissatisfaction. Initially, we anticipated that people during the pandemic were likely to feel very insecure and dissatisfied, and those feelings might influence their inflation expectations. However, it was not the case, at least in the autumn of 2020. The Japanese government's financial support for households and workers (e.g., employment adjustment

subsidy or special cash payments) might have mitigated those effects.

We did not find a significant influence from unfairness compared to friends and parents. This result might be related to the conceptual difficulty of the fairness question relative to the “worse-off” question. In the case of the “worse-off” question, respondents can almost instantly judge if they are worse-off. Conversely, in the case of the “unfair” question, they were required to compare their effort with that of others as well as their rewards with those of others, to judge the answer. In our survey, there were no questions about the effort of the respondents nor others.

5. Alternative specification of the estimation model

5.1. The alternative specification model

We modified the baseline model by taking the difference in inflation expectations. It brought our specification closer to the standard adaptive expectation form. The core part of the typical adaptive expectation model is described as follows.

$$E_{2020}\pi_{2021,i} - E_{2019}\pi_{2020,i} = \alpha(\pi_{2020} - E_{2019}\pi_{2020,i})$$

So, we incorporated this core part into our baseline model, so our alternative specification model is specified as follows:

$$\Delta E_{2020}\pi_{2021,i} = -\alpha(E_{2019}\pi_{2020,i} - \pi_{2020,i}) + \Gamma^*Z_{2020,i} + u_{2020,i}$$

where $\Delta E_{2020}\pi_{2021,i} \equiv E_{2020}\pi_{2021,i} - E_{2019}\pi_{2020,i}$. The term $(E_{2019}\pi_{2020,i} - \pi_{2020,i})$ is the error adjustment term. The vector $Z_{2020,i}$ is composed of all of the explanatory variables in the baseline model, including the perception variables.

This difference model focuses on the adjustment in inflation expectations between 2019 and 2020. This tries to clarify how that adjustment may be explained by the time-varying variables concerning the current situation and/or by the respondents’ persistent characteristics.

In addition, we estimated another variant form that uses the absolute-value of the expectation adjustment, $|\Delta E_{2020}\pi_{2021,i}|$. This absolute-value model focuses on the adjustment size of the inflation expectation¹³. In Figure 1, we learned that not only the high inflation forecasts but also the severe deflation forecasts decreased from 2019 to 2020. Their adjustment directions were opposite so that they can cancel out each other in the difference model. Thus, we adopted the absolute-value model which can avoid that kind of cancelation.

Table 4-1. Estimation results on typical explanatory variables

VARIABLES	Difference		Absolute-Value Difference	
	Economic	Perception	Economic	Perception
Error adjustment term	-0.838*** (0.0144)	-0.843*** (0.0146)	0.0234 (0.0154)	0.0188 (0.0155)
Household income	-0.0155 (0.0232)	-0.00887 (0.0236)	-0.0875*** (0.0247)	-0.0869*** (0.0252)
Change in financial asset	-0.0252 (0.0851)	0.0240 (0.0876)	0.0927 (0.0906)	0.133 (0.0934)
Change in debt	-0.125 (0.138)	-0.141 (0.138)	0.0387 (0.147)	0.0157 (0.147)
Non-regular employment dummy	-0.0728 (0.124)	-0.0700 (0.125)	0.147 (0.132)	0.121 (0.134)
Regular employment dummy	0.0345 (0.124)	0.0634 (0.125)	0.237* (0.132)	0.206 (0.133)
Views on business conditions	0.109*** (0.0422)	0.0190 (0.0492)	0.238*** (0.0450)	0.174*** (0.0524)
Recognition of the monetary policy	-0.503*** (0.113)	-0.511*** (0.113)	0.245** (0.120)	0.270** (0.120)
Recognition of the inflation target	-0.0776 (0.0877)	-0.0979 (0.0877)	-0.207** (0.0933)	-0.226** (0.0934)
Prefectural COVID-19 infection rate	0.000339 (0.00515)	-0.000176 (0.00514)	-0.00139 (0.00548)	-0.00203 (0.00548)

Standard errors appear in parentheses.

*** p < 0.01, ** p < 0.05, * p < 0.1.

Weighted Least Squares.

5.2. Results of the alternative specification models

5.2.1. Typical explanatory variables

The estimation results are reported in Table 4-1. We examine the difference model first. The coefficient of the error adjustment term, α , takes a significantly high value in both specifications.

The view on business conditions positively influenced the expectation adjustments, but its statistical significance was again lost when the perception variables were added. Recognition of current monetary policy significantly reduced expectation adjustments. All of the other variables did not influence inflation expectations significantly.

Next, we examine the absolute-value model. The error adjustment term lost statistical significance. Household income negatively influenced the expectation adjustment size. This means that lower-income people adjusted their inflation expectations more. This might suggest that lower-income people faced the changing conditions in the more severe ways during the pandemic.

Recognition of current monetary policy influenced the adjustment size positively. It negatively influenced the adjustment in the difference model. These two results imply that people with the correct understanding of monetary policy adjusted their expectations in a major way in the negative direction, for example, from zero inflation in 2019 to severe deflation in 2020 or from high inflation in 2019 to zero inflation in 2020.

Table 4-2. Estimation results on price review frequencies

VARIABLES	Difference		Absolute-Value Difference	
	Economic	Perception	Economic	Perception
Food	0.122** (0.0481)	0.114** (0.0481)	0.0200 (0.0512)	0.0157 (0.0513)
Rent and housing	-0.141 (0.0941)	-0.141 (0.0939)	0.0855 (0.100)	0.0835 (0.100)
Utility	0.0693 (0.0822)	0.0550 (0.0821)	-0.0315 (0.0875)	-0.0342 (0.0875)
Furniture	0.00345 (0.109)	-0.00356 (0.109)	0.179 (0.116)	0.168 (0.116)
Clothing	0.0818 (0.0929)	0.0968 (0.0928)	-0.0634 (0.0989)	-0.0680 (0.0989)
Health	-0.00951 (0.0919)	-0.0101 (0.0917)	-0.0404 (0.0978)	-0.0534 (0.0977)
Transportation	0.0703 (0.0855)	0.0646 (0.0855)	-0.0320 (0.0911)	-0.0222 (0.0911)
Communication	0.0829 (0.0938)	0.0839 (0.0936)	0.0678 (0.0998)	0.0639 (0.0998)
Education	-0.163 (0.112)	-0.132 (0.112)	-0.174 (0.119)	-0.161 (0.120)
Culture	0.0536 (0.108)	0.0399 (0.108)	0.220* (0.115)	0.223* (0.115)
Social relation	-0.165* (0.0925)	-0.158* (0.0923)	-0.0269 (0.0984)	-0.0330 (0.0984)

Standard errors appear in parentheses.

*** p < 0.01, ** p < 0.05, * p < 0.1.

Weighted Least Squares

Conversely, correct recognition of the inflation target significantly reduced the adjustment size. Its influence was not significant in the difference model. This means that people tended not to change their expectations much, if they knew the correct inflation target. This seems reasonable and suggests an expectation anchoring effect of the inflation target.

5.2.2. Price review frequency

Now, we turn to the influence of the price review frequency (Table 4-2). A higher frequency of food price review positively influenced the expectation adjustment. The food price index in the consumer price index (CPI) rose 0.4% annually in 2019 but 1.4% annually in 2020. This could be the reason for the rise in inflation expectations, in particular for the people who reviewed food prices frequently.

5.2.3. Respondents' characteristics

In the difference model, we found that only the female dummy significantly influenced the difference model in a positive way (Table 4-3). In contrast, in the absolute-value adjustment model, several other characteristics significantly influenced the adjustment size, in addition to the female dummy, the youth dummy and the without-college-degree dummy influenced the adjustment size negatively, and the senior dummy influenced it positively.

This result suggests that in response to a large shock to society and the economy like the

Table 4-3. Estimation results on attributes and perceptions

VARIABLES	Difference		Absolute-Value Difference	
	Baseline	Perceived	Baseline	Perceived
Youth dummy	-0.0281 (0.125)	0.00247 (0.125)	-0.302** (0.133)	-0.281** (0.133)
Senior dummy	0.129 (0.104)	0.159 (0.105)	0.420*** (0.111)	0.425*** (0.112)
Without-college-degree dummy	-0.0130 (0.0872)	-0.00911 (0.0871)	0.237** (0.0929)	0.232** (0.0929)
Female dummy	0.207** (0.0855)	0.214** (0.0856)	0.162* (0.0910)	0.156* (0.0913)
No-marriage dummy	0.0550 (0.101)	0.0183 (0.102)	-0.160 (0.107)	-0.153 (0.108)
Single living dummy	-0.0386 (0.112)	-0.0232 (0.112)	0.102 (0.119)	0.107 (0.119)
Job insecurity		0.100 (0.0944)		0.0894 (0.101)
Job and income Dissatisfaction		-0.0603 (0.0619)		0.0559 (0.0660)
Worse-off compared to friends and parents		0.181*** (0.0590)		-0.165*** (0.0629)
Unfair compared to friends and parents		-0.0252 (0.0510)		0.0928* (0.0543)
Relative decline of the living level		0.135* (0.0788)		0.133 (0.0840)
Prospects for current and future standard of living		0.144*** (0.0539)		0.118** (0.0575)
Constant	yes	yes	yes	yes
Observations	2,724	2,724	2,724	2,724
R-squared	0.574	0.577	0.517	0.519

Standard errors appear in parentheses
 *** p < 0.01, ** p < 0.05, * p < 0.1
 Weighted Least Square

COVID-19 pandemic, different generations tend to adjust their inflation expectations differently. Older people tend to adjust their expectations a lot, but younger people tend to adjust them very little. This might suggest a discrepancy between the simple rational model and the actual expectation formation. This seems to conform to the experience hypothesis, which advocates that people's past inflation experience might influence their current expectation formation (e.g., Malmendier and Nagel, 2016). Indeed, Japan's older people experienced both high inflation and low inflation periods, but its younger population only experienced low inflation periods.

People without a college degree might have faced a relatively difficult situation during the pandemic. If that was the case, they tended to worry about high inflation in our hypothesis. That anxiety may have led to larger adjustments in their inflation expectations. On the other hand, people with college degrees could be expected to have better information-processing ability, so they were able to stabilize their inflation expectations under the complex information environment of the pandemic (e.g., Bruine de Bruin et al., 2010).

5.2.4. The perception variables

The difference perception model shows that the worse-off dummy, the poor prospect degree, and the relative decline degree positively influenced the expectation adjustment. People with negative perceptions tend to adjust inflation expectation higher during the pandemic. This is consistent with our results from the baseline perception model.

The absolute-value difference perception model shows that the unfairness dummy increases the size of the expectation adjustment. In addition, poor prospects on their standard of living increases the size of the adjustment. Conversely, the worse-off dummy reduces the size of the expectation adjustment.

Thus, people with a negative perception tend to adjust their inflation expectations upward, although its adjustment size varies. At the time of the 2020 survey, the CPI was declining and the gross domestic product was less than the pre-pandemic level, so rational agents would have adjusted their inflation expectations downward. Therefore, the expectation adjustments of the self-perceived vulnerable people are quite remarkable.

6. Conclusions

The aim of this study was to determine the characteristics of inflation expectations during the early period of the COVID-19 pandemic in Japan based on panel data that were acquired through two surveys conducted in December 2019 and December 2020. In addition to other hypotheses posited in the existing literature, we examined one main hypothesis: vulnerable people tend to have higher inflation expectations.

Our data have two advantages. The first is that because of the timing of the two surveys, we were able to analyze the change in inflation expectations over the first year of Japan's pandemic. The second is that we included questions on the respondents' perceptions of their standard of living in the survey as well as questions on more objective characteristics. Since the level of uncertainty was particularly high during the early stages of the pandemic, vulnerable people might have experienced significant levels of anxiety and behaved accordingly.

Regarding most of the objective characteristics of the respondents such as household income, working status, and age, our estimation results did not clearly support the main hypothesis. However, the inflation expectations of females were consistently higher. Furthermore, females raised their inflation expectations during the first year of the pandemic. These results concerning female respondents seem to support the main hypothesis, since females were reported to face a more severe situation during the pandemic.

We found that several negative perceptions led to significantly higher inflation expectations. People who perceived their standard of living as worse-off compared to their friends or parents,

people whose relative outlook for their standard of living compared to the social average was poor, and people with a poor outlook on their own standard of living tended to have higher inflation expectations. Other perceptions, like job insecurity or unfairness, did not significantly influence inflation expectations, although those perceptions might have changed during the pandemic.

Those results seem to support our main hypothesis rather substantially. Several perception factors significantly influenced inflation expectations, but, except for gender, the most objective factors did not. The insignificance of the objective characteristics related to vulnerability might have been caused by a lack of information. For example, people with irregular jobs might have other family members with a regular job, so they were not vulnerable. On the other hand, the perception answers offered direct recognition of the respondents' own vulnerability, although they could not escape from being subjective.

Other than the main hypothesis, a couple of results are worth mentioning that are mostly in accordance with the previous literature. First, the price review frequency on food and social relationships matters. This result seems to suggest that people update their inflation expectation with their price reviews. Second, recognition of monetary policy also matters. Both the recognition of current monetary expansion and the inflation target tended to lower inflation expectations. The former lowered the expectation adjustment and the latter reduced the size of the adjustment.

In sum, we demonstrated two points related to our main hypothesis. First, the finding that women who are seen to be vulnerable have higher inflation expectations is strongly robust. This result is in line with that of the existing literature. Second, vulnerable people who have a negative perception of their standard of living and the socioeconomic environment also have higher inflation expectations. This is the first paper to show this result, so this result is our academic contribution. However, our future works could be improved with respect to the design of the questions on both the objective characteristics and the subjective perceptions.

NOTES

1. Without knowing about the coming pandemic, in 2019, we tried to clarify the influence of respondents' basic characteristics as well as their job status (i.e., regular vs. non-regular employment) on inflation expectations when we designed the first survey.
2. The demographic structure of Japan's population is based on the data published in May 2021.
3. The survey and answers are reported in Umino (2020). The relationship between inflation

- expectations and working status is analyzed in Umino and Jinushi (2021).
4. Previous studies have focused on people's perceptions. Hvidberg, Kreiner, and Stantcheva (2020) examined the Danish people's perceptions concerning inequality and their own relative positions.
 5. These are edited so that they are directly related to the later analysis. The original questions can be found in our webpage (<https://drive.google.com/file/d/1liZI6k9B5pOleQOoZiBdnHIR9AGIYoN2/view?usp=sharing>)
 6. This tendency may explain large forecast errors in 2019. As for the 3-month and 1-year forecasts, the forecast error was small (0.20 and 0.04% points) in 2020 but quite large (0.97 and 2.40% points) in 2019. In 2019, the actual inflation rates were negative, but the average expected rates were positive.
 7. The summary statistics are reported in Appendix 1.
 8. Other than this data, we tried to change it 1 month before, the rate of change in the mobile population from 1 year ago, the rate of change in the view count of restaurants' online information, the rate of change in event ticket purchases from 1 year ago, and the rate of change rate in job vacancies from 1 year ago. All of those prefectural data were available online from V RESAS (<https://v-resas.go.jp/>). However, none of these data affected the inflation forecasts in a statistically significant way.
 9. This is equivalent to the generalized Tobit approach. See Cameron and Crivedi (2022).
 10. We report the results of the two estimations in Tables 3-1, 3-2, and 3-3. The results are quite similar, so only the weighted least squares results are reported in Tables 4-1, 4-2, and 4-3.
 11. In Japan's low inflation circumstance, some of the low-income people expected high inflation, but other low-income people might have expected severe deflation. If this is the case, the low-income characteristic may not influence inflation expectations significantly.
 12. See, e.g., Okinawa and Hokkaido.
 13. This model might be suitable for Japan's low inflation environment. After the persistent mild deflation, not only high inflation but also severe deflation could be a realistic scare for vulnerable people. Thus, their anxiety may have caused them to anticipate severe deflation rather than high inflation.

REFERENCES

- Ahn, Y. B., & Tsuchiya, Y. (2022). Consumer's perceived and expected inflation in Japan—irrationality or asymmetric loss? *Empirical Economics*, 63(3), 1247–1292.
- Binder, C. (2020). Coronavirus fears and macroeconomic expectations. *Review of Economics*

- and *Statistics*, 102(4), 721–730.
- Blanchflower, D. G., & MacCoille, C. (2009). *The formation of inflation expectations: an empirical analysis for the UK* (No. w15388). National Bureau of Economic Research.
- Bruine de Bruin, W., Vanderklaauw, W., Downs, J. S., Fischhoff, B., Topa, G., & Armantier, O. (2010). Expectations of inflation: The role of demographic variables, expectation formation, and financial literacy. *Journal of Consumer Affairs*, 44(2), 381–402.
- Bryan, M. F., & Venkatu, G. (2001). *The curiously different inflation perspectives of men and women*. Federal Reserve Bank of Cleveland, Research Department.
- Cameron, A. C., & Trivedi, P. K. (2022). *Microeconometrics using stata* (Vol. 2). College Station, TX: Stata press.
- Cavallo, A., Cruces, G., & Perez-Truglia, R. (2017). Inflation expectations, learning, and supermarket prices: Evidence from survey experiments. *American Economic Journal: Macroeconomics*, 9(3), 1–35.
- Coibion, O., & Gorodnichenko, Y. (2015). Is the Phillips curve alive and well after all? Inflation expectations and the missing disinflation. *American Economic Journal: Macroeconomics*, 7(1), 197–232.
- Georganas, S., Healy, P. J., & Li, N. (2014). Frequency bias in consumers' perceptions of inflation: An experimental study. *European Economic Review*, 67, 144–158.
- D'Acunto, F., Hoang, D., Paloviita, M., & Weber, M. (2019). *IQ, expectations, and choice* (No. w25496). National Bureau of Economic Research.
- D'Acunto, F., Malmendier, U., & Weber, M. (2021a). Gender roles produce divergent economic expectations. *Proceedings of the National Academy of Sciences*, 118(21), e2008534118.
- D'Acunto, F., Malmendier, U., Ospina, J., & Weber, M. (2021b). Exposure to grocery prices and inflation expectations. *Journal of Political Economy*, 129(5), 1615–1639.
- Diamond, J., Watanabe, K., & Watanabe, T. (2020). The formation of consumer inflation expectations: new evidence from Japan's deflation experience. *International Economic Review*, 61(1), 241–281.
- Hori, M., & Kawagoe, M. (2013). Inflation expectations of Japanese households: Micro evidence from a Consumer Confidence Survey. *Hitotsubashi Journal of Economics*, 17–38.
- Hvidberg, K. B., Kreiner, C., & Stantcheva, S. (2020). *Social positions and fairness views on inequality* (No. w28099). National Bureau of Economic Research.
- Johannsen, B. K. (2014). Inflation experience and inflation expectations: Dispersion and disagreement within demographic groups. *Available at SSRN 2529160*.
- Jonung, L. (1981). Perceived and expected rates of inflation in Sweden. *The American Economic Review*, 71(5), 961–968.

- Kikuchi, J., & Nakazono, Y. (2022). The Formation of Inflation Expectations: Microdata Evidence from Japan. *Journal of Money, Credit and Banking*.
- Lindé, J. (2005). Estimating New-Keynesian Phillips curves: A full information maximum likelihood approach. *Journal of Monetary Economics*, 52(6), 1135–1149.
- Malmendier, U., & Nagel, S. (2016). Learning from inflation experiences. *The Quarterly Journal of Economics*, 131(1), 53–87.
- Niizeki, T. (2021). Inflation Expectations and Household Expenditure: Evidence from Pseudo-Panel Data in Japan (No. 364). *ESRI Discussion Paper Series*.
- Palmqvist, S., & Strömberg, L. (2004). Households' inflation opinions - A tale of two surveys. *Economic Review*, 4, 23–42.
- Pfajfar, D., & Santoro, E. (2013). News on inflation and the epidemiology of inflation expectations. *Journal of Money, Credit and Banking*, 45(6), 1045–1067.
- Umino, S. (2020). *Inflation expectation, and wage History: An household survey* (No. 239). Kagawa University - The Institute of Economic Research Working Paper Series.
- Umino, S., & Jinushi, T. (2021). *The characteristics of inflation expectations on households' styles of working* (No. 24). The Daiginkyo-Forum.
- Weber, M., Gorodnichenko, Y., & Coibion, O. (2022). *The expected, perceived, and realized inflation of us households before and during the covid19 pandemic* (No. w29640). National Bureau of Economic Research.

Appendix 1. Summary statistics on the explanatory variables

Variable	Mean	Std. Dev.	Min	Max
Inflation expectations in 2020	0.676	2.046	-6	6
Inflation expectations in 2019	1.114	2.714	-6	6
Household income	4.018	2.157	1	8
Change in financial asset	-0.049	0.462	-1	1
Change in debt	-0.010	0.276	-1	1
Non-regular employment dummy	0.278	0.448	0	1
Regular employment dummy	0.449	0.498	0	1
Views on business conditions	3.337	1.023	1	5
Recognition of the monetary policy	0.162	0.358	0	1
Recognition of the inflation target	0.362	0.457	0	1
Prefectural COVID-19 infection rate	14.893	7.844	0.099	27.23
Price review frequencies				
Food	1.010	1.082	0	3
Rent and housing	0.387	0.694	0	3
Furniture	0.618	0.832	0	3
Utility	0.507	0.753	0	3
Health	0.581	0.785	0	3
Furniture	0.514	0.788	0	3
Com	0.577	0.825	0	3
Clothing	0.620	0.822	0	3
Culture	0.396	0.721	0	3
Health	0.476	0.760	0	3
Social relation	0.526	0.800	0	3
Youth dummy	0.131	0.328	0	1
Senior dummy	0.214	0.391	0	1
College degree dummy	0.468	0.479	0	1
Female dummy	0.442	0.468	0	1
Marriage dummy	0.437	0.471	0	1
Youth dummy	0.131	0.328	0	1
Job insecurity	0.315	0.451	0	1
Job and income Dissatisfaction	0.108	0.686	-1	1
Worse-off compared to friends and parents	0.439	0.727	0	2
Unfair compared to friends and parents	0.711	0.812	0	2
Relative decline of the living level	0.278	0.539	-1	1
Prospects for current and future standard of living	0.410	0.902	-2	2