The Formation of Inflation Expectations: Micro-data Evidence from Japan*

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Abstract

Using a large panel dataset in Japan, we examine the formation of inflation expectations by households. It is widely known that the expectation formation of inflation rates are not necessarily "rational". Rather, forecasts of inflation rates by households are biased upward. The literature shows that the upward bias is explained by socio-economic factors as well as information rigidities. This study investigates whether not only respondent's attributes but also the hypothesis of sticky information determine the bias of households' inflation forecasts. In order to uncover the determinants of the forecast bias, we conduct online survey about inflation outlook to about 50,000 households to collect the data about the inflation outlook and the frequency of updating information about inflation rates. There are three findings. First, the revision of inflation expectations over both shorter and longer horizons respond to changes in food prices not those of oil prices as in Coibion and Gorodnichenko (2015b). It is suggested that perceived inflation rates in food prices may affects inflation expectations of households. Second, about half of households update their inflation set every quarter. The fraction of households who revise their information about inflation rates is larger than that reported in Carroll (2003). Third, the upward bias of inflation expectations shrinks when respondents update their information set.

JEL Classification: C53; D84; E31

Keywords: disagreement; forecast data; forecast bias; inflation expectations; information rigidities; sticky information

*We thank INTAGE for their cooperation regarding the online household survey. Nakazono acknowledges financial support from JSPS KAKENHI Grant Number 15K17024 and Tokyo Center for Economic Research.

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1 Introduction

It is widely known that the expectation formation of inflation rates are not necessarily "rational". Rather, forecasts of inflation rates by households are biased upward. The literature shows that the upward bias is explained by socio-economic factors as well as information rigidities. This study investigates whether not only respondent's attributes but also the hypothesis of sticky information determine the bias of households' inflation forecasts.

2 Data

We conduct online survey about inflation outlook to about 50,000 households and ask how often they update the frequency of updating information about inflation rates. Respondents are asked to answer the price levels after one, three, and ten years if the price level is 10,000 today. The data covers from 2015:Q4 to 2018:Q2. Tables 1 and 2 show the basic statistics of inflation expectations and the fraction of households who update their information about inflation rates. Table 2 shows that about half of households revise their information set every quarter and the fraction is larger than that reported in Carroll (2003). The fact that not all respondents do not update their information set about inflation rates supports the sticky information hypothesis.

3 Estimation Strategy and Results

In order to examine the determinants of the upward bias of inflation expectations, we first regress the gap between inflation expectations between households and professionals on changes in food and oil prices. Following Coibion and Gorodnichenko (2015b), we estimate the following equation:

$$E_t[\pi_{t,t+4}^{Households}] - E_t[\pi_{t,t+4}^{Professionals}] = \beta \times \pi_{t-k,t-1} + \varepsilon_t,$$

where $E_t[\pi_{t,t+4}]$ and $\pi_{t-k,t-1}$ are denoted as inflation forecasts over the four-quarter-ahead and changes of energy prices or food prices from $t-k$ to $t-1$. Table 2 shows that the gap between inflation expectations of households and professionals is determined by not energy price changes but food price changes.

This result is supported by panel data. We regress respondent i's revisions ($E_t^i[\pi_{t,t+4}] - E_{t-2}^i[\pi_{t-2,t+2}]$) on $\pi_{t-2,t}^{Energy}$ and $\pi_{t-2,t}^{Food}$. Table 4 reports that households' forecasts respond more strongly to food price changes than energy price changes, significantly.

We also test the sticky information hypothesis. If the sticky information hypothesis holds, the bias of respondents who update their information set should shrink. We regress the individual forecasters' bias from median on socio-economic factors and the intersection of the factors with the dummy variable (D^{Update}) which takes one if information is updated, otherwise zero. Table 5 shows that while socio-economic factors such as sex, age, income, education, and marital status explain the upward bias of inflation expectations, the sings of the intersections with D^{Update} are negative and significant in almost all cases. This result implies that the bias shrinks when information are revised. These findings are consistent with Ehrmann et al. (2017) and support the sticky information hypothesis.

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Table 1: The basic statistics of inflation expectations

	1-year average			3-year average			10-year average		
	Mean	Median	Obs.	Mean	Median	Obs.	Mean	Median	Obs.
All	2.5%	0.5%	106,079	2.1%	0.9%	107,008	1.4%	0.9%	106,783
Woman	2.8%	0.9%	51,209	2.3%	0.9%	51,439	1.6%	0.9%	51,224
Man	2.3%	0.5%	54,870	1.8%	0.6%	55,569	1.3%	0.9%	55,559
L. Edu.	2.8%	0.9%	47,654	2.3%	0.9%	47,990	1.6%	0.9%	47,863
H. Edu.	2.3%	0.5%	58,425	1.9%	0.6%	59,018	1.3%	0.9%	58,920
L. Income	2.7%	0.5%	63,758	2.2%	0.9%	64,286	1.5%	0.9%	64,145
H. Income	2.3%	0.5%	42,321	1.9%	0.6%	42,722	1.3%	0.9%	42,638
Not Married	2.8%	0.5%	28,987	2.3%	0.9%	29,385	1.6%	0.9%	29,584
Married	2.4%	0.5%	77,092	2.0%	0.8%	77,623	1.4%	0.9%	77,199
Updated	2.6%	0.5%	86,022	2.1%	0.9%	86,737	1.4%	0.9%	86,358
Not Updated	2.4%	0.2%	20,057	2.1%	0.6%	20,271	1.5%	0.9%	20,425

Note: “Lower”, “Higher”, and “Education” are abbreviated as “L”, “H”, and “Edu”, respectively.

Table 2: The fraction of households who update information about inflation rates

		Sex		Total
		Male	Female	
Information	Not Updated	59,035	94,333	153,368
		44.23%	53.08%	49.29%
	Updated	74,426	83,382	157,808
		55.77%	46.92%	50.71%
	Total	133,461	177715	311,176
		100.00%	100.00%	100.00%

Table 3: Determinants of the bias between households and professionals

	$E_t[\pi^{Households}_{t,t+4}] - E_t[\pi^{Professionals}_{t,t+4}] = \beta \times \pi_{t-k,t-1} + \varepsilon_t$					
	(1)	(2)	(3)	(4)	(5)	(6)
$\pi^{Energy}_{t-2,t-1}$	0.0530				0.0287	
	(0.0958)				(0.0847)	
$\pi^{Energy}_{t-3,t-1}$		0.0499				0.0298
		(0.0574)				(0.0498)
$\pi^{Food}_{t-2,t-1}$			0.572***		0.559***	
			(0.185)		(0.195)	
$\pi^{Food}_{t-3,t-1}$				0.466***		0.449***
				(0.127)		(0.134)
Observations	54	53	54	53	54	53

Note: *** indicates 1% significance. Standard errors in parentheses are calculated by the Newey-West (1987) estimator. The data covers from 2004Q2 to 2017Q3.

Table 4: Do revisions respond to price changes? Joint Test

	$E^i_t[\pi_{t,t+4}] - E^i_{t-2}[\pi_{t-2,t+2}] = \alpha + \beta_1 \times \pi^{Energy}_{t-2,t} + \beta_2 \times \pi^{Food}_{t-2,t} + \varepsilon^i_t$				
	"Spot"			"Forward"	
	1 year	3 year	10 year	1–3 year	3–10 year
α	−0.745***	−0.516***	−0.270***	−0.425***	−0.168***
	(0.033)	(0.022)	(0.015)	(0.022)	(0.013)
β_1 : $\pi^{Energy}_{t-2,t}$	0.121***	0.069***	0.030***	0.044***	0.017***
	(0.009)	(0.006)	(0.004)	(0.006)	(0.004)
β_2 : $\pi^{Food}_{t-2,t}$	0.183***	0.141***	0.066***	0.125***	0.037***
	(0.016)	(0.011)	(0.008)	(0.012)	(0.007)
F-test ($H_0 : \beta_1 = \beta_2$)	13.597	38.326	16.592	44.511	7.490
p-value	0.000	0.000	0.000	0.000	0.006
Observation	37,537	38,103	37,745	37,111	36,856

Note: Standard errors in parentheses are clustered at individual levels, and *** indicates 1% significance.

Table 5: The determinants of bias from median ($\bar{\pi}^{e}_{i,t}$)

	1-year	3-year	10-year	1 to 3-year	3 to 10-year
$\beta:\ \pi^{Food}_{t-2,t}$	0.129***	0.0530***	0.0151***	0.0765***	0.00964**
	(0.00878)	(0.00659)	(0.00499)	(0.00662)	(0.00382)
Woman	0.745***	0.583***	0.371***	0.489***	0.282***
	(0.0763)	(0.0592)	(0.0451)	(0.0561)	(0.0325)
Age ($<$ 50 years old)	0.359***	0.196***	0.0783*	0.234***	0.0621**
	(0.0695)	(0.0529)	(0.0409)	(0.0517)	(0.0287)
Lower Income	0.539***	0.322***	0.243***	0.343***	0.193***
	(0.0701)	(0.0530)	(0.0404)	(0.0506)	(0.0290)
Lower Education	0.680***	0.446***	0.239***	0.385***	0.184***
	(0.0755)	(0.0598)	(0.0443)	(0.0567)	(0.0328)
Not Married	0.669***	0.548***	0.323***	0.506***	0.203***
	(0.0864)	(0.0701)	(0.0512)	(0.0672)	(0.0368)
D^{Update}	1.170***	0.485***	0.180***	0.546***	0.287***
	(0.0413)	(0.0308)	(0.0233)	(0.0291)	(0.0187)
$D^{Update}\times$ Woman	-0.223***	-0.155**	-0.123**	-0.207***	-0.174***
	(0.0833)	(0.0635)	(0.0477)	(0.0606)	(0.0349)
$D^{Update}\times$ Age	-0.330***	-0.126**	0.00293	-0.193***	-0.0625*
	(0.0773)	(0.0580)	(0.0441)	(0.0566)	(0.0319)
$D^{Update}\times$ Income	-0.223***	-0.0867	-0.0843*	-0.159***	-0.105***
	(0.0774)	(0.0579)	(0.0436)	(0.0554)	(0.0321)
$D^{Update}\times$ Education	-0.349***	-0.227***	-0.0789*	-0.233***	-0.0914***
	(0.0827)	(0.0642)	(0.0473)	(0.0613)	(0.0352)
$D^{Update}\times$ Not Married	-0.223**	-0.182**	-0.0467	-0.213***	-0.0875**
	(0.0951)	(0.0756)	(0.0555)	(0.0726)	(0.0400)
Observations	106,079	107,008	106,783	104,857	104,642