How anchored are inflation expectations in Asia?

Evidence from surveys of professional forecasters

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1. Introduction

Well-anchored inflation expectations – where anchoring refers both to the level and variability of anticipated future inflation – are important for the monetary transmission mechanism. If inflation expectations are not well anchored, forward-looking price and wage setting behaviour are likely to be a source of macroeconomic volatility. In standard New Keynesian models, for example, inflation depends in part on expected inflation. In such a framework, well-anchored inflation expectations can significantly contribute to stabilising actual inflation.

Inflation performance has improved considerably in emerging Asia since the regional crisis in the late 1990s, likely reflecting changes in macroeconomic policies, at least in part. Some economies in the region adopted inflation targeting frameworks, but the improvement in inflation performance has not been limited to the inflation targeters (Filardo and Genberg, 2010). However, maintaining stable inflation in the region is not without challenges. The volatility of global commodity prices has been reflected in fluctuations of headline inflation rates, central bank balance sheets in emerging Asia have ballooned as a result of reserve accumulation and unconventional monetary policies in the advanced economies may have contributed to strong capital flows into the region. If not well managed, such factors could affect the anchoring of inflation expectations, and make a central bank's job of maintaining price stability more difficult.

This paper investigates how well anchored inflation expectations are in Asia, using inflation forecasts by professional forecasters from Consensus Economics. We examine inflation expectations using three different methods. First, we assess the behaviour of longer-term (both five-year and two-year ahead) forecasts in the different economies over time. Second, we assess the uncertainty related to inflation expectations by computing an indicator of forecast disagreement. Third, we use a novel method to model the behaviour of forecasts over different horizons, capturing the fact that inflation forecasts converge towards actual inflation as the forecast horizon becomes shorter. This analytically simple method is based on an exponential decay function, and provides a convenient way to parameterise the degree to which inflation expectations are anchored. Overall, we find that inflation expectations generally appear to be well-anchored in the region. We close with some policy implications.

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2. Empirical evidence

Our measures of inflation expectations are for inflation based on the consumer price index (CPI) and come from Consensus Economics. We use the *median* inflation forecasts across a panel of professional forecasters, except when the uncertainty surrounding these forecasts is of interest. Each month, the forecasters are asked to provide their forecasts of the average level of inflation for both the current calendar year and the following calendar year. Thus, these are fixed-event forecasts. The data give us a panel of inflation expectations for any given year across 24 monthly horizons, for months h = 1 to h = 24.[2]

We include ten Asian economies in the sample. Four of them are inflation targeters (Indonesia, Korea, the Philippines and Thailand). The other six follow other monetary policy frameworks (China, Hong Kong SAR, India, Japan, Malaysia, Singapore), generally with a declared focus on price stability, even if the framework is not officially described as inflation targeting.

i) Long-term forecasts and actual inflation

Forecasts of inflation are available at monthly horizons out to a maximum of 24 months. In Graph 1, we show the development of actual inflation and the 24-month-ahead forecasts for the same year on the x-axis, for our sample of Asian economies. As an example, the forecast shown for 1999 is the forecast made in January 1998 for average inflation in 1999. Longer-term forecasts are also available but for a shorter time period, and at semi-annual rather than monthly frequency. The graph also displays the five-year-ahead forecasts for the time period 2005–2012, based on forecasts made in 2000–2007 (April of each year).

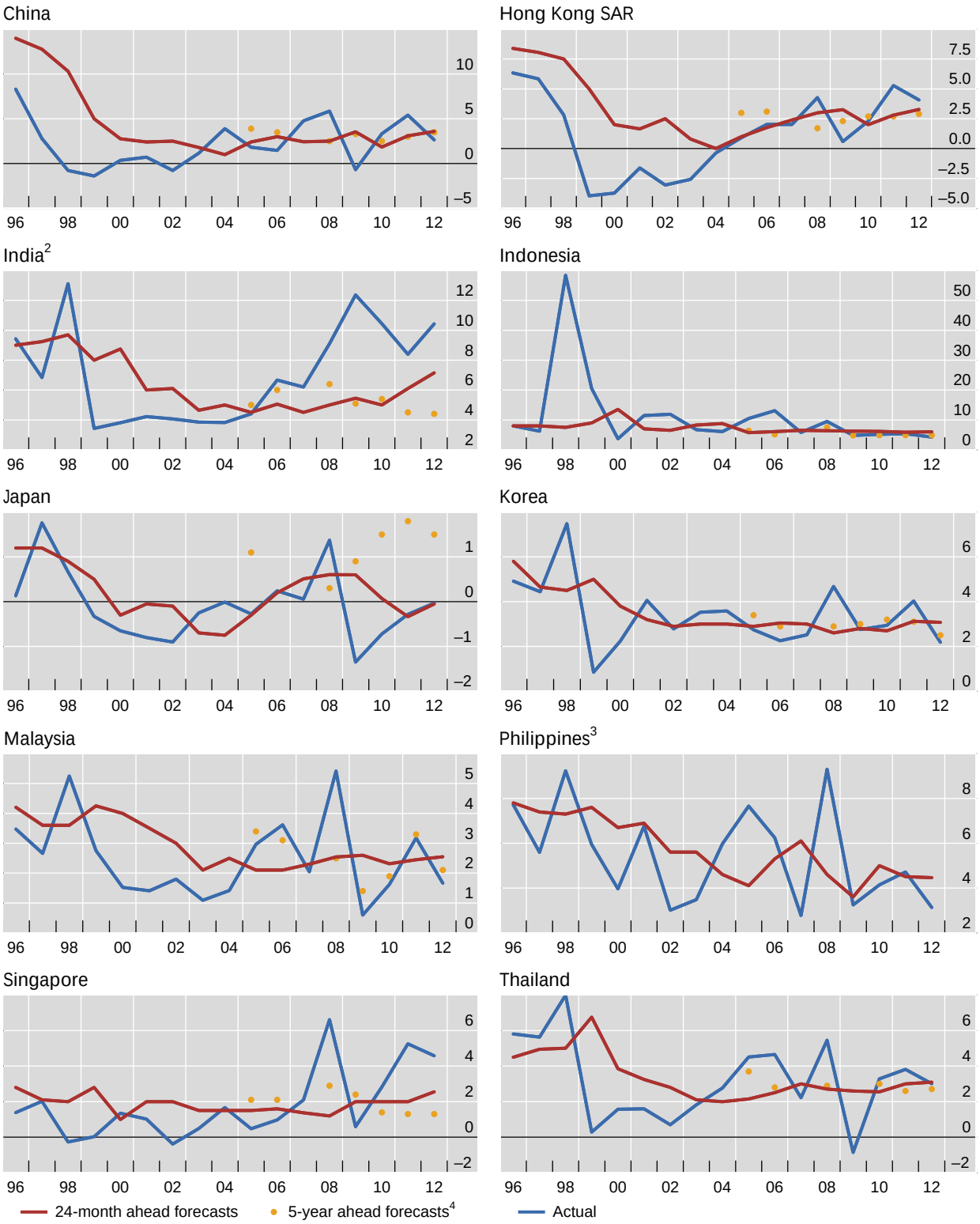
Graph 1 shows that long-run inflation expectations have fallen over time in most Asian economies. In many cases, the decline occurred early in the sample, during the Asian crisis of the late 1990s. We also see that longer-term inflation forecasts are less volatile than actual inflation. One explanation for this is that inflation expectations are well anchored. Notably, there was little volatility in these median inflation forecasts during the international financial crisis. However, uncertainty over future inflation did increase at the time, as we will show. In many economies, lower frequency movements in forecasts do seem to track actual inflation, albeit with some delay.

There are also some country-specific differences in the behaviour of long-term forecasts. In Japan and Singapore, inflation expectations had already fallen to low levels by the mid-1990s. In India, long-term inflation expectations have followed a U-shape over time, falling to relatively low levels in the mid-2000s but climbing again since then. A similar phenomenon can be observed for Hong Kong SAR. But overall, long-run inflation expectations have been mostly either trending down over time or have remained at relatively low levels.

[2] When examining long-term forecasts the next section, we also use data on inflation expectations five-years-ahead.

CPI inflation[1]

% change over previous calendar year — Graph 1



[1] Horizontal axis represents the year being forecasts. [2] Fiscal year beginning April 1. [3] Survey of 5-year ahead forecasts is not available for the period shown. [4] Forecasts published in April of each year.

Source: Consensus Economics©.

ii) Uncertainty about future inflation

While point forecasts of inflation are important for economic decision making, uncertainty about future inflation is also of relevance. From a policymaking perspective, an increase in the uncertainty of inflation expectations could signal an erosion of monetary policy credibility, for example. More uncertain inflation forecasts could also reflect elevated tail risks as perceived by the forecasters, providing useful information to policymakers.

In order to illustrate the uncertainty about inflation forecasts, we use a measure of forecast disagreement based on the (modified) squared deviation measure, as in Siklos (2013). Forecast disagreement at time t, over a forecast horizon of h, is defined as:

$$d_{th} = \frac{1}{N-1}\sum_{i=1}^{N}(F_{ith} - \bar{F}_{th})^2.$$

Here F denotes the inflation forecast, i identifies the forecaster, N is the number of forecasts, and $\bar{F}$ is the median forecasted value across forecasters at time t. A higher value for forecast disagreement is taken as indicating greater uncertainty about future inflation, which could affect private sector consumption and investment decisions.[3] We illustrate developments in forecast uncertainty for the years 2000, 2005, 2010 and 2012, both at 12 and 24-month horizons (Table 1).

Forecast disagreement

Table 1

	12-month ahead forecasts				24-month ahead forecasts			
	2000	2005	2010	2012	2000	2005	2010	2012
China	0.48	0.87	0.46	0.12	0.73	1.14	1.08	0.45
Hong Kong SAR	1.59	0.23	0.71	0.42	2.21	0.33	2.52	0.53
India	1.66	0.31	2.46	0.32	1.57	0.46	0.94	1.17
Indonesia	3.45	0.50	0.48	0.40	25.50	1.73	1.25	0.40
Japan	0.05	0.06	0.12	0.05	0.25	0.11	0.15	0.20
Korea	0.15	0.08	0.13	0.08	2.76	0.27	1.26	0.17
Malaysia	0.13	0.19	0.29	0.14	3.29	0.28	0.60	0.21
Philippines	--	--	1.01	0.11	--	--	--	0.68
Singapore	0.20	0.06	0.71	0.11	0.44	0.17	0.85	0.12
Thailand	0.33	0.28	0.50	0.17	1.54	0.13	2.13	0.31

Sources: Consensus Economic©; authors' calculations.

Table 1 indicates that forecast disagreement increased during the international financial crisis in all other economies except China and Indonesia. This is visible from the 12-month-ahead forecasts for 2010, made in January 2009. For the 24-month-ahead forecasts for the same year, made in early 2008, the heightened level of forecast disagreement reflects not

[3] An alternative approach would be to use forecasts of the probability distribution of future inflation, as in Zarnowitz and Lambros (1987). However, probabilistic inflation forecasts are not available for many of the economies in our panel.

only growing uncertainty about potential spillovers from the growing turbulence in some of the major advanced economies, but also the effects of a commodity price boom on the region. However, this episode stands in contrast to the overall trend of declining forecast disagreement in the region over time.

iii) Modelling the behaviour of inflation expectations

In this section, we present a novel method for modelling the behaviour of inflation expectations, drawing on current research at the BIS Asian Office (Mehrotra and Yetman, 2013). The framework fully utilises the multiple-horizon dimension of the data. In contrast, previous research has typically resorted to different approximations to convert fixed-event forecasts to horizon-based forecasts (see eg Dovern and Fritsche, 2008; Dovern et al., 2009; Siklos, 2013).[4]

The basic assumption behind the adopted functional form is that, if inflation expectations are well anchored at a particular level, inflation forecasts made sufficiently far in advance should be equal to that level. Indeed, in an environment where inflation expectations are well anchored, there should exist some horizon beyond which long-run expectations are fixed and do not systematically respond to new data about economic conditions.[5] As time passes, and the forecast horizon shortens, inflation expectations will eventually start to deviate from the anchored level towards the level of actual inflation. Forecasters gradually learn more about the realisation of shocks to inflation for a given period, for example. A slow adjustment could arise due to information about the economic conditions being disseminated only slowly through the economy. This could result from costs of acquiring and processing new information, as in Devereux and Yetman (2003) and Mankiw and Reis (2002).

The inflation expectations process for each economy is modelled 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 until the end of the year that is being forecast. π^* is the level that long-run inflation expectations are anchored to, which we estimate, and $\pi(t-h)$ is the level of inflation observed at the time the forecast is made. $\varepsilon(t,t-h)$ is a residual term.[6]

$\alpha(h)$ denotes the decay function. As the horizon shortens, there is greater weight on realised outcomes and less on the long-run anchor point.[7] In particular, we assume that $\alpha(\infty) = 1$ and $\alpha(0) = 0$. The decay process is modelled as the exponential of a polynomial function:

[4] Lahiri and Sheng (2008) study fixed-event forecasts, although of GDP growth rather than inflation, for the G7 economies. They consider forecaster-level data and find that forecaster disagreement is greatest at longer horizons and diminishes as the horizon shortens. They also find that forecast variation for a given forecaster is lowest at longer horizons, and increases as the horizon decreases.

[5] Long-run expectations could still change if, for example, the level of monetary policy credibility varies or the central bank announces a new level for an inflation target. We consider the latter possibility below and evaluate whether the adoption of inflation targeting brought about a change in the inflation rate at which inflation expectations are anchored in the long run.

[6] To correct for the publication lag in inflation data, we use the 12-month growth rate in monthly CPI lagged by one month as the actual inflation rate. This also helps to address any potential endogeneity issues between expected and actual inflation. See the Annex for information about the variance-covariance structure of the model and other details about the econometric methodology.

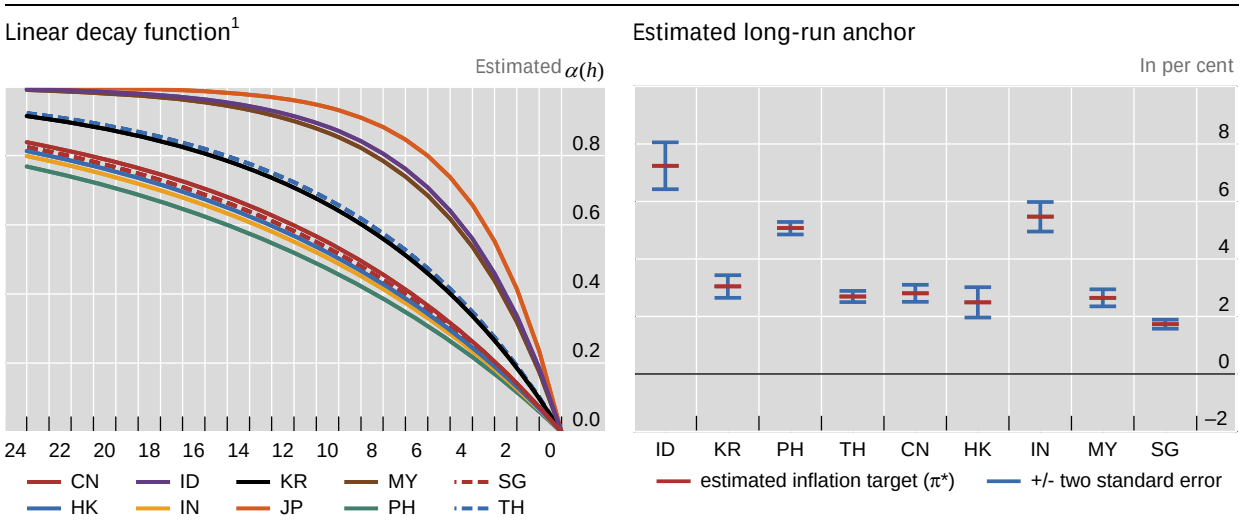
$$\alpha(h) = 1 - \exp\big(g(-\gamma, h)\big). \tag{2}$$

With a linear function, $g(.)$ takes the form:

$$g(-\gamma, h) = -\gamma_1(i)h. \tag{3}$$

The estimated decay functions are shown in Graph 2 (left-hand panel), for the sample period 2000–12.[8] The graph shows that, at our longest forecast horizon of h = 24 months, inflation expectations are mostly driven by the long-run anchor. At that horizon, the weight on the long-run anchor is estimated to be between 75% and 100% and the weight on actual inflation correspondingly between 0% and 25%. Expected inflation is relatively rigid in most economies and starts to move closer to actual inflation only gradually. Finally, when the horizon becomes very short, inflation expectations are driven almost entirely by actual inflation.

Decay function and estimated long-run anchor — Graph 2



[1] Horizontal axis represents forecast horizon *h*, which is the number of months before the end of the calendar year being forecasts.

Source: authors' calculations.

However, there are some differences in the estimated decay function across economies. One group of economies, comprised of Japan, Indonesia and Malaysia (the three upper-most lines in Graph 2), stand out in the sense that inflation expectations are more driven by the long-run target, relative to actual inflation, compared to other economies in the sample. As shown later, the estimated γ coefficient in these economies is correspondingly higher. Note that this does not imply anything about the *level* at which inflation expectations are anchored. It is possible that long-run inflation expectations are anchored at a high level regardless of the horizon at which expectations are affected by actual inflation.

Our method yields two straightforward measures of anchoring of expectations: the level of the estimated long-run anchor π^* and the tightness of this anchor – the latter given by the

[7] The use of decay functions in forecasting applications is not entirely new. Gregory and Yetman (2004) use a polynomial decay function and Blue Chip survey data to model the behaviour of professional forecasters, in particular the phenomenon that the forecasts converge towards a consensus, as the forecast horizon shortens.

[8] Results are broadly similar if we consider a quadratic or cubic polynomial in (3) instead.

estimated standard error of π^*. Graph 2 (right-hand panel) shows these two measures in our sample of Asian economies.

For the inflation targeting economies, the graph suggests that the estimate of the long-run anchor falls relatively close to the announced inflation targets of the central banks. As an example, for 2012 the inflation target for Indonesia was specified as 4.5±1%; for Korea 3.0±1%; for Philippines 4.0±1%; and for Thailand at 0.5–3.0%.[9] This could be interpreted as indicating that the announced inflation targets in these economies have been credible, at least when considering inflation expectations by professional forecasters.

But inflation is anchored at relatively low levels for all the economies our sample. Indeed, on average, the estimated long-run anchor is lower in the non-inflation targeting economies than the inflation targeters. This result also holds when Japan is excluded from the sample (where the recurrent bouts of deflation are reflected in the low value of the estimated π^*). The low estimate for the long-run anchor in the case of the non-inflation targeters is consistent with the broad success economies in the region have had in bringing down inflation.

Regarding the tightness of anchoring, the standard errors around the estimates for the long-run anchor are very similar on average for the inflation and non-inflation targeters. At the same time, there are differences between economies with similar estimates for the long-run anchor. Consider, for instance, Hong Kong SAR and Malaysia, where inflation expectations are anchored at very similar levels but the degree of anchoring differs in terms of the tightness of the long-run anchor. Such differences could be relevant if a central bank wants to change the level of private agents' inflation expectations, as is arguably the case currently in Japan.

Changes in the anchoring of inflation expectations over time could also be relevant. We evaluate whether the level at which inflation expectations are anchored changed with the introduction of inflation targeting frameworks. Due to the limited sample size, we compare estimates obtained from the full sample against those obtained using only the inflation targeting period. As a comparison, for the non-inflation targeters, we compare estimates obtained from the full sample against those obtained over the period beginning in 2000. The results are shown in Table 2 below.

Table 2 suggests that the adoption of inflation targeting was associated with a drop in the level at which inflation expectations are anchored in all inflation targeting economies. The average π^* for the inflation targeters fell from 4.739 to 4.210, although the fall is not always statistically significant at the 95% level. The standard error of the estimates of the π^* coefficient for all four economies declined as inflation targeting was adopted, suggesting that inflation expectations became more tightly anchored. The magnitude of the fall in the standard error is especially prominent in the cases of Indonesia and Thailand.

For the non-inflation targeters, there was similarly a fall in the estimated π^* between the 1990s and the 2000s (from 3.450 to 2.507) in all economies. Their drop is even higher on

[9] The inflation target in the case of Thailand is set in terms of core inflation, whereas we use CPI inflation rates. In the case of Indonesia, the announced inflation targets have generally fluctuated more than elsewhere and have also trended down over time. This may partly explain why the estimated long-run anchor is higher for Indonesia than the announced target range for 2012.

average than for the inflation targeting economies.[10] Inflation expectations also became better anchored over time in the non-inflation targeting economies, in the sense that the standard error of the estimate for π^* fell, by an average magnitude of 0.074. So while inflation targeting was associated with a decline in inflation expectations, inflation expectations in the non-inflation targeters have also fallen and become more tightly anchored over time. These results are in line with those of Filardo and Genberg (2010) who suggested that the improved inflation performance is not limited to the explicit inflation targeters in the region.

	Non-inflation targeters					
	CN		HK		IN	
	Coeff	std error	Coeff	std error	Coeff	std error
Full sample	4.570	0.370	4.421	0.428	6.318	0.244
2000-	2.808	0.148	2.490	0.263	5.469	0.255
	JP		MY		SG	
	Coeff	std error	Coeff	std error	Coeff	std error
Full sample	0.456	0.138	2.952	0.148	1.982	0.116
2000-	–0.111	0.108	2.651	0.148	1.733	0.079

	Inflation targeters							
	ID		PH		TH		KR	
	Coeff	std error	Coeff	std error	Coeff	std error	Coeff	std error
Full sample	6.493	0.234	5.723	0.229	3.186	0.209	3.553	0.239
Since IT	6.033	0.040	4.786	0.174	2.695	0.109	3.325	0.168

Table 2. Estimated π^*, full sample and subsamples

3. Conclusion and policy implications

In this paper, we have shown that the level of long-run inflation expectations has generally fallen in Asian economies during the past decade. At the same time, uncertainty about future inflation has declined, as there is now less disagreement among professional forecasters about the level of future inflation rates. Using a novel methodology to model the behaviour of inflation expectations, we also find that long-run forecasts appear to be anchored at levels that are close to the explicit inflation targets in the region, suggesting that the announced targets have been viewed as credible. However, the degree of anchoring of inflation expectations appears to be similar for both the inflation and non-inflation targeting economies.

[10] An obvious caveat when comparing the change in the estimated π^* between the inflation targeters and the other economies is that the respective samples are small and economy characteristics vary considerably across the two samples.

These findings suggest that the ballooning central bank balance sheets have, at least so far, not led to unanchored inflation expectations in the region. Caruana (2011) mentions inflation as one of the broad policy risks that large balance sheets could pose for central banks, and suggests that the track record of delivering low inflation has granted central banks some leeway. Similarly, we note that inflation expectations in Asia have been well behaved so far, even in the context of unconventional monetary policies in the advanced economies that may at times have encouraged volatile capital inflows into Asia, partly driven by a "search for yield". But, given the robust credit growth and strong property price increases in many Asian economies, policymakers need to remain vigilant about dynamics that could occur beyond the conventional policy horizon.

While our results generally point to a reasonable degree of anchoring of inflation expectations in the sample of Asian economies, it must be borne in mind that our data on inflation expectations only cover professional forecasters. It is plausible that these forecasters pay more attention to the central bank's announcements regarding policy objectives. Surveys of consumers and firms would offer additional information, but such indicators are not generally comparable across economies.

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Annex

The variance is modelled using a flexible functional form:

$$V\big(\varepsilon(i,h,t)\big) = \delta_0^i + \delta_1^i h. \tag{A.1}$$

The formulation in (A.1) allows the variance to shrink as the forecasting horizon h declines and there is less uncertainty about the inflation outturn.

Forecasts made at different horizons for the same inflation outcome are likely to be highly correlated, especially if the horizons are close together. We explicitly model this, assuming that the correlation between residuals for forecasts of the same inflation rate, but made at two different horizons h and k, is given by:

$$Corr\big(\varepsilon(t,t-h),\varepsilon(t,t-k)\big) = \phi_0^i - \phi_1^i|h-k|. \tag{A.2}$$

The assumed gradual adjustment of inflation expectations is in line with the observation that the empirical autocorrelation of inflation that only decays slowly (see Fuhrer and Moore, 1995). In practical terms, this implies that the off-diagonal elements of the variance-co-variance matrix take the form:

$$Cov\big(\varepsilon(t,t-h),\varepsilon(t,t-k)\big) = \left[\sqrt{V\big(\varepsilon(t,t-h)\big)V(\varepsilon(t,t-k))}\right]\left[\phi_0^i - \phi_1^i|h-k|\right]. \tag{A.3}$$

For details on the estimation procedure, see Mehrotra and Yetman (2013).