



Bank of Japan Working Paper Series

# Downward Rigidity in Households' Price Expectations: An Analysis Based on the Bank of Japan's 'Opinion Survey on the General Public's Views and Behavior'

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No.13-E-15  
November 2013

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Downward Rigidity in Households' Price Expectations:  
An Analysis Based on the Bank of Japan's  
'Opinion Survey on the General Public's Views and Behavior'\*

(Translated from the Japanese original released in March 2008)

Koichiro Kamada<sup>†</sup>

Abstract

This paper investigates the characteristics of households' inflation expectations using the micro-data of the *Opinion Survey on the General Public's Views and Behavior* conducted by the Bank of Japan. The results of the Kahn test indicate the existence of strong downward rigidity in households' price expectations. One consequence of this downward rigidity is that survey answers strongly react to shocks to inflation expectations in a high inflation environment, but only weakly in a low inflation environment. Furthermore, this downward rigidity may hide potential links between inflation expectations and other economic indicators and may produce spurious correlations between them. To overcome these problems, this paper adjusts the distribution of survey answers on inflation expectations for downward rigidity. Using this adjusted distribution, the paper examines the relationships between households' inflation expectations and their views on various economic issues. The main results are as follows. From the end of 2005 onward, a negative correlation between households' inflation expectations and their outlook for economic conditions can be observed. Regarding the activities of the Bank of Japan, the following relationships can be observed from 2006. First, the more strongly households are interested in the Bank's activities, the more stable are their inflation expectations. And second, the more confidence households have in the Bank, the more tightly are their inflation expectations anchored.

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\* I would like to thank the staff of the Bank of Japan for their helpful comments. The opinions expressed here, as well as any remaining errors, are those of the author and should not be ascribed to the Bank of Japan or the Monetary Affairs Department.

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## NON-TECHNICAL SUMMARY

- This paper uses the Bank of Japan's *Opinion Survey on the General Public's Views and Behavior* to investigate households' inflation expectations. The analysis focuses on three aspects: (i) the basic characteristics of households' inflation expectations, (ii) the relationship of inflation expectations with households' outlook for general economic conditions and their personal economic circumstances, and (iii) the relationship with their views on the Bank of Japan.
- Households' answers on inflations expectations are characterized as follows. Households often give their inflation expectations in integers; and there are many zeros, many multiples of 5, and few negatives values. The presence of many zeros and of few negative values suggests that many households give an answer of zero percent even if they actually expect deflation, i.e., there exists downward rigidity in households' answers on price expectations.
- This paper applies the Kahn test, which was originally designed for identifying downward rigidity in wages (Kahn, 1997), to the answers on households' price expectations and measures their downward rigidity. The test results indicate that the share of answers influenced by downward rigidity is 90 percent in the case of 1 year inflation expectations and 80 percent in the case of 5 year inflation expectations as well as in the case of current inflation perceptions.
- One consequence of this downward rigidity is that survey answers strongly react to shocks to inflation expectations in a high inflation environment, but only weakly in a low inflation environment. This non-linear reaction of surveyed answers is particularly important when the economy is emerging from a deflationary environment.
- The paper adjusts the survey answers for downward rigidity and estimates the "underlying" inflation expectations behind them, i.e., the inflation expectations that households would have given in their answers in the absence of downward rigidity. The results indicate that, reflecting the prolonged economic stagnation Japan had already experienced, households expected that mild deflation would continue at least for a year. In addition, the perceived rate of deflation was as much as a few percent.

- Households' inflation expectations can suddenly become unstable. For instance, they jumped in 2006 and remained unstable thereafter. One of the main causes was the rise in oil prices. The Bank of Japan's exit from quantitative easing likely was another trigger, potentially leading households to expect a surge of inflation in the near future. Regarding the increases in expected and perceived inflation in 2007, the rises in prices of gasoline and other necessities like foods were the main causes.
- If survey answers indeed suffer from downward rigidity, this distorts the distribution of inflation expectations, giving rise to various problems. That is, downward rigidity may hide potential links between inflation expectations and other economic indicators and may produce spurious correlations between them.
- This paper uses the "underlying" inflation expectations to examine the relationship between households' inflation expectations and their economic outlook. The analysis suggests that up to mid-2005 no significant correlation between households' inflation expectations and their outlook for general economic conditions can be observed; however, from the end of 2005, a negative correlation can be found.
- This implies that households did not take demand conditions—or, in technical terms, the Phillips curve relationship—into account in their formation of inflation expectations. This means that households' inflation expectations instead must have been driven by supply shocks, such as a rise in oil prices, rather than demand shocks.
- As in the case of the relationship between households' inflation expectations and their outlook for the economy, in a low inflation environment the downward rigidity of inflation expectations means that it becomes difficult to statistically identify any relationship between households' inflation expectations and their views on the Bank of Japan.
- Therefore, the paper uses the underlying inflation expectations to examine the relationship between households' inflation expectations and their views on the Bank of Japan. The analysis shows that correlations can be observed from 2006. First, the more strongly households are interested in the Bank's activities, the more stable are their inflation expectations; and second, the more confidence households have in the Bank,

the more tightly are their inflation expectations anchored.

- This suggests that the behavior of the Bank of Japan has a direct impact on households' inflation expectations even when there are no changes in supply and demand conditions. To keep inflation expectations low, the Bank needs to maintain the public's interest in its activities and enhance its institutional reputation by explaining its policies clearly and frequently.

## 1. INTRODUCTION

Well-anchored inflation expectations are indispensable for economic stability. In modern economics, inflation expectations play an important role in households' and entrepreneurs' decision making.<sup>1</sup> In addition, the experience of galloping inflation during the first and second oil crises means that it is vital for monetary authorities to understand the importance of well-anchored expectations for price stability. Against this background, various central banks around the world—including those of the United Kingdom, Canada, and New Zealand—have adopted inflation targeting, a policy approach that aims at stabilizing actual inflation through expectation formation. The Bank of Japan's understanding of price stability was introduced in the same spirit.<sup>2</sup>

Given the importance of inflation expectations, data to measure inflation expectations have accumulated at a slow but steady pace. In Japan, the two major data sources for households' inflation expectations are the Bank of Japan's *Opinion Survey on the General Public's Views and Behavior* (*Opinion Survey* hereafter) and the Cabinet Office's *Consumer Confidence Survey*. Meanwhile, regarding business inflation expectations, the main source is the Bank of Japan's *Short-term Economic Survey of Enterprises in Japan* (*TANKAN*), a survey of businesses' economic perceptions. Finally, the Economic Planning Association's *ESP Forecast* collects data on the inflation expectations of professional forecasters. The break-even inflation rate (BEI)—the difference between the nominal yield on a fixed-income bond and the real yield on an inflation-indexed bond—is often used as a measure of inflation expectations of participants in financial markets.

Despite the increased recognition of the importance of inflation expectations and the steady efforts to measure them, our understanding of inflation expectations is still limited. One reason is that existing measures suffer from various distortions,

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<sup>1</sup> Roberts (1995) explains the role of inflation expectations in the Phillips curve framework. Regarding the importance of expectation formation from a new Keynesian perspective, see Clarida et al. (1999).

<sup>2</sup> Although the Federal Reserve of the United States does not have an official inflation target, inflation expectations clearly are an important factor in monetary policy decisions, as indicated in one of the remarks given by Bernanke (2007).

which make it difficult to monitor the development of inflation expectations precisely.<sup>3</sup> For instance, compared with actual inflation rates, households' inflation expectations in the *Opinion Survey* appear to have an upward bias, as indicated in Figure 1. Yet, this bias has received little attention thus far. The purpose of this paper is to provide a practical approach to adjust survey answers in the *Opinion Survey* for various distortions so as to capture the characteristics of households' inflation expectations.

This paper focuses on the downward rigidity observed in households' answers on expected prices. There is a vast literature on the downward rigidity of wages. Similarly, since the late 1990s, there has been a growing body of literature on the downward rigidity of prices in the context of the flattening of the Phillips curve.<sup>4</sup> To provide evidence of price rigidity, researchers have been using vast micro-datasets to conduct empirical analyses.<sup>5</sup> To the best of the author's knowledge, however, no serious attention has been paid to downward rigidity in price expectations or forecasts. This paper provides statistical evidence of the existence of downward rigidity in households' price expectations. It then proceeds to adjust households' inflation expectations for this downward rigidity to obtain the "underlying" distribution behind them, i.e., the distribution of inflation expectations that households would have given in their answers in the absence of downward rigidity. This "underlying" distribution is then used to investigate the relationships of households' inflation expectations with their outlook for the economy and views on the central bank.

The remainder of this paper is organized as follows. Section 2 provides an overview of households' inflation expectations collected in the *Opinion Survey*. Specifically, the section highlights various characteristics of these inflation expectations

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<sup>3</sup> The break-even inflation rate is determined based on actual transactions in inflation-indexed bonds in the market and thus is relatively free from deliberate actions. However, it should be noted that the BEI is affected by risk and liquidity premiums. In addition, in Japan the market for inflation-indexed bonds is insufficiently developed to regard the BEI as representative of market participants' expectations, as discussed by Nishioka and Baba (2004).

<sup>4</sup> An overview of research on the downward rigidity of wages is provided by Kahn (1997) and Kuroda and Yamamoto (2006).

<sup>5</sup> Although strictly speaking not a micro-data analysis, a study on Japan along these lines is that by Saita et al. (2006) using the *Retail Price Survey* to examine developments in Japan's consumer price index.

such as their downward rigidity, employing histograms and simple descriptive statistics. Section 3 then uses Kahn's (1997) approach to test statistically the existence of downward rigidity in households' answers on expected prices. Next, the data are adjusted for downward rigidity and the underlying distribution of inflation expectations is estimated. Based on this distribution, Section 4 explores the relationships of households' inflation expectations with their outlook for the economy and views on the central bank. Section 5 concludes.

## 2. HOUSEHOLDS' INFLATION EXPECTATIONS IN THE *OPINION SURVEY*

### 2.1 *Outline of the Opinion Survey*

This paper uses the micro-data from the Bank of Japan's *Opinion Survey*. The survey started in 1993 and the latest survey available for this study was the 31st survey conducted in September 2007. The survey was on a semi-annual basis (March and September) from March 1999 through December 2003 and has been conducted on a quarterly basis (March, June, September, and December) since. The result of the September 2005 survey was not released because of its low quality. For each survey, 4,000 individuals aged 20 or over are randomly chosen from throughout Japan.<sup>6</sup> About 50 percent of responses in the latest surveys were valid for inclusion in the compilation of the dataset.<sup>7</sup> The survey was conducted using the "in-home" method through June 2006 and the mail method thereafter. The mail method was also employed in the June 2006 survey as a trial. Therefore, both "in-home" and mail surveys are available in that month. The survey consists of two broad categories of items: (i) households' perceptions of and outlook for the economy and (ii) their views on the Bank of Japan.

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<sup>6</sup> The *Opinion Survey* uses stratified two-stage random sampling to mitigate geographical sampling bias. Respondents are replaced in every survey, so that the survey does not provide panel data. The *Kokumin Seikatsu Monitor Chosa (National Life Monitors)*, issued by the Cabinet Office, provided panel data from 2001 onward, but was discontinued in 2003; thus recent data are not available in this survey. Therefore, the *Opinion Survey* is the next best choice to trace recent developments in households' inflation expectations.

<sup>7</sup> Response rates tend to be low when the mail method is used and are generally in the region of 30 percent (Tanioka, 2007). Compared with this value, the valid response rate for the *Opinion Survey*—70 percent in March 2005 and before and around 50 percent thereafter—is quite high.



The uniqueness of the *Opinion Survey* lies in its questions on inflation expectations, which ask respondents how much they expect prices to change in the next year and in the next 5 years. The survey also asks respondents about their perception of current inflation. Specifically, since March 1997, the survey contains qualitative questions on expected prices asking respondent to choose one from five possible answers.<sup>8</sup> Additionally, since March 2004, the survey also contains quantitative questions asking respondents to provide a specific figure for their inflation expectations. This paper uses the answers to the quantitative questions compiled from March 2004 onwards, for which the survey frequency and the questions remained unchanged.

## *2.2 Characteristics of answers on inflation expectations*

For the analysis in this paper, respondents' answers to the quantitative questions are used. Examining these answers shows the following. Households often give their inflation expectations in integers; and there are many zeros, many multiples of 5, and few negative values. Table 1 provides a summary.

### *a. Many integers*

Households have a tendency to provide answers in terms of integers (e.g., 1 percent or 2 percent) and rarely give a figure with a decimal place (e.g., 1.2 percent or 2.5 percent). As shown in Table 1, 90 percent of answers are in integers.<sup>9</sup>

### *b. Many zeros*

Figures 2 to 5 provide histograms of expected and perceived rates of inflation (Figure 2 shows the average for March 2004 through September 2007). All histograms show a heavy concentration at zero percent. As shown in Table 1, the share of respondents

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<sup>8</sup> Respondents are given five choices regarding their outlook for prices: "Will go up significantly," "Will go up slightly," "Will remain almost unchanged," "Will go down slightly," and "Will go down significantly." Note that seven choices were given to respondents in the four annual surveys from 1993 to 1996.

<sup>9</sup> Households are unfamiliar with decimals as well as with billions and trillions (Tanioka, 2007). They tend to round numbers with decimals, so that decimal numbers are rarely obtained in surveys such as this one.

who answered zero percent is around 40 percent for 1 year expectations, about 20 percent for 5 year expectations, and around 50 percent for current perceptions. These shares get smaller for higher rates of expected and perceived inflation.

c. Multiples of 5

In addition to zero percent answers, there are many answers consisting of multiples of 5, as can be seen in the histograms in Figure 2. Table 1 shows that the share of respondents who answered zero percent or gave multiples of 5 is about 70 percent for 1 year expectations, about 50 percent for 5 year expectations, and around 80 percent for current perceptions.

d. Few negative values

In the period from March 2004 to September 2007, a total of 15 surveys were conducted (counting both the “in-home” and mail surveys conducted in June 2006). During this period, actual inflation was under zero percent 9 times, i.e., more than half of the period. On the other hand, Table 1 shows that only 10 percent of respondents perceived inflation to be negative during this period and 5 percent had negative inflation expectations. The underrepresentation of negative values can also be seen by the fact that the histograms in Figure 2 are skewed to the right.

The fact that there are many zeros and few negative values suggests that there is downward rigidity in households’ price expectations. There are two potential explanations for this finding. The first is that households may think that consumer prices are downwardly rigid and will continue to be so in the future. The second potential explanation is that households’ actual price expectations are not downwardly rigid, but for some reason many households answer zero percent instead of giving a negative figure.

The first possible explanation, which assumes that households think that prices are downwardly rigid, does not seem very plausible. First, the Japanese economy has experienced deflation too long for households to think that prices across the board are downwardly rigid. Second, although there are some goods whose prices

are downwardly rigid, this is unlikely to be the case for the majority of consumer goods, and the *Opinion Survey* asks about the weighted average of consumer prices. Third, although households' perceptions may be shaped by downward rigidity in the past, since the late 1990s no downward rigidity has been observed for almost all consumer goods and services, as shown by Saita et al. (2006). These points suggest that the first explanation is unlikely to hold for Japan.

The remainder of this paper takes the second hypothesis, which assumes that households tend to hold back their deflationary expectations and to answer zero percent instead. Answers to the *Opinion Survey* show that households view inflation as unfavorable. Therefore, those who are worried about future inflation have an incentive to exploit the opportunity of answering the survey to steer the central bank in the direction of containing inflationary pressures in the economy. In contrast, households may view deflation as favorable. If this is the case, those who expect deflation have an incentive to answer zero percent instead in an attempt to prevent the central bank from doing anything.

### *2.3 Identifying downward rigidity of price expectations using skewness measures*

When price expectations are downwardly rigid, many of the answers that otherwise would fall into negative territory pile up at the point of zero percent instead. In this situation, (i) the distribution of answers is skewed to the right, and (ii) the skewness is negatively correlated with actual inflation. Therefore, the existence of downward rigidity can be identified by testing for these two properties.<sup>10</sup>

The most commonly used measure for testing for downward rigidity is the coefficient of skewness. Note, however, that this measure is substantially influenced by outliers. As discussed above, there are many households answering in multiples of 5,

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<sup>10</sup> McLaughlin (1994) uses this approach to identify downward rigidity in wages. However, Knoppik (2007) conducted a simulation where downward rigidity is imposed on a normal distribution and showed that this approach does not necessarily work as expected. First, the coefficient of skewness sometimes takes a negative value; second, the coefficient of skewness and the median are sometimes negatively correlated. These phenomena occur particularly when the median is close to zero. Unfortunately, it is not easy to specify the critical value at which the correlation changes from negative to positive. Skewness measures therefore need to be used with these limitations in mind.

thus providing values that are too large in the context of Japanese inflation rates during this period. Therefore, it seems advisable not to rely on the coefficient of skewness alone. Furthermore, the coefficient of skewness provides no information about whether zero percent is a critical value, below which answers on inflation expectations are distorted.

Taking these points into consideration, Lebow, Stockton, and Wascher (1995) propose the following measure:

$$\text{LSW measure} = \{1 - F(2m)\} - F(0), \quad (1)$$

where  $m$  denotes the median. This is written alternatively as

$$\text{LSW measure} = \Pr(x > 2m) - \Pr(x < 0), \quad (2)$$

where  $x$  denotes an answer on inflation. Equations (1) and (2) look similar but differ slightly in their treatment of  $x = 0$ .<sup>11</sup> Below, equation (2) is used, unless indicated otherwise.

The LSW measure gauges the degree of asymmetry of a distribution. The second term on the right hand side of equation (2) is the probability of  $x$  being smaller than zero. Using the median as the reference point, this can be restated as the probability of  $x$  being smaller by more than one median than the median. Symmetrically, the first term is the probability of  $x$  being larger by more than one median than the median. The LSW measure is zero if a distribution is symmetric, positive if it is skewed to the right, and negative if it is skewed to the left. Since the LSW measure is an order statistic by definition, it is almost free from outliers, which is a desirable property in the current situation.

Figure 6 shows the coefficient of skewness and the LSW measure for inflation expectations and perceptions. The figure allows two observations. First, most of the skewness coefficients and LSW measures have a positive sign. This implies that the

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<sup>11</sup> The probabilities of  $x = 0$  and  $x = 2m$  are treated asymmetrically in equation (1) (symmetrically in equation (2)). Therefore, equation (1) may wrongly identify a symmetric distribution as asymmetric. This point is particularly important since households' answers have a tendency to pile up at zero, as discussed above. Therefore, using equation (1) would be inappropriate in the current context.

distributions are skewed to the right. Second, the skewness of 1 year expectations measured by the LSW approach is negatively correlated with actual inflation. However, 5 year expectations and current perceptions have no similar relationships with actual inflation.

There are a number of potential explanations for the lack of negative correlation between the skewness of inflation expectations and the level of actual inflation. First, there may be no downward rigidity in expected prices. Second, expected inflation may not co-move with actual inflation. Third, inflation expectations may be distributed asymmetrically. As shown by Lebow et al. (2003), when the distribution is asymmetric, the value of the LSW measure changes, even if there is no downward rigidity. This means that comparing the skewness of inflation expectations with the level of actual inflation would not be the appropriate approach here, since it cannot *a priori* be assumed that the distribution of inflation expectations in Japan is symmetric.

### **3. HOUSEHOLDS' UNDERLYING INFLATION EXPECTATIONS**

The previous section examined the correlation between the skewness of inflation expectations and the level of actual inflation to check for the existence of downward rigidity in price expectations. As highlighted, however, the situation in Japan was such that some of the necessary conditions for this approach to yield reliable results did not hold, so that it remained ambiguous whether price expectations were downwardly rigid. Against this background, the present section applies the Kahn test, originally developed to identify downward rigidity in wages (Kahn, 1997), to households' answers on expected prices and tests for their downward rigidity. The Kahn test is applicable under a broad range of conditions and thus provides a reliable method to measure downward rigidity in Japanese households' price expectations.

#### *3.1 The Kahn test for measuring downward rigidity*

In the spirit of Kahn, this paper distinguishes the answers on inflation expectations and

the underlying inflation expectations behind them, i.e., the inflation expectations that households' would have given in their answers in the absence of downward rigidity. If downward rigidity is found, the underlying inflation expectations can be obtained by adjusting for this downward rigidity.

The Kahn test does not require the assumption of a specific shape for the underlying distribution, but only requires the shape to remain the same over time. The tests discussed in the previous section, which are based on the coefficient of skewness and the LSW measure, are applicable only when households' underlying inflation expectations are symmetrically distributed. In contrast, the Kahn test requires no such symmetry. In addition, the Kahn test is robust against outliers and thus can be used for a sample such as the one here including many multiples of 5.

The Kahn test is applied as follows. First, a histogram for the relative frequency distribution (in terms of percent) is constructed of households' answers on inflation expectations. Next, a model is fitted to this histogram. In doing so, various parameters are estimated, such as the degree of downward rigidity. Specifically, denote the median of answers on inflation expectations by  $m$  and the share of answers lying between  $m + q$  and  $m + q + 1$  by  $P_q$ .<sup>12</sup> Then the model to be estimated is given by

$$\begin{aligned} P_{q,t} = & \alpha_q - \alpha_q \cdot \beta \cdot D0_{q,t} + (\sum_{j < q} \alpha_j) \beta \cdot Z_{q,t} \\ & - \theta \cdot D1_{q,t} + 4\theta \cdot D2_{q,t} \\ & - \phi \cdot U1_{q,t} + 4\phi \cdot U2_{q,t} + \varepsilon_{q,t}, \quad \forall q = -13, \dots, 13. \end{aligned} \quad (3)$$

The first term on the right hand side of the equation,  $\alpha_q$ , is the share of answers that would fall between  $m + q$  and  $m + q + 1$  if there were neither distortion nor noise in price expectations.<sup>13</sup> This is the density of the "potential" distribution and denoted by

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<sup>12</sup> As discussed above, most of the answers on inflation expectations are given in integers. However, the median of inflation expectations sometimes is a number with decimal places, though this is quite rare. Thus, this paper defines  $m$  as the largest integer no greater than the median value. By doing so, the possibility is avoided that the value of  $m$  is affected by whether, by pure chance, the household with the median value rounded its answer.

<sup>13</sup> By assumption,  $\alpha_q$  takes a non-negative value if  $q$  falls between  $-13$  and  $13$ , and zero otherwise. If  $\alpha_q$  is estimated to be negative for some  $q$ , then that  $\alpha_q$  is set to be zero and the other  $\alpha_q$  are re-estimated. This process is repeated until all the  $\alpha_q$  take non-negative values.

$$P_{q,t}^p \equiv \alpha_q. \quad (4)$$

Note that the second and third terms in equation (3) measure the degree of downward rigidity of price expectations. Define  $D0_q$  as a dummy variable that takes 1 if the interval from  $m+q$  to  $m+q+1$  falls into negative territory and 0 otherwise. Further, let  $Z_q$  be a dummy variable that takes 1 if the interval from  $m+q$  to  $m+q+1$  includes zero and 0 otherwise. Then,  $\beta$  indicates the degree of downward rigidity. If this parameter is positive and significant, this provides evidence of the existence of downward rigidity.

The fourth to seventh terms on the right hand side of equation (3) are included to deal with multiples of 5. Define  $D2_q$  as a dummy variable that takes 1 if the interval from  $m+q$  to  $m+q+1$  includes -5 or -10 and 0 otherwise. Meanwhile,  $D1_q$  is a dummy variable that takes 1 if the interval from  $m+q$  to  $m+q+1$  includes -4 or a smaller number, excluding -5 and -10, and takes 0 otherwise. Then,  $\theta$  is the share of answers rounded to -5 or -10, i.e., multiples of 5. That is, the shares of answers of -4, -6, -7, and -8 are reduced by  $\theta$  and are added on to the share of answers of -5 as  $4\theta$ .<sup>14</sup> Dummies  $U1_q$  and  $U2_q$  are similarly defined for positive territory. Then  $\phi$  is the share of answers rounded to multiples of 5.

By removing distorting factors such as downward rigidity and multiples of 5 from the answers on inflation expectations using the second to the seventh terms on the right hand side of equation (4), the underlying distribution of households' inflation expectations is obtained. Its density is given by

$$P_{q,t}^o \equiv \alpha_q + \varepsilon_{q,t}. \quad (5)$$

Equation (5) includes an error term,  $\varepsilon_q$ , which contains the contribution of all remaining sample-specific factors after removing the effects of downward rigidity and multiples of 5. Although this term may include additional distorting factors, its effects are likely to be relatively small compared with those of downward rigidity and

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<sup>14</sup> An alternative assumption is that the share of -5 increases by  $4\theta$ , while the shares of -3, -4, -6, and -7 decrease by  $\theta$ . Note, however, that the share of -3 is much smaller than that of -4 in the distribution of 1 year inflation expectations. It is unreasonable to attribute all of this difference to the differential in the associated potential probabilities.

multiples of 5. Thus, there are likely to be no major problems in treating equation (5) in the following discussion as the density of households' underlying inflation expectations.

### 3.2 Estimation results

Table 2 shows the estimates of the degree of downward rigidity and the effects of multiples of 5. The degree of downward rigidity is 0.9 in the answers on 1 year price expectations. This implies that 90 percent of respondents who expect deflation answer with zero percent instead of answering with a negative number. The downward rigidity in the answers on 5 year price expectations is 0.8, which is still large but smaller than for 1 year price expectations. The table further shows that the degree of downward rigidity in the answers on current perceptions is also 0.8.<sup>15</sup>

Figure 7 presents the estimated potential distributions ( $P_q^p \equiv \alpha_q$ ). These distributions look closer to a bell shape than the distributions of answers on inflation expectations (see Figure 2 above). Furthermore, the distribution of 5 year inflation expectations looks smoother than that of 1 year inflation expectations, which in turn looks smoother than that of current inflation perceptions. To see whether the potential distributions are normal or not, descriptive statistics are calculated. The results are summarized in Table 3.<sup>16</sup> As for 1 year inflation expectations, the coefficients of skewness and kurtosis are 0.13 and 2.91, respectively, compared to 0 and 3 for a normal distribution. Thus, the potential distribution of 1 year inflation expectations is almost

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<sup>15</sup> Table 2 also indicates that in the right half of the distributions, 2 percent of households round their answers into multiples of 5. Moreover, the share of households who round their answers to multiples of 5 is smaller in the left than in the right half. This finding applies regardless of whether expected inflation or perceived inflation is used and whether 1 year expectations or 5 year expectations are examined. The fact that more households in the left than in the right half of the distribution round their answers to multiples of 5 reflects the existence of downward rigidity in expectations. To see whether this is the case, based on the estimated share of households who round their answers in the right half of distribution, the same share in the left half of the distribution is calculated. The result is that that share should be 0.2 to 0.4 percent, which more or less coincides with the estimated share in the left half shown in Table 2.

<sup>16</sup> Two types of test are conducted for the normality of the distributions of inflation expectations. However, the conclusions differ depending on the approach employed. The normality hypothesis is often rejected by the Jarque-Bera test, but rarely rejected by the Chi-squared test.



normal in terms of kurtosis, but not in terms of skewness. Similar results obtain for 5 year inflation expectations and current inflation perceptions.

It is also worth noting that the dispersion of households' price expectations shrinks as the forecast horizon extends. The standard deviation of current inflation perceptions is more than 6 percent, which is greater than the 5 percent for 1 year inflation expectations, which is in turn is greater than the 4 percent for 5 year inflation expectations. Usually, uncertainty tends to grow as the forecast horizon extends, since unexpected events are more likely to occur. Therefore, the declining dispersion in price expectations is a puzzling result that will be explored in greater detail in the investigation of the structure of households' inflation expectations.

Two hypotheses are presented here regarding the negative correlation between the forecast horizon and the dispersion of inflation expectations. In the first hypothesis, each household thinks as follows: unexpected events recently observed are likely to occur again in the near future, but are less likely in the distant future. If this is the case, households' subjective uncertainty decreases as the forecast horizon increases.

The second hypothesis distinguishes between the diversity of outlooks across households regarding price developments and the degree of uncertainty households attach to their expectations. It may be possible that uncertainty about future inflation is greater the longer the forecast horizon, but that at the same time the diversity of expectations decreases to an extent that more than offsets the increased uncertainty. If this is the case, we would find that the diversity of inflation expectations gets smaller the longer the forecast horizon.

### *3.3 Non-linear reaction of survey answers to inflation expectations shocks*

The mean of the answers on inflation expectations, if distorted by downward rigidity, has a non-linear relationship with the mean of the potential distribution. To examine whether this is indeed the case, let us focus on the potential distribution of 1 year inflation expectations, which was shown in Figure 7(a) above.

The solid curve in Figure 8(a) shows the simulated relationship between the mean of answers on 1 year inflation expectations and the mean of the potential

distribution. The 45 degree line (broken line) is shown for reference. When the mean of the potential distribution is 0 percent, the mean of answers on inflation expectations is pushed up to 2 percent due to downward rigidity. Now suppose that the potential distribution shifts to the right. Then the portion of the distribution that falls into negative territory decreases. This results in a reduction of the distortion caused by downward rigidity. Therefore, as the mean of the potential distribution goes up, the mean of answers on inflation expectations approaches asymptotically to the 45 degree line, yielding a downward-convex curve.

Figure 8(b) shows how much the mean of the potential distribution and the mean of answers on inflation expectations change when the median of answers increases by 1 percentage point from a specific figure. The chart shows the following three things:

- (i) Answers on inflation expectations increase by less than 1 percentage point when potential inflation expectations increase by 1 percentage point.
- (ii) For a given increase in potential inflation expectations, answers on inflation expectations change more in a high inflation environment than in a low inflation environment.
- (iii) Answers on inflation expectations change more when potential inflation expectations increase than when they decrease.

Similar results obtain for perceived inflation, as long as it has downward rigidity. Table 2 suggests that downward rigidity is statistically significant for current perceptions of prices. Therefore, the mean of potential inflation perceptions has a non-linear relationship with the mean of answers on perceived inflation (Figure 9).

### *3.4 Characteristics of underlying inflation expectations*

Figure 10 provides descriptive statistics of households' underlying inflation expectations ( $P_{q,t}^o \equiv \alpha_q + \varepsilon_{q,t}$ ) and answers on inflation expectations. As for the answers on inflation expectations, the means of answers on 1 and 5 year expectations have been positive since 2004. Meanwhile, as for the underlying inflation expectations, the mean

of 5 year expectations has been positive since 2004, but the mean of 1 year expectations was negative until the first half of 2006. It is also noteworthy that households' underlying perceived inflation was -3 to -2 percent during the period 2004–2005, diverging from actual inflation rates. Clearly, the downward rigidity of answers on price expectations is one of the main sources of this difference between perceived and actual inflation.

Another important characteristic of inflation expectations is that they have a tendency to suddenly become unstable. One example is the behavior of 1 year inflation expectations between March and June 2006: households' inflation expectations jumped by 2 percentage points during this period and fluctuated substantially thereafter. A similar, but less extreme, increase in instability can be observed in the answers on inflation expectations. Recall that the 2006 March and June surveys were both conducted using the “in-home” method; thus, the abrupt change in price expectations was not due to any change in survey methodology.

The jump in inflation expectations occurred against the following background. First, in June 2006, the CPI inflation rate turned positive mainly due to the rise in oil prices. Second, the Bank of Japan's actions may have significantly affected households' inflation expectations. Until March 2006, the Bank had committed itself to continuing quantitative easing as long as the CPI inflation rate was under zero percent. However, in the same month, the Bank announced that it would exit from its policy of quantitative easing. It is therefore not surprising that households took this as a sign indicating that prices were going up, triggering the sudden jump in inflation expectations. The June 2006 survey was the first survey since then.

### *3.5 Retrospective estimation of inflation expectations*

This subsection estimates households' inflation expectations for the period during which the survey asked only multiple choice questions on prices. As mentioned above, the *Opinion Survey* includes quantitative questions asking respondents by what percentage they thought prices had changed and by what percentage they expected them to change in the future only since March 2004. On the other hand, qualitative

questions asking respondents to choose an answer from five choices have been included since March 1997. This subsection proposes a way to produce quantitative histograms from the qualitative data on inflation expectations, making it possible to extend the sample period from three years (starting in March 2004) to ten (starting in March 1997), which in turn makes it possible to investigate households' inflation expectations from a longer-term perspective.

The qualitative data on inflation expectations—answers from 5 choices—can be transformed into a quantitative histogram in the following way. First, for each survey since March 2004, a histogram of quantitative answers of inflation expectations (a relative histogram in terms of percent) is constructed for those who select a particular answer from the 5 choices. Second, the resulting histograms are averaged over time for each choice. Doing so yields five average histograms, each corresponding to one of the 5 choices. Finally, these 5 average histograms are combined, with the share of each choice in each survey used as a weight. This produces quantitative histograms from March 1997 to December 2003 similar to those already constructed for the period from 2004.<sup>17</sup>

Figure 11(a) shows the means of 1 year expected inflation and currently perceived inflation, calculated in the manner describe above. These are the counterparts to the means of answers on inflation expectations discussed in the previous sections. The figure indicates that 1 year inflation expectations were always positive. In addition, deflation was perceived only in the short interval from 2001 to 2004.

Some interesting characteristics can be observed in the development of households' inflation perceptions. First, households' inflation perceptions closely follow the actual inflation rate from 2001 to 2004. This suggests that households' perceptions were strongly affected by the actual inflation rate. Second, households' inflation perceptions move in tandem with the consumer price index including fresh

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<sup>17</sup> An alternative approach to deriving quantitative data on inflation expectations from qualitative data would be to use the Carlson-Parkin method. However, there is no need to rely on this method, since the *Opinion Survey* has richer information that can be used from 2004 onward, i.e., the quantitative data on inflation expectations together with qualitative data.

food. This implies that households' price perceptions are strongly influenced by changes in the prices of goods they purchase on a regular basis. Third, households' perceptions were higher than actual inflation until 2000 and then again after 2005. Two factors are relevant here: (i) The prices of some items included in the consumer price index, such as computers, effectively become cheaper as models with improved functionality are introduced. This gives rise to a gap between the prices compiled in the index and households' perceptions. And (ii) households' answers in the survey are mainly affected by prices of necessities like gasoline and food items.

However, removing distortions from the distributions of 1 year expected inflation and currently perceived inflation for March 1997 to June 2006 using the Kahn test to obtain households' underlying inflation expectations, quite a different picture from the one using unadjusted inflation expectations and perceptions emerges. The means of underlying inflation expectations and perceived inflation are plotted in Figure 11(b). The figure shows that the mean of underlying 1 year inflation expectations was negative from the increase in the consumption tax rate in 1997 until June 2006. Moreover, adjusted inflation perceptions indicate that households perceived deflation from as early as late 1998 and continued to do so until early 2006, with deflation perceived to be particularly severe at a rate of about 4 percent in March 2002.

#### **4. HOUSEHOLDS' INFLATION EXPECTATIONS AND PERCEPTIONS OF THE ECONOMY AND THE CENTRAL BANK**

The *Opinion Survey* covers various economic issues, such as economic conditions and monetary policy, in addition to price developments. This section investigates households' expectation formation further by examining the relationship of their inflation expectations with their perceptions of the economy and the central bank.

The downward rigidity of price expectations is key to understanding the correlation between households' inflation expectations and perceptions of other economic issues. That is, this downward rigidity introduces distortions into survey answers, which may weaken a genuine correlation and/or create a spurious correlation

between them. To avoid these problems, the analysis here does not use answers on inflation expectations as they are; instead, the underlying distribution of households' inflation expectations, which is adjusted for downward rigidity, etc., is used to examine the relationship between inflation expectations and other economic perceptions.

#### 4.1 Analytical approach

The following model is used to test statistically the relationships between households' inflation expectations and their outlook on the economy as well as their perceptions on the central bank. In the model, respondents are asked to select from choices 1 to  $k$  the one that is closest to their view with regard to event  $O$ . Those selecting choice  $i$  are labeled group  $i$ . Denoting the mean inflation expectations of this group by  $\mu_i$ , the inflation expectation of household  $j$  belonging to group  $i$  is given by

$$x_{ij} = \mu_i + \varepsilon_{ij}, \quad (6)$$

where  $\varepsilon_{ij}$  is the error term. For simplicity, time subscript  $t$  is suppressed below unless necessary.

Consider the null hypothesis  $H_0^\mu$ ,

$$H_0^\mu : \mu_1 = \dots = \mu_k. \quad (7)$$

The following procedure is used to test this null, which states that households' inflation expectations are uncorrelated with event  $O$ . If the null is rejected, this implies the existence of correlation, providing useful information for investigating the structure of households' inflation expectations.

Two traditional one-way analysis of variance (ANOVA) approaches are employed to test the null. The first is the  $F$  test. Denote the mean squared deviation of each group's mean from the overall mean by  $V_A$  and the mean squared deviation of each household's answer from its group mean by  $V_E$ . That is,

$$V_A \equiv \sum_i n_i (\bar{x}_i - \bar{x})^2 / (k - 1); \quad (8)$$

$$V_E \equiv \sum_i \sum_j (x_{ij} - \bar{x}_i)^2 / (n - k), \quad (9)$$

where  $n_i$  denotes the number of households belonging to group  $i$ ;  $n \equiv \sum_i n_i$  is the

total number of households;  $\bar{x}_i$  stands for the sample mean of inflation expectations of households belonging to group  $i$ ; and  $\bar{x}$  is the sample mean of inflation expectations of all the households. Then the statistic

$$F_0 = \frac{V_A}{V_E} \quad (10)$$

follows an  $F$  distribution with  $k - 1$  degrees of freedom in the numerator and  $n - k$  degrees of freedom in the denominator. If  $F_0$  is greater than  $F_{k-1, n-k}(\alpha)$ , where  $\alpha$  is the significance level, the null is rejected. This implies that event  $O$  is correlated with households' inflation expectations.

The second approach is a multiple comparison test comparing the mean inflation expectations of two arbitrarily chosen groups. Suppose that there are more than two groups. In this case, the first approach may indicate that at least one group is different from the other groups, but it does not provide any information on which group is different. In contrast, a multiple comparison test does provide such information by comparing the means of every pair of groups.

The multiple comparison test employed here is Scheffe's method (Scheffe, 1953, 1977). This method calculates the difference between the two means of groups  $i$  and  $j$  as follows:

$$S_{0ij} = \frac{|\bar{x}_i - \bar{x}_j|}{\sqrt{\left(\frac{1}{n_i} + \frac{1}{n_j}\right) V_E (k-1)}}. \quad (11)$$

The relevant critical value is given by the square root of the  $F$  distribution with  $k - 1$  degrees of freedom in the numerator and  $n - k$  degrees of freedom in the denominator. Suppose that  $S_{0ij}$  is greater than the critical value given by the square root of  $F_{k-1, n-k}(\alpha)$  for  $i$  and  $j$  ( $\neq i$ ). Then, the null of  $H_0^\mu$  is rejected, implying that households' perceptions of event  $O$  are correlated with their inflation expectations, and in particular that groups  $i$  and  $j$  have different perceptions from each other.

Scheffe's method is arduous to implement, since it requires testing for every pair of groups. For instance, when there are 5 groups, the test must be conducted for all 10 ( $=_5 C_2$ ) pairs. Note, however, that the  $F$  test and Scheffe's test usually provide

similar results. Thus, there is no need to conduct Scheffe's test when the  $F$  test does not reject the null. In other words, only when the  $F$  test rejects the null, Scheffe's test is used to identify which group is different from the other groups.

The data for  $\bar{x}_i$ ,  $V_A$ , and  $V_E$  provide sufficient information to calculate the test statistics  $F_0$  and  $S_{0ij}$ .  $\bar{x}_i$  is given by the mean inflation expectations of each group;  $V_A$  is calculated as  $\bar{x} = \sum_i n_i \bar{x}_i / n$ , with  $\bar{x}_i$  as given. Let  $V_i$  be the variance of each group's inflation expectations. Then  $V_E$  is calculated from  $\sum_j (x_{ij} - \bar{x}_i)^2 = (n_i - 1)V_i$ . Therefore, all that needs to be done is to obtain the mean and variance of the underlying distribution of inflation expectations.

To sum up, the test statistics  $F_0$  and  $S_{0ij}$  are obtained as follows:

- (i) Answers on inflation expectations are divided into multiple groups based on the choices households made on a specific economic issue;
- (ii) a histogram of inflation expectations is constructed for each group;
- (iii) the Kahn test is applied to the histogram to obtain the underlying distribution of inflation expectations;
- (iv) the mean and variance are calculated for the underlying distribution of inflation expectations.
- (v)  $V_A$  and  $V_E$  are calculated using the size of groups, the means, and the variances;
- (vi) the test statistics  $F_0$  and  $S_{0ij}$  are calculated using equations (10) and (11).

The above statistical tests are valid under the condition that the variance of  $\varepsilon_{ij}$  is identical for any  $i$  and  $j$ . The equality of variance across different groups is called homoscedasticity, which can be examined using the Bartlett test (see Appendix). The test results indicate that homoscedasticity is often violated. However, the Bartlett test is not reliable when a distribution is not normal. As discussed in the previous section, both the potential distribution of inflation expectations—the underlying distribution here—and the distribution of answers on inflation expectations cannot be regarded as normal distributions. Therefore, it would be unwise to reject homoscedasticity relying



solely on the results of the Bartlett test. In addition, the  $F$  statistic is known to be quite robust in a general context. Taking these considerations into account, it is assumed here that the different groups are homoscedastic.

#### 4.2 Households' inflation expectations and perceptions of the economy

To begin with, the relationship of households' inflation expectations with their outlook on the economy is examined, based on the test statistics  $F_0$  and  $S_{0ij}$ .

##### 4.2.1 Households' inflation expectations and general economic conditions

The *Opinion Survey* has questions on the outlook on economic conditions 1 year from now. Respondents are asked to choose among the following options: "*Will improve*," "*Will remain the same*," and "*Will worsen*." Given that the answers on inflation expectations are distorted by the downward rigidity of price expectations, the underlying distribution of inflation expectations is used to examine the relationship between price expectations and economic conditions. Table 4(a) and Figure 12(a) indicate that the mean inflation expectations of those choosing "*Will worsen*" were higher than those of other groups from December 2005 onward. These results imply that households that expected the economy to deteriorate tended to expect higher inflation in the future. However, until June 2005, the difference of the means between those choosing "*Will improve*" and those choosing "*Will worsen*" was not statistically significant.

Next, let us turn to Table 4(b) and Figure 12(b). The mean inflation expectations of the group choosing "*Will worsen*" were higher than those of other groups from June 2004 onward, and the differences of the means are statistically significant. Thus, regarding the surveys until June 2005, the relationship that households expecting the economy to deteriorate tended to expect higher inflation may reflect a spurious correlation created by the downward rigidity of inflation expectations.

#### 4.2.2 Household' inflation expectations and private economic circumstances

The *Opinion Survey* also asks respondents about the outlook for their income and spending 1 year from now.<sup>18</sup> Comparing answer to these questions with respondents' inflation expectations makes it possible to clarify how households relate inflation expectations to economic conditions in their expectation formation process.

Figure 13(a) and Table 5(a) show the relationship of inflation expectations with households' outlook for their income. According to the *F* test, the hypothesis that mean inflation expectations are equal across groups cannot be rejected in the surveys until June 2005. In this period, households thought that inflation was unrelated to their income. In contrast, the same hypothesis is rejected for the surveys from December 2005 onward. Scheffe's test indicates that the inflation expectations of those choosing "*Will worsen*" tend to be higher than of those choosing "*Will improve*." That is, households who expect their income to decline tend to expect higher inflation. Next, Figure 14(a) and Table 6(a) show the relationship of inflation expectations and the outlook for spending. They indicate that in the surveys until March 2006, households answered that they would not change their spending even if inflation changed in the future. In contrast, in the surveys conducted from June 2006 onward, they answered that they would reduce their spending if inflation increased.

In examining the relationship between respondents' inflation expectations and their outlook on the economy, the answers of households who choose "*remain the same*" are quite difficult to interpret. Clearly, their inflation expectations are lower than those of other groups. Similar tendencies are observed in the relationship between inflation expectations and perceptions of the central bank's activities. This issue is discussed in Section 4.3.4.

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<sup>18</sup> Respondents are given three options to choose on the outlook for their income: "*Will increase*," "*Will remain the same*," and "*Will decrease*." Three choices are given for their outlook for spending: "*Will increase*," "*Will neither increase nor decrease*," and "*Will decrease*."

#### 4.2.3 Background to the negative correlation between economic conditions and inflation expectations

As discussed above, from December 2005 onward, a negative correlation between inflation expectations and economic conditions can be observed. A possible explanation is that households see only a weak link between economic activity and inflation, or they think of demand shocks as having only a weak impact on inflation. This contradicts the prediction of the Phillips curve, which implies that economic recession (a negative demand shock) causes inflation to fall, which means there should be a positive correlation between economic activity and inflation. Note, however, that the Phillips curve has flattened since the latter half of the 1990s. Therefore, the empirical results obtained here are not surprising if households—consciously or unconsciously—incorporated this fact into their price expectations.<sup>19</sup>

A natural inference is that households took the effects of supply shocks, i.e., price shocks, more seriously than demand shocks at that time. That is not to say that households did not consider demand shocks at all, but it seems fair to say that supply shocks probably were more on their mind than demand shocks. Thus, although a bit of a detour, it is worthwhile to discuss here how such a negative correlation between households' inflation expectations and their outlook on economic conditions may arise.

The first potential channel is energy prices. A change in energy prices, particularly oil prices, has a significant impact both on inflation expectations and on economic activity. An increase in oil prices leads to income transfers from Japan to oil producing countries, thus reducing aggregate domestic demand in Japan. A small portion of the increased purchasing power of these oil producing countries will find its way back to Japan in the form of greater demand for Japanese exports, but the largest portion will go toward demand for the products of other countries. Therefore, the net effect on demand is negative.

Second, if consumer prices go up while nominal wages remain unchanged,

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<sup>19</sup> There is broad consensus among economists on the existence of the Phillips curve. However, when households' inflation expectations are discussed, the possibility should be taken into account that most households are not familiar with the Phillips curve.

workers' real income declines, which may lead households to expect the economy to deteriorate. Note that in this case there are income transfers in real terms from workers to stockholders. If workers' propensity to consume is greater than stockholders', then aggregate demand would decline.<sup>20</sup> Furthermore, workers may reduce their current expenditure in nominal terms to intertemporally smooth consumption in real terms.

Third, the actions of the central bank affect inflation and economic activity simultaneously. When inflation occurs, the central bank conducts monetary policy to contain it by slowing economic activity. Note, however, that the central bank stops raising its policy rate well before reversing the rise in inflation completely, since an economic slowdown itself represents a welfare loss. Therefore, the economy will experience both some inflation and recession.

Finally, there may be respondents who want to send a message to the Bank of Japan in their survey answers. The *Opinion Survey* is conducted by the Bank of Japan, which is responsible for implementing monetary policy. Therefore, if respondents think of inflation and recession as unfavorable, they may answer that they expect both inflation and recession to occur simultaneously, whatever their expectations are.

#### *4.3 Households' inflation expectations and views on the central bank*

Next, the relationship between households' inflation expectations and their views on the Bank of Japan is examined.<sup>21</sup> The *Opinion Survey* has questions on households' interest in, recognition of, and evaluation of the Bank. That is, respondents are asked: (i) "How would you describe your level of interest in the Bank's activities?" (ii) "How would you describe the Bank's relationship to our lives?" (iii) "How would you describe the Bank's contribution to our lives?" (iv) "How would you describe the Bank's explanations to the public?" and (v) "How would you describe your level of confidence in the Bank?" The

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<sup>20</sup> The share of respondents who link inflation with economic stagnation may increase even if there is no difference in the propensity to consume. The number of stockholders, whose income increases in real terms, is much smaller than the number of workers, whose income decreases in real terms. Therefore, when inflation expectations go up, the number of those expecting a real income decline and hence a recession outweighs the number of those expecting a boom.

<sup>21</sup> Based on a household survey, Shimizutani (2005) measured the effects of monetary policy on inflation rates, although his analytical purpose and sample period are different from those here.

respondents are given 5 choices for their answers. For instance, the choices for the question on their interest in the Bank's activities are "*Interested*," "*Somewhat interested*," "*Difficult to say*," "*Not particularly interested*," and "*Not interested*."

In the analysis of the relationship between households' inflation expectations and their views on the central bank, the results may differ depending on whether the answers on inflation expectations are used as they are or the underlying distribution, which is adjusted for downward rigidity, is utilized. When monetary policy exerts a shock on inflation expectations in a high inflation environment, the downward rigidity of expected prices does not matter, and answers on inflation expectations strongly react to such a shock (see Figure 8 above). However, in a low inflation environment, the shift in answers on inflation expectations may be so small that it is difficult to identify the effects of monetary policy on inflation expectations. Given that inflation in Japan during the observation period was very low, this suggests that it may be preferable to employ the underlying distribution of inflation expectations to examine the impact of households' views on the Bank of Japan.

#### 4.3.1 Households' interest in the Bank's activities and inflation expectations

To begin with, the effects of households' interest in central bank activities on inflation expectations are examined. The *Opinion Survey* asks respondents to indicate their level of interest in the Bank's activities in five grades. Based on these grades, respondents are divided into five groups. Figure 15 shows households' mean inflation expectations for each of these five groups. Table 7 presents the results of the  $F$  test and Scheffe's test for the difference in means between two arbitrarily chosen groups.

When the survey answers are used, inflation expectations are affected by the level of interest only in two periods, June 2004 and September 2006. In contrast, when the underlying inflation expectations are used, a statistically significant relationship between inflation expectations and the level of interest is observed in almost all periods. The results for the following three surveys are particularly noteworthy: (i) the March 2006 survey, the first survey after March 9th, 2006, when the Bank exited from quantitative easing; (ii) the September 2006 survey, the first survey after the policy rate

target was raised to 0.25 percent in July 14th, 2006; and (iii) the March 2007 survey, the first survey after February 21st, 2007, when the policy rate target was raised to 0.5 percent.

As shown in Figure 15, the variation of mean inflation expectations of households who chose "*Interested*" or "*Somewhat interested*" is smaller than that of those who chose "*Not particularly interested*" or "*Not interested*." That is, the inflation expectations of households that were interested in the Bank's activities were more stable than the inflation expectations of other households. This implies that it may be possible for the Bank to stabilize inflation expectations by getting the general public more interested in its activities.

During the last half year of the observation period, i.e., in the June and September 2007 surveys, the correlation between households' inflation expectations and interest in the Bank's activities weakened significantly. A possible explanation for this is the following. Households interested in the Bank's activities reset their "inflation anchor" in the face of the change in the monetary policy regime and adjusted their expectations to this new anchor. On the other hand, households not interested in the Bank's activities needed time to find a new inflation anchor through trial and error and adjusted their inflation expectations gradually. This view is supported by Figure 15, where inflation expectations eventually converge to the same inflation level regardless of whether households are interested in the Bank's activities. This figure also suggests that the difference in inflation expectations, if one arises, lasts for only about one year.

#### 4.3.2 Households' confidence in the Bank and inflation expectations

Next, the relationship between households' inflation expectations and their confidence in the Bank of Japan is investigated. In the *Opinion Survey*, respondents are asked to indicate their level of confidence in the Bank in five grades: "*Confident*," "*Somewhat confident*," "*Difficult to say*," "*Not particularly confident*," and "*Not confident*." Respondents are divided into five groups based on their level of confidence. Figure 19 shows the mean inflation expectations of these five groups, while Table 11 presents the results of the *F* test and Scheffe's test to see whether there is any difference in those

means.

The underlying distribution of inflation expectations is used and the relationship with respondents' confidence in the Bank is examined. The test results show no correlation between inflation expectations and confidence in the Bank up to March 2006. However, from June 2006 onward, the mean inflation expectations of those that chose "*Not particularly confident*" or "*Not confident*" were significantly different from those of the other groups. That is, the less confident households were in the Bank, the higher were their inflation expectations. In other words, confidence in the Bank may be effective in containing inflation expectations. On the other hands, when the survey answers are used instead, no clear relationship between confidence in the Bank and inflation expectations can be observed.

As mentioned above, households have a general tendency to think that inflation implies a loss of income. Thus, policy measures to lower inflation will strengthen their confidence, but policy measures to push up inflation rates may fail to gain any support from households and weaken their confidence in the Bank. If this is the case, inflationary policies may trigger a vicious feedback cycle between inflation expectations and confidence in the Bank, resulting in actual inflation rates higher than the Bank intends. This risk becomes especially large at the time of a policy change. As discussed above, inflation expectations jump suddenly as soon as households recognize a shift in the policy regime. If this jump prompts actual inflation, this will likely damage the Bank's reputation and may lead to hyperinflation.

#### 4.3.3 Households' perception of the Bank's contribution to their lives and inflation expectations

Next, let us briefly consider the effects of households' perception of the Bank's contribution to their lives on their inflation expectations. The *Opinion Survey* has a question on how the Bank makes a contribution to households' lives, requiring respondents to select one from five choices: "*Contributing*," "*Somewhat contributing*," "*Difficult to say*," "*Not particularly contributing*," and "*Not contributing*." Respondents are divided into five groups based on their choice. The group means of inflation

expectations are shown in Figure 17. The results of the  $F$  test and Scheffe's test for differences in those means are shown in Table 9.

The underlying distribution of inflation expectations is used and the relationship with respondents' perceptions of the Bank's contribution to their lives is examined. A statistically significant relationship can be observed from March 2004 onward. Note, however, that the relationship between inflation expectations and perceptions of the Bank's contribution to respondents' lives changed in June 2006. Specifically, from that survey onward, the less households felt that the Bank contributed to their lives, the higher were their inflation expectations. Of course, more or less the only thing that households expect of the Bank is to maintain low inflation. Therefore, as long as the Bank succeeds in achieving low inflation, households consider that the Bank's actions contribute to their lives.

#### 4.3.4 Interpretation of the choice "*Difficult to say*"

Finally, let us focus on the relationship between households' perceptions of the Bank's contribution to their lives and inflation expectations up to June 2006. Note that the inflation expectations of the group choosing "*Difficult to say*" were lower than those of the other groups. This tendency is observed for all five questions regarding households' view on the Bank, although the difference is not always statistically significant.

The results for the group of respondents choosing "*Difficult to say*" need to be interpreted with care. Households in this group likely tend to fall into one of the following two types. The first type think that the Bank is doing neither a particularly good job nor a particularly bad job and therefore chooses "*Difficult to say*," since this is located at the middle of the five choices. The second type choose "*Difficult to say*" when in fact they have no idea how to judge whether the Bank is doing a good job. It is known that respondents have a tendency to pick the middle option when they do not know what to choose (Tanioka, 2007). This is a very important point to keep in mind when interpreting the empirical results.

Given this, let us consider the following hypothesis: respondents who have no



idea how to judge whether the Bank is making a contribution to their lives have a tendency to give the same answer on expected and perceived inflation. If this is the case, the inflation expectations of those who choose “*Difficult to say*” have a downward bias (see Figure 1 above). To test this hypothesis, respondents are divided into five groups based on their view on the Bank’s contribution to their lives. Then, for each group the share of those who expected no change in inflation—i.e., those who gave the same answer for currently perceived inflation and 1 year expected inflation—was calculated. As seen in Figure 20, up to March 2006, the share of households expecting no change is higher among those responding with “*Difficult to say*” than among those responding with “*Somewhat contributing*” or “*Not particularly contributing.*” This suggests that households choosing “*Difficult to say*” have a no-change bias in inflation expectations, which results in lowering inflation expectations.

A similar bias may be present in households’ outlook on economic conditions as well as in inflation expectations. That is, some households may write zero percent when they have no idea about future inflation. In addition, there is a high possibility that respondents indicate that they expect no change in economic conditions when in fact they have no clear idea what their expectation is. Thus, the discussion here can be summarized as follows: There are likely two types of respondents who choose the middle option, but it is difficult to distinguish them from each other, and this ambiguity is one of the many sources that prevent us from gaining a precise understanding of the process of expectation formation by households with regard to future inflation.

## 5. CONCLUSION

This paper used the micro-data collected in the *Opinion Survey on the General Public’s Views and Behavior* to investigate households’ inflation expectations. The analysis focused on (i) the basic characteristics of inflation expectations, (ii) their relationship with respondents’ outlook on economic conditions, and (iii) the possibility of the central bank exerting any influence on inflation expectations. The main results are as follows.

First, households have a tendency to give answers in integers, and especially in multiples of 5. In addition, households' price expectations display downward rigidity. Adjusting inflation expectations for this downward rigidity using the Kahn test provides the potential and underlying distributions of households' inflation expectations. The simulation suggests that survey answers react non-linearly to a shock to inflation expectations; that is, they strongly react to a shock to inflation expectations in a high inflation environment, but only weakly in a low inflation environment. In addition, reflecting the prolonged economic stagnation that Japan had already experienced, the underlying inflation expectations and perceived inflation indicated that households expected mild deflation to continue for some time. Another noteworthy finding is that inflation expectations can suddenly become unstable, as illustrated by the jump in 2006 and the continued instability thereafter.

Second, if the distribution of inflation expectations is distorted by downward rigidity, the potential correlation between inflation expectations and other economic data may be difficult to detect and/or spurious correlations may arise. For this reason, the underlying distribution, i.e., the distribution of inflation expectations adjusted for downward rigidity and other distorting factors, is estimated to examine the relationship between households' inflation expectations and their outlook for general economic conditions and their own economic circumstances. The analysis suggests that until mid-2005, no significant relationship can be observed, but thereafter a negative correlation can be found between inflation expectations and the outlook for economic conditions. This suggests that households' inflation expectations are affected by price shocks, such as a rise in oil prices, but are relatively unaffected by demand conditions; i.e., households do not appear to take the relationship suggested by the Phillips curve into account.

Third, the relationship between households' inflation expectations and their views on the central bank were examined. Again, such relationship may be weakened by downward rigidity of inflation expectations in a low inflation environment, so that again it is important to adjust for downward rigidity. The analysis suggested that there was a clear correlation between households' inflation expectations and their

perceptions of the Bank from 2006 onward. First, the more interested households were in the Bank's activities, the more stable were their inflation expectations. Second, the more confidence respondents had in the Bank, the lower their inflation expectations tended to be, suggesting that by ensuring it has the trust of the public the Bank can more effectively prevent a rise in inflation expectations. As mentioned above, most households are unaware of the Phillips curve relationship between economic conditions and inflation and therefore do not take it into account when answering the survey. Taken together, these results imply that the Bank's conduct has a direct impact on households' inflation expectations even if there are no changes in supply and demand conditions. To make use of this fact, the Bank needs to maintain the public's interest in its activities and thereby enhance its institutional reputation. And for these purposes, the Bank should make an effort to explain its policies clearly and frequently.

## APPENDIX. BARNETT'S HOMOSCEDASTICITY TEST

Denote the variance of inflation expectations of households belonging to category  $i$  by  $\sigma_i^2$ . Consider the following null hypothesis  $H_0^\sigma$ .

$$H_0^\sigma : \sigma_1^2 = \dots = \sigma_k^2. \quad (\text{A.1})$$

Then the Barlett statistic is given by

$$B_0 = \frac{(n-k) \ln V_E - \sum_i (n_i - 1) \ln V_i}{C}, \quad (\text{A.2})$$

where

$$V_i \equiv \frac{\sum_j (x_{ij} - \bar{x}_i)^2}{n_i - 1}, \quad (\text{A.3})$$

$$C \equiv 1 + \frac{1}{3(k-1)} \left( \sum_i \frac{1}{n_i - 1} - \frac{1}{n - k} \right). \quad (\text{A.4})$$

Under the null, the Bartlett statistic  $B_0$  follows a  $\chi^2$  distribution with  $k-1$  degrees of freedom. Thus, if the Bartlett statistic is greater than the critical value  $\chi_{k-1}^2(\alpha)$  for significance level  $\alpha$ , the null is rejected, with the result that homoscedasticity fails to hold.

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Table 1. Characteristics of Households' Answers on Inflation

Horizon	Total	Integer	Zero	Multiples of 5 (excluding 0)	Negative
1 Year Expectations	2177	94	42	31	4
5 Year Expectations	2145	88	24	29	5
Current Perceptions	2165	94	51	28	11

Notes: 1. "Total" indicates the number of households; the other figures are in %.  
2. Averaged from March 2004 to June 2007.  
3. Both "in-home" and mail surveys are counted in June 2006.

Table 2. Results of Kahn Test

		Estimate	Standard Error	t-value	p-value
1 Year Expectations	$\beta$	0.91	0.01	72.13	0.00
	$\theta$	0.15	0.01	13.05	0.00
	$\phi$	2.56	0.06	42.25	0.00
5 Year Expectations	$\beta$	0.78	0.01	52.85	0.00
	$\theta$	0.12	0.01	17.58	0.00
	$\phi$	2.15	0.05	45.66	0.00
Current Perceptions	$\beta$	0.84	0.03	31.49	0.00
	$\theta$	0.40	0.11	3.58	0.00
	$\phi$	2.14	0.10	22.42	0.00



Table 3. Descriptive Statistics of Potential Distribution of Inflation Expectations

	Mean (%)	Standard Error (%)	Skewness	Kurtosis
1 Year Expectations	m - 0.09	5.61	0.13	2.91
5 Year Expectations	m + 0.50	4.39	0.40	4.06
Current Perception	m - 1.33	6.15	0.33	2.69

Note: "m" stands for the median of answers on inflation rates.

Table 4. Test for Correlation Between Outlook for Economic Conditions and Inflation Expectations

(a) Underlying inflation expectations

		04/3	04/6	04/12	05/3	05/6	05/12	06/3	06/6	06/9	06/12	07/3	07/6	07/9	
F-test		3.84	4.67	4.79	4.46	4.44	22.08	8.02	28.74	20.29	12.07	9.59	18.91	33.39	22.63
Scheffe	1&2	2.42	2.10	1.66	1.99	1.39	1.92	1.89	2.12	0.43	0.20	0.98	3.23	2.12	0.49
	1&3	0.58	0.41	0.42	0.00	0.85	3.92	1.88	4.44	4.66	3.47	2.03	1.46	3.46	3.98
	2&3	1.75	2.55	2.83	2.49	2.82	6.63	3.82	7.57	6.29	4.86	4.38	5.74	8.16	6.52

(b) Answers on inflation expectations

		04/3	04/6	04/12	05/3	05/6	05/12	06/3	06/6	06/9	06/12	07/3	07/6	07/9	
F-test		0.04	12.67	11.35	5.28	8.41	11.69	13.39	18.56	25.09	24.26	15.40	7.78	28.04	13.40
Scheffe	1&2	0.18	0.08	0.49	0.65	0.13	0.25	0.92	0.54	1.64	1.04	0.34	1.02	0.72	1.18
	1&3	0.17	2.80	2.52	0.97	2.10	2.56	3.43	3.69	4.67	4.19	2.26	1.10	3.86	2.82
	2&3	0.03	3.49	3.22	2.27	2.84	3.39	3.31	4.07	4.23	4.51	3.91	2.74	5.00	3.20

Notes: 1. Lightly and darkly shaded cells indicate significance at the 5% and 1% levels, respectively.

2. The figures in the rows labeled 1&2, 1&3, etc., correspond to the lines denoted by (1), (2), etc., in Figure 12.

Table 5. Test for Correlation Between Outlook for Income and Inflation Expectations

## (a) Underlying inflation expectations

		04/3	04/6	04/12	05/3	05/6	05/12	06/3	06/6		06/9	06/12	07/3	07/6	07/9
F-test		2.08	0.95	2.13	1.76	2.47	10.24	1.64	8.13	15.44	10.93	6.66	10.53	30.47	17.38
Scheffe	1&2	0.78	0.66	0.74	0.42	0.58	0.67	0.82	0.60	0.14	0.56	1.24	2.11	0.26	0.39
	1&3	0.14	1.19	0.24	0.55	0.58	1.67	0.23	1.63	3.13	2.07	0.76	0.41	3.97	2.55
	2&3	2.00	1.06	2.03	1.87	2.22	4.52	1.75	4.03	5.45	4.65	3.62	4.45	7.68	5.84

## (b) Answers on inflation expectations

		04/3	04/6	04/12	05/3	05/6	05/12	06/3	06/6	06/9	06/12	07/3	07/6	07/9	
F-test		2.75	7.60	12.59	2.60	4.37	13.86	4.89	4.69	8.07	6.10	4.86	5.23	24.47	7.17
Scheffe	1&2	0.04	1.74	0.23	0.03	0.70	0.30	0.14	0.32	1.36	0.11	0.76	0.91	0.52	0.37
	1&3	0.71	2.59	1.84	0.83	1.60	1.59	1.11	0.89	2.54	1.26	0.45	0.34	3.02	1.62
	2&3	1.63	1.74	3.43	1.57	1.79	3.70	2.19	2.16	2.13	2.43	2.18	2.25	4.69	2.52

Notes: 1. Lightly and darkly shaded cells indicate significance at the 5% and 1% levels, respectively.

2. The figures in the rows labeled 1&2, 1&3, etc., correspond to the lines denoted by (1), (2), etc., in Figure 13.

Table 6. Test for Correlation Between Outlook for Spending and Inflation Expectations

(a) Underlying inflation expectations

		04/3	04/6	04/12	05/3	05/6	05/12	06/3	06/6		06/9	06/12	07/3	07/6	07/9
F-test		1.78	0.18	0.03	0.28	0.06	0.59	0.27	3.53	11.69	10.06	11.81	5.03	6.18	13.79
Scheffe	1&2	0.23	0.26	0.02	0.13	0.19	0.24	0.47	1.89	0.14	0.19	0.48	2.84	1.21	0.32
	1&3	0.27	0.10	0.05	0.10	0.12	0.53	0.25	1.10	2.36	1.83	1.69	1.87	0.39	1.98
	2&3	1.89	0.57	0.26	0.75	0.30	1.03	0.62	2.13	4.66	4.41	4.82	2.10	3.50	5.18

(b) Answers on inflation expectations

		04/3	04/6	04/12	05/3	05/6	05/12	06/3	06/6	06/9	06/12	07/3	07/6	07/9	
F-test		0.46	5.49	9.31	5.80	4.69	0.20	1.61	3.42	13.20	14.04	10.29	4.56	7.53	10.82
Scheffe	1&2	0.01	0.23	0.03	0.78	0.75	0.10	0.23	1.20	0.20	0.12	0.03	1.67	0.65	0.93
	1&3	0.17	0.43	0.79	0.05	0.27	0.03	0.20	0.63	1.84	1.54	1.36	0.87	0.59	0.56
	2&3	0.67	2.34	3.03	2.36	2.09	0.45	1.27	1.57	3.47	3.67	3.13	1.72	2.74	3.29

Notes: 1. Lightly and darkly shaded cells indicate significance at the 5% and 1% levels, respectively.

2. The figures in the rows labeled 1&2, 1&3, etc., correspond to the lines denoted by (1), (2), etc., in Figure 14.

Table 7. Test for Correlation Between Households' Interest in BoJ's Activities and Inflation Expectations

## (a) Underlying inflation expectations

		04/3	04/6	04/12	05/3	05/6	05/12	06/3	06/6	06/9	06/12	07/3	07/6	07/9	
F-test		1.47	3.00	3.12	1.62	1.42	3.09	5.55	4.39	6.08	9.93	3.03	5.72	1.47	1.72
Scheffe	1&2	0.41	0.00	0.68	0.05	0.33	0.16	0.10	1.35	0.12	0.10	0.57	0.03	0.21	0.36
	1&3	0.20	0.65	1.32	0.46	0.20	0.62	1.19	1.50	0.35	0.08	0.22	1.12	0.17	0.44
	1&4	0.01	0.32	0.89	0.12	0.19	0.44	0.86	1.29	0.58	1.65	0.52	0.63	0.22	0.15
	1&5	0.00	0.41	1.02	0.39	0.06	0.41	0.93	0.89	1.17	1.32	0.47	1.46	0.47	0.03
	2&3	1.20	1.57	1.26	1.00	1.07	1.68	2.08	0.13	0.35	0.26	0.60	1.77	0.63	1.22
	2&4	0.88	0.80	0.38	0.34	0.32	1.38	1.65	0.34	1.11	2.20	0.11	1.03	0.01	0.33
	2&5	0.89	1.06	0.66	0.91	0.60	1.33	1.75	1.03	1.75	1.56	1.53	1.97	0.97	0.47
	3&4	0.47	1.18	1.14	0.85	0.95	0.52	0.66	0.75	1.64	2.61	0.55	0.84	0.71	0.99
	3&5	0.51	0.94	0.86	0.20	0.67	0.63	0.51	1.59	2.14	1.82	1.08	0.68	0.49	0.49
	4&5	0.02	0.37	0.35	0.74	0.36	0.12	0.15	1.10	0.97	0.14	1.55	1.28	1.04	0.23

## (b) Answers on inflation expectations

		04/3	04/6	04/12	05/3	05/6	05/12	06/3	06/6		06/9	06/12	07/3	07/6	07/9
F-test		1.81	3.94	0.98	0.41	0.83	1.39	0.31	2.10	0.95	3.19	0.05	0.96	0.66	0.71
Scheffe	1&2	0.37	1.64	0.18	0.27	0.26	0.38	0.43	0.86	0.65	0.26	0.04	0.28	0.65	0.53
	1&3	0.23	1.92	0.47	0.50	0.32	0.42	0.46	0.94	0.46	0.10	0.11	0.73	0.34	0.26
	1&4	0.21	1.92	0.20	0.46	0.56	0.39	0.52	0.76	0.33	0.28	0.06	0.48	0.48	0.62
	1&5	0.63	1.91	0.13	0.40	0.31	0.10	0.54	0.50	0.02	1.14	0.16	0.12	0.20	0.53
	2&3	0.30	0.47	0.57	0.44	0.10	0.05	0.04	0.05	0.35	0.52	0.12	0.69	0.54	0.44
	2&4	0.37	0.43	0.03	0.35	0.60	0.03	0.12	0.36	0.55	0.77	0.03	0.30	0.32	0.10
	2&5	0.50	0.41	0.14	0.25	0.07	0.68	0.16	0.81	0.84	1.75	0.19	0.16	0.58	0.07
	3&4	0.06	0.08	0.69	0.14	0.57	0.10	0.08	0.63	0.22	0.27	0.10	0.43	0.26	0.61
	3&5	0.98	0.15	0.93	0.28	0.05	0.91	0.12	1.16	0.61	1.39	0.09	0.69	0.16	0.43
	4&5	1.15	0.07	0.22	0.15	0.72	0.93	0.04	0.73	0.45	1.18	0.17	0.39	0.36	0.01

Notes: 1. Lightly and darkly shaded cells indicate significance at the 5% and 1% levels, respectively.

2. The figures in the rows labeled 1&2, 1&3, etc., correspond to the lines denoted by (1), (2), etc., in Figure 15.

Table 8. Test for Correlation Between BoJ's Relationship to Households' Lives and Inflation Expectations

## (a) Underlying inflation expectations

		04/3	04/6	04/12	05/3	05/6	05/12	06/3	06/6	06/9	06/12	07/3	07/6	07/9	
F-test		5.07	6.29	4.27	4.90	2.99	5.63	2.81	4.00	5.39	6.59	4.48	1.55	6.77	3.71
Scheffe	1&2	0.54	0.72	0.37	0.20	0.28	0.04	0.04	0.57	0.14	0.23	0.76	0.10	0.02	0.21
	1&3	2.04	2.32	1.83	1.66	1.48	1.86	1.28	1.43	1.36	0.84	0.85	0.66	1.06	1.26
	1&4	0.84	0.88	0.14	0.66	0.17	0.07	0.24	1.01	1.77	2.00	0.00	0.87	2.07	0.28
	1&5	0.81	0.34	0.29	0.58	0.65	0.37	0.51	1.11	0.28	1.10	2.00	0.22	0.07	1.21
	2&3	1.79	1.84	1.65	2.04	1.38	2.13	1.53	1.53	1.43	0.97	0.23	0.58	1.06	1.41
	2&4	0.45	0.36	0.14	0.85	0.05	0.11	0.29	0.76	1.82	1.84	0.43	0.92	2.04	0.16
	2&5	0.45	0.17	0.04	0.75	0.50	0.42	0.57	0.89	0.21	1.01	1.67	0.26	0.07	1.29
	3&4	0.92	0.97	1.29	0.63	1.10	1.51	0.85	1.10	0.72	2.32	0.55	1.21	2.59	1.09
	3&5	0.82	1.40	1.04	0.59	0.37	1.02	0.39	0.50	0.92	1.40	1.48	0.49	0.46	0.58
	4&5	0.03	0.42	0.14	0.01	0.48	0.28	0.29	0.32	1.31	0.17	1.71	0.26	1.32	1.23

## (b) Answers on inflation expectations

		04/3	04/6	04/12	05/3	05/6	05/12	06/3	06/6	06/9	06/12	07/3	07/6	07/9	
F-test		0.59	2.65	1.37	1.00	0.72	0.56	0.44	1.22	2.12	2.92	2.48	2.62	1.50	1.31
Scheffe	1&2	0.48	0.16	0.13	0.65	0.08	0.36	0.11	0.66	0.19	0.06	1.08	0.43	0.40	0.14
	1&3	0.15	0.45	0.36	0.37	0.29	0.65	0.19	0.93	1.35	0.14	0.59	0.76	0.59	0.36
	1&4	0.64	0.20	0.89	0.24	0.02	0.41	0.37	0.92	0.46	0.57	0.15	0.66	0.64	0.99
	1&5	0.09	1.20	0.80	0.62	0.78	0.03	0.28	0.63	0.16	1.62	0.20	0.99	0.49	0.27
	2&3	0.37	0.33	0.26	0.29	0.24	0.35	0.10	0.43	1.15	0.09	1.43	1.08	0.90	0.47
	2&4	0.29	0.08	0.85	0.76	0.04	0.14	0.49	0.41	0.34	0.53	0.76	0.89	0.87	1.06
	2&5	0.29	1.39	0.75	0.19	0.77	0.29	0.37	0.05	0.23	1.59	0.66	1.14	0.66	0.33
	3&4	0.57	0.16	0.64	0.54	0.23	0.13	0.55	0.04	0.47	0.43	0.24	0.08	0.17	0.66
	3&5	0.02	1.59	0.55	0.37	0.60	0.52	0.43	0.52	0.80	1.49	0.11	0.62	0.16	0.09
	4&5	0.48	1.23	0.03	0.73	0.70	0.35	0.04	0.50	0.41	1.07	0.07	0.53	0.03	0.34

Notes: 1. Lightly and darkly shaded cells indicate significance at the 5% and 1% levels, respectively.

2. The figures in the rows labeled 1&amp;2, 1&amp;3, etc., correspond to the lines denoted by (1), (2), etc., in Figure 16.

Table 9. Test for Correlation Between BoJ's Contribution to Households' Lives and Inflation Expectations

## (a) Underlying inflation expectations

		04/3	04/6	04/12	05/3	05/6	05/12	06/3	06/6	06/9	06/12	07/3	07/6	07/9	
F-test		4. 67	7. 30	4. 83	5. 06	3. 38	2. 39	3. 50	6. 93	9. 91	16. 12	16. 65	8. 82	1. 97	7. 34
Scheffe	1&2	0. 10	0. 26	0. 92	0. 28	0. 45	0. 16	0. 00	1. 24	0. 17	1. 60	0. 41	0. 01	0. 86	0. 28
	1&3	1. 27	1. 31	1. 67	1. 47	1. 06	0. 91	1. 02	1. 42	0. 21	1. 03	0. 92	0. 69	0. 38	0. 94
	1&4	0. 20	0. 37	0. 05	0. 10	0. 48	0. 25	0. 10	0. 25	2. 31	3. 43	2. 80	1. 58	1. 16	1. 62
	1&5	0. 25	0. 55	0. 24	0. 01	0. 04	0. 01	0. 34	0. 38	1. 56	2. 54	0. 95	1. 54	0. 77	0. 47
	2&3	1. 62	1. 49	0. 95	1. 54	0. 74	0. 98	1. 35	0. 22	0. 46	0. 73	0. 55	0. 85	0. 61	0. 81
	2&4	0. 14	0. 72	0. 82	0. 38	0. 98	0. 45	0. 11	1. 99	2. 34	2. 38	3. 32	1. 74	0. 58	2. 03
	2&5	0. 39	0. 90	0. 54	0. 23	0. 33	0. 13	0. 38	0. 64	1. 53	1. 65	1. 23	1. 63	0. 29	0. 32
	3&4	1. 10	1. 86	1. 53	1. 51	1. 62	1. 20	1. 10	2. 27	2. 70	2. 94	3. 89	2. 39	0. 99	2. 66
	3&5	1. 53	1. 91	1. 16	1. 21	0. 82	0. 77	1. 25	0. 79	1. 79	2. 07	1. 55	2. 08	0. 60	0. 08
	4&5	0. 45	0. 22	0. 19	0. 09	0. 46	0. 23	0. 25	0. 66	0. 31	0. 24	1. 12	0. 31	0. 16	1. 66

## (b) Answers on inflation expectations

		04/3	04/6	04/12	05/3	05/6	05/12	06/3	06/6	06/9	06/12	07/3	07/6	07/9	
F-test		0.59	2.65	1.37	1.00	0.72	0.56	0.44	1.22	2.12	2.92	2.48	2.62	1.50	0.00
Scheffe	1&2	0.11	0.12	1.28	0.09	0.32	0.51	0.35	0.88	0.32	0.95	0.73	0.03	0.30	0.02
	1&3	0.15	0.44	0.86	0.30	0.20	0.17	0.24	0.26	1.54	1.10	0.14	0.15	0.50	0.79
	1&4	0.47	0.63	0.29	0.18	0.73	0.18	0.18	0.32	1.41	1.52	0.74	1.01	1.04	1.66
	1&5	1.00	1.86	0.38	1.02	0.31	0.09	0.30	0.29	1.24	2.51	1.80	2.15	1.46	0.40
	2&3	0.38	0.44	0.68	0.52	0.71	0.50	0.18	0.89	1.43	0.09	0.74	0.23	1.04	0.93
	2&4	0.70	0.64	1.58	0.29	1.15	0.29	0.13	0.73	1.27	0.87	1.39	1.15	1.43	1.78
	2&5	1.08	2.08	1.57	1.23	0.08	0.34	0.04	1.11	1.11	2.00	2.33	2.31	1.76	0.43
	3&4	0.46	0.37	1.19	0.07	0.72	0.05	0.01	0.10	0.41	0.84	0.94	1.03	0.79	1.22
	3&5	1.40	1.95	1.22	0.96	0.53	0.03	0.15	0.57	0.40	1.99	2.01	2.24	1.28	0.04
	4&5	1.51	1.31	0.10	0.83	0.95	0.07	0.13	0.62	0.06	1.08	1.12	1.28	0.60	0.84

Notes: 1. Lightly and darkly shaded cells indicate significance at the 5% and 1% levels, respectively.

2. The figures in the rows labeled 1&amp;2, 1&amp;3, etc., correspond to the lines denoted by (1), (2), etc., in Figure 17.

Table 10. Test for Correlation Between BoJ's Explanations to General Public and Inflation Expectations

## (a) Underlying inflation expectations

		04/3	04/6	04/12	05/3	05/6	05/12	06/3	06/6	06/9	06/12	07/3	07/6	07/9	
F-test		11.45	20.66	20.62	18.35	15.08	10.12	14.22	14.29	25.70	26.05	17.66	14.24	35.81	25.17
Scheffe	1&2	0.05	0.53	0.14	0.21	0.22	0.70	0.01	0.39	0.12	0.44	0.37	0.21	0.17	0.69
	1&3	0.59	1.22	0.57	0.76	0.43	1.13	1.16	2.13	0.39	0.98	0.25	0.55	0.20	0.07
	1&4	0.01	0.54	0.02	0.01	0.44	0.74	0.37	0.21	0.33	0.07	0.91	0.01	0.68	0.78
	1&5	0.09	0.59	0.00	0.17	0.33	0.85	0.41	0.98	0.84	0.34	1.16	0.21	1.21	0.96
	2&3	1.26	1.14	0.99	1.17	1.23	0.93	1.78	2.80	1.21	1.06	0.33	1.93	0.78	1.88
	2&4	0.15	0.11	0.40	0.45	0.36	0.03	0.57	0.33	0.47	1.17	1.13	0.59	1.01	0.09
	2&5	0.08	0.02	0.34	0.11	0.17	0.23	0.63	0.95	1.64	1.67	1.64	0.04	2.06	0.49
	3&4	3.09	3.79	3.73	3.84	3.43	2.82	3.05	3.46	3.34	4.16	3.15	2.86	4.18	4.22
	3&5	2.76	3.69	3.75	3.07	2.96	2.03	2.90	1.96	4.92	4.50	3.76	3.40	5.64	4.17
	4&5	0.54	0.26	0.15	0.73	0.37	0.72	0.15	1.41	2.16	0.95	1.09	1.04	2.25	0.75

## (b) Answers on inflation expectations

		04/3	04/6	04/12	05/3	05/6	05/12	06/3	06/6	06/9	06/12	07/3	07/6	07/9	
F-test		0.20	2.98	4.09	4.42	1.25	1.29	2.42	1.73	3.95	4.72	5.89	2.36	2.41	1.61
Scheffe	1&2	0.18	1.00	0.10	0.09	0.34	0.01	0.49	0.63	0.64	0.07	0.55	0.42	0.22	0.23
	1&3	0.19	0.91	0.20	0.10	0.59	0.33	0.04	0.92	0.43	0.11	0.67	0.59	0.04	0.03
	1&4	0.22	0.78	0.29	0.31	0.77	0.38	0.20	0.36	0.56	0.39	0.80	0.37	0.10	0.29
	1&5	0.15	0.66	0.49	0.45	0.65	0.28	0.39	0.82	0.90	0.68	1.18	0.28	0.41	0.20
	2&3	0.03	0.41	0.23	0.44	0.38	0.89	0.84	0.46	0.59	0.06	0.16	0.36	0.41	0.49
	2&4	0.06	0.63	0.42	0.89	0.71	0.98	0.58	0.48	0.29	0.69	0.46	0.21	0.29	0.09
	2&5	0.11	0.84	0.90	1.19	0.50	0.74	0.28	0.29	0.49	1.26	1.28	0.39	0.33	0.10
	3&4	0.19	0.67	0.55	1.11	0.74	0.31	0.64	1.02	0.59	1.17	0.65	1.18	0.30	1.24
	3&5	0.19	1.39	1.93	1.88	0.28	0.38	1.42	0.18	1.85	2.03	2.15	1.36	1.48	0.66
	4&5	0.40	0.62	1.16	0.65	0.41	0.62	0.71	0.84	1.40	1.05	1.66	0.37	1.26	0.36

Notes: 1. Lightly and darkly shaded cells indicate significance at the 5% and 1% levels, respectively.

2. The figures in the rows labeled 1&amp;2, 1&amp;3, etc., correspond to the lines denoted by (1), (2), etc., in Figure 18.



Table 11. Test for Correlation Between Households' Confidence in BoJ and Inflation Expectations

## (a) Underlying inflation expectations

		04/3	04/6	04/12	05/3	05/6	05/12	06/3	06/6		06/9	06/12	07/3	07/6	07/9
F-test		3.01	1.84	1.76	1.86	2.74	2.29	1.39	14.20	8.19	13.19	3.91	12.09	20.34	4.80
Scheffe	1&2	1.08	0.62	0.57	0.47	0.80	0.27	0.67	0.73	0.18	0.38	0.28	0.84	0.82	0.15
	1&3	0.16	0.08	0.26	0.36	0.01	0.28	0.14	2.37	0.03	1.28	0.37	0.18	1.58	0.15
	1&4	0.18	0.57	0.29	0.51	0.90	1.03	0.31	0.47	2.21	3.06	1.59	2.66	3.72	1.01
	1&5	0.32	0.74	0.17	0.03	0.79	0.34	0.27	0.92	1.45	1.79	1.07	1.64	2.60	1.61
	2&3	1.70	0.93	1.23	1.13	1.14	0.72	1.08	3.44	0.26	1.04	0.10	0.92	1.00	0.43
	2&4	0.81	0.03	0.25	0.14	0.32	0.90	0.22	1.10	2.22	3.03	1.55	2.29	3.59	1.03
	2&5	0.59	0.30	0.27	0.30	0.31	0.52	0.69	0.49	1.40	1.64	0.97	1.24	2.31	1.63
	3&4	0.37	0.72	0.67	0.94	1.08	1.38	0.47	1.48	2.45	2.40	1.53	3.06	3.11	1.35
	3&5	0.53	0.88	0.40	0.28	0.88	0.21	0.22	2.54	1.52	1.18	0.94	1.67	1.95	1.83
	4&5	0.14	0.24	0.07	0.37	0.06	1.06	0.47	1.19	0.02	0.28	0.06	0.19	0.01	0.87

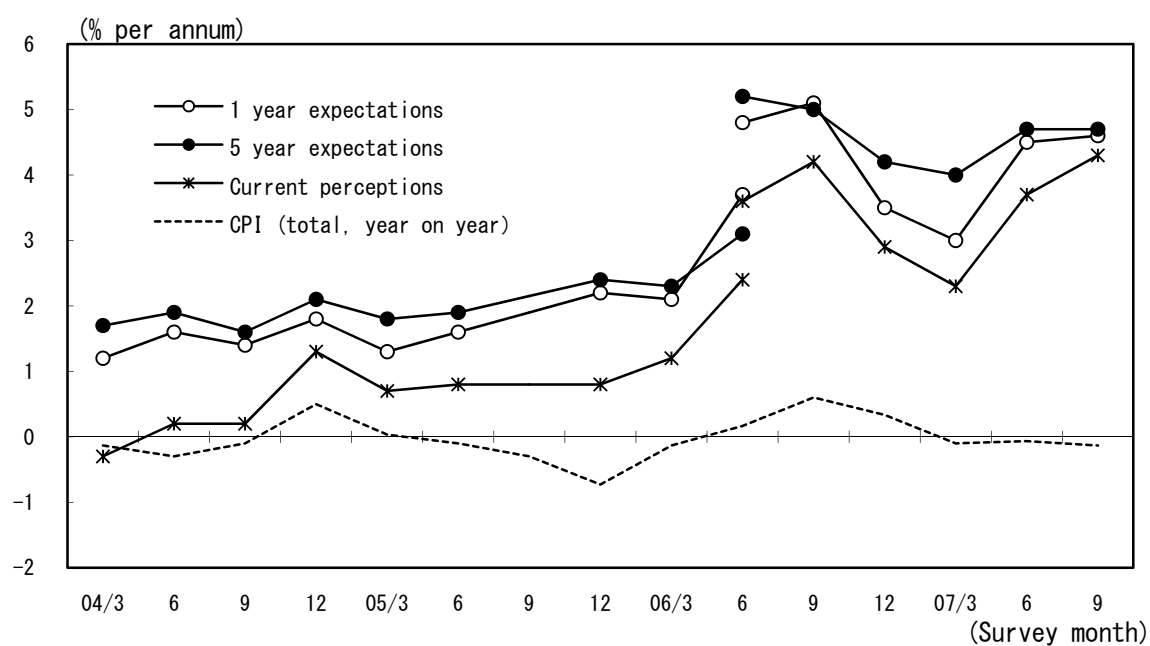
## (b) Answers on inflation expectations

		04/3	04/6	04/12	05/3	05/6	05/12	06/3	06/6		06/9	06/12	07/3	07/6	07/9
F-test		4.10	5.45	2.77	1.84	4.21	1.79	0.49	2.57	5.95	6.98	5.46	2.65	8.51	1.58
Scheffe	1&2	0.25	0.58	0.04	0.05	0.66	1.07	0.44	0.24	0.36	0.47	1.02	0.06	0.03	0.19
	1&3	0.47	0.75	0.28	0.46	0.39	0.63	0.07	1.38	1.15	1.51	0.40	0.09	1.07	0.19
	1&4	0.04	1.35	0.58	0.80	1.67	0.22	0.05	0.69	0.90	1.83	0.52	0.44	1.83	0.26
	1&5	1.28	1.96	1.40	0.95	1.17	0.15	0.08	0.10	1.49	1.92	1.07	1.35	1.80	1.02
	2&3	0.92	0.15	0.33	0.64	0.44	0.70	0.68	1.30	1.82	1.23	1.81	0.03	1.54	0.54
	2&4	0.28	1.04	0.65	0.94	1.26	1.06	0.41	0.55	1.21	1.60	1.52	0.57	2.18	0.48
	2&5	1.19	1.77	1.52	1.05	0.80	0.50	0.19	0.05	1.70	1.73	1.68	1.48	1.95	1.20
	3&4	0.39	1.08	0.49	0.60	1.67	0.72	0.00	0.43	0.20	0.75	0.24	0.62	1.27	0.15
	3&5	1.96	1.86	1.46	0.78	1.06	0.20	0.13	0.83	1.06	1.17	0.92	1.52	1.35	1.00
	4&5	1.26	0.78	0.94	0.27	0.19	0.30	0.11	0.43	0.81	0.64	0.72	1.02	0.51	0.80

Notes: 1. Lightly and darkly shaded cells indicate significance at the 5% and 1% levels, respectively.

2. The figures in the rows labeled 1&amp;2, 1&amp;3, etc., correspond to the lines denoted by (1), (2), etc., in Figure 19.

Figure 1. Households' Inflation Expectations in the *Opinion Survey*

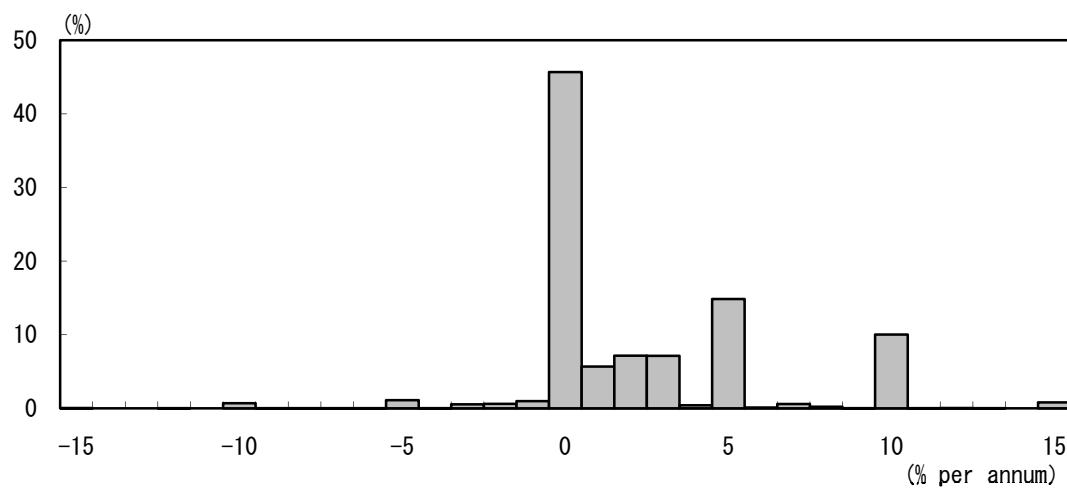


Notes: 1. Averages of answers on price changes in the *Opinion Survey*; outliers above and below 0.5% (1% in June 2005 and before) are cut off.

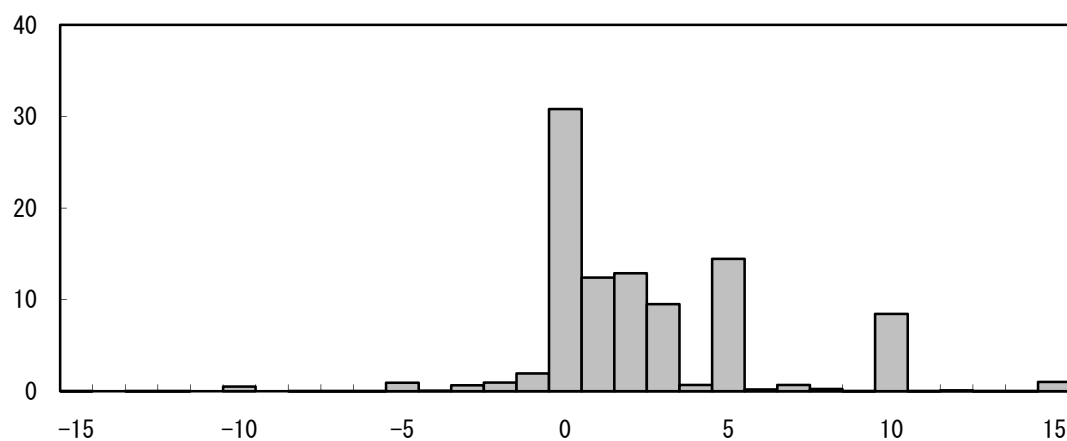
2. "In-home" method until March 2006; mail method from September 2006; both in June 2006.

Figure 2. Distributions of Survey Answers on Inflation Expectations (All surveys averaged)

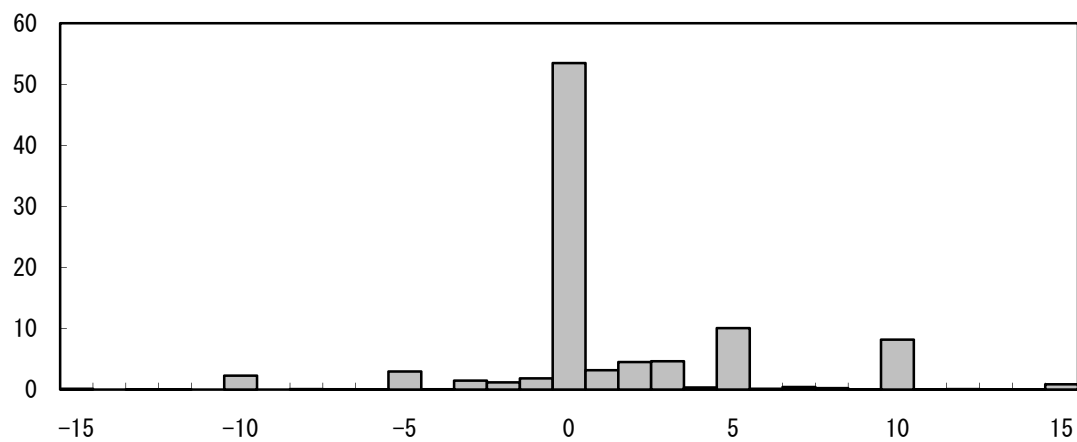
(a) 1 Year Expectations



(b) 5 Year Expectations

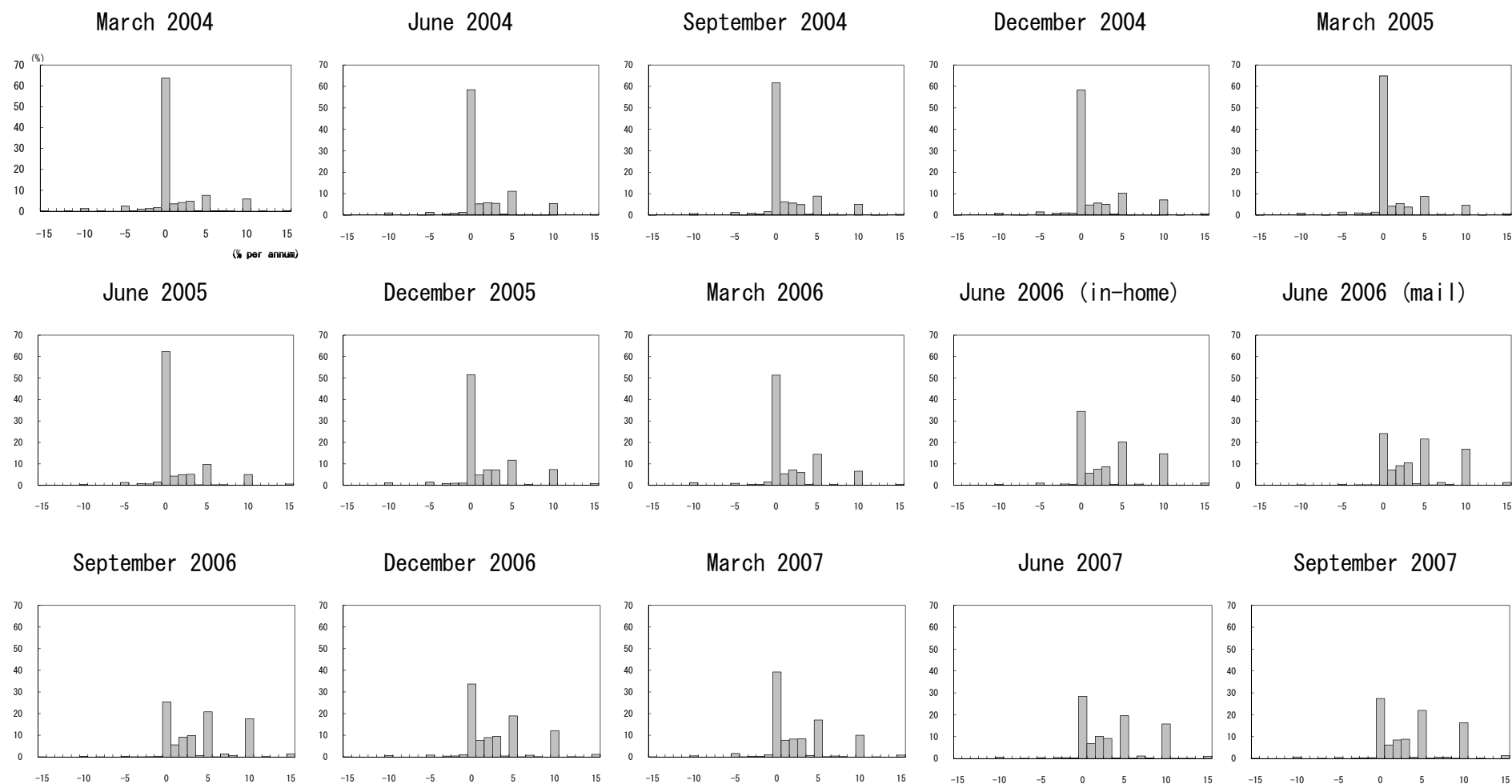


(c) Current Perceptions



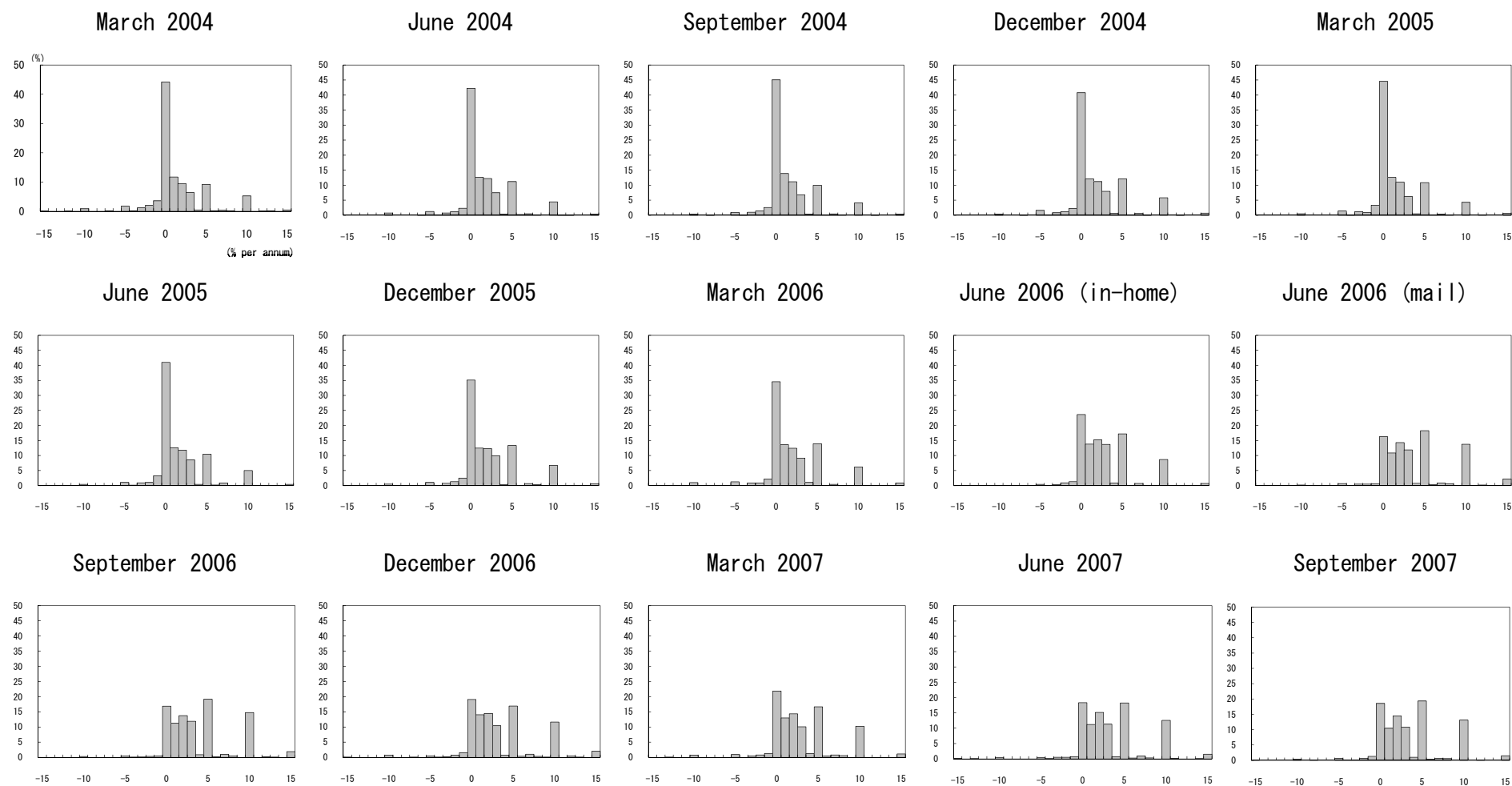
Note: Averages of all the surveys since March 2004.

Figure 3. Distributions of Survey Answers on 1 Year Inflation Expectations (Individual surveys)



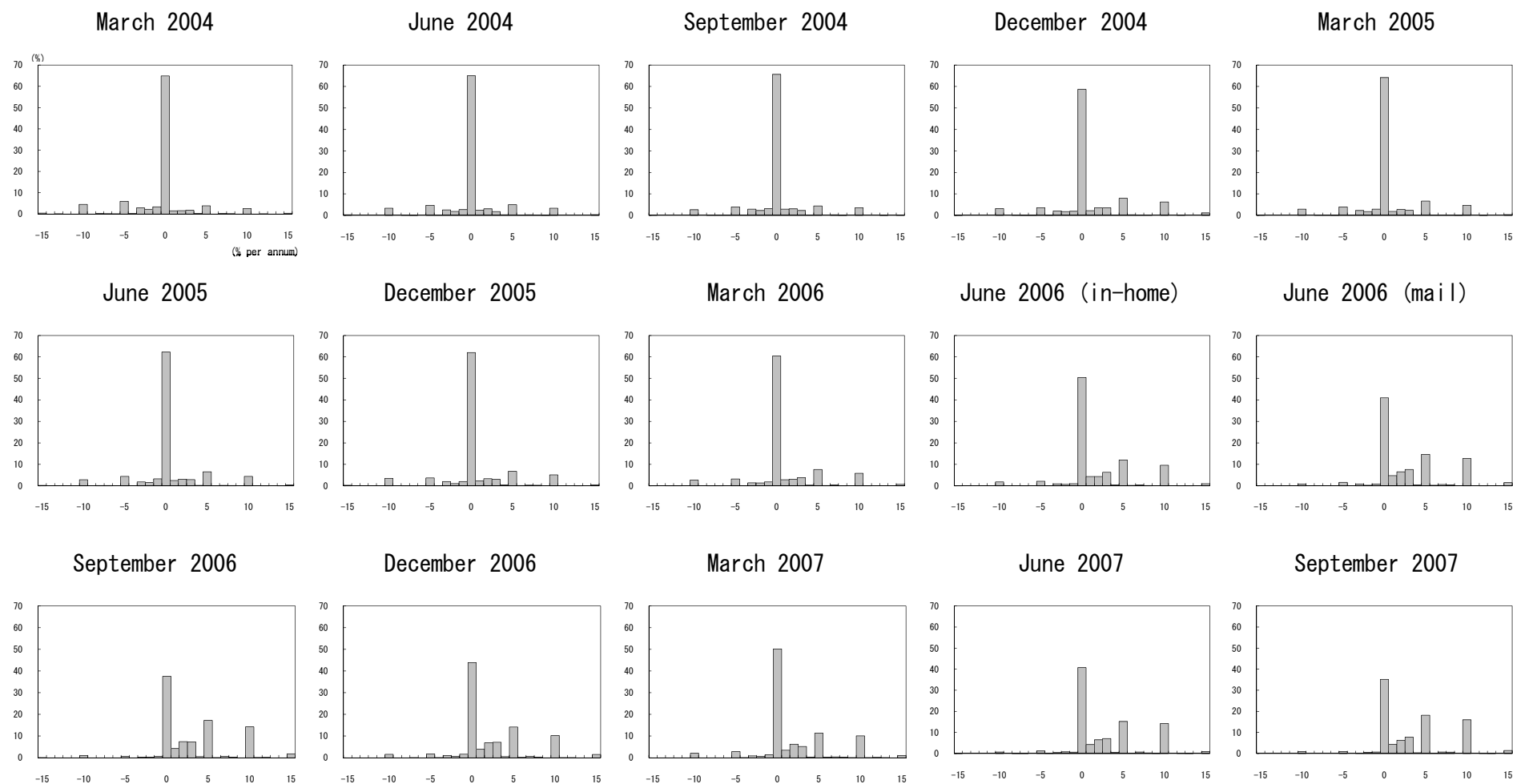
Note: In-home method until March 2006; mail method from September 2006; both in June 2006.

Figure 4. Distributions of Survey Answers on 5 Year Inflation Expectations (Individual surveys)



Note: In-home method until March 2006; mail method from September 2006; both in June 2006.

Figure 5. Distributions of Survey Answers on Current Inflation Perceptions (Individual surveys)



Note: In-home method until March 2006; mail method from September 2006; both in June 2006.

Figure 6. Skewness of Survey Answers on Inflation Expectations

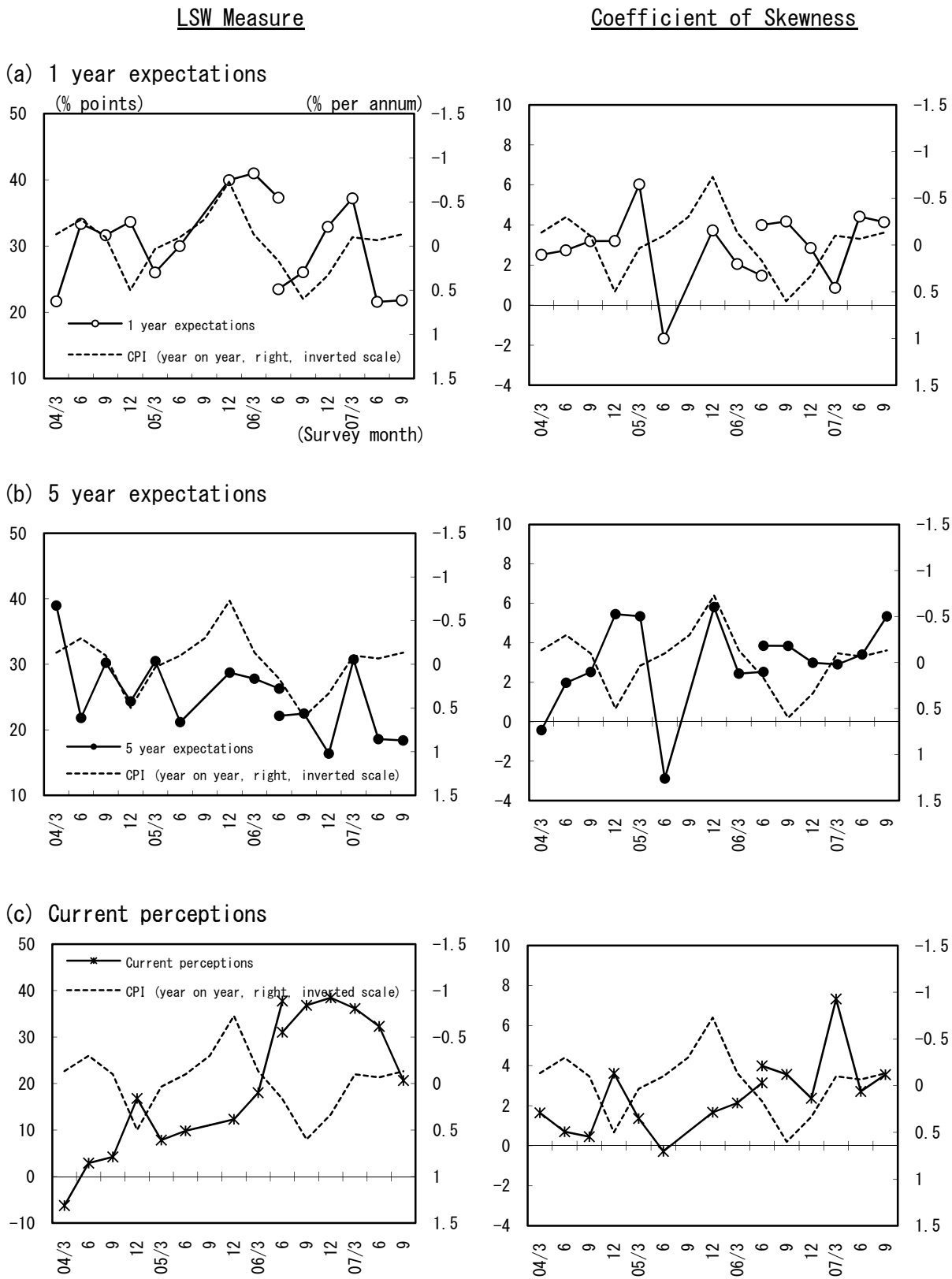
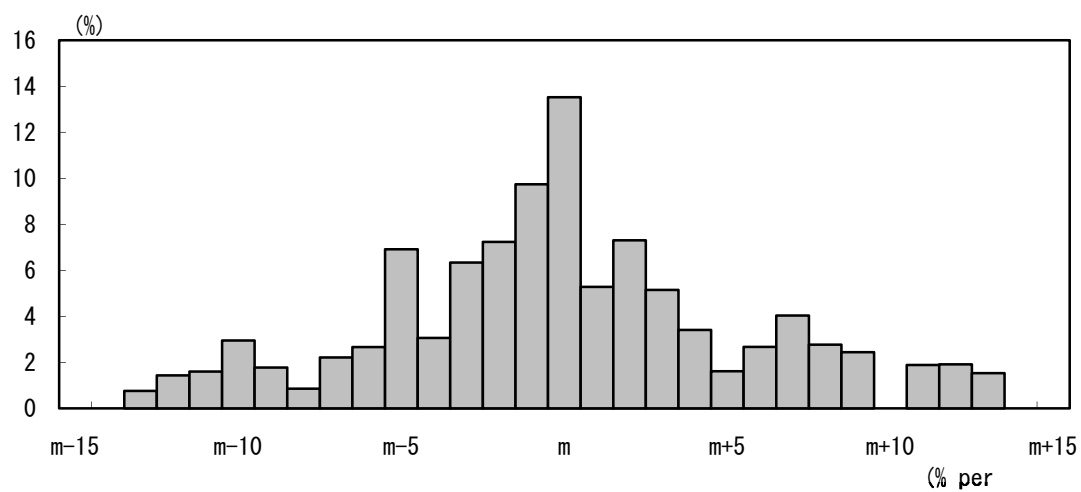
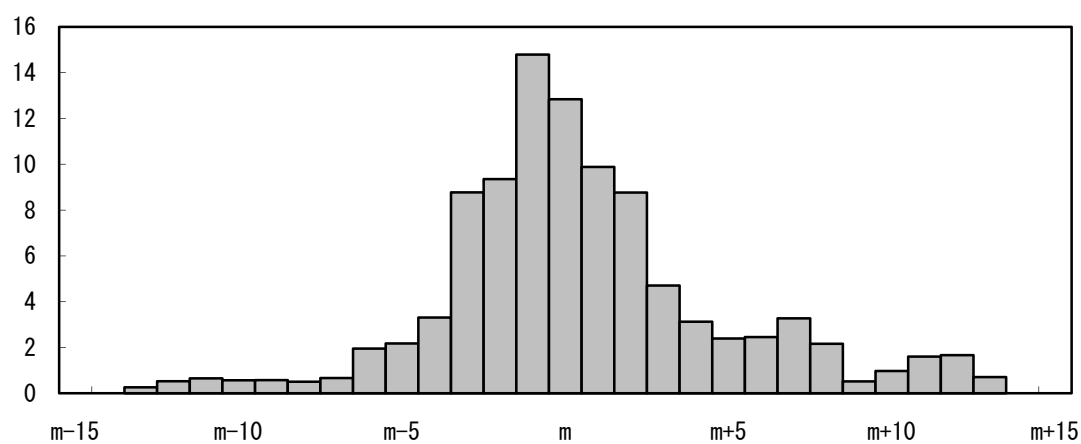


Figure 7. Potential Distributions of Inflation Expectations

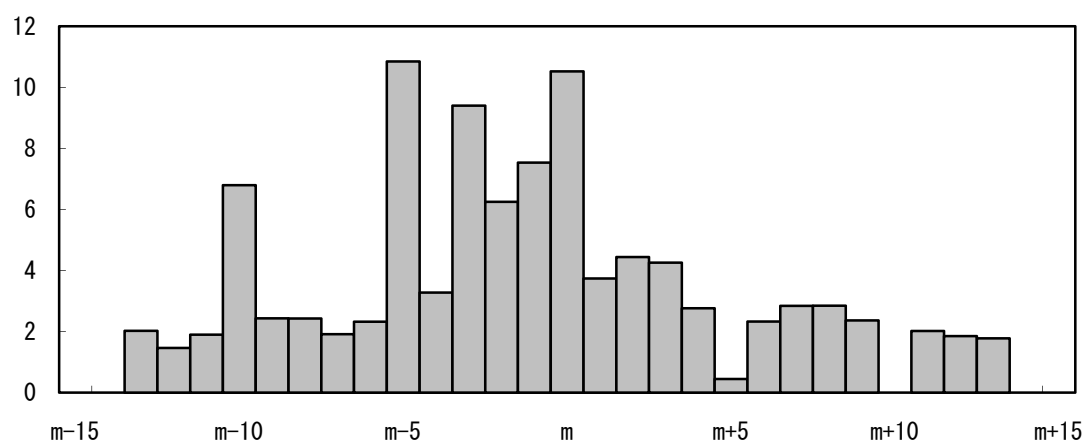
(a) 1 year expectations



(b) 5 year expectations



(c) Current perceptions

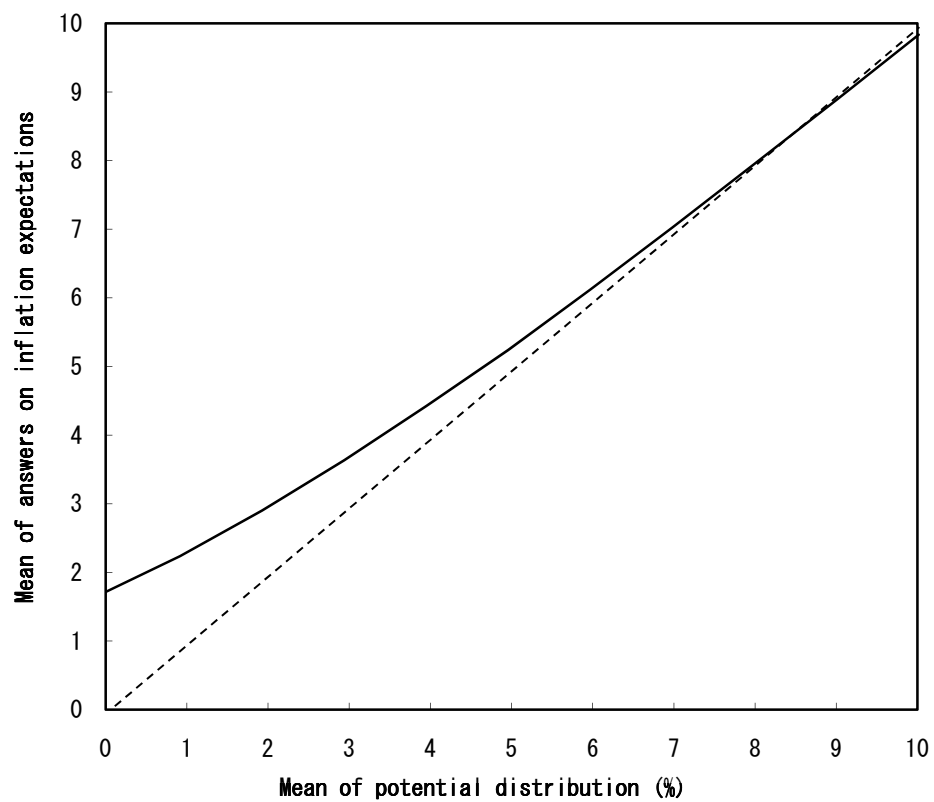


Notes: 1. Estimated from the surveys since March 2004.  
2. "m" stands for the median.



Figure 8. Non-linearity of 1 Year Inflation Expectations

(a) Means of potential distribution and survey answers



(b) Change in means of potential distribution and survey answers

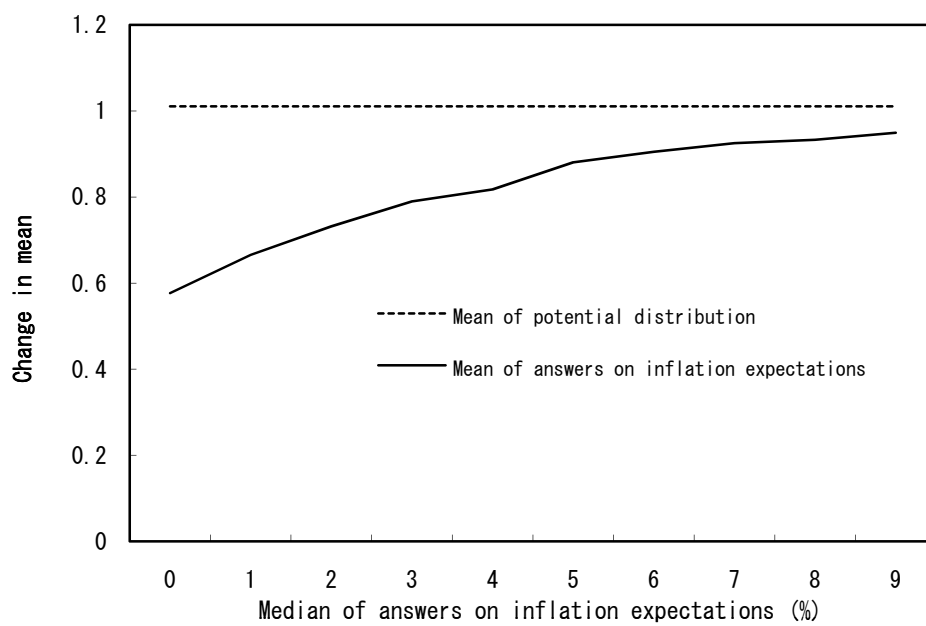
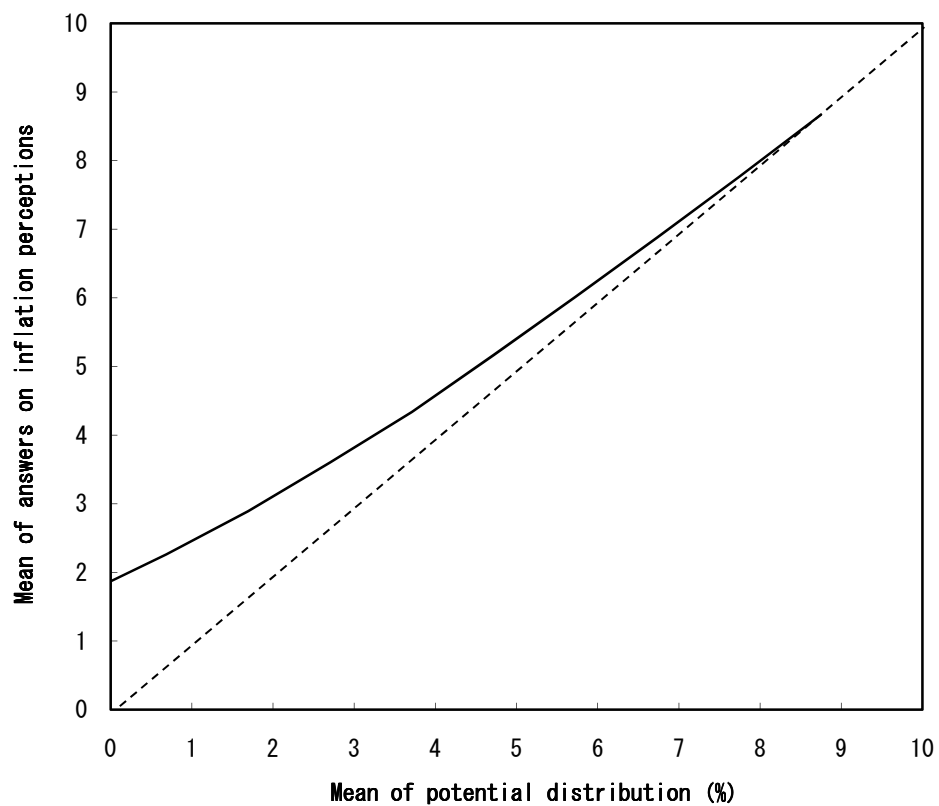


Figure 9. Non-linearity of Current Inflation Perceptions

(a) Means of potential distribution and survey answers



(b) Change in means of potential distribution and survey answers

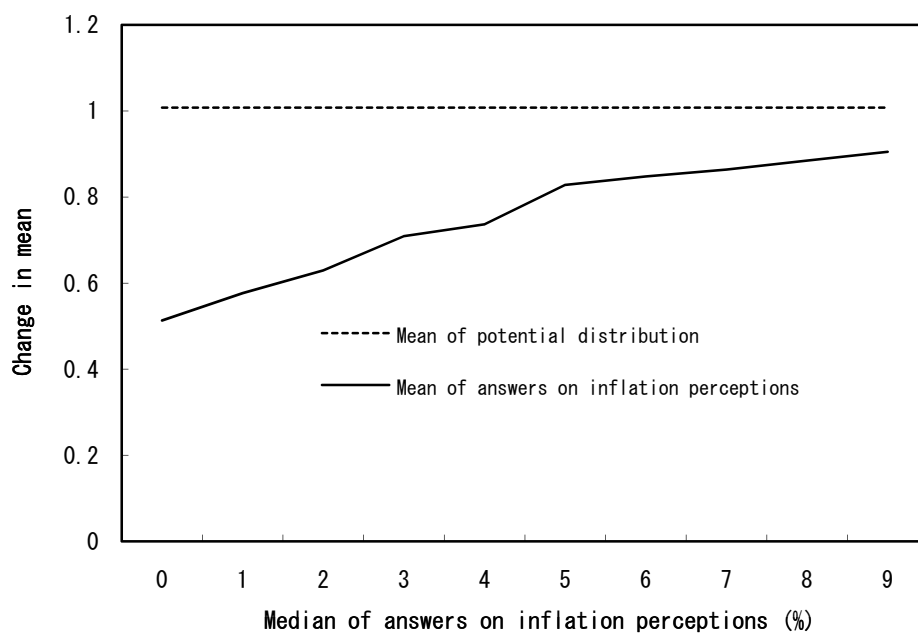
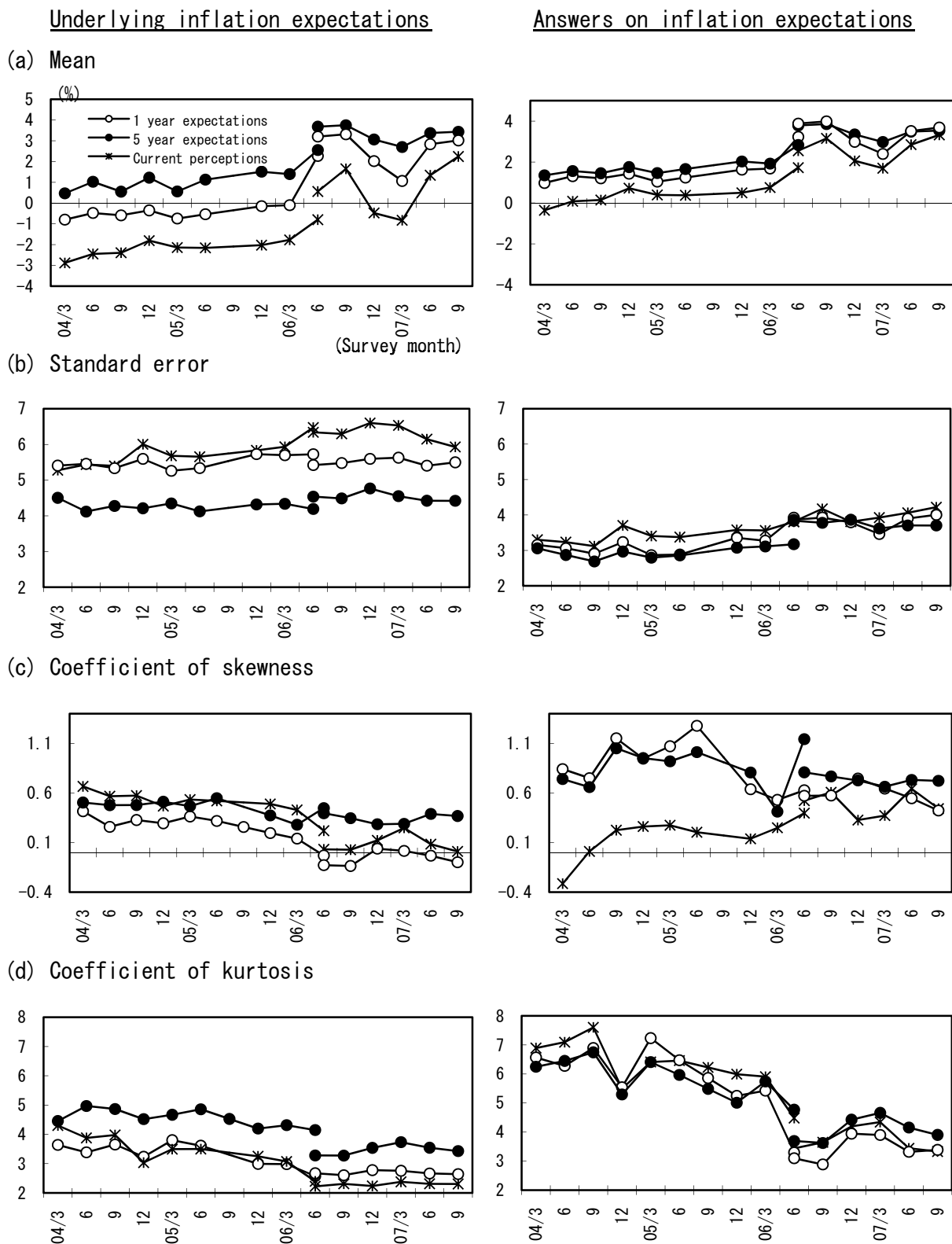


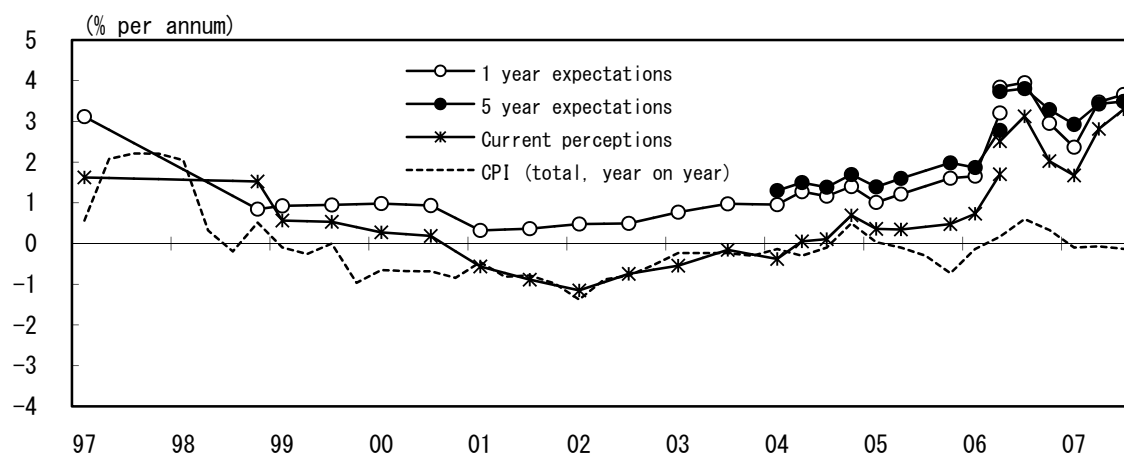
Figure 10. Characteristics of Underlying Inflation Expectations



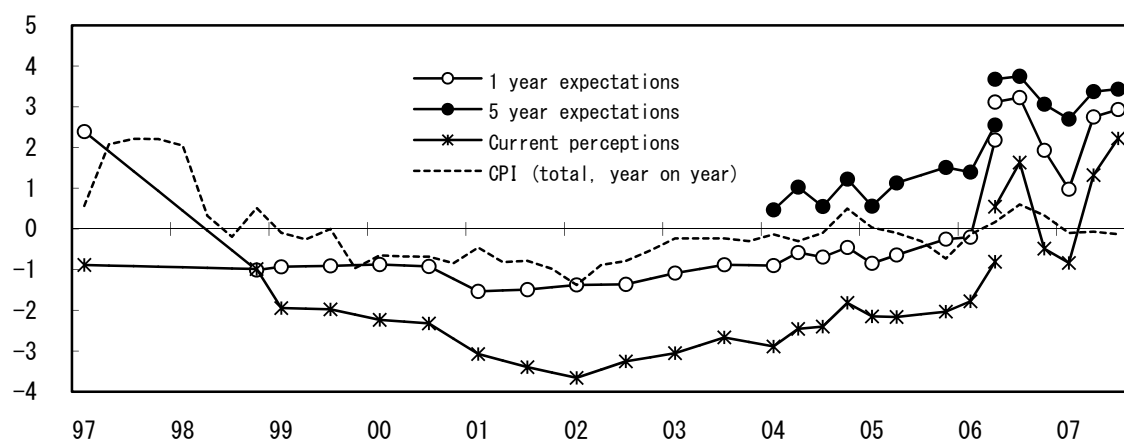
Note: Answers on inflation expectations 13 percentage points above or below the median are dropped as outliers.

Figure 11. Households' Inflation Expectations Estimated Retrospectively

(a) Mean of answers on inflation expectations



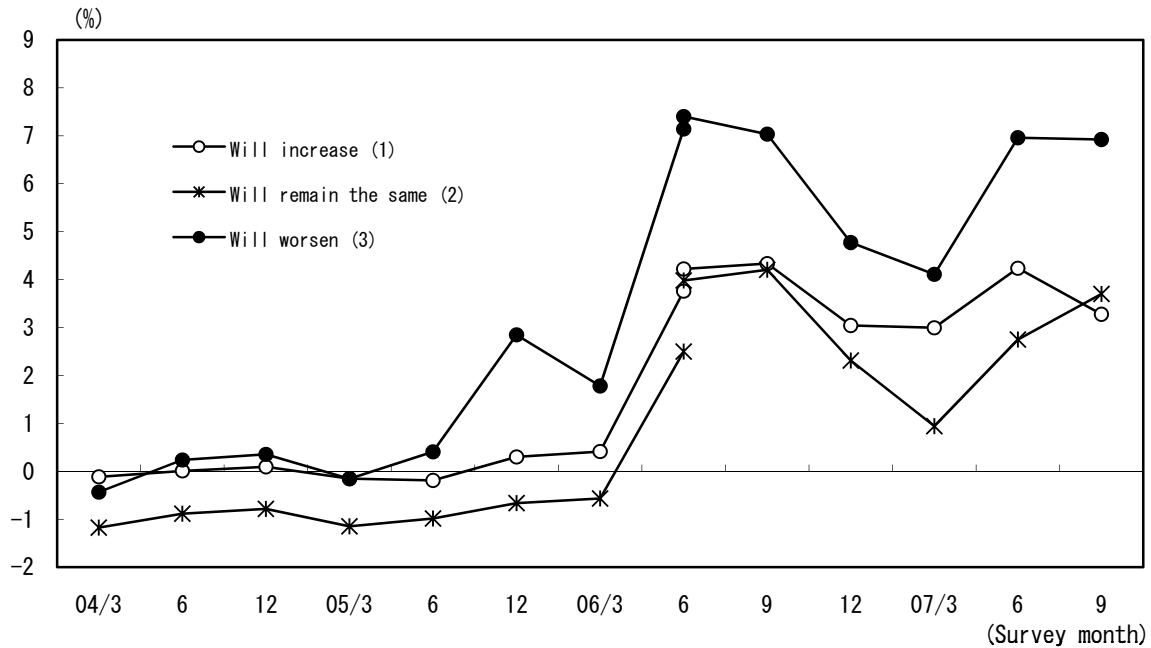
(b) Mean of underlying inflation expectations



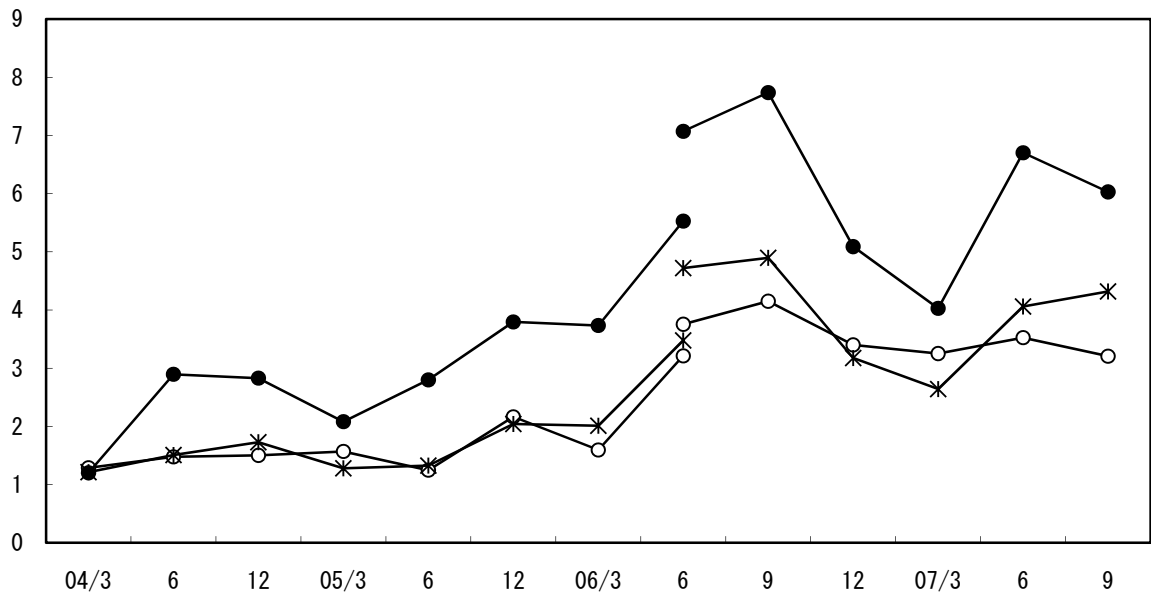
Note: Inflation expectations since 2004 are estimates based on the surveys conducted until 2003.

Figure 12. Outlook on Economic Conditions and Inflation Expectations

(a) Underlying inflation expectations



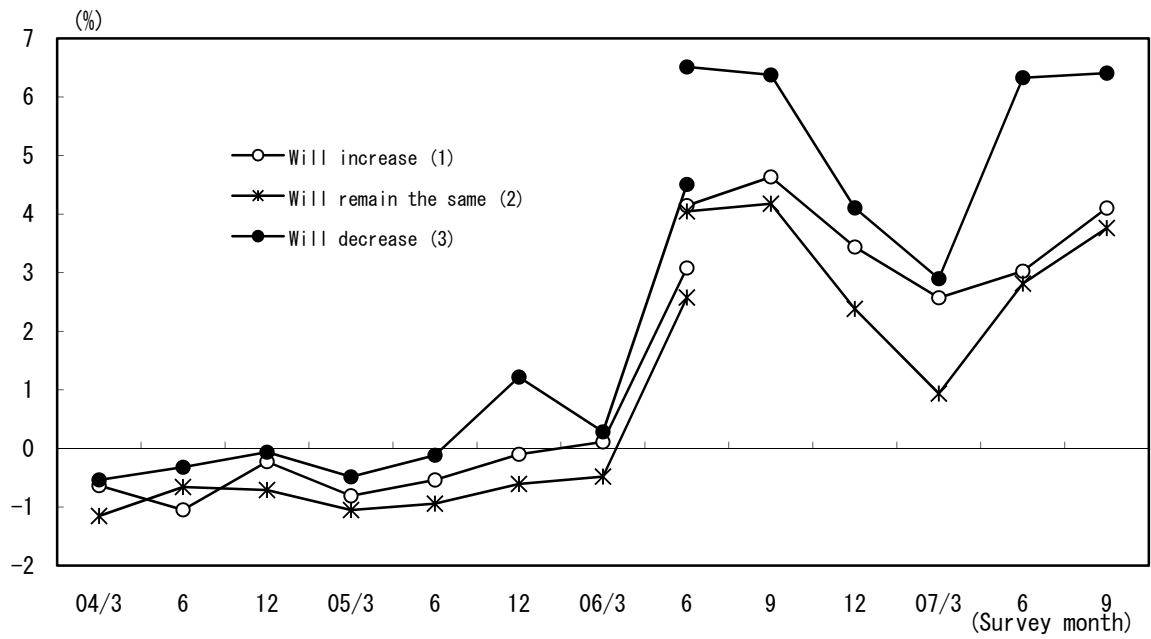
(b) Answers on inflation expectations



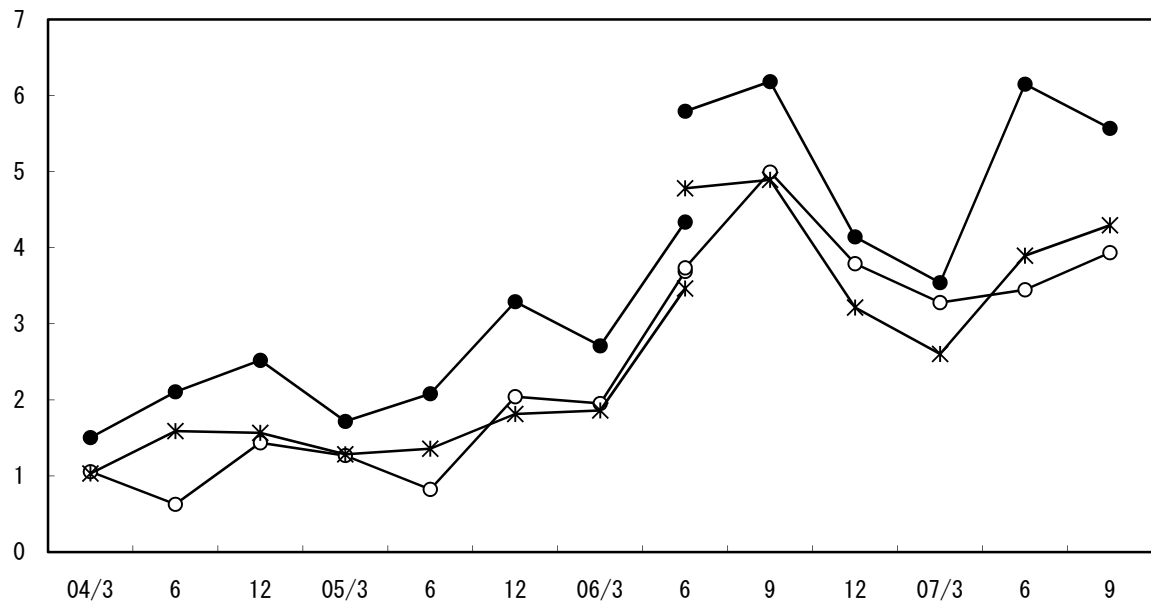
Note: The lines denoted by (1), (2), etc., correspond to the figures in the rows labeled 1&2, 1&3, etc., in Table 4.

Figure 13. Income Outlook and Inflation Expectations

(a) Underlying inflation expectations



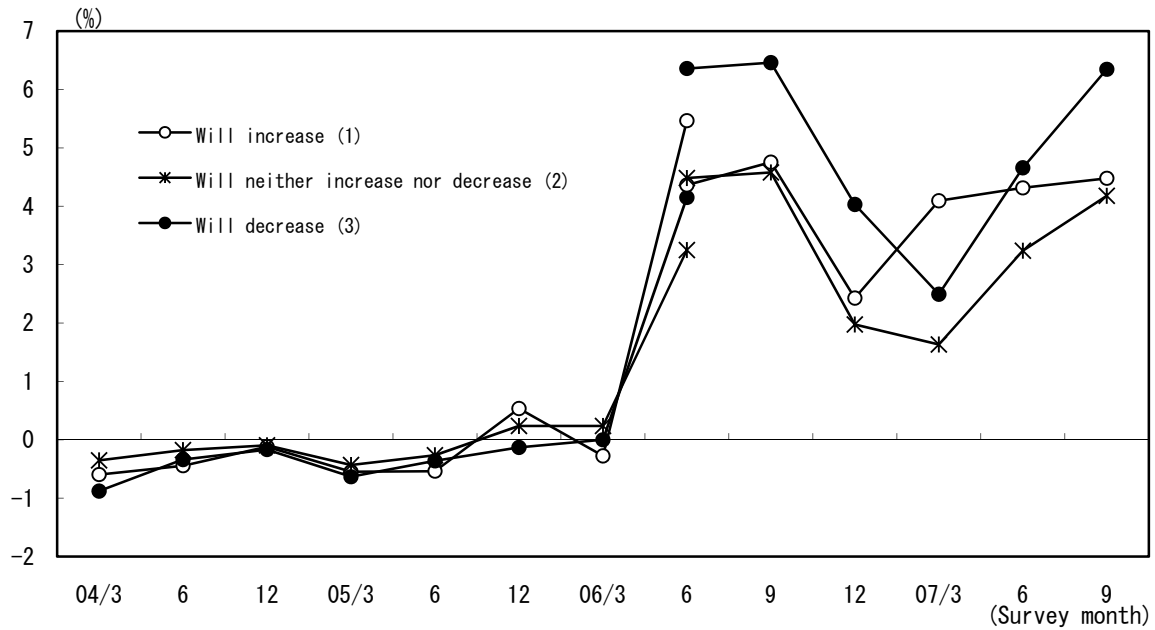
(b) Answers on inflation expectations



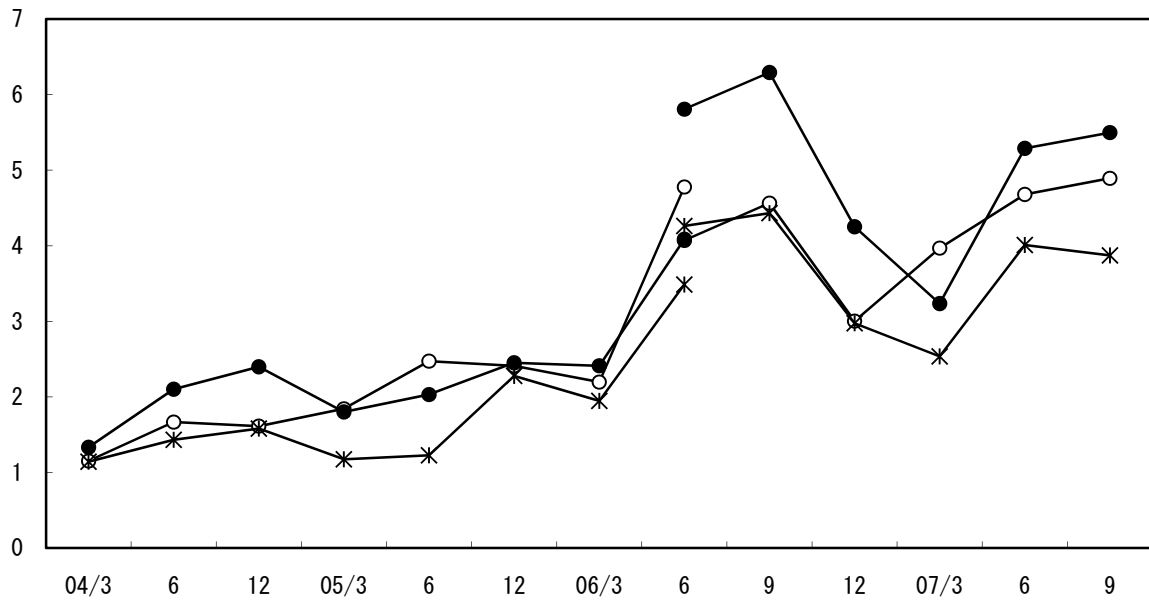
Note: The lines denoted by (1), (2), etc., correspond to the figures in the rows labeled 1&2, 1&3, etc., in Table 5.

Figure 14. Spending Outlook and Inflation Expectations

(a) Underlying inflation expectations



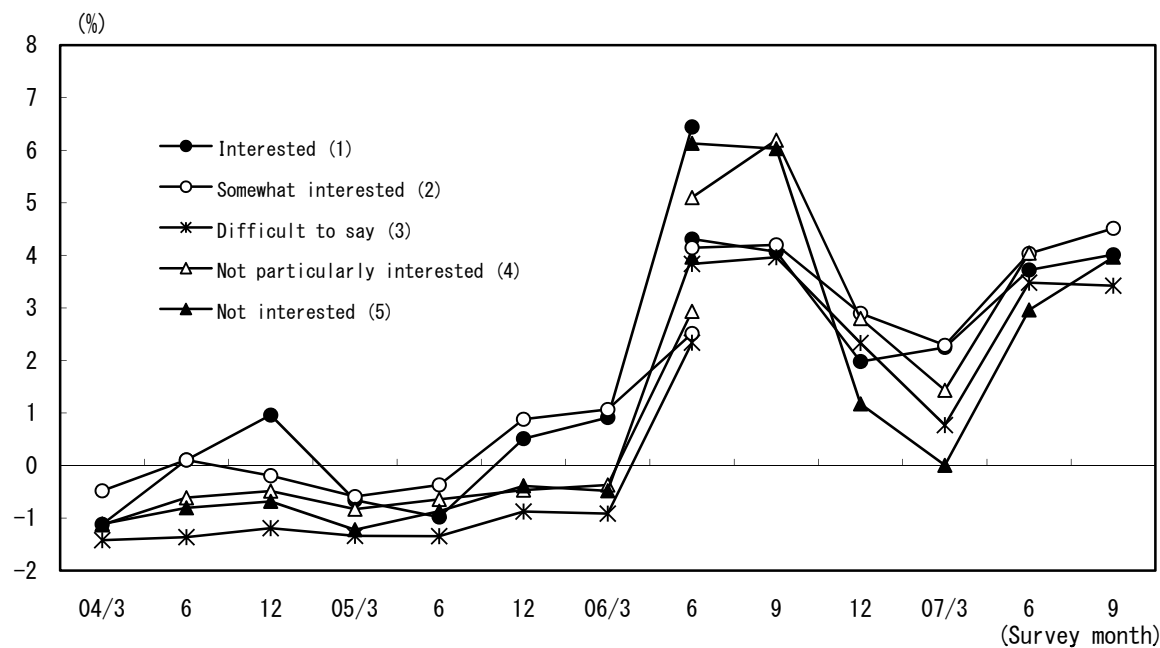
(2) Answers on inflation expectations



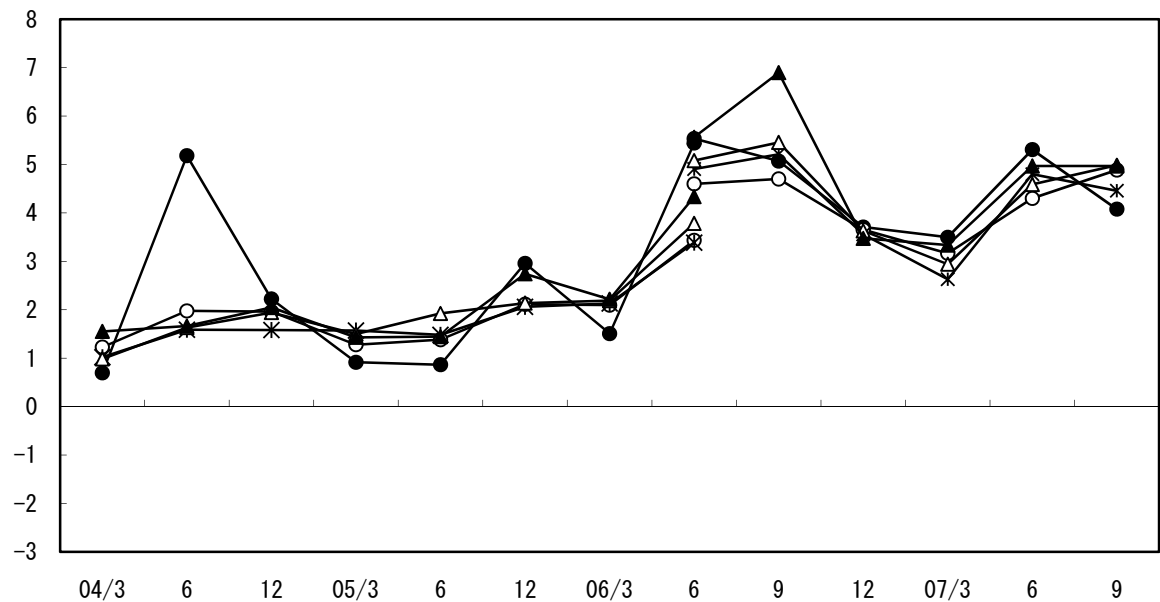
Note: The lines denoted by (1), (2), etc., correspond to the figures in the rows labeled 1&2, 1&3, etc., in Table 6.

Figure 15. Households' Interest in BoJ's Activities and Inflation Expectations

(a) Underlying inflation expectations



(b) Answers on inflation expectations

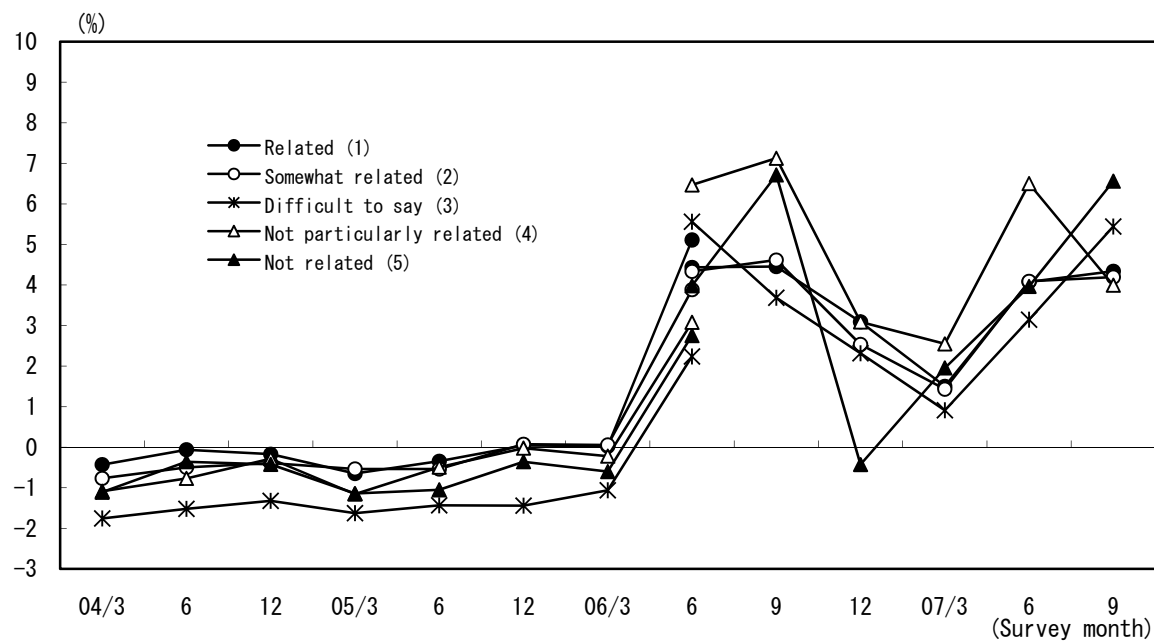


Note: The lines denoted by (1), (2), etc., correspond to the figures in the rows labeled 1&2, 1&3, etc., in Table 7.

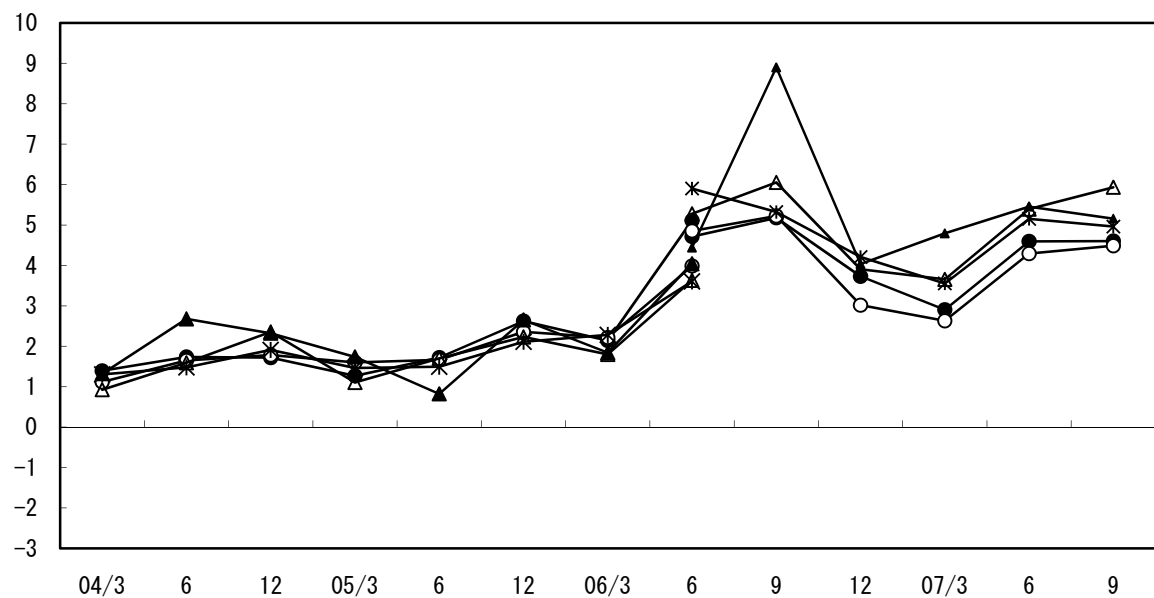


Figure 16. BoJ's Relationship to Households' Lives and Inflation Expectations

(a) Underlying inflation expectations



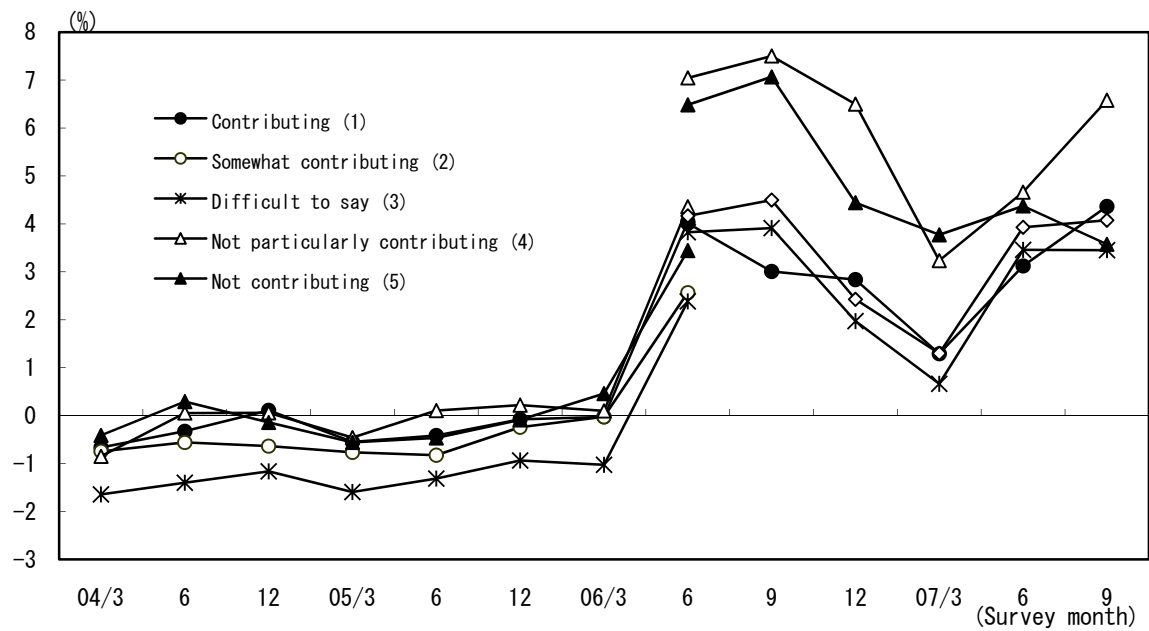
(2) Answers on inflation expectations



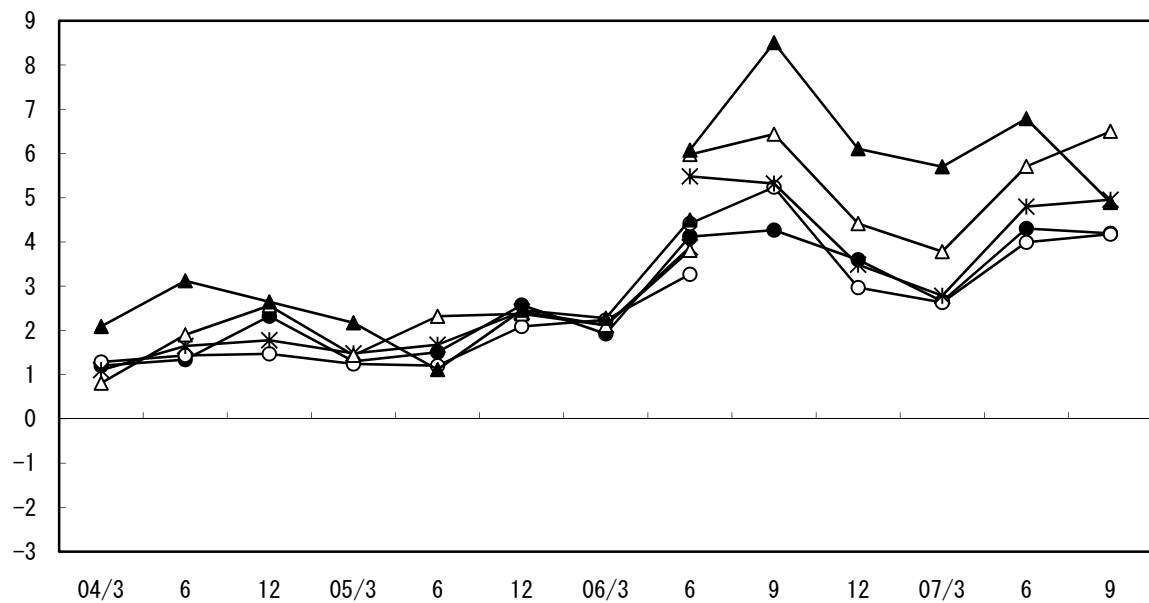
Note: The lines denoted by (1), (2), etc., correspond to the figures in the rows labeled 1&2, 1&3, etc., in Table 8.

Figure 17. BoJ's Contribution to Households' Lives and Inflation Expectations

(a) Underlying inflation expectations



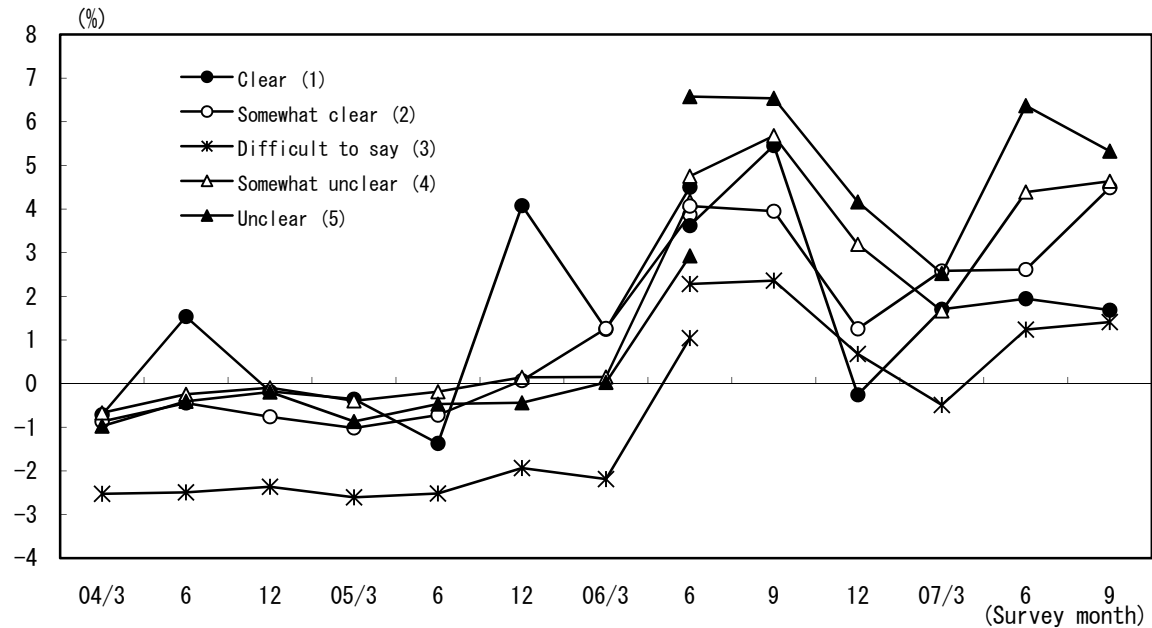
(2) Answers on inflation expectations



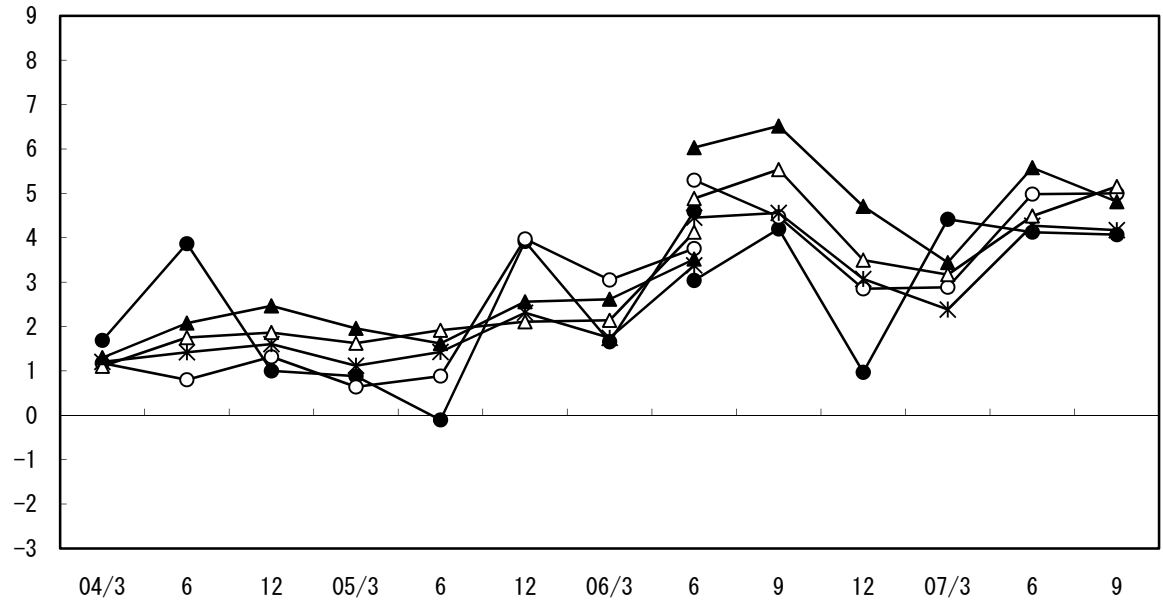
Note: The lines denoted by (1), (2), etc., correspond to the figures in the rows labeled 1&2, 1&3, etc., in Table 9.

Figure 18. BoJ's Explanation to the General Public and Inflation Expectations

(a) Underlying inflation expectations



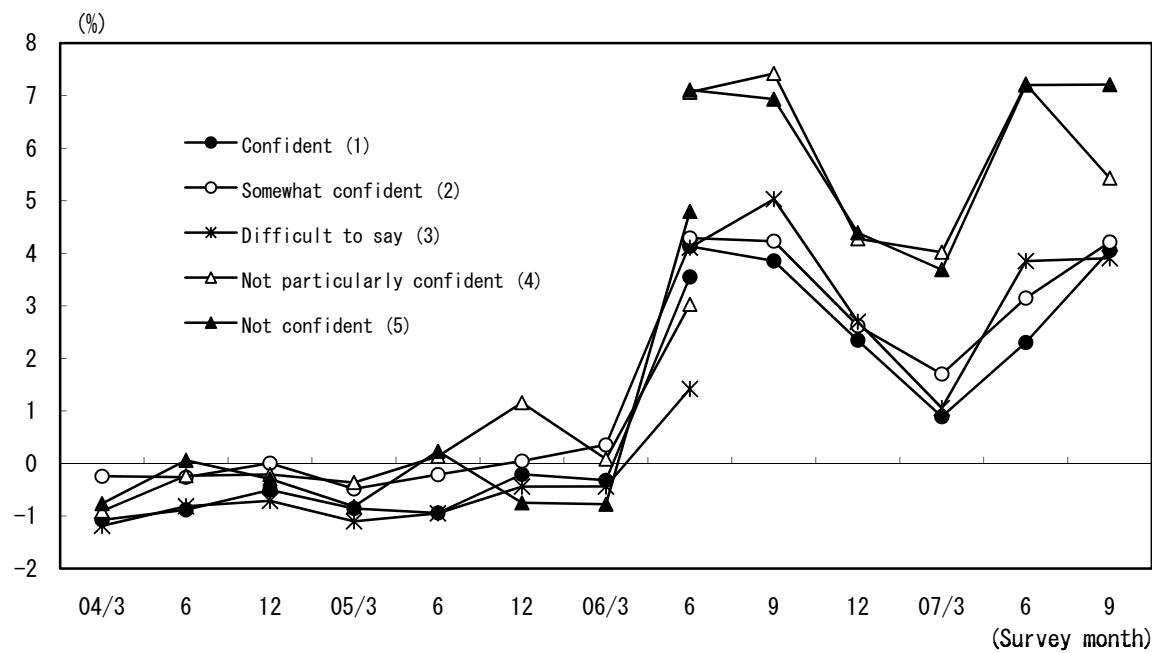
(b) Answers on inflation expectations



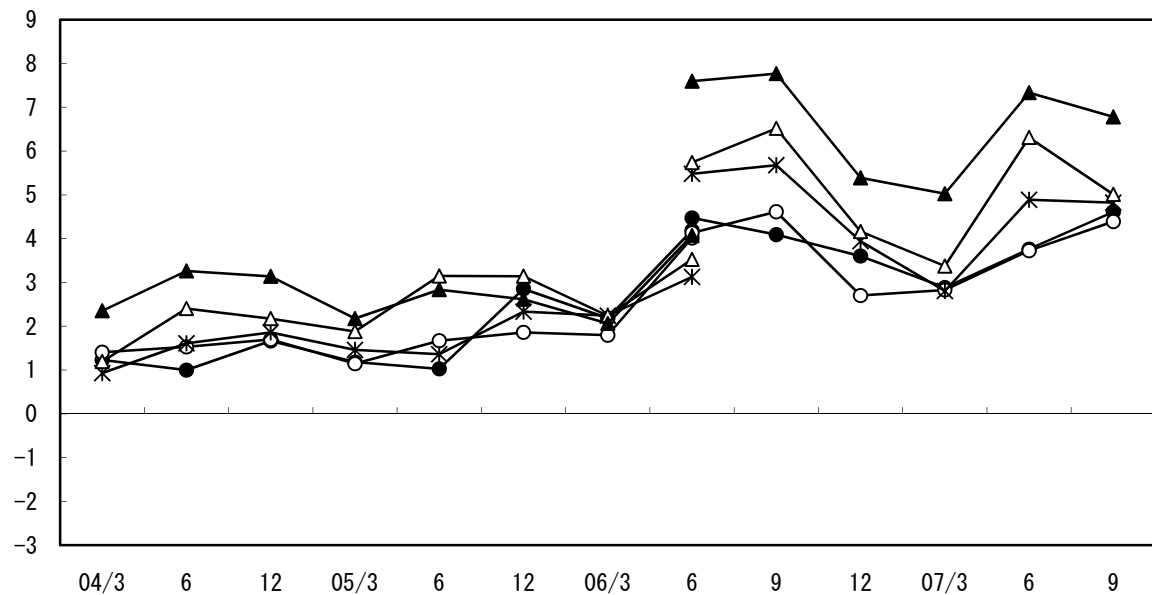
Note: The lines denoted by (1), (2), etc., correspond to the figures in the rows labeled 1&2, 1&3, etc., in Table 10.

Figure 19. Households' Confidence in BoJ and Inflation Expectations

(a) Underlying inflation expectations



(b) Answers on inflation expectations



Note: The lines denoted by (1), (2), etc., correspond to the figures in the rows labeled 1&2, 1&3, etc., in Table 11.

Figure 20. Ratio of No-change Answers (BoJ's Contribution to Households' Lives)

