

The evolution of inflation expectations in Japan

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Abstract

We model inflation forecasts as monotonically diverging from an estimated long-run anchor point towards actual inflation as the forecast horizon shortens. Fitting the model with forecaster-level data for Japan, we find that the estimated anchors across forecasters have tended to rise in recent years, along with the dispersion in estimates across forecasters. Further, the degree to which these anchors pin down inflation expectations at longer horizons has increased, but remains considerably lower than found in a similar study of Canadian and US forecasters. Finally, the wide dispersion in estimated decay paths across forecasters points to a diverse set of views across forecasters about the inflation process in Japan.

Keywords: Inflation expectations, decay function, inflation targeting, deflation

JEL classification: E31, E58

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1. Introduction

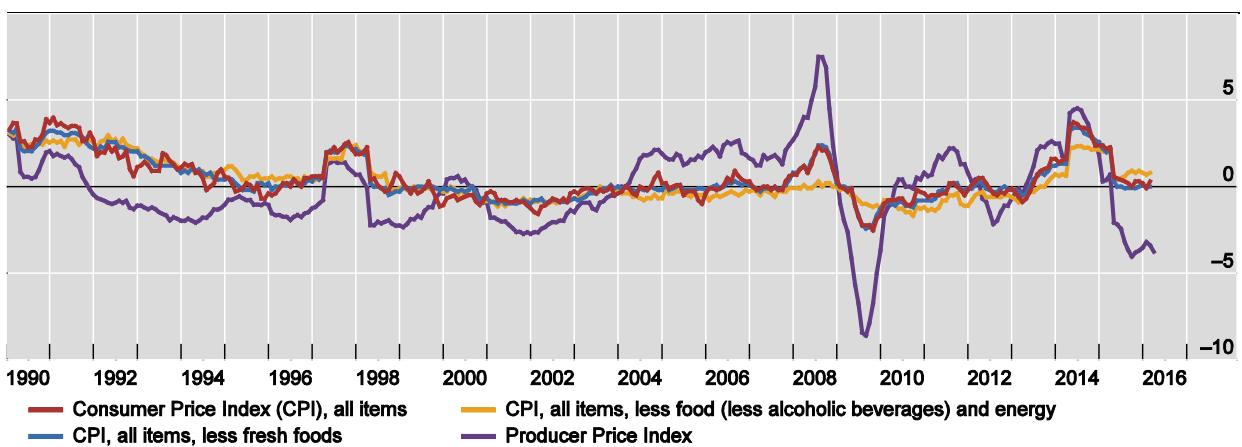
In this paper, we assess the evolution of inflation expectations for Japan. Japan experienced repeated bouts of mild deflation in the Consumer Price Index (CPI) from the latter half of the 1990s until positive inflation returned soon after the Bank of Japan's introduction of quantitative and qualitative monetary easing (QQE) in 2013, followed by near-zero inflation beginning in 2015 (see Graph 1).² Measures of core inflation display similar patterns while the Producer Price Index (PPI) looks broadly similar, but with larger swings in each direction.

Many different factors are likely to play a role in explaining these dynamics. Nishizaki et al (2014) identified a number of structural features that underpin Japan's chronic low inflation. These include the zero-lower bound on the nominal interest rate, public attitudes toward the price level, central bank communication, weak growth expectations backed by declining potential growth and the low natural rate of interest, private banks' risk averse behaviour, deregulation and the growing presence of emerging economies in the global economy.

Price indices in Japan

Year-on-year changes, in per cent

Graph 1



Sources: Datastream; national data.

Aside from structural features, inflation expectations may also play a key role in the dynamics of inflation outcomes. In New Keynesian models, for example, firms adjust prices in response to expected inflation. In reduced form, the New Keynesian Phillips Curve implies that inflation responds approximately one-for-one to shocks to inflation expectations. Inflation expectations are, in turn, likely to be affected by many factors, including the inflationary environment.

One key facet of the inflation environment for Japan has been a declining level of trend inflation over a prolonged period. Saito et al (2012), Nishizaki et al (2014) and Kaihatsu and Nakajima (2015) report declining trend inflation based on a New Keynesian Phillips Curve model of the Japanese economy during the 1990s. The estimation results of Saito et al (2012) show the declining trend extending to the mid-2010s. This is likely to have affected inflation expectations, particularly in the

² Bank of Japan (2015) attributed various factors to the recent near-zero inflation including oil price developments, softer consumption after the consumption tax hike and weakness in emerging market economies.

longer run, by influencing the level of inflation that the economy would converge to in the absence of shocks. From a theoretical point of view, inflation expectations, especially at longer horizons, are likely to be influenced by two main factors: the central bank's target inflation rate, whether implicit or explicit, and the public's confidence in the central bank's achievement of the target rate. At short horizons, however, inflation expectations may be more heavily influenced by actual inflation outcomes, and reflect nominal shocks to the economy, as well as the output gap.

In the case of Japan, there have been a number of changes in the explicit target of monetary policy in recent years that may have influenced the anchoring of inflation expectations. In January 2013, the Bank of Japan implemented a monetary policy regime with an explicit numerical inflation rate target based on the CPI for the first time. But this change was only one step in the evolution of the central bank's public pronouncements on the desired role of price stability, reaching back at least a decade. Even mentioning a numerical reference point for the inflation rate in the context of setting monetary policy in central bank statements is a relatively recent change. By contrast, there was a time when the central bank suggested that providing an explicit reference to the inflation rate of any particular price index could be misleading and work against securing price stability. Appendix I summarizes the various official statements that are helpful for understanding the evolution of views at the Bank of Japan regarding price stability and inflation rate references.³

References to the CPI inflation rate started increasing around the middle of the 2000s. In March 2006, for example, policy board members' views of a connection between "understanding of medium- to long-term price stability" and a numerical reference to the CPI inflation rate were first aired. At that time, the reference was to a rate of CPI inflation between zero and two percent, with a focus on the midpoint of around one percent. In February 2012, the Bank of Japan became more explicit about its understanding of desirable inflation rate, and adjusted its language of its "understanding of price stability" as an "inflation goal" of one percent rate of CPI inflation, but without any commitment to the time horizon at which the goal would be achieved. At the same time, the central bank announced that, in its judgement, the price stability goal in the medium- to long-term was in the positive range of two percent or lower.

The Bank of Japan moved to a formal inflation targeting regime, with a two percent target specified in terms of CPI inflation, in January 2013. Within a few months, in April 2013, it had introduced quantitative and qualitative easing (QQE) measures with the objective of achieving that target, within a horizon of two years. The QQE measures were intended to de-anchor persistent deflationary expectation and re-anchor inflation expectation at the target level.⁴

The two-year time-horizon for achieving the two percent inflation target was later modified in response to inflation developments. While the initial adoption of the time horizon implied that the inflation objective would be achieved around the end of the 2015 fiscal year, successive publications of the Bank of Japan's "Outlook for Economic Activity and Prices" in April and October 2015 and January and April 2016 have pointed to delays in the achievement of the objective to "around the first

³ Appendix I builds on and extends Appendix I in Nishizaki et al. (2014), including information about the introduction of QQE and the adoption of an inflation target with a time horizon of two years.

⁴ In the words of Kuroda (2013a), "[...] Japan faces a different type of challenge. In the United States and Europe, people's inflation expectations have been anchored around the central banks' targeted inflation rates. In Japan, amid some 15 years of deflation, deflationary expectations have become entrenched among people – in other words, people's inflation expectations have been anchored at a substantially low level of around 0 percent. We need to de-anchor such expectations, increase them to the price stability target of 2 percent, and anchor the expectations again at this level."

half of fiscal 2016", "around the second half of fiscal 2016", "around the first half of fiscal 2017" and "during fiscal 2017", respectively.⁵

In this paper, we apply the approach introduced in Mehrotra and Yetman (2014), and extended to forecaster-level data in Yetman (2017), to examine how inflation expectations' anchoring has varied over time in Japan. Inflation forecasts for each forecaster are modelled as being the weighted sum of two components: a long-run forecaster-specific anchor that is estimated, and the latest available actual inflation rate at the time that the forecast was made, with the weights summing up to one. The weight on the anchor is modelled with a flexible decay function, so that inflation forecasts monotonically diverge from their estimated anchor towards actual inflation as the forecast horizon shortens.

The motivation for considering a model of this nature is easy to see from looking at the behaviour of panels of forecasts through time. The left-hand panels of Graph 2 display the forecasts from the three most frequent forecasters for the 2006-2015 period. The horizontal axes are the forecast horizons, which run from $h = 24$ (forecasts made at the start of January, 24 months before the completion of the calendar year being forecast, the longest horizon at which Consensus Economics makes individual forecaster-level forecast data available) to $h = 1$ (made in December of the calendar year being forecast). The figures confirm our prior regarding the behaviour of expectations. The forecasts across the different years for a given forecaster are much more similar to each other at longer horizons than shorter ones. They then increasingly diverge as the horizon shortens.

The right-hand panels of Graph 2 illustrate another facet of forecast data that we wish to exploit. They display the difference between forecasts and the latest available year-on-year inflation data at the time that the forecasts were made. As the forecast horizon shortens, especially below 12 months, the gaps shrink and inflation forecasts look increasingly like the latest available inflation outcome. This is not surprising given that there is an overlap between the period being forecast and the period covered by the corresponding inflation outcome that increases as the horizon shortens. Even at horizons longer than 12 months, there is some evidence of a similar relationship, although there are clearly exceptions to this – generally in the highly volatile years of 2009, 2014 and 2015.

One possible concern with our approach is that we are using relatively short run expectations (out to two years) to try to identify an inflation anchor, which might be thought of as a longer-run concept. However, there are two important rationales for this choice. First, the forecasts we are using are available at the forecaster level. This means that we can use the variation across forecasters as an important indicator of the degree of anchoring. Further, because these forecasts are published with the name of the forecaster attached, we believe that they are taken seriously by the forecasters. By contrast, while Consensus provides long horizon inflation forecasts (out to 6-10 years, published in April and October of each year), these are only available as aggregates, so there is no scope to compare the behaviour of different forecasters. And since the forecasts of the individual forecasters are not revealed, they may face less incentive to forecast accurately.

Second, forecasts at horizons of up-to-two years strike us as the most important for being relevant for inflation dynamics. Many nominal wage and price contracts are renegotiated at least once every few years; very few are fixed for 6-10 years. Hence it is the anchoring of expectations at

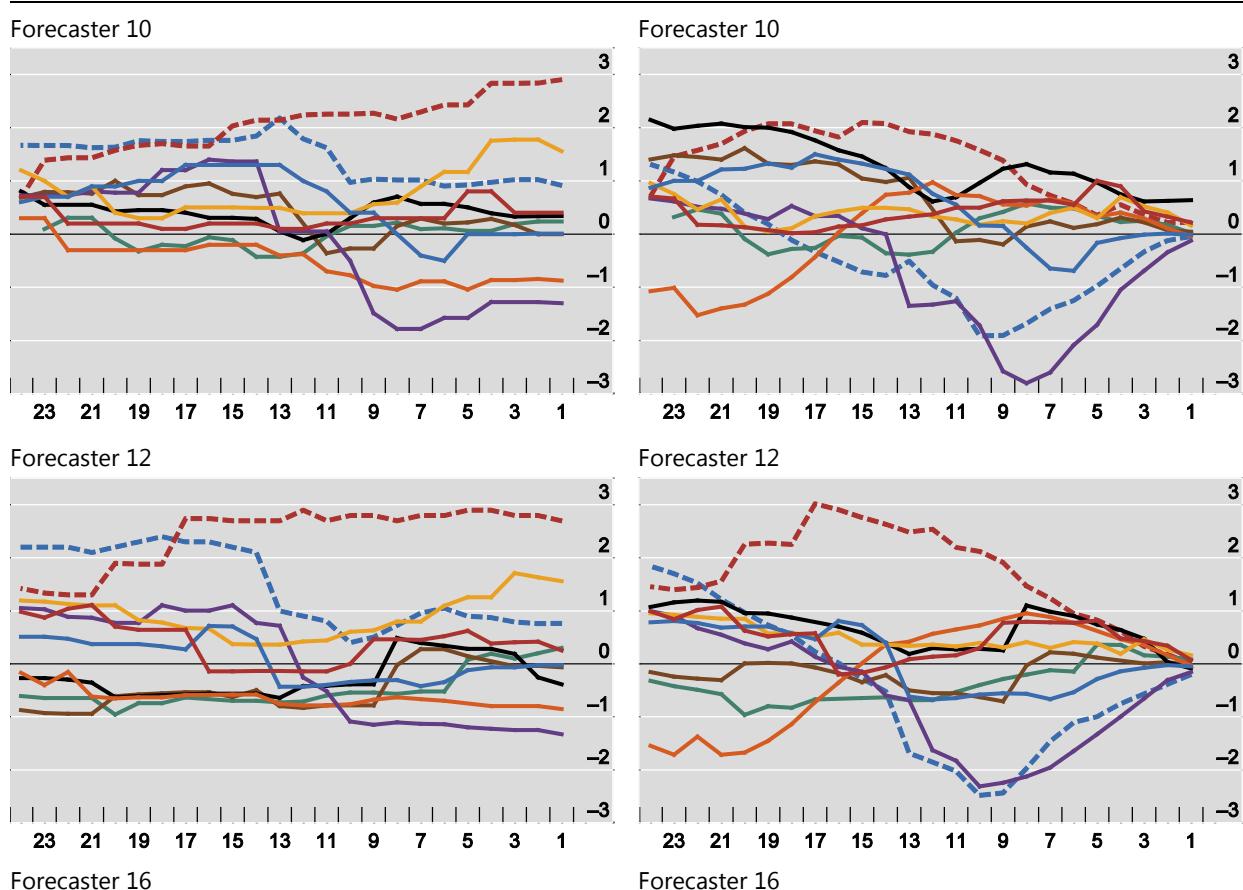
⁵ In the Outlook for Economic Activity and Prices published on October 31, 2014, the Bank of Japan expected to achieve the objective "in or around fiscal 2015". Some of media interpreted this statement as indicating a postponement, but the Bank of Japan suggested that this did not represent a change in the time horizon.

these shorter horizons, filtering out the effects of current inflation shocks, which we would like to assess. Our modelling approach is intended to do just that.⁶

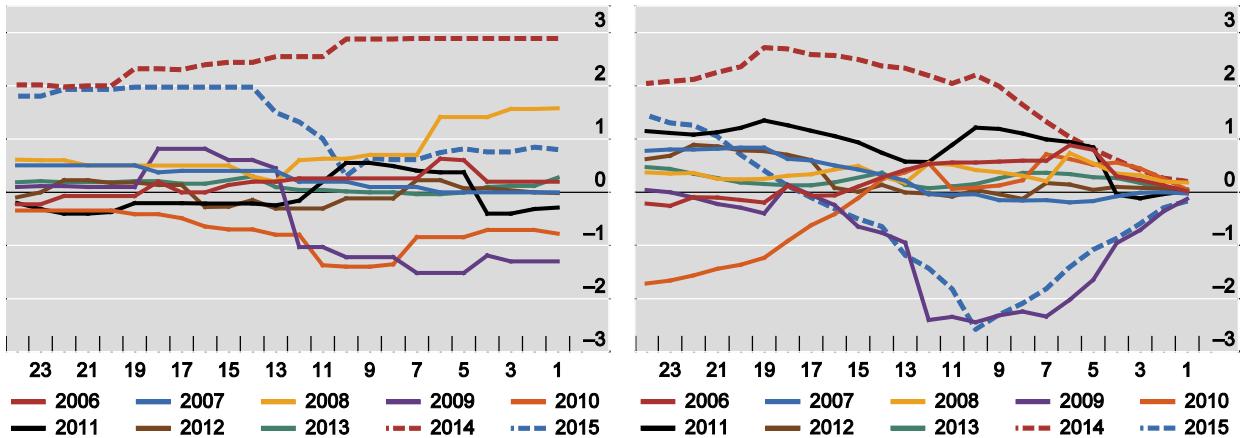
To summarise our main results, we find that the estimated anchors across forecasters have tended to rise in recent years, along with the dispersion in estimates across forecasters, although these effects are diminished somewhat when forecasts and outcomes are adjusted for the effect of consumption tax hikes. Further, the degree to which these anchors pin down inflation expectations at longer horizons has increased, but remains considerably lower than found in a similar study of Canadian and US forecasters (Yetman, 2017). Finally, the wide dispersion in estimated decay paths across forecasters points to a diverse set of views across forecasters about the inflation process in Japan.

Forecasts of inflation (left-hand panels) and the gap between forecasts and outcomes (right-hand panels) across horizons

Graph 2



⁶ For Japan, this distinction matters. Since 2000, the average 6-10 year forecast has been much higher than the average 24-month horizon forecast (1.2% vs 0.4%). For most countries, the difference is minor (Mehrotra and Yetman 2014).



Note: Left-hand panels: each line shows forecasts of a given inflation outcome at different horizons. Right-hand panels: each line shows the gap between forecasts and the latest inflation outcome available at the time that the forecast was made. The horizontal axis shows the forecast horizon, eg "24" indicates forecasts made 24 months before the completion of the calendar year being forecast. The vertical axis is measured in percentage points.

Source: Authors' calculations.

In the next section we discuss the related literature on the evolution of inflation expectations in Japan. Section 3 outlines the methodology and describes the data. Section 4 reports the results, section 5 discusses adjusting the data for changes in sales taxes, and section 6 looks at shorter rolling samples as a further robustness check of our results. Section 7 then concludes.

2. Inflation expectations in Japan

We build on an extensive literature that has studied inflation expectations in the Japanese context. For example, Saito et al (2012), Nishizaki et al (2014) and Kaihatsu and Nakajima (2015) estimate the trajectory of trend inflation in Japan over time. The underlying idea is that, in a New-Keynesian Phillips curve model, trend inflation can be interpreted as the inflation rate to which long-run inflation is expected to converge in the absence of shocks, and is therefore similar to an anchor for rational inflation expectations. All three papers report a declining level of trend inflation, using a variety of different econometric techniques. For example, Kaihatsu and Nakajima (2015) decompose the factors driving the declining trend into different components and conclude that the declining trend during the 1990s is mostly attributable to a flattening of the Phillips curve, and in the later period due to a persistent negative output gap.

The relationship between realized inflation and inflation expectations at both short and longer horizons has been investigated in several studies. Nishizaki et al (2014) test for Granger causality between trend inflation, short-run inflation expectations and inflation outcomes. They find that changes in trend inflation significantly influence short-run inflation expectations and inflation outcomes, but that trend inflation is not itself affected by the other two variables. In contrast, Fuhrer et al (2012) finds little influence of long-run inflation expectations on the other two variables. They also report that short-run inflation expectations are important to the evolution of inflation, and both

recent realizations of inflation and the output gap drive the short-run inflation expectations.⁷ This finding is consistent with one of the mechanisms that the Bank of Japan has identified by which QQE is expected to raise inflation expectations in general: a rise in prices leads to inflation expectations due to an adaptive or backward-looking elements in the formulation of inflation expectations (Kuroda (2013b)).

Some recent papers try to identify the effect of the Bank of Japan's QQE policy on inflation expectations. Kaihatsu and Nakajima (2015) conclude the trend inflation increased after the QQE policy was implemented. Nishiguchi et al (2014) consider the effect on the distribution of households' inflation expectations based on survey evidence. They find that the introduction of QQE reduced the negative skew in household inflation expectations and also reduced the thickness of the tails, with the spike in expectations around 2% becoming more pronounced. In the same vein, Kamada et al (2015) report that QQE strengthened the anchor of long-term inflation expectations, with higher expected inflation and less dispersion, based on a parametric model intended to correct for distortions in household inflation expectations including asymmetry and fat-tails. However, not all studies point to an increase in inflation expectations following QQE: Nakazono (2016) concludes that any effect was limited, based on assessing various inflation expectations data from surveys for households, firms, professionals and market participants. De Michelis and Iacoviello (2016) point to the necessity of further measures to raise inflation to 2 percent in a stable manner. They suggest that one factor helping to explain the limited impact of the introduction of the inflation targeting in Japan is imperfect observability of the inflation target shocks: agents can only observe the sum of the persistent and transitory monetary shocks and so they revise their expectations about the persistent component only slowly over time.

Regarding the formation of inflation expectations in Japan more generally, two influential hypotheses of rational expectations in models with information frictions have been tested: the sticky information model of Mankiw and Reis (2002), and the noisy information model of Woodford (2003). Hori and Kawagoe (2013) use data from a survey and report that households do not appear to instantaneously incorporate into their expectations relevant information that is freely available, which they conclude provides support for the sticky information hypothesis. Nakazono (2016) also finds support for the sticky information hypothesis, based on developments in a wide range of survey data on Japanese inflation outlook; an exception is professional forecasts, in which he finds some support for both hypotheses. On the other hand, Abe and Ueno (2016) argue that the noisy information hypothesis is appropriate for understanding biases in household inflation expectations, as this is consistent with the Bayesian updating of household expectations in response to news that they find in the data.

The Bank of Japan moved to an inflation targeting regime at a time when existing inflation was below the new target. In contrast, most other advanced economies introduced inflation targeting in an effort to bring higher-than-desired inflation down and stabilise it at low levels. Work by Ehrmann (2015) suggests that this distinction may be important. In cross-country work, he finds that a central bank may have more difficulty in hitting newly adopted inflation targets from below than from above because inflation expectations in such cases can be sticky in response to positive inflation surprises and tend to be more susceptible to negative shocks.

A final international comparison is also worth noting. Ueda (2010) uses a VAR model including survey data on households' inflation expectations for Japan and the US to investigate their properties.

⁷ Relatedly, Buono and Formai (2016) assess anchoring by considering how long-term inflation forecasts vary in response to changes in short-term forecasts. Their point estimates suggest poorly anchored long-term expectations for Japan throughout their sample (1999-2015), although their wide confidence band precludes drawing strong conclusions.

He finds that the effects of an exogenous price shock on inflation and inflation expectations in Japan are smaller and shorter-lived than in the US.

3. Methodology and data: forecaster-level data

3.1 Functional form

We adopt the same parsimonious framework for fitting inflation forecasts used in Mehrotra and Yetman (2014) and Yetman (2016). This framework fully utilises the multiple-horizon dimension of the available forecast data. It is based on the assumption that, if inflation expectations are well anchored at a particular level, inflation forecasts made sufficiently far in advance should be equal to their anchor. Then, as the forecast horizon shortens and forecasters observe information that improves their ability to predict inflation outcomes, even well-anchored inflation expectations start to deviate from their long-run anchor towards the level of actual inflation. We apply this model to the forecasts made by individual institutions as follows. The forecast of inflation for year t made at horizon h , denoted $f(t, t - h)$, is assumed to follow:

$$f(t, t - h) = \alpha(h)\pi^* + [1 - \alpha(h)]\pi(t - h) + \varepsilon(t, t - h). \quad (1)$$

In (1), h is measured in months before the end of the year that is being forecast and π^* is the level that long-run inflation expectations are anchored to, which will be estimated. $\pi(t - h)$ is the level of actual inflation observed at the time when the forecast is made. This is defined as the annual average inflation rate (the year-on-year change in a 12-month moving average of the level of the CPI), to be consistent with the definition of inflation being forecast, and lagged by one month to correct for publication lag. $\varepsilon(t, t - h)$ is a residual term.

$\alpha(h)$ denotes a decay function. We require a functional form for this that captures the idea that inflation expectations are equal to the anchor plus noise at sufficiently long horizons ($\alpha(\infty) = 1$), move increasingly towards inflation outcomes as the horizon shortens ($\alpha'(h) < 0$), and converge to actual outcomes (except for a random noise term) when the horizon is zero ($\alpha(0) = 0$). We model the decay function as:

$$\alpha(h) = 1 - \exp\left(-\left(\frac{h}{b}\right)^c\right), \quad (2)$$

which is based on the cumulative density function of the Weibull distribution, and provides for a wide variety of possible decay paths for different values of b and c , as illustrated in Graph 3. The variance of the residual in (1) is modelled using a flexible functional form that allows it to vary across the forecasting horizon with minimal restrictions:

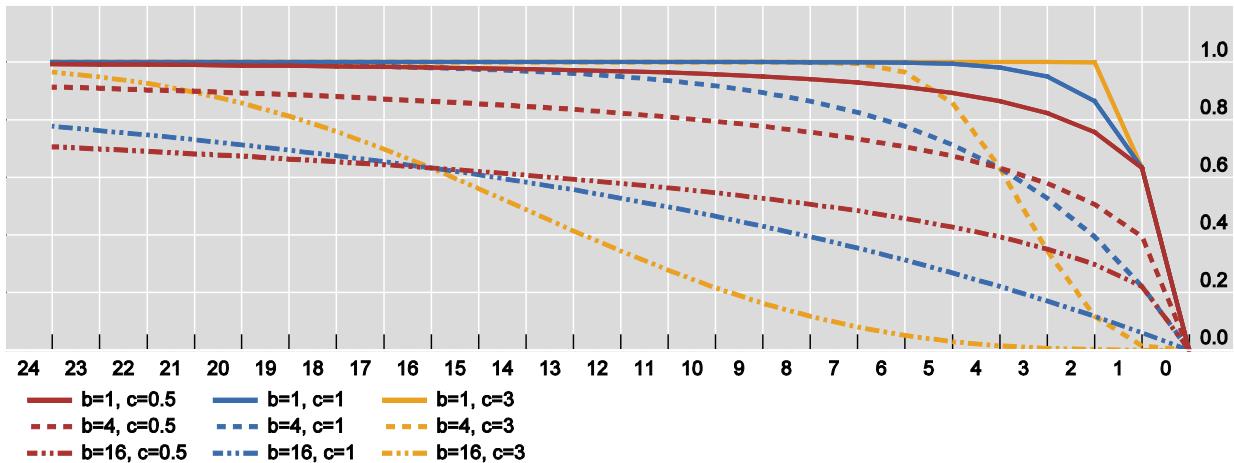
$$V(\varepsilon(h, t)) = \exp(\delta_0 + \delta_1 h + \delta_2 h^2). \quad (3)$$

We also allow for forecasts for the same inflation outcome made at two different horizons, h and k , to be more highly correlated the closer the horizons are, by assuming that:

$$\text{Corr}(\varepsilon(t, t - h), \varepsilon(t, t - k)) = 1 - \phi_1|h - k| - \phi_2(h - k)^2, \quad (4)$$

implying that the off-diagonal elements of the variance-co-variance matrix take the form:

$$\text{Cov}(\varepsilon(t, t - h), \varepsilon(t, t - k)) = \left[\sqrt{V(\varepsilon(t, t - h))V(\varepsilon(t, t - k))} \right] [1 - \phi_1|h - k| - \phi_2(h - k)^2]. \quad (5)$$



Note: Horizontal axis represents the forecast horizon h , which is the number of months before the end of the calendar year being forecast.

Source: Authors' calculations

3.2 The data

Mehrotra and Yetman (2014) applied the above framework to median inflation forecasts across 44 economies. However, median forecasts are likely to miss important aspects of forecast behaviour: Oinonen and Paloviita (2016), for example, report important heterogeneity in the behaviour of forecasts collected by the ECB. Thus Yetman (2017) focused on forecaster-level data, including one large inflation targeting economy (Canada) and one non-inflation targeter (at least for most of the sample, the US) in his study. Here we focus on Japan, a large economy that has a history of very low inflation / mild deflation over an extended period of time. In addition, Japan has seen repeated attempts to raise the inflation rate over the sample period, as outlined in section 2.

We use the model outlined in the previous section to examine several different aspects of inflation forecast anchoring. In terms of the anchor, we estimate its level and the degree of dispersion in these estimates across the panel of forecasters. In addition, we examine the estimated path away from the anchor as the forecast horizon shortens.

In applying our framework to inflation forecast data from Consensus Economics, we first need to identify forecasters. One possibility would be to simply treat each forecaster name listed in the Consensus forecast database as a separate forecaster. However, that would leave us with a very large number of possible forecasters (108 after combining those whose only difference appears to be due to errors in entering their names into the database), many of which are present in the panel for too short a time to enable precise estimation of the parameters in our model. So instead we seek to combine them to take account of the evolution of institutions over time, including name changes, mergers and acquisitions. The underlying assumption is that forecasts from a given institution are likely to be made by similar people, using similar methods, from one month to the next.

We combine different names wherever two conditions are satisfied: (i) there is plausible evidence that the underlying entities are the same, via corporate websites, news stories or elsewhere, in either Japanese or English; and (ii) the timing of the name change lines up with the departure and arrival of the associated names from the panel.⁸ Where there is more than one conceivable match, we include the one where the timing is most synchronous. For example, the Mizuho Research Institute was

⁸ A list of the full set of sources outlining the connections over time is available on request.

formed from Dai-Ichi Kangyo Research Institute, Industrial Bank of Japan and Fuji Research Institute, and initially had three chief economists, one from each contributing organisation. We link Mizuho with Dai-Ichi Kangyo because the timing is matched (Dai-Ichi's final forecast was on March 2002 and Mizuho's first forecast was the following month); in contrast, Industrial Bank of Japan ceased providing forecasts in July 2000, and Fuji in October 2001. We also drop individual forecasters completely if the resulting panel is too short or incomplete, based on conditions that we outline later.⁹ A full set of the 28 Japanese forecasters we use in our estimation is listed in Table 1, with the names that were dropped from the estimation listed in Appendix II.

Consensus Economics starts collecting forecasts for calendar-year inflation outcomes in January of the preceding year ($h = 24$). They generally collect these forecasts each month until December of the year being forecast ($h = 1$), for a total of 24 monthly forecasts of the same outcome.

4. Results

The model is estimated by maximum likelihood, forecaster-by-forecaster, using 10-year rolling samples (where years are defined in terms of the inflation rate being forecast, rather than when the forecasts are made) to allow for the degree of anchoring to evolve over time.

Forecasters

Table 1

1	Bank of Tokyo 10/1989-03/1996	Bank of Tokyo Mitsubishi 08/1996-06/2006	Bank of Tokyo-Mitsubishi UFJ 07/2006-12/2015
2	CS First Boston 10/1996-04/1998	Credit Suisse First Boston 08/1998-01/2006	Credit Suisse 02/2006-12/2015
3	Dai-Ichi Kangyo Bank 10/1989-07/1997	Dai-Ichi Kangyo Rsrch Institute 08/1997-03/2002	Mizuho Research Institute 04/2002-12/2015
4	Daiwa Securities Research 10/1989-11/1992	Daiwa Institute of Research 12/1992-12/2015	
5	Deutsche Securities 05/2000-12/2015		
6	Econ Intelligence Unit 11/2003-12/2015		
7	Global Insight 11/2003-10/2008	IHS Global Insight 11/2008-12/2013	IHS Economics 01/2014-12/2015
8	Goldman Sachs 05/2000-12/2015		
9	HSBC 06/2000-12/2015		
10	Industrial Bank of Japan 10/1989-07/2000		
11	ITOCHU Institute 01/2003-12/2015		
12	Japan Ctr for Econ Research 10/1989-12/2015		
13	JP Morgan - Japan 10/1992-11/2015		
14	Long Term Credit Bank	LTCB	Shinsei Bank

⁹ In the previous example, we ultimately drop Fuji Research Institute from the sample due to the limited number of forecasts for this entity.

	10/1989-06/1998	08/1998-05/2000	06/2000-12/2002	
15	Merrill Lynch - Japan 10/1989-12/2015			
16	Mitsubishi Research 10/1989-02/1996	Mitsubishi Research Institute 01/1997-11/2015		
17	Nikko Research Center 10/1989-02/1999			
18	Nippon Credit Bank 10/1989-05/1997	NCB Research Institute 06/1997-04/2000		
19	NLI Research Institute 04/1996-12/2015			
20	Nomura Research Institute 10/1989-04/2005	Nomura Securities 05/2005-12/2015		
21	S G Warburg - Tokyo 10/1989	S G Warburg - Japan 11/1989-09/1995	SBC Warburg - Japan 11/1995-05/1998	LTCB Warburg - Japan 06/1998-07/1998
		Warburg Dillon Read - Japan 11/1998-10/1999	UBS Warburg 06/2000-05/2003	UBS 06/2003-12/2015
22	Salomon Brothers Asia 04/1996-12/1997	Salomon Smith Barney Asia 02/1998-03/1998	Salomon Smith Barney 04/1998-02/1999	Nikko Salomon Smith Barney 03/1999-03/2003
		Nikko Citigroup 04/2003-06/2010	Citigroup Global Mkts Japan 07/2010-04/2012	Citigroup Japan 05/2012-12/2015
23	Sanwa Research Institute 04/1996-03/2002	UFJ Institute 04/2002-12/2005	Mitsubishi UFJ Research 03/2006-12/2015	
24	Smith Barney - Tokyo 09/1994-11/1997	Smith Barney - Japan 10/1989-10/1993	Smith Barney Shearson - Tokyo 11/1993-08/1994	
25	Sumitomo Life Rsrch Institute 12/1990-03/2005			
26	Tokai Bank 10/1989-09/2001			
27	Toyota Motor Corporation 10/1989-12/2015			
28	Yamaichi Research Institute 10/1989-11/1997			

Source: Consensus Economics; Authors' calculations.

For most rolling samples, the panel of forecasts is unbalanced, as is clear from Table 1, and is visible as gaps in the series plotted in Graph 2. We take explicit account of this in our estimation by setting the contribution to the likelihood function to zero for missing observations. We then include all rolling samples where more than 50% of the possible 240 observations are present in the sample for each forecaster and there is a forecast available for at least one horizon of both the first and last years of the rolling sample.¹⁰ We consider 40 different possible starting values for each sample, and maximise the likelihood function using the hill-climbing method of Broyden, Fletcher, Goldfarb and Shanno (see Shanno (1985) for details) for each, until the estimates converge. We then choose the estimates with the highest log-likelihood function value where the parameters of the decay function and the inflation target are identified ($b > 0, c > 0, V(b) > 0, V(c) > 0, V(\pi^*) > 0$). In most cases, a majority of the starting values considered lead to virtually identical parameter estimates; in all cases, our selection criteria lead to unique estimates for each rolling sample – forecaster combination.¹¹

¹⁰ This second condition ensures that the estimates in one rolling sample are different from those in the next. Without such a condition, if a forecaster provided a complete panel of forecasts from 1996 to 2000 (say), the first condition would imply that we would estimate the model for all rolling samples from 1991-2000 to 1996-2005, and report identical results in all cases.

¹¹ We drop one resulting estimate of the inflation anchor in our discussion of the results. For forecaster 15 and sample 1991-2000, the estimated π^* across most starting values is -21%. However, the estimates of b and c in this case are such that the weight on the anchor never exceeds 0.02 at horizons of up to 24 months. Thus the anchor is poorly identified in this case. In all other cases, estimated anchors are empirically plausible.

4.1 The estimated inflation anchor

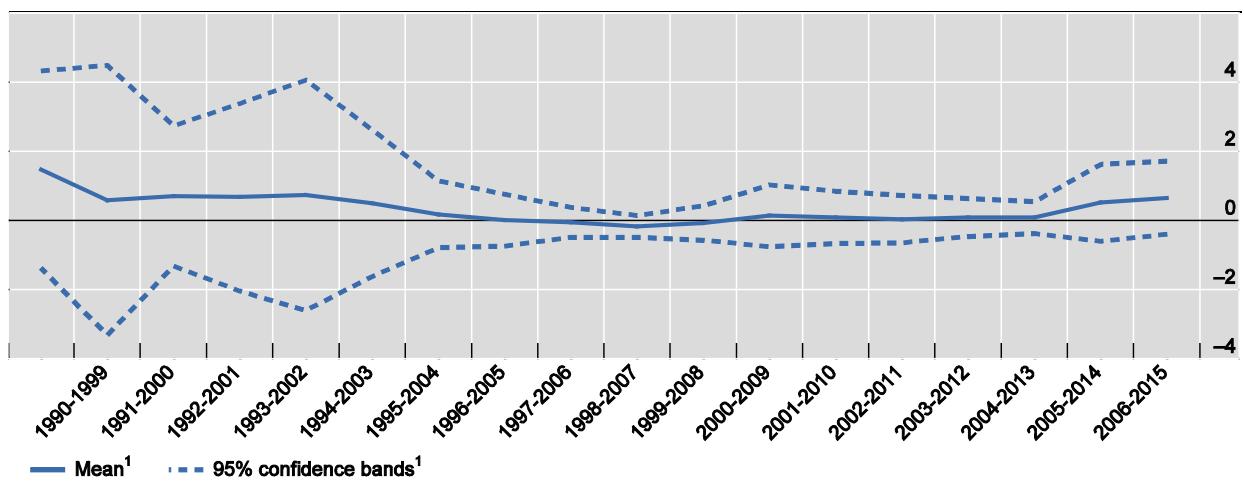
We first present results on the estimates of the inflation anchors across our panels. We have one estimate of the inflation anchor for each rolling sample for every forecaster. Graph 4 provides the mean, together with 95% confidence bands of the inflation anchor estimates.¹² In the earliest rolling sample, there are 15 forecasters present. This number declines to a minimum of 10 forecasters for the 1995-2004 sample before trending upwards, and stabilising at 19 forecasters for the final four rolling samples.

The results indicate that the average estimated inflation anchor dropped early in the sample, from around 1.5% in 1989-1998 to zero by 1996-2005. It then stayed close to zero until 2004-2013, before rising in the final two rolling samples. Perhaps more interesting is the behaviour of the confidence bands. These were very wide in the early rolling samples, indicating that the estimated anchors varied widely across the different forecasters. They then narrowed dramatically by the 1996-2005 sample, indicating that the forecasts of most forecasters were anchored to a level of inflation close to zero. They were narrowest for the rolling sample ending in 2007, which roughly coincides with the period when deflation expectations and pessimism about future economic growth were at their strongest. This period covers the bankruptcies of Sanyo Securities, Hokkaido Takushoku Bank and Yamaichi Securities (in November 1997), at the height of a domestic financial crisis, when corporate financial conditions tightened (Fukao, 2002), as well as 1998, when the Japanese economy experienced real GDP growth of negative two percent. Suspicion about the fragility of the domestic financial system, and its negative effects on the economy, lingered. Following the domestic financial crisis, CPI inflation hovered mostly in negative territory, especially in the early 2000s, until the end of the rolling samples (see Graph 1). The band then remained relatively narrow until the final couple of rolling samples, when it started to widen again.

Japanese inflation anchors

In per cent

Graph 4



¹² The 95% confidence bands are based on the distribution of the estimates of the anchors for the individual forecasters, without reference to the estimates of their standard errors (analogous to the calculation of the inter-quartile range displayed in later graphs).

¹ Rolling sample.

Source: Authors' calculations

One can interpret these results as indicating a mixed success of the recent policy measures intended to increase inflation expectations discussed in the introduction. On the one hand, the inflation anchor has started to rise for most forecasters, reflecting increased expected inflation outcomes. On the other hand, the increase in the confidence band, with the bottom of the band virtually unchanged, suggests that not all forecasters are convinced that inflation is going to increase. One possible explanation is that even as the introduction of QE has increased longer-term inflation expectations, there is considerable disagreement about the achievable level of inflation, perhaps due to uncertainty about the effectiveness of unconventional monetary policy.

We demonstrate the robustness of the results in a number of different ways. We consider dropping the forecasters with the highest and lowest anchor estimates from each rolling sample. We also drop all forecasters who are present for only a small number of rolling samples, to reduce the influence of forecasters who are not always present in the panel, with two different thresholds. We first exclude all forecasters who are present for less than four rolling samples, followed by ten rolling samples. In the latter case, our sample consists of 8-13 forecasters, 6 of whom are present in every sample.

We also consider the median as an alternative summary measure of the level of the inflation anchor, and the inter-quartile range in place of the standard deviation. A full set of results for all of these measures is given in Graph 5. In all cases, the results are broadly consistent with those reported above: the (mean or median) inflation anchor declined early in the sample, but has recently increased – more dramatically so in the case of the median; and the variation in estimated anchors across forecasters (measured using the standard deviation or inter-quartile range) fell dramatically early in the sample, but has since started to rebound.

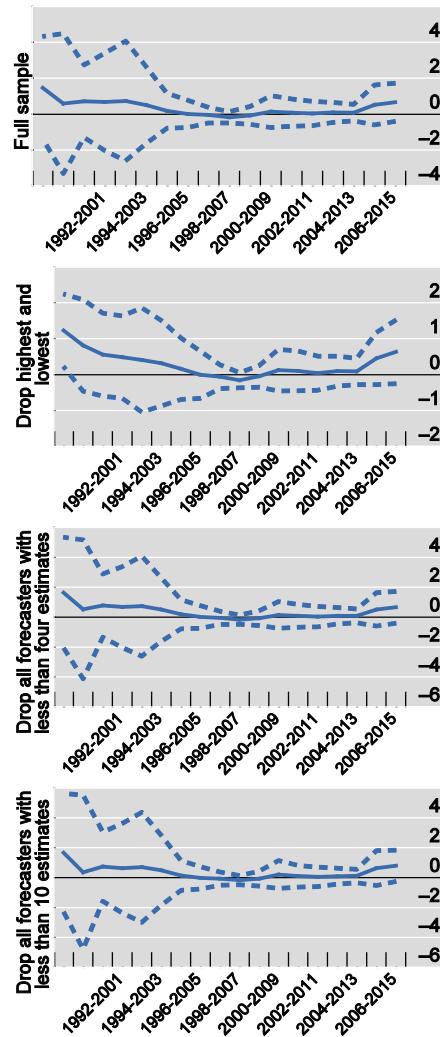
4.2 The decay path

Thus far we have focused on estimates of the inflation anchor. We also have estimates of how strongly forecasts are anchored at different forecast horizons, to which we now turn.

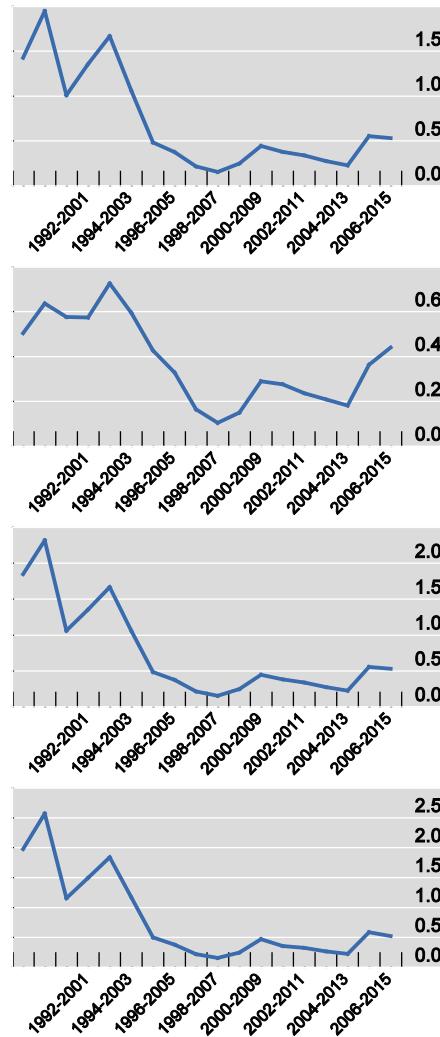
Japanese inflation anchors: robustness checks

Graph 5

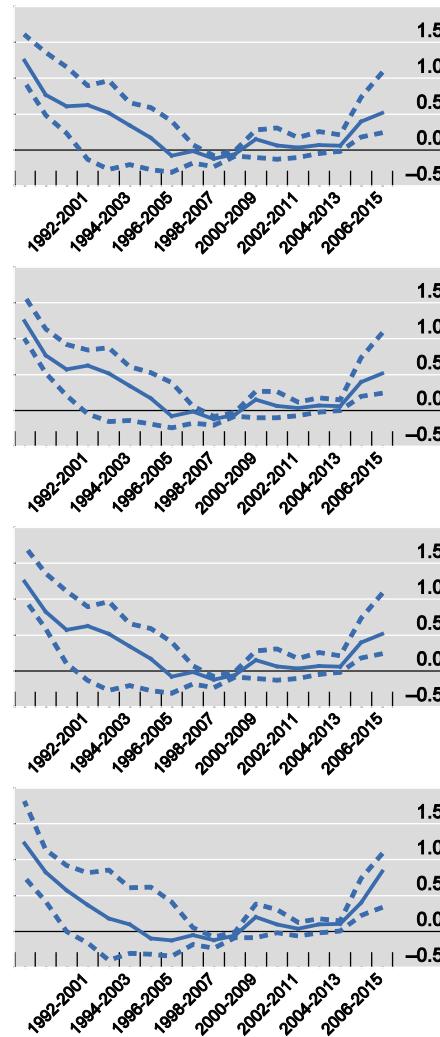
Mean anchor estimate and 95% confidence



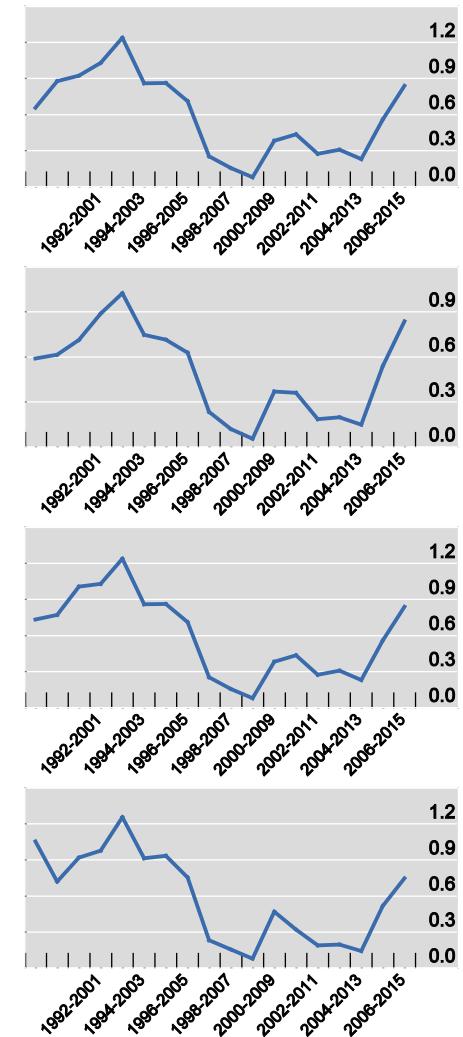
Standard deviation of estimates



Median anchor estimate and inter-quartile range



Inter-quartile range of anchor estimates

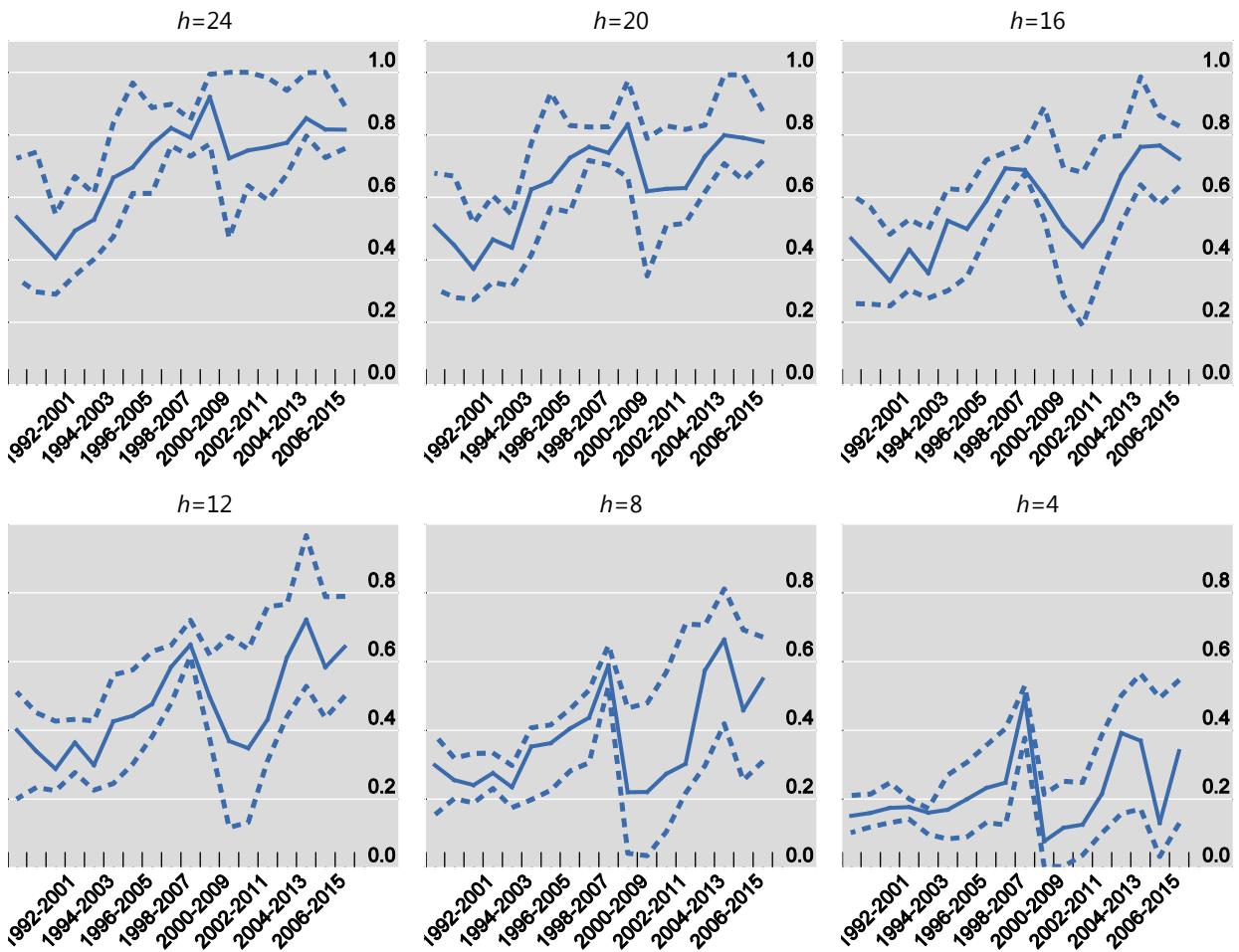


From the left: the first column contains the average estimated inflation anchor and 95% confidence band across all forecasters for each rolling sample. The second column contains the standard deviation of estimated inflation anchors. The third column contains median estimated inflation anchors and inter-quartile ranges. The final column contains inter-quartile ranges.

Source: Authors' calculations.

Japanese $\alpha(h)$: median and inter-quartile range for different values of h

Graph 6



Source: Authors' calculations.

Our estimates of b and c provide for a wide range of possible decay paths. We use the estimates of these for each forecaster to compute the full decay path for all horizons and then calculate the median and inter-quartile range of the weight on the inflation anchor, $\alpha(h)$, for different horizons, h . These are displayed in Graph 6.

For most horizons, there has been some increase in the weight on the anchor over time. A dip is apparent for samples around 2000-2009, but the weight subsequently increased again. Note, however, that even for the longest horizons reported here ($h = 20$ and $h = 24$), $\alpha(h)$ is around 0.7-0.8. This contrasts with the results of a similar exercise on Canadian and US inflation forecasts reported in Yetman (2016), where the median weight increased to around 0.9 in US data and close to 1.0 for Canadian data.

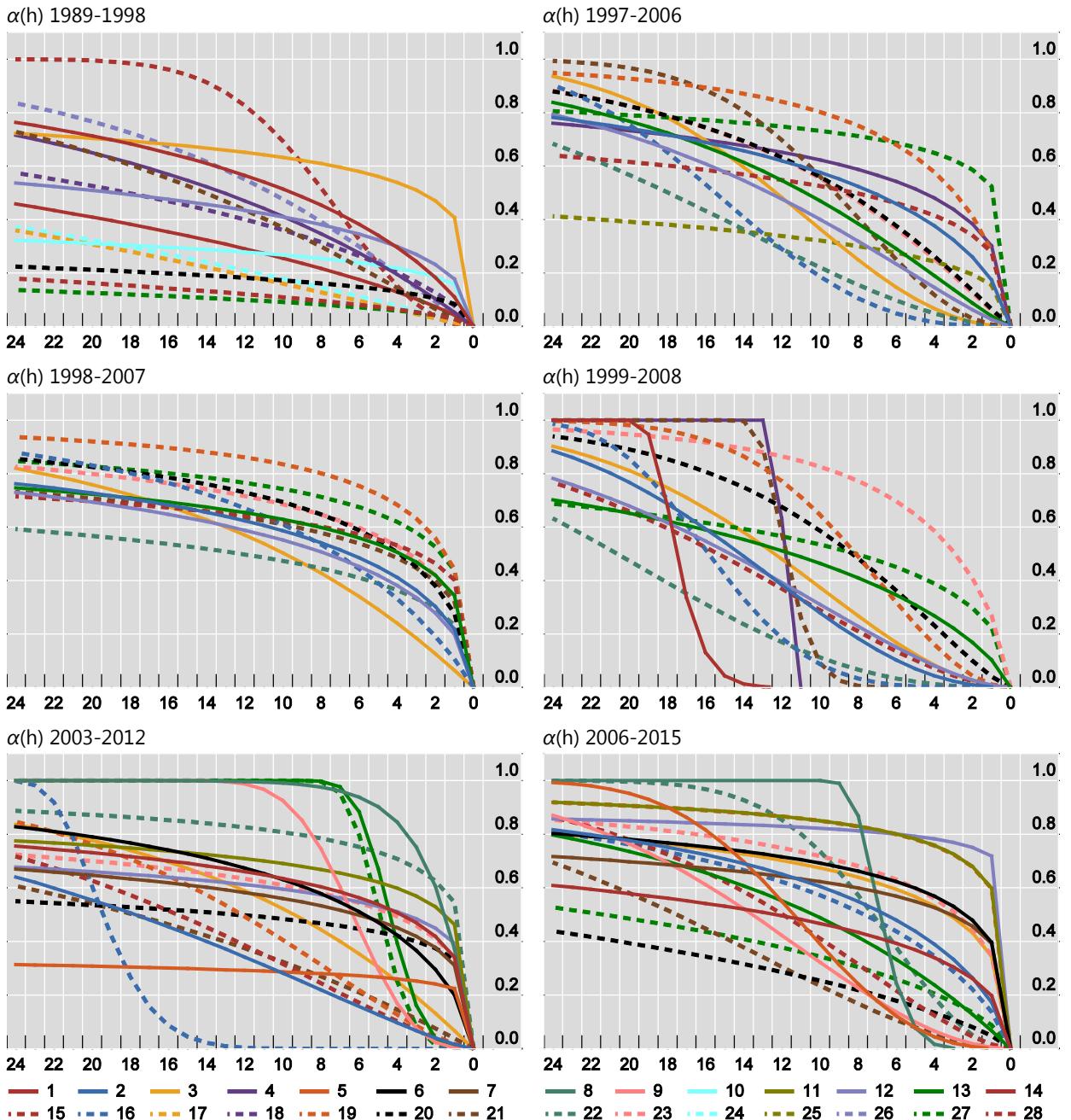
Finally, we examine the decay paths for each of the individual forecasters, since summary measures discussed above may mask some important aspects of forecaster heterogeneity. We focus on six different rolling samples, spread over our sample period, presented in Graph 7.

The early rolling samples are characterised by low levels of anchoring for many forecasters at all horizons. Even at a 24 month horizon, the weight on the anchor for the majority of forecasters in the 1989-1998 to 1994-2003 panels is lower than 0.5. The degree of anchoring then increases, and is at its highest level in 1998-2007. Incidentally, this coincides with the period when the estimated anchor was at its lowest level and the degree of dispersion across forecasters was also the smallest (see

Graph 4). Thus this period coincided with a very high degree of inflation expectations anchoring, albeit at a very low level of inflation.

Estimated decay paths by forecasters

Graph 7



Forecaster numbers correspond to Table 1.

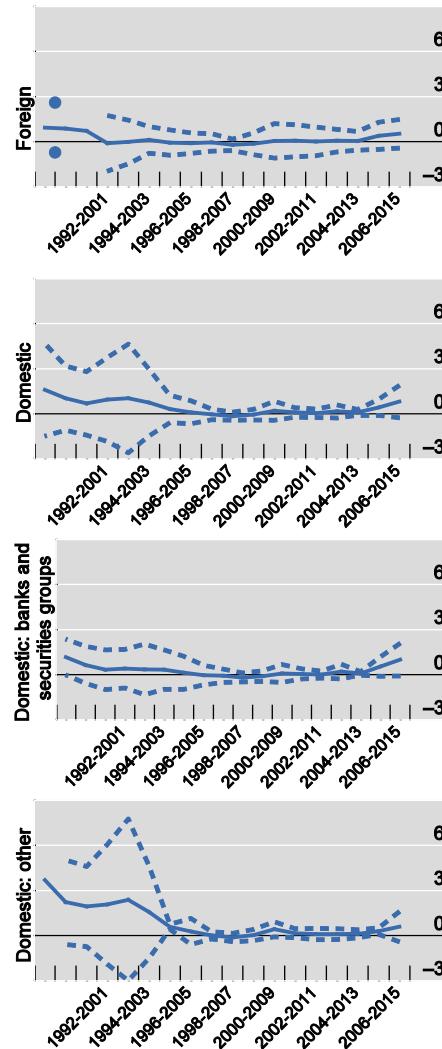
Source: Authors' calculations.

Following the 1998–2007 rolling sample, the decay paths start to vary a lot by forecaster. For a small number of forecasters, the estimated degree of anchoring falls away very quickly as the horizon declines from 24 months. And the estimated degree to which expectations are anchored also starts to decline, although never to the low levels seen in the earliest rolling samples.

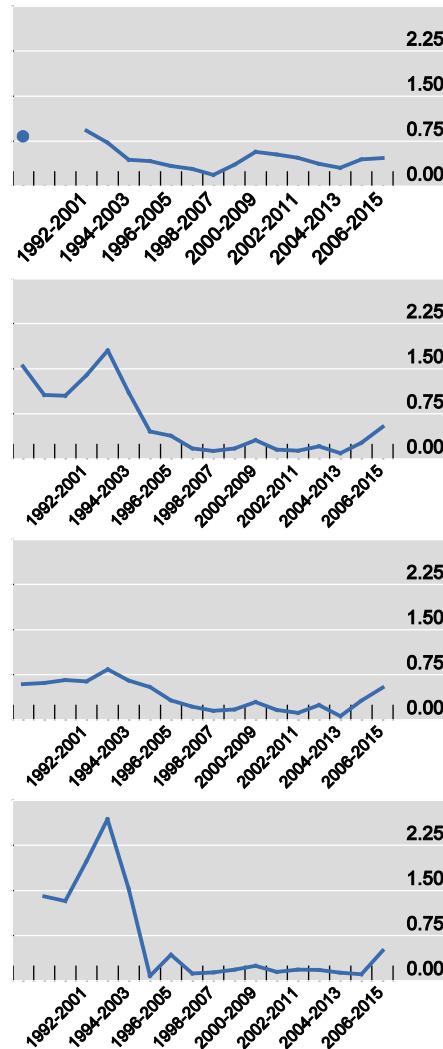
Japanese inflation anchors: by type of forecaster

Graph 8

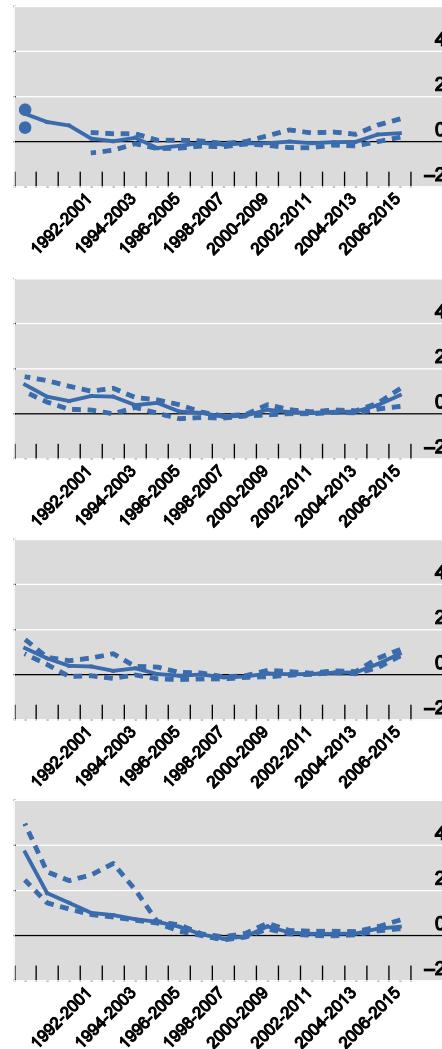
Mean anchor estimate and 95% confidence



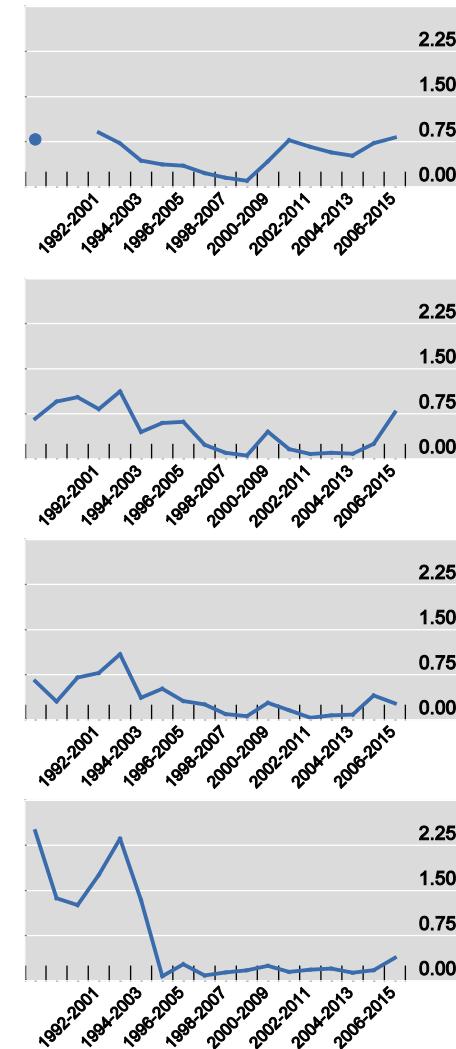
Standard deviation of estimates



Median anchor estimate and inter-quartile range



Inter-quartile range of anchor estimates



From the left: the first column contains the average estimated inflation anchor and 95% confidence band across all forecasters for each rolling sample. The second column contains the standard deviation of estimated inflation anchors. The third column contains median estimated inflation anchors and inter-quartile ranges. The final column contains inter-quartile ranges.

Source: Authors' calculations.

4.3 Comparing forecaster types

All the estimation results reported so far are for the full sample of available forecasters. But not all forecasters are necessarily alike.¹³ To investigate if there are any systematic patterns in development of inflation expectations held by different types of forecasters, we categorize forecasters into several smaller groups based on the type of institution. We first divide the forecasters into whether they are domestic or foreign, with the former defined as those institutions whose head offices are in Japan. Among domestic forecasters, we further divide the sample between financial institutions (consisting of banks and securities groups) and others.¹⁴

There are notable differences in development of inflation anchors between domestic and foreign forecasters (Graph 8, top two rows). Early in the sample, domestic forecasters were anchored at noticeably higher levels of inflation. Then, beginning around the 1996-2005 sample, domestic forecasters all become very alike in terms of their anchors, with a very narrow range around them, measured in terms of either the standard deviation or inter-quartile range, while anchors for foreign forecasters are more dispersed. Finally, in the latest rolling samples, the dispersion in estimated anchors for domestic forecasters increases such that they are similar to those for foreign forecasters, in terms of both the average level and the amount of dispersion across forecasters. Within the domestic forecasters (bottom two rows), those from outside of financial firms display much more dispersion in the early samples, although the distribution looks broadly similar across the two types for all rolling samples beginning with the 1996-2005 rolling sample. Overall, one result that is common to all the groups of forecasters that we have examined is that the average estimated anchor has increased in the final rolling samples, and the dispersion in estimates of the anchor across forecasters has generally increased as well.

We further examine the difference between different types of forecasters quantitatively. To do so, we regress the estimates of the anchors for each forecaster and rolling sample on fixed effects for each rolling sample and a dummy that is equal to one for domestic forecasters, and zero for foreign forecasters. We run a Prais-Winsten regression, allowing for both cross-sectional and serial correlation in the errors.¹⁵ The estimated coefficient on the dummy is 0.35, indicating that estimated inflation anchors for domestic forecasters are around one-third of a percentage point higher than those for foreign forecasters in our sample. This economically large difference is also statistically significant, with a p-value of 0.018. When we further classify domestic forecasters into "banks and securities groups" and "other", we find that this result is driven entirely by the "other" category, for whom estimated anchors are much higher for the early rolling samples (see also the bottom two rows of Graph 8).¹⁶

¹³ We thank Frank Packer for suggesting this line of enquiry.

¹⁴ We do not divide the foreign forecasters into further sub-groups because of the small number of foreign forecasters.

¹⁵ We use the "xtpcse" function in Stata, with the "pairwise" option, and allow the AR(1) coefficient to vary by forecaster. The panel is incomplete and sufficiently sparse that the variance-covariance matrix cannot generally be identified for the full panel. Reported results are therefore based on forecasters who are present in the panel at least 10 times, but are very similar if we use a somewhat lower cut-off.

¹⁶ We also examine whether the weight on the anchor at longer horizons differs systematically across the different forecaster types. In general, the differences are quantitatively small and statistically insignificant.

5. Adjusting for the effect of consumption tax hikes

All the estimation results so far are based on sample forecaster's raw forecasts, unadjusted for consumption tax hikes that affected both outcomes and forecasts of inflation for some years within the sample period. One possibility is that the changes in apparent inflation expectations anchoring that we identify are influenced by changes in the consumption tax over the sample. In this section, we report results run on adjusted data to take account of this.

The Japanese government first introduced a consumption tax, at a rate of 3 percent, in April 1988. Then, in April 1997, the tax rate was raised from 3 to 5 percent. A second hike, from 5 to 8 percent, occurred in April 2014. In addition, a planned consumption rate increase, from 8 to 10 percent in October 2015, may influence the estimates for the last rolling sample, although its implementation was postponed in November 2014.¹⁷

To adjust for the consumption tax hikes, we follow the Bank of Japan's explanation of the effects of the 2014 and 2015 tax hikes on inflation (Bank of Japan, 2012, 2013a, 2013b, 2014). They assumed that the three percentage point increase in the tax rate in April 2014 would push up the headline CPI inflation rate for the April 2014-March 2015 (fiscal) year by 2.0 percentage points, suggesting 67% inflation pass-through, with no direct inflationary impact beyond this 12 month window. Similarly, the expected effect on inflation of the proposed October 2015 tax hike was 1.3 percentage points spread over the second half of fiscal 2015 (October 2015-March 2016) and the first half of the following fiscal year (April 2016-September 2016). We will assume a similar pass-through ratio for the previous tax-hike as well: the two percentage point increase in April 1997 raising inflation by 1.3 percentage points in the following 12 months.

The underlying principle that we apply to adjusting the data for inflation is that consumption tax hikes caused temporary deviations in both inflation forecasts and outcomes, and that our estimating equation (1) should be used on data that has had these effects stripped out.

One issue is choosing the horizon when forecasters first incorporated the tax effects into their forecasts. For the first two tax increases (April 1997 and April 2014), we assume that forecasters incorporate the effects in their forecasts for all horizons, since these tax increases were widely expected well in advance of their implementation.^{18, 19} For the October 2015 tax hike, we assume that the expected effects of the tax were incorporated into the forecasts at the earliest horizons, but eliminated beginning with forecasts made in December 2014 (when $h = 13$ for 2015), consistent with the announcement that the tax increase had been postponed.²⁰

¹⁷ The Prime Minister formally announced its postponement on November 18.

¹⁸ The legislation for the 1997 tax hike was passed in the Diet in November 1994. As for the 2014 and 2015 tax hikes, the Cabinet decided in June 2011 to raise the consumption tax rate to 10% and, in March 2012, decided on the two-step increases in 2014 and 2015 to implement this. The associated legislation was passed in the Diet in August 2012.

¹⁹ In August 2013 the Prime Minister held meetings to review the appropriateness of the April 2014 tax hike and formally announced its implementation as planned on October 1, 2013. In September preceding the announcement, the media repeatedly reported his intention to carry through on the planned implementation. Based on this chronology, an alternative view of the April 2014 tax hike is that forecasters incorporated the effects in the forecasts of 2014 inflation only from October 2013 (ie beginning at $h = 15$ for forecasts of 2014 inflation). This would imply that forecasts for 2014 should have jumped by around 1.5 percentage points in October 2013. However, the evidence does not support this: for forecasters present in the survey in both September and October, the percentage changes in mean, median, maximum and minimum are 0.03, 0.0, 0.38 and -0.3 respectively. The same story holds for nearby months. Hence we assume that the tax hike was expected ahead of its official announcement.

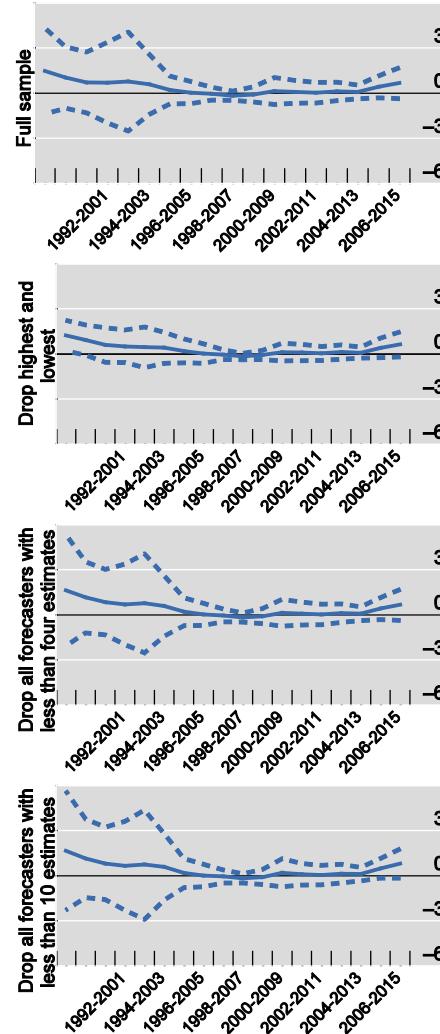
²⁰ The tax postponement was reported in the media a few days before the formal announcement on 18 November 2014, but too late to have influenced forecasts made in November.

Another issue is apportioning the effect of the tax hike on inflation following the implementation of the tax, since these occur partway through calendar years. We assume that the effects fall uniformly across all months, so that the effects are proportional to the number of months in the calendar year that fall into the 12 month period following the tax hike. Thus we can express the adjusted inflation forecast as:

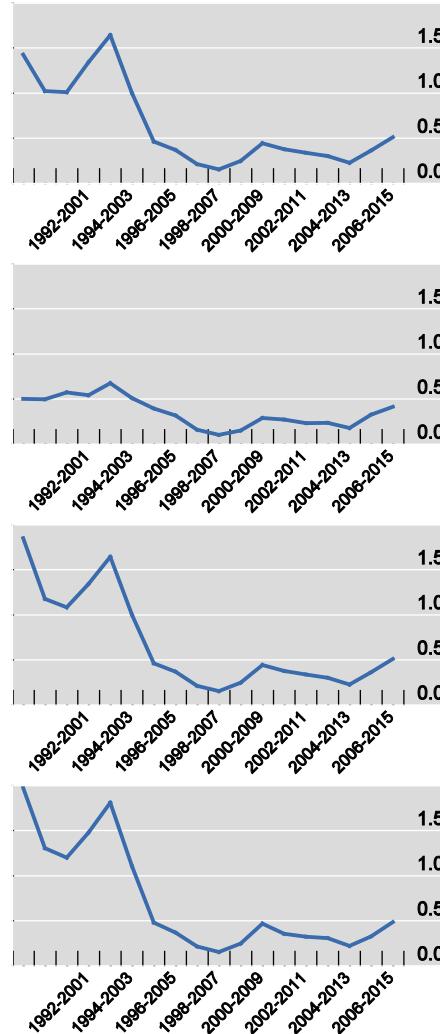
Japanese inflation anchors: tax adjustment

Graph 9

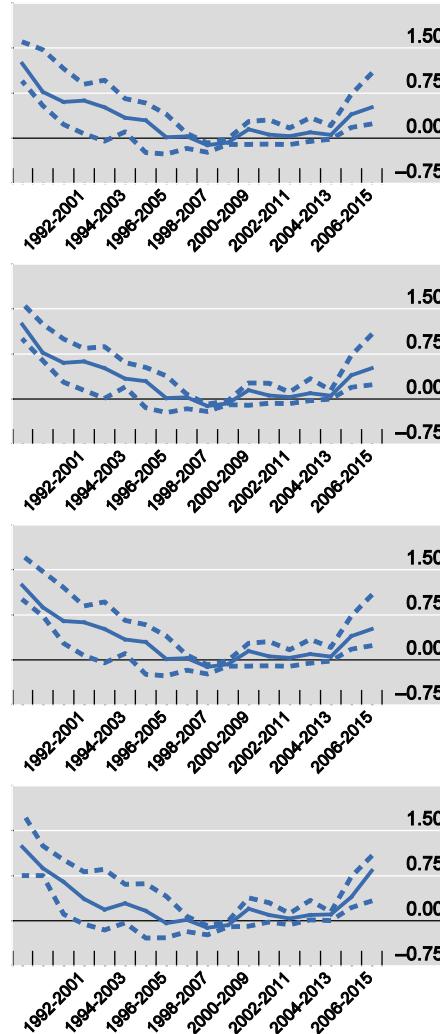
Mean anchor estimate and 95% confidence



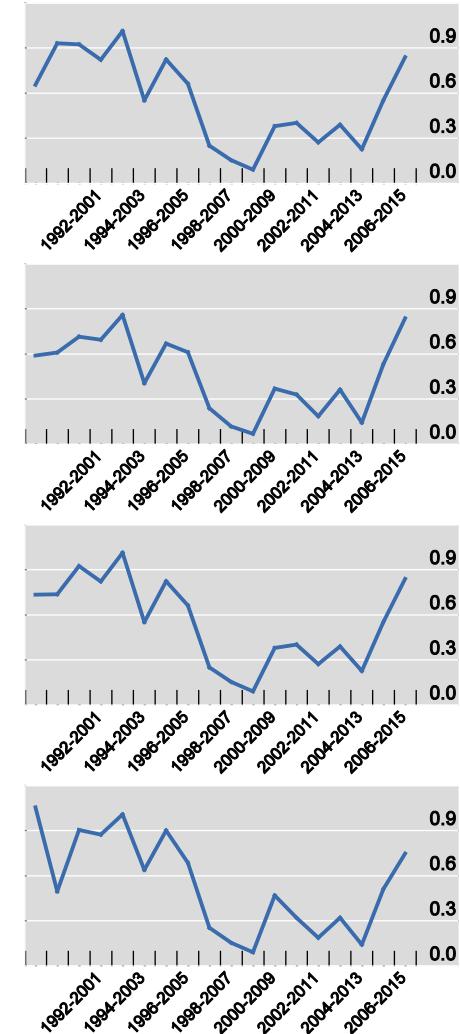
Standard deviation of estimates



Median anchor estimate and inter-quartile range



Inter-quartile range of anchor estimates



From the left: the first column contains the average estimated inflation anchor and 95% confidence band across all forecasters for each rolling sample. The second column contains the standard deviation of estimated inflation anchors. The third column contains median estimated inflation anchors and inter-quartile ranges. The final column contains inter-quartile ranges.

Source: Authors' calculations.

$$x_i = X_i - z \left(\frac{y}{12} \right), \quad (6)$$

where X_i is the raw forecast by an individual forecaster i ; z is the overall effect of the tax hike on inflation (as discussed above); y is the number of months in the calendar that are within 12 months of the tax increase; and x_i is the adjusted forecast (excluding the effects of the tax hike). We apply this formula to adjust forecasts for both the calendar year with a tax hike and the following year, given that the latter also includes some months within 12 months of the tax change. Thus we adjust inflation forecasts for calendar years 1997, 1998, 2014, 2015 and 2016.

In addition to adjusting forecasts, we also correspondingly adjust the value of actual inflation that enters our estimating equation (1), based on the same principle. The assumption is that the effect of actual inflation on forecasts depends on the level of inflation with the direct effect of the tax increase stripped out. Note that, given that actual inflation in equation (1) is the 12-month growth rate in monthly CPI, the size of the correction depends on the forecast horizon: the y in equation (6) will vary between one and 12, depending on the number of months of the past 12 that are within 12 months of the tax rate increase.

The estimation results, adjusting for the effects of taxes, are given in Graph 9. In general, they are similar to those reported previously. Perhaps this should not be surprising given that our approach effectively averages the influence of any tax effect over the length of our rolling sample. However, the degree to which the final rolling samples differ from earlier samples is generally less pronounced: the estimated anchor rises, but only modestly, and the increase in the standard deviation and inter-quartile range of estimated anchors is smaller than before. But focusing on the median and inter-quartile range, which downplays the tails of the distribution of estimates of the anchor, the evidence of an increase in the anchor and more dispersion across forecasters remains strong.

However, not all differences are smaller once we adjust the data for the effects of taxes. When we repeat the second stage regressions (discussed at the end of section 4) on the tax-adjusted estimation results, the difference between estimated anchors for domestic and foreign forecasters is larger (0.51 vs 0.35 percentage points), although the statistical significance of this difference is smaller (p value of 0.042 vs 0.018).

6. Shorter rolling samples robustness check

As a final check, we also consider shorter rolling samples. Results so far have focused on 10 year rolling samples, so that any evidence of a recent change in anchoring may not have had time to filter through to our estimates. We instead reduce the rolling sample to 5 years, and add the most recent year of data (forecasts and outcomes for 2016) to the panel. To partly offset the reduction in the number of observations in each rolling sample, we only include a forecaster in the sample if two-thirds of the possible 120 forecasts in a given rolling sample are available (compared with a cut-off of half of the possible 240 forecasts previously).²¹

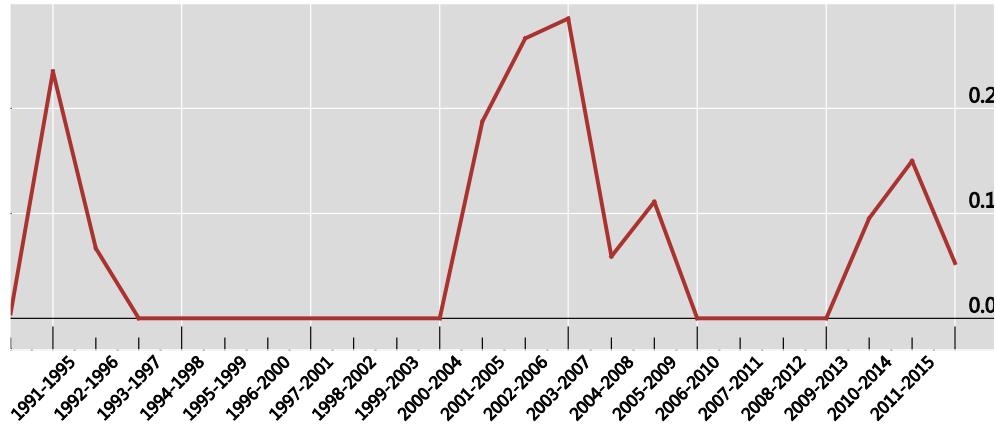
In these shorter samples, it is sometimes more difficult to pin down an anchor at all. Graph 10 displays the share of forecasters in each rolling sample where the weight on the anchor at all horizons up to 24 months is very low (defined here as less than 0.06). In many of these cases, a wide variety of different estimates of the anchor yield almost exactly the same likelihood. For example, for

²¹ The net result of this is the inclusion of five additional forecasters in the panel for at least one rolling sample, as follows. 1: Baring Securities – Japan; 2: Barclays Capital / Barclays Capital Group / BZW – Japan; 3: Japan Tech Info Services Corp / Nippon Steel & Sumikin Research Institute; 4: Mitsubishi Bank; and 5: Mizuho Securities. Note, also, that the name of Forecaster 7 (in Table 1) changes from IHS Economics to IHS Markit from 10/2016.

the 2002-2006 and 2003-2007 rolling samples, a precise estimate of the anchor cannot be obtained in over 25% of all forecasters otherwise included in our panel.

Share of forecasters with no identified anchor in 5-year rolling samples

Graph 10



Horizontal axis displays the rolling sample dates.

Source: Authors' calculations

Focusing on the forecasters for whom an anchor is identified, Graph 11 displays the results across the same specifications as displayed previously. For the third-to-last rolling sample, there are a number of extreme estimates (estimated anchors range from -1.2% to 12.9%). But the more robust measures based on medians and inter-quartile ranges in the final two columns, which are less influenced by the tails of the distribution of estimated anchors, show a similar increase in the anchor and also an increase in the dispersion of estimated anchors across forecasters in the final rolling samples that include the explicit inflation targeting period in Japan.

7. Conclusion

In this paper, we have modelled the behaviour of inflation forecasts using a decay function. Inflation forecasts are assumed to monotonically diverge from an estimated anchor towards actual inflation as the forecast horizon shortens. Fitting the data on forecaster-level data for Japan, we find that estimated inflation anchors declined early in the sample, remained close to zero for rolling samples from 1996-2005 until 2004-2013, before rising slightly. The variability in these estimates across forecasters indicates a divergence in recent samples, consistent with more diverse views across forecasters about the level at which inflation is anchored. The increase in the level of the anchor can be viewed as reflecting success in trying to increase inflation expectations, while the increase in variability across forecasters suggests that not all professional forecasters are persuaded that there has been a change in the inflation regime. These effects are diminished somewhat, however, when forecasts and outcomes are adjusted for the effects of the consumption tax hikes.

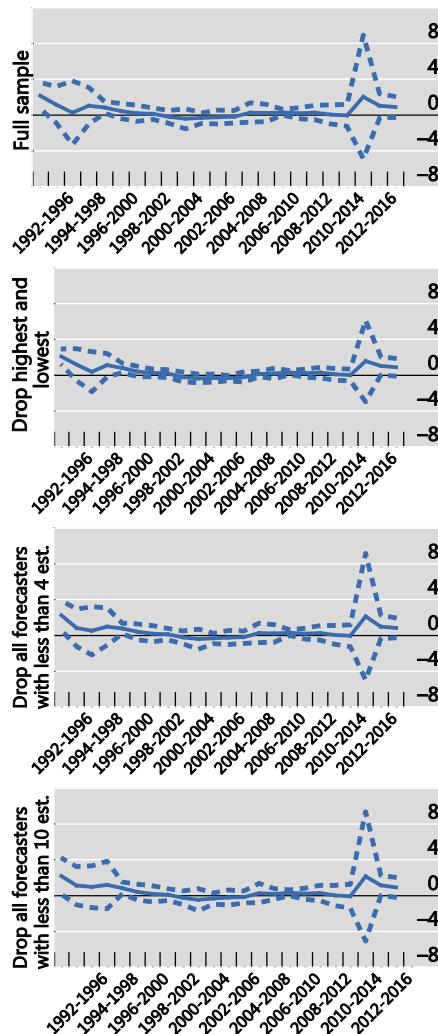
In terms of the weight on the estimated anchor, this has increased over time, indicating greater anchoring. However, on the whole, the estimated weight at longer horizons remains lower than that obtained in a similar exercise on Canadian and US forecasters reported in Yetman (2017), indicating that there remains considerable room for increased expectations anchoring going forward. Finally, the wide dispersion in estimated decay paths across forecasters also points to a diverse set of views across forecasters about the inflation process in Japan. Taken together, these results suggest that

inflation expectations anchoring has improved in Japan in recent years, but that there remains considerable scope for greater anchoring in future.

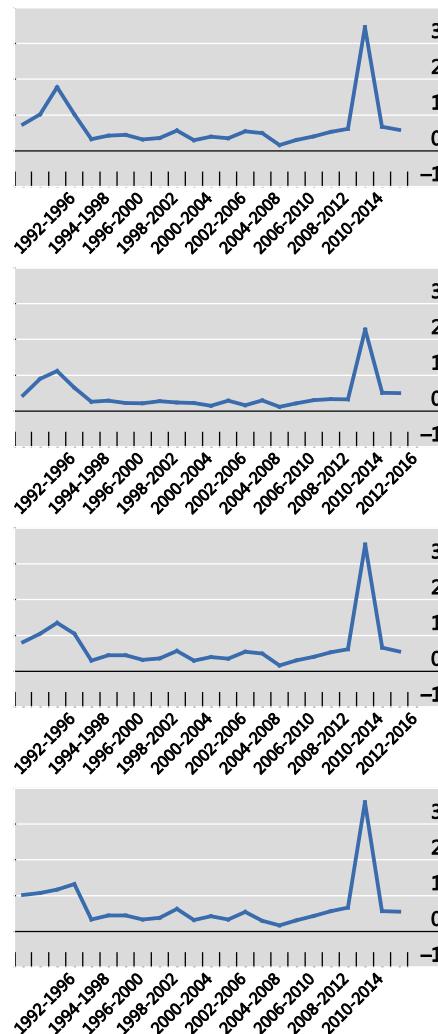
Japanese inflation anchors: 5-year rolling samples

Graph 11

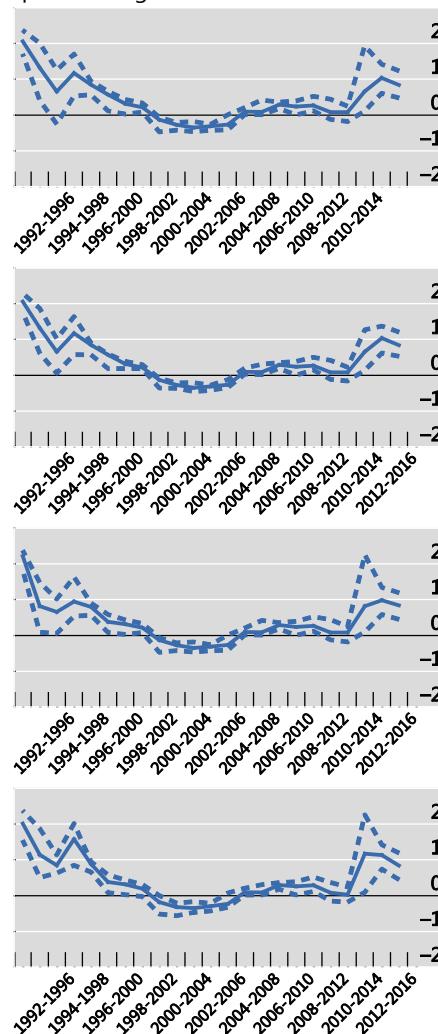
Mean anchor estimate and 95% confidence



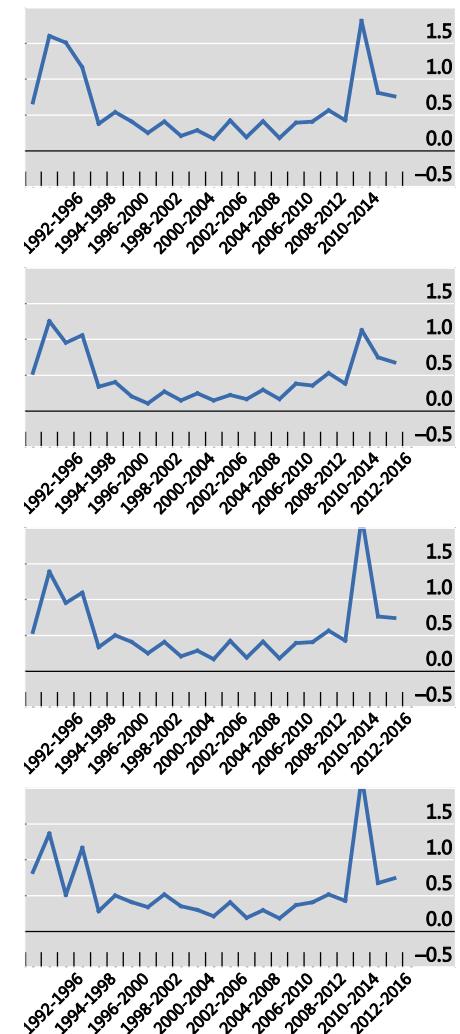
Standard deviation of estimates



Median anchor estimate and inter-quartile range



Inter-quartile range of anchor estimates



From the left: the first column contains the average estimated inflation anchor and 95% confidence band across all forecasters for each rolling sample. The second column contains the standard deviation of estimated inflation anchors. The third column contains median estimated inflation anchors and inter-quartile ranges. The final column contains inter-quartile ranges.

Source: Authors' calculations.

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Appendix I

Bank of Japan's communication on price stability and numerical reference (chronology)

April 27, 1994: Principles for the Conduct and the Goal of Monetary Policy (Speech made by Governor Mieno) (translation in Nishizaki et al (2014))

"One of the main goals of monetary policy is delivering 'sustainable growth without inflation' in the medium- to long-run." "The question is often posed on which price indicator, the Consumer Price Index or the Wholesale Price Index, the definition of price stability should be based. However, it is inappropriate to single out a price indicator, as the goal of monetary policy is the 'stability of prices' not the 'stability of a price index.' "

October 11, 1996: Financial Innovation, Financial Market Globalization, and Monetary Policy Management (Speech made by Governor Matsushita)

"The Bank of Japan . . . intends to manage monetary policy appropriately with the aim of maintaining price stability, preventing inflation or deflation of domestic prices."

June 27, 1997: A New Framework of Monetary Policy under the New Bank of Japan Law (Speech made by Governor Matsushita)

"It is, however, not easy to define price stability. There are diverse types of price indicators: for example, the Consumer Price Index, Wholesale Price Indexes, and the GDP deflator. Each of these has its limitation, such as the range of items covered or the timing of release. Further, many studies have been conducted more recently on the possibility that these indicators offer a substantially biased measurement of prices."

October 13, 2000: On Price Stability

"[I]t is not deemed appropriate to define price stability by numerical values." "Price stability, a situation neither inflationary nor deflationary, can be conceptually defined as an environment where economic agents including households and firms can make decisions regarding such economic activity as consumption and investment without being concerned about the fluctuation of the general price level."

March 9, 2006: The Introduction of a New Framework for the Conduct of Monetary Policy

"Price stability is a state where various economic agents including households and firms may make decisions regarding such economic activities as consumption and investments without being concerned about the fluctuations in the general price level." "Price stability is, conceptually, a state where the change in the price index without measurement bias is zero percent."

March 9, 2006: An Understanding of Medium- to Long-term Price Stability

"It was agreed that, by making use of the rate of year-on-year change in the consumer price index to describe the understanding, an approximate range between zero and two percent was generally consistent with the distribution of each Board member's understanding of medium- to long-term price stability. Most Board members' median figures fell on both sides of one percent."

May 27, 2007: Outlook for Economic Activity and Prices

"The 'understanding' expressed in terms of the year-on-year rate of change in the CPI, takes the form of a range approximately between 0 and 2 percent, with most Policy Board members' median figures falling on one side or the other of 1 percent."

December 18, 2009: Clarification of the "Understanding of Medium- to Long-Term Price Stability"

"In a positive range of 2 percent or lower, and the midpoints of most Policy Board members' 'understanding' are around 1 percent."

February 14, 2012: The Price Stability Goal in the Medium to Long Term

"The Bank judges that 'the price stability goal in the medium to long term' is in a positive range of 2 percent or lower in terms of the year-on-year rate of change in the consumer price index (CPI) and, more specifically, set a goal at 1 percent for the time being."

January 22, 2013: The "Price Stability Target" under the Framework for the Conduct of Monetary Policy

"The newly-introduced 'price stability target' is the inflation rate that the Bank judges to be consistent with price stability on a sustainable basis . . . [T]he Bank sets the 'price stability target' at 2 percent in terms of the year-on-year rate of change in the consumer price index (CPI) – a main price index."

April 4, 2013: Introduction of the "Quantitative and Qualitative Monetary Easing"

"The Bank will achieve the price stability target of 2 percent in terms of the year-on-year rate of change in the consumer price index (CPI) at the earliest possible time, with a time horizon of about two years. In order to do so, it will enter a new phase of monetary easing both in terms of quantity and quality."

April 30, 2015: Outlook for Economic Activity and Prices

"Although the timing of reaching around 2 percent depends on developments in crude oil prices, it is projected to be around the first half of fiscal 2016, assuming that crude oil prices will rise moderately from the recent level."

October 30, 2015: Outlook for Economic Activity and Prices

"Although the timing of reaching around 2 percent depends on developments in crude oil prices, it is projected to be around the second half of fiscal 2016, assuming that crude oil prices will rise moderately from the recent level."

January 29, 2016: Outlook for Economic Activity and Prices

"[T]he timing of the year-on-year rate of change in the CPI reaching around 2 percent -- the price stability target -- is projected to be around the first half of fiscal 2017."

April 28, 2016: Outlook for Economic Activity and Prices

"[T]he timing of the year-on-year rate of change in the CPI reaching around 2 percent -- the price stability target -- is projected to be during fiscal 2017."

Appendix II

Dropped Forecasters

Table A1

Baring Securities - Japan	Barclays	Barclays Capital	BZW - Japan
Dai-Ichi Life Research	Deutsche Bank (Asia)	Dresdner Kleinwort Asia	Dresdner Kleinwort Benson
Fuji Research Institute	Hitachi Research Institute	IBJ Securities	Japan Tech Info Services Corp
Jardine Fleming	Jardine Fleming Securities	Kleinwort Benson - Tokyo	Kokumin Keizai Research Inst
Lehman Brothers	Mitsubishi Bank	Mizuho Securities	Morgan Stanley
Nippon Steel & Sumikin Rsrch	Oxford Economics	Sakura Institute of Research	Schroder Securities
Schroders	Schroders - Japan	Sumitomo Bank	UBS Phillips & Drew
UBS Phillips & Drew - Tokyo	UBS Securities - Japan	UBS Securities - Tokyo	