

Inflation expectations and monetary policy

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Abstract

Emerging market central banks have come to rely on an increasing number of measures of inflation expectations from a variety of sources. We highlight some of the empirical limitations of the various measures, and argue that different measures are likely to be best suited for different purposes. We discuss what drives inflation expectations based on central bank survey responses, and provide evidence that inflation expectations in emerging market economies have become more strongly anchored over time.

Keywords: Emerging market central banks, inflation expectations, surveys

JEL classification: E31, D84, E58

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Introduction

Inflation expectations generally play at least two important roles in central banking. First, as important inputs into price and wage setting, they provide a summary statistic of where inflation is likely to be headed. Second, they may be used to assess the credibility of the central bank's inflation objective.

Some measures of expectations are likely to be better suited for some purposes than others. All have different limitations. Not surprisingly, then, central banks rely on a range of measures.

In this paper, we start by summarising how different central banks in emerging market economies (EMEs) measure inflation expectations, and for what purpose. Next, we compare the relative performance of the different measures using a variety of metrics. Then, we provide empirical evidence on what inflation expectations, in the form of inflation forecasts from professional forecasters, imply for the degree of anchoring of inflation expectations, based on updated results from Mehrotra and Yetman (2014).

Measurement of inflation expectations

EME central banks appear to be using an increasing number and variety of measures of inflation expectations than in the past. Table 1 reports the number of survey measures, by type, both now and at the time of our questionnaire on central bank inflation expectations conducted for a meeting in 2009 (BIS (2010)). The increase is especially evident for inflation targeting central banks, including those in Hungary, Poland and Russia, which collect the highest number.² The fixed exchange rate currency regimes are exceptions: Hong Kong SAR, Saudi Arabia and the United Arab Emirates do not rely on such measures, not least since the central bank credibility in those economies drives expectations of the exchange rate, rather than inflation.³

Measures of inflation expectations can be classified as (i) forecasts based on surveys of professional forecasters; (ii) forecasts based on surveys of households or firms; and (iii) market price-based measures.

Professional forecasters' inflation forecasts are widely used. These economic agents are frequent and careful monitors of inflation developments. They are likely to be better informed and to respond faster than other agents. In some cases, the forecasts are collected by the central bank itself (eg Poland), but often they are obtained from external sources, such as Consensus Economics (eg Peru and Thailand).

Such surveys are used for a variety of purposes. Some purposes derive from their usefulness as predictors of inflation, including: (i) influencing policy decisions (Hungary, India and Thailand); (ii) gauging economic confidence (the Czech Republic, Indonesia, Poland, Singapore and Thailand); and (iii) gauging short-term inflationary pressure (Thailand). Others relate to their value for assessing policy credibility, namely: (iv) checking how well inflation expectations are anchored (Indonesia, Israel,

² As the note from the Philippines discusses, firms' and consumers' views on the future path of inflation play an important role in inflation targeting regimes.

³ See, for instance, the note from Saudi Arabia. In addition, the note from the Czech Republic discusses the implications of a temporarily fixed exchange rate on inflation expectations.

Malaysia and Singapore); and (v) testing the formation of expectations (Poland).⁴ In China, Colombia, Mexico, Peru, the Philippines, Poland, Russia, South Africa and Turkey, they serve most of these purposes.

Economy	2009	2015	Memo item: inflation targeter:	
			2009	2015
Brazil	1	4	X	X
Chile	1	3	X	X
China	.	2	X	X
Colombia	2	3	X	X
Czech Republic	3	3	X	X
Hong Kong SAR	0	0		
Hungary	2	5	X	X
India	1	3		X
Indonesia	2	5	X	X
Israel	1	3		
Korea	2	4	X	X
Malaysia	.	3		
Mexico	1	2	X	X
Peru	.	2	X	X
Philippines	1	3	X	X
Poland	2	5	X	X
Russia	.	6		X
Saudi Arabia	0	0		
Singapore	.	3		
South Africa	1	2	X	X
Thailand	.	3	X	X
Turkey	2	3	X	X
United Arab Emirates	.	0		

¹ As reported by central banks in response to BIS questionnaire; see Table A1 in the appendix (and Table A1 in Moreno and Villar (2010), pp 84–90) for details. Information about inflation targeters comes from Jahan (2012), updated based on central bank websites. A dot indicates missing data. An “X” indicates that the economy has an inflation targeting regime.

One limitation of forecasts from professional forecasters is that most externally provided inflation forecasts are fixed event forecasts and hence relate to different horizons for the inflation rate in a given calendar year, whereas surveys of expectations collected by central banks themselves are typically at fixed horizons. In the case of fixed event forecasts, the forecast horizon varies through the year, and may become shorter than the policy horizon. In contrast, fixed horizon forecasts are more easily comparable over time and easier to use for policy purposes. For instance, inflation targeters may be most interested in inflation expectations one to two years

⁴ As the note from Singapore points out, well anchored expectations may help to explain why surveys provide good forecasts of near-term inflation outcomes.

ahead, as this is the horizon where monetary policy will have its greatest impact, and may have less use for shorter horizon forecasts (eg Svensson (1997)).

Another limitation is that professional forecasters face incentives to make relatively extreme forecasts in order to maximise their publicity value. Being correct when other forecasters are also correct is unlikely to attract attention; in contrast, being correct when everyone else is wrong may have considerable marketing value.⁵ Consequently, forecasts by professional forecasters may be likely to deviate from the expectations of inflation used by price-setters and decision-makers in the economy.⁶

The second way to measure inflation expectations is via surveys of households and firms. These are generally used to assess the credibility of the central bank and the degree to which inflation expectations are anchored. In some cases they are also used to assess the degree of economic confidence (the Czech Republic, Indonesia, Korea, Malaysia, Peru, the Philippines, Russia, Singapore and Turkey) and gather additional evidence missed by other measures (Poland and Thailand).

Expectations of households and firms are often criticised as poor predictors of inflation outcomes, given that they are too heavily influenced by food and energy prices. Despite this, if agents act on the basis of biased expectations, then it is important to understand the nature of that bias, since it will affect spending, pricing and wage setting.

Unfortunately, measures of firms' expectations are not widely available. Coibion and Gorodnichenko (2015) suggest using consumers' expectations as a proxy, since firms' expectations are likely to be similar. Kumar et al (2015) find that managers of firms tend to: (i) have a poor knowledge about the dynamics of inflation; (ii) be unaware of the central bank's goals; and (iii) display expectations that are not well anchored.

One risk common to all the measures discussed so far is that the corresponding economic agents are not directly compensated based on the accuracy of their stated forecasts (Schuh (2001)).⁷ Accordingly, a subset of central banks uses measures extracted from financial market instruments (eg break-even inflation rates between nominal and real bonds) (Gürkaynak et al (2010); De Pooter et al (2014)).⁸ These are also typically available at high frequency, on a timely basis, and are often based on

⁵ For example, Laster et al (1999) suggest that publicity may be more important than accuracy in terms of attracting customers and maximising profits, and Lamont (2002) finds that well established forecasters with strong reputations tend to produce less accurate, and more extreme, forecasts.

⁶ Alternatively, if an inflation targeting central bank becomes highly credible, the dominant option for forecasters who are simply trying to be as accurate as possible – especially at longer horizons – may be to use the target as their inflation forecast, at which point forecasts may become uninformative, except as a measure of credibility (Morris and Shin (2005)).

⁷ For instance, Lim (2001) finds that financial analysts overestimate corporate earnings in order to get inside information to improve accuracy. Given the preference that firms' managers have for favourable forecasts (because they help to support higher capital market valuations and their own compensation), they typically refrain from providing non-public information about their firm to analysts that make unfavourable forecasts, even if these simply reflect weaker fundamentals. As a result, analysts' forecasts are biased. In principle, the same kind of compromise could influence the performance of survey-based measures of inflation expectations.

⁸ For an analysis of the factors that are priced into the inflation (or deflation) risk premium, see the note from Mexico. For instance, while changes in the price level can affect inflation risk compensation by creating intertemporal wealth distortions, a more developed financial system can help reduce these costs.

transactions among a large number of market participants. Moreover, they are often based on inflation outcomes at a constant horizon.

The instruments used vary. Our survey indicates that inflation-indexed government bonds are followed by a growing subset of emerging market central banks (eg Chile, Colombia, Israel, Korea, Peru, Poland, Russia, South Africa and Thailand) (see Table A2 of the Appendix). For the Philippines and Thailand, financial market expectations of inflation are inferred from nominal interest rates, based on the secondary bond market. Israel retrieves inflation expectations from the difference between non-indexed and indexed interest rates of commercial banks, while Chile uses the cost of buying insurance against inflation outcomes and the pricing of inflation swaps.

Yet, even where financial market indicators of inflation expectations are available, these have a mixed record. For example, Bauer and McCarthy (2015) show that market-based inflation expectations are poor predictors of future inflation compared with surveys of professional forecasters, and contain little forward-looking information about future inflation. This is partly because market-based measures reflect not just the expected level of inflation, but also market liquidity and the value of insurance against alternative inflation outcomes (Hördahl (2009)). For Brazil, Chile and Mexico, De Pooter et al (2014) find that one-year inflation compensation tends to be too low over the long run, and sensitive to macroeconomic news. Differences in the risk premium or the incorporation of expectations of large-scale asset purchases by the central bank into investors' portfolio decisions can also reduce the usefulness of market-based measures as predictors of inflation. Finally, if the underlying markets in which these instruments trade is relatively underdeveloped, the prices may reflect the views of only a small subset of market participants.

The performance of inflation expectation measures

How well do different survey-based measures of inflation expectations perform in forecasting inflation? Table 2 reports summary statistics of the forecast errors. We focus on the mean forecast error (ME) and the root mean squared error (RMSE). These are widely used measures of accuracy. The ME is the average forecast error, where a positive (negative) number indicates that actual outcomes are higher (lower) than forecasts on average. It gives the same weight to all forecast errors.

In contrast, the RMSE is a measure of the magnitude of the forecast errors, ignoring their sign. It weights large forecast errors more heavily than small forecast errors. For most measures, the sample starts around 2000, but for some it begins only much more recently. We also test formally whether forecast errors are unbiased (Holden and Peel (1990)). Some results stand out.

Forecast accuracy and bias of different survey-based measures of expectations¹

Table 2

Economy	Survey number	Name of survey/measure	Start date	ME	RMSE
Brazil	(1)	Market Expectations System CPI (IPCA)	2000	0.67***	1.85
	(2)	Market Expectations System CPI (INPC)	2000	0.57***	1.79
	(3)	Market Expectations System General Price Index (IGP-DI)	1999	-0.64***	3.33
	(4)	Market Expectations System General Price Index (IGP-M)	1999	-0.62***	3.30
Chile	(5)	EEE (Economic Expectation Survey)	2001	0.06	1.86
	(6)	EOF (Survey of financial operators)	2009	0.13	1.09
Czech Republic	(7)	Inflation expectations (financial market)	1999	-0.55***	1.25
	(8)	Inflation expectations (managers of non-financial corporations and companies)	1999	-0.64***	1.25
Hungary	(9)	Quantitative_Household_Tárki-MNB	2002	-10.03***	10.22
	(10)	Quantitative_Corporation_Tárki-MNB	2005	-3.66***	5.07
Israel	(11)	Expectations (professional forecasters)	2001	-0.11	1.61
	(12)	Consumer survey	2012	-3.41***	3.54
	(13)	Business tendency survey	2013	-1.37***	1.48
Korea	(14)	Consumer survey index (BOK)	2002	-0.75***	1.23
	(15)	Consensus Economics survey (financial corporations)	2000	-0.13**	0.84
Malaysia	(16)	BNM Consumer Sentiment Survey	2005	-3.13***	3.35
	(17)	Analysts' Consensus forecast	2013	-0.17	1.18
Peru	(18)	Survey to analysts and the financial system	2002	0.28***	1.13
	(19)	Survey of macroeconomic expectations (economic analysts)	1999	0.39	1.15
	(20)	Survey of macroeconomic expectations (financial corporations)	2001	-0.11	1.27
	(21)	Survey of macroeconomic expectations (non-financial corporations)	2002	0.05	1.39
Philippines	(22)	Consumer Expectations Survey	2007	-4.00***	4.46
Poland	(23)	Consumers: current CPI inflation	2004	-0.00	1.12
	(24)	Consumers: perceived inflation	2004	-2.07***	2.32
	(25)	Consumers: Consumer Perceived Price Index	2004	-1.78***	2.10
	(26)	Financial sector analysts	2004	-0.00	1.16
	(27)	Enterprises: current CPI inflation	2008	-0.03	0.92
Singapore	(28)	Asia Pacific Consensus Forecast	1999	-0.01	1.75
	(29)	SKBI-Mastercard Singapore Index (Headline)	2011	-1.89***	2.31
	(30)	SKBI-Mastercard Singapore Index (MAS Core Inflation)	2011	-1.98***	2.43
Thailand	(31)	Business Sentiment Survey (BSI)	2007	-0.89***	1.97
	(32)	Asia Pacific Consensus Forecast	2004	-0.18	1.71

¹ Colours indicate whether the frequency is monthly, quarterly or annual. Each row corresponds to a different survey-based measure of inflation expectations. To test for bias, we regress the forecast error on a constant ie: $FE_t = \alpha + \varepsilon_t$, where FE_t is the difference between actual inflation and expected inflation and ε_t is the corresponding error term. Forecasts are considered to be unbiased if we cannot reject the null hypothesis that $\alpha = 0$. ***, ** and * indicate significance at the 1%, 5% and 10% levels. The survey-based measures of inflation expectations are those provided by central banks with a forecast horizon of one year.

Source: Authors' calculations.

First, with the exception of Brazil, Chile and Peru, inflation outcomes are significantly lower than inflation expectations, on average. Similar evidence of a bias for advanced economies is found by Öller and Barot (2000) and discussed in Posen (2011). This may partly reflect the slow adjustment of households' inflation expectations and the downward trend of inflation in emerging markets during the period considered (Arslan and Takáts (2016)).⁹

Second, household surveys perform comparatively poorly. For instance, the errors are larger than those of non-financial corporations in Hungary and Israel or financial sector analysts in Poland. This bias is also strong in the case of the Philippines.

In Table 3, we show the mean forecast error (ME) and the root mean squared error (RMSE) of the market-based measures of inflation expectations provided by central banks, and also test whether forecast errors display a bias. As can be seen, the sample period goes back, at longest, to 2006 and the number of measures is also small.

Forecast accuracy and bias of different market-based measures of inflation expectations¹

Table 3

Economy	Measure number	Name of measure	Start date	ME	RMSE
Brazil	(1)	Inflation indexed government bonds	2006	0.27***	0.68
Chile	(2)	Insurance against inflation (average; in one year)	2010	0.29*	1.20
Peru	(3)	Implicit inflation expectations from inflation-indexed government bonds ²	2010	0.21***	0.54
Philippines	(4)	One-year bid rate of government securities in the secondary market based on the yield curve	2007	0.80***	1.65
Poland	(5)	Inflation-indexed government bonds (break-even inflation) (IZ 0816) ²	2009	0.12	1.37
	(6)	Inflation-indexed government bonds (break-even inflation) (IZ 0823) ²	2011	-0.66***	1.48

¹ Each row corresponds to a different market-based measure of inflation expectations. To test for bias, we regress the forecast error on a constant ie: $FE_t = \alpha + \varepsilon_t$, where FE_t is the difference between actual inflation and expected inflation and ε_t is the corresponding error term. Forecasts are considered to be unbiased if we cannot reject the null hypothesis that $\alpha = 0$. ***, ** and * indicate significance at the 1%, 5% and 10% levels. The market-based measures of inflation expectations are those provided by central banks with a forecast horizon of one year. ² Based on monthly averages from daily data of yields.

Source: Authors' calculations.

The empirical findings are mixed. In Chile, Peru and the Philippines, there is a significantly positive bias, with inflation outcomes exceeding implicit inflation expectations. In contrast, for one of the market-based measures provided by Poland, the bias is significantly negative, and for Brazil and another measure provided by

⁹ In contrast, forecasts made by international organisations have typically underestimated inflation. This can be partly explained by large variations in commodity prices or unexpected hikes in indirect taxes (ECB (2012)). "Budgetary wishful thinking" on the part of government agencies may also play a role (Frankel and Schreger (2013)).

Poland, there is no evidence of a significant bias. In general, the RMSE statistics are similar to those found for the survey-based measures.

Efficiency of different survey-based measures of inflation expectations ¹						Table 4
Economy	Survey number ²	Household expectations?	(1) <i>F</i> -stat	(2) β -test	(3) ρ -test	
Brazil	(1)	No	19.06***	-0.12	0.94***	
	(2)	No	26.85***	-0.19***	0.91***	
	(3)	No	124.02***	-0.66***	0.83***	
	(4)	No	127.29***	-0.65***	0.81***	
Chile	(5)	No	0.30	0.25	0.98***	
	(6)	No	6.01***	-0.78***	0.98***	
Czech Republic	(7)	No	43.28***	0.25***	0.97***	
	(8)	No	15.39***	0.17	0.84***	
Hungary	(9)	Yes	1916.32***	-0.47***	0.50**	
	(10)	No	268.81***	-0.78***	0.83***	
Israel	(11)	No	0.46	0.21	0.97***	
	(12)	Yes	794.31***	-0.69***	0.27	
	(13)	No	479.34***	2.12***	0.99***	
Korea	(14)	Yes	98.27***	-0.45***	0.98***	
	(15)	No	2.27	0.17	0.98***	
Malaysia	(16)	Yes	546.60***	-1.22***	0.78***	
	(17)	No	0.50	-0.18	0.80***	
Peru	(18)	No	5.37***	0.23	0.97***	
	(19)	No	0.69	-0.07	-0.28	
	(20)	No	1.75	-0.49*	0.09	
	(21)	No	2.94*	-0.77*	-0.26	
Philippines	(22)	Yes	116.38***	-0.77***	0.66***	
Poland	(23)	Yes	8.13***	-0.24***	0.92***	
	(24)	Yes	294.82***	-0.11	0.88***	
	(25)	Yes	333.48***	-0.35***	0.89***	
	(26)	No	50.03***	1.60***	1.00***	
	(27)	No	0.02	-0.00	0.66***	
Singapore	(28)	No	13.82***	-0.41***	0.95***	
	(29)	No	76.17***	2.72***	0.92***	
	(30)	No	69.93***	3.32***	0.92***	
Thailand	(31)	No	19.68***	-0.93***	0.98***	
	(32)	No	4.23**	-1.08**	0.83***	

¹ Colours indicate whether the frequency is monthly, quarterly or annual. Each row corresponds to a different survey-based measure of inflation expectations, as listed in Table 2. All measures refer to one-year-ahead inflation expectations. To test for efficiency, we regress actual inflation on a constant and the forecast ie: $\pi_t = \alpha + \beta\pi_t^e + \varepsilon_t$, where π_t is the actual inflation, π_t^e is the expected inflation and ε_t is the error term. Forecasts are efficient if we cannot reject the null hypothesis that $\alpha = 0$ and $\beta = 1$. Column 1 displays the *F*-statistic of this joint hypothesis test. Following Barrionuevo (1997) and Pons (2000), we further investigate the sources of forecast inefficiency. Thus we regress the forecast error on the forecast (the so-called β -test) ie: $FE_t = \alpha + \beta\pi_t^e + u_t$, where FE_t is the difference between actual inflation expected inflation, π_t^e is expected inflation and u_t is the error term. Column 2 presents the coefficient estimates of β . We also regress the current-period forecast error on the previous-period forecast error (the so-called ρ -test) ie: $FE_t = \alpha + \rho FE_{t-1} + \xi_t$, where ξ_t is the error term. Column 3 presents the coefficient estimates of ρ . ***, ** and * indicate significance at the 1%, 5% and 10% levels. ² Survey numbers correspond with Table 2.

Source: Authors' calculations.

As well as bias, another statistical feature of interest is whether all the information is utilised efficiently. There are several definitions of such efficiency, and we consider three in particular. The formal definitions are given in the footnote to Table 4. The three tests are as follows (Barrionuevo (1997); Pons (2000)): (i) whether the inflation outcomes are perfectly correlated with inflation expectations and, in addition, average forecast errors are nil (as indicated by the F -statistics); (ii) whether the forecast errors are uncorrelated with the forecast itself (referred to as the β -test); and (iii) whether the forecast errors are uncorrelated with their lags (called the ρ -test).

For the survey-based measures of inflation expectations, our results (reported in Table 4) show that, in the majority of cases, inefficiency arises partly because new information is not fully incorporated into forecasts and partly because forecast errors are correlated across time (test (i)). But for some measures for Israel and Peru, the inefficiency can be attributed to the observation that the larger the forecast is, the larger the forecast error will be (test (ii)). And in other cases, including for Chile, the Czech Republic, Israel, Korea, Malaysia, Peru, Poland and Thailand, it is mainly that the past forecast errors tend to be repeated over time (test (iii)). For the market-based measures of inflation expectations, the evidence summarised in Table 5 reveals that, with the exception of Brazil, inefficiency arises because of both the process by which new information is incorporated into forecasts and the correlation of forecast errors across time.

Economy	Measure number ²	(1) F -stat	(2) β -test	(3) ρ -test
Brazil	(1)	9.96***	-0.08	0.83***
Chile	(2)	17.69***	-1.12***	0.96***
Peru	(3)	7.14***	-1.30***	0.93***
Philippines	(4)	100.49***	-0.46***	0.92***
Poland	(5)	18.25***	1.09***	0.98***
	(6)	77.34***	2.42***	0.99***

¹ Each row corresponds to a different market-based measure of inflation expectations, as listed in Table 3. All measures refer to one-year-ahead inflation expectations. To test for efficiency, we regress actual inflation on a constant and the forecast ie: $\pi_t = \alpha + \beta\pi_t^e + \varepsilon_t$, where π_t is the actual inflation, π_t^e is the expected inflation and ε_t is the error term. Forecasts are efficient if we cannot reject the null hypothesis that $\alpha = 0$ and $\beta = 1$. Column 1 displays the F -statistic of this joint hypothesis test. Following Barrionuevo (1997) and Pons (2000), we further investigate the sources of forecast inefficiency. Thus we regress the forecast error on the forecast (the so-called β -test) ie: $FE_t = \alpha + \beta\pi_t^e + u_t$, where FE_t is the difference between actual inflation and expected inflation, π_t^e is expected inflation and u_t is the error term. Column 2 presents the coefficient estimates of β . We also regress the current-period forecast error on the previous-period forecast error (the so-called ρ -test) ie: $FE_t = \alpha + \rho FE_{t-1} + \xi_t$, where ξ_t is the error term. Column 3 presents the coefficient estimates of ρ . ***, ** and * indicate significance at the 1%, 5% and 10% levels. ² Market-based numbers correspond with Table 3.

³ Based on monthly averages from daily data of yields.

Source: Authors' calculations.

Key variables in the evolution of inflation expectations¹

Table 6

	Past inflation		Nominal effective exchange rate	Policy interest rate	Nominal wage growth	Unemployment	Industrial production	Others ²
	Level	Volatility						
Brazil	1		3	2	5	7	8	4: (primary) fiscal balance; 6: output surprises; 9: public debt
Chile	1		4	2				3: oil/food prices; world output gap; 5: output gap; CB forecasts
China	1				2			3: asset price growth
Colombia	1	2	4	5				3: output surprises
Czech Republic	3		2		4	5		1: inflation target
Hungary	1	4			3			2: movements in food and regulated energy prices
India	1	3	4	5	2			
Indonesia	1		2	3	4	5		6: asset price growth
Israel	1	4		3		2		
Malaysia	3		2		5	6	4	1: changes in domestic policies
Mexico			3	1		4=		2: commodity price shocks and food price shocks; 4=: (primary) fiscal balance, output surprises and public debt
Peru	1	2	3	4	7=		5=	5=: asset price growth; 7=: output surprises
Philippines	3	4		2	5		6	1: inflation gap (current inflation – target)
Poland ³	2		4=	4=		7	6=	1: inflation target; 3 inflation perceptions gap; 6= oil prices
Saudi Arabia	2		3	4				1: (primary) fiscal balance
South Africa	1	6	2	4	3	11	10	5: output surprises; 7: (primary) fiscal balance; 8: public debt; 9: asset price growth
Thailand	1	2						
Turkey	1		2	2	4			
United Arab Emirates	1		4		3			2: asset price growth

¹ The numbers in the table indicate a ranking given by central banks of the importance of different variables in driving the evolution of inflation expectations, where 1 signifies the most important variable. ² Includes write-in responses suggested by central banks. ³ For Poland, the ordering is based on average rankings across the different measures of inflation expectations.

Source: BIS questionnaire.

Focusing on household expectations, these generally exhibit greater bias, and more volatility, than those by professional forecasters. But they may still provide valuable information. For example, Coibion and Gorodnichenko (2015) find that, by using consumer expectations for US inflation in a Phillips curve instead of those of professional forecasters, they can explain the surprising absence of a persistent fall in inflation during the Great Recession. The reason is that consumers' inflation expectations, which respond more strongly to oil prices, actually rose between 2009 and 2011. However, whether this is a more general relationship, or specific to this particular episode, is unclear. Relatedly, Binder (2015) argues that the expectations of "high-income, college-educated, male and working-age people" play the largest role in explaining inflation dynamics in the context of estimating an expectations-augmented Phillips curve. In addition, as many central banks have indicated in their survey responses, inflation expectations are indicators of central bank credibility and the degree of confidence in the economy.

Regardless of the specific measure, most central banks agree on the determinants of inflation expectations (Table 6). Most view past inflation as the most important driver, perhaps reflecting some backward-looking behaviour and/or relatively high, albeit falling, inflation persistence (Arslan and Takáts (2016)). The second most important driver, cited for Colombia, Peru and Thailand, is the volatility of past inflation. Other nominal variables play a very important role for many economies, including the nominal effective exchange rate, the policy interest rate and nominal wage growth. Real variables come next, including the level of unemployment and industrial production, suggesting a looser link between real economic developments and anticipated future inflation.

In addition, institutional factors play a role. Almost all central banks report that the degree of central bank independence and/or the presence of an inflation targeting framework as the most important ones (Table 7). The exceptions are Saudi Arabia ((primary) fiscal balance) and the United Arab Emirates (labour market flexibility), both of which have bilateral exchange rate pegs. Graph 1 appears to confirm a negative relationship between the RMSE of the inflation forecast error from survey-based measures of inflation expectations and degree of central bank independence as proxied by the index developed by Cukierman et al (1992), and updated by Crowe and Meade (2007).

Central banks also cite other institutional determinants, and indicate that these are relatively less important. These include labour market flexibility, trade or financial liberalisation and product market regulations. Their relative importance is reported to have remained broadly unchanged since before the crisis. Hungary stands out as an exception. In 2012, the Hungarian government announced the first round of regulated energy price cuts (affecting district heating, electricity and gas prices), followed by another round in 2014. In the light of the large weight on these items in the CPI, inflation expectations fell considerably. In the Czech Republic, both labour market flexibility and product market regulations are perceived to have gained importance.

Institutional drivers of inflation expectations¹

Table 7

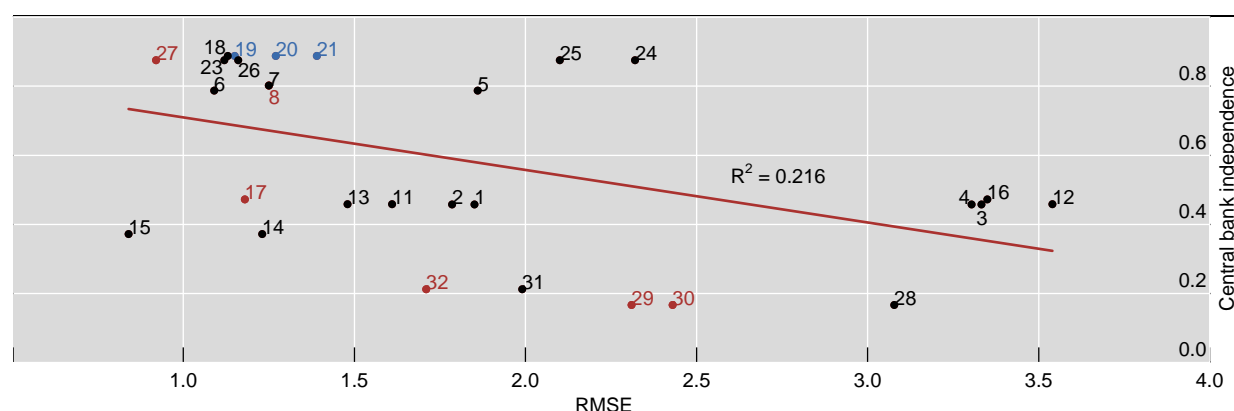
	Central bank independence/ inflation targeting	Labour market flexibility	Trade/ financial liberalisation	Product market regulations
Brazil	1			
Chile	1	2		
Colombia	1	2 ²	4	3
Czech Republic	1	2		3
Hungary	1			2 ³
Indonesia	1			2
Mexico	1	4	3	2
Peru	1			
Philippines	1		2	
Poland	1			
Saudi Arabia			2	1
South Africa	1	2	3	4
Turkey	1	2		3
United Arab Emirates		1		

¹ The numbers indicate a ranking given by central banks of the importance of different institutional factors in driving inflation expectations, where 1 signifies the most important variable. ² Indexation of contracts. ³ Regulated energy price cuts.

Source: BIS questionnaire.

Inaccuracy of inflation forecasts and central bank independence¹

Graph 1



¹ Given the small number of observations and the presence of outliers for some measures, surveys where the RMSE differs from the average RMSE by more than one standard deviation are not displayed in the graph. Based on this rule, the surveys with the three largest RMSE (numbered (9), (10) and (22) in Table 1) are excluded. For included surveys, the labels correspond with the survey numbers listed in Table 1.

Sources: Cukierman et al (1992); Crowe and Meade (2007); BIS questionnaire; authors' calculations.

Finally, our survey points to no large discrete shifts in inflation expectations over the past 10 years in most countries. Since inflation targeting generally pre-dates this window, this may not be surprising. However, where central banks do identify a structural shift, they highlight the role of financial crises (in particular, the financial

turmoil of 2008–09) (Czech Republic, Hong Kong SAR, Hungary, India, Israel, Korea, South Africa and the United Arab Emirates) or currency crises (South Africa (2008) and Russia (2014–15)). In the Czech Republic, the European sovereign debt crisis and the decision of the Czech National Bank to start using the exchange rate as an additional monetary policy instrument also had a significant effect on inflation expectations, mainly at shorter horizons. And in the United Arab Emirates, the slowdown of the property sector and the slump in property rents (which account for almost one third of the CPI basket) caused a downward shift in inflation expectations. Other central banks emphasise international price pressures (Chile), fiscal consolidation involving indirect tax increases (Hungary, 2009–12), regulated energy prices (Hungary, 2013–14), supply shocks impacting food and/or energy prices (Colombia, Indonesia, Israel and Saudi Arabia) and VAT reforms (the Philippines). Yet, the effect is generally reported as temporary to the extent that long-term inflation expectations are anchored to an inflation target.

Assessing the anchoring of inflation expectations

With the exception of India and the fixed exchange rate regimes in our sample, central banks use measures of inflation expectations to assess central bank credibility and/or the anchoring of expectations. Further, nearly all central banks use inflation forecasts from professional forecasters as one measure. Here, we report some recent research results on central bank credibility based on these forecasts.

Where a central bank has a numerical inflation target, one way to assess credibility is to measure how strongly inflation expectations are anchored to the target, regardless of what happens to inflation in the short term.¹⁰ As the note from Hungary highlights, anchored expectations contribute to monetary policy effectiveness. One simple assessment of the degree of credibility is to test if long-horizon forecasts agree with the inflation target. However, most professional forecasts are available at horizons that are too short to apply this test: such forecasts also reflect shocks that drive inflation away from target, as central banks have limited ability to control inflation at short horizons.

Mehrotra and Yetman (2014) propose a method to deal with this challenge. They model inflation forecasts as a weighted sum of a long-run anchor and the latest available inflation rate at the time that forecasts are made, with the weight on the long-run anchor assumed to decline monotonically with the forecast horizon. Their methodology produces (i) an estimate of the long-run anchor and (ii) an estimate of how sensitive expectations are to this anchor. They argue that this model fits the data well and makes efficient use of the multiple horizons over which professional forecasts are generally available. Here we report some updated results based on their methodology, using median inflation forecasts from Consensus Economics at forecast horizons of up to 24 months.

The values of the estimated inflation anchors generally indicate a high degree of credibility. Graph 2 displays these estimates based on CPI inflation over the 2010–14 period, together with 95% confidence bands and the average inflation target (level or band, where applicable), for a wide selection of EMEs.¹¹ For China and Hungary, the

¹⁰ See the related discussion in the note from Indonesia.

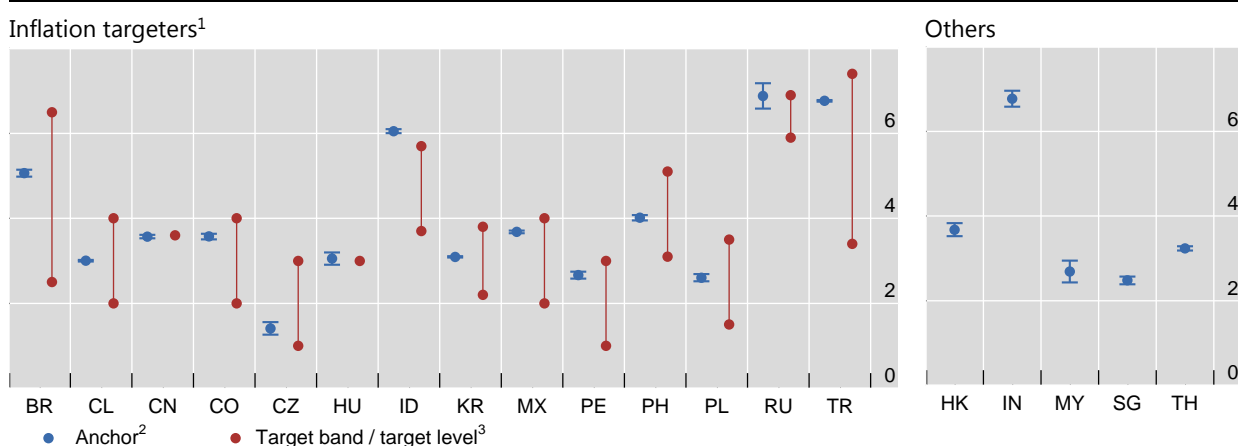
¹¹ Argentina and Venezuela are missing from the sample as we could not identify an anchor for this sample period because of the very high inflation volatility.

point inflation target is within the 95% confidence band of the estimated anchor. For most other inflation targeting countries, with a band rather than a point target, the estimated anchor is within the band, and very close to its centre in the cases of Chile, Korea, the Philippines and Poland. This possibly reflects a relatively longer period since the adoption of the inflation targeting regime in these countries when compared with other economies. Only in the case of Indonesia does the estimated anchor lie (barely) outside the target band. Interestingly, although the level of the estimated inflation anchors for the non-inflation targeters looks similar to those of the inflation targeters, the confidence bands, while quite tight, are generally larger. Applying the same methodology to rolling samples, the estimated anchors have been trending down for most EMEs over recent years (see Graph A1 in the appendix for detailed graphical evidence).

Estimated inflation anchors and inflation targets

In per cent

Graph 2



BR = Brazil; CL = Chile; CN = China; CO = Colombia; CZ = Czech Republic; HK = Hong Kong SAR; HU = Hungary; ID = Indonesia; IN = India; KR = Korea; MY = Malaysia; MX = Mexico; PE = Peru; PH = the Philippines; PL = Poland; RU = Russia; SG = Singapore; TH = Thailand; TR = Turkey.

¹ Based on policy framework over the 2010–14 period. ² Estimated inflation anchor based on methodology in Mehrotra and Yetman (2014). Vertical bars indicate 95% confidence bands. ³ Average over the 2010–14 period.

Sources: Consensus Economics; national data; authors' calculations.

This approach also generates estimates of how strongly expectations are anchored, as measured by the weight (between 0 and 1) that forecasts place on the anchor. The weight has increased over time for most economies, but especially at longer horizons for those with inflation targets. For example, focusing on the sample of inflation targeters displayed in Graph 2 above, in rolling samples the average estimated weight on the target at the 24-month horizon (that is, forecasts made in January for the following calendar year¹²) has increased from 0.71 for 2000–04 to 0.92 for 2010–14. By contrast, for non-inflation targeters, while higher at the beginning of the sample, the weight increased by less, from 0.79 to 0.85. At shorter horizons, the improvement was similar in the two groups.

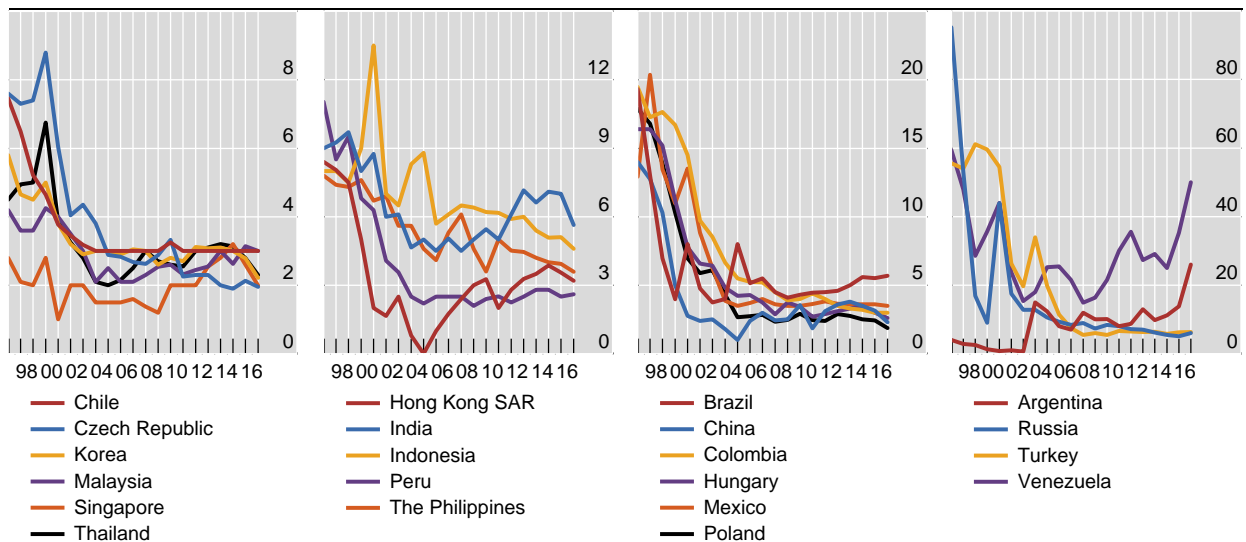
¹² With the exception of India, where the forecasts are based on a year ending in March.

One limitation of this analysis is that any change in the degree of anchoring may take time to influence the estimates, as these are derived from rolling samples. There is an ever-present risk that expectations could become unanchored, as discussed in the note from Columbia. To gain a better sense of such a risk, Graph 3 displays median forecasts at the 24-month horizon (or 23 where 24 is unavailable) from Consensus Economics. This is near the horizon at which inflation expectations should primarily reflect the central bank's perceived policy objective, rather than the anticipated propagation of shocks. With the exceptions of Argentina and Venezuela, recent movements in these forecasts have been limited. And in Turkey and Russia two-year-ahead inflation forecasts go from being highly volatile to stable, despite recent economic and political developments.

Two-year-ahead inflation forecasts¹

In per cent

Graph 3



¹ For all economies except India, forecasts made in January for the following calendar year (ie January 2015 for 2016); where January forecasts unavailable, February forecasts are used instead. For India, forecasts made in April for the following 12-month period ending in March (ie April 2015 for the April 2016–March 2017 period). Horizontal axis refers to the year being forecast; for India, March years (ie 2016 refers to April 2016–March 2017). Median forecast where individual forecasts available; otherwise mean.

Sources: Consensus Economics; national data.

Appendix

Central bank surveys on inflation expectations

Table A1

Economy	Survey name	Inflation measure	Frequency	Population and number of respondents	Primary use
Brazil	Market Expectations System (IPCA)	CPI	Daily	120 professional forecasters	Setting policy, monitoring credibility, checking anchoring of expectations, gauging information about confidence
Brazil	Market Expectations System (INPC)	CPI	Daily	120 professional forecasters	Setting policy, monitoring credibility, checking anchoring of expectations, gauging information about confidence
Brazil	Market Expectations System (IGP-DI)	General Price Index	Daily	120 professional forecasters	Setting policy, monitoring credibility, checking anchoring of expectations, gauging information about confidence
Brazil	Market Expectations System (IGP-M)	General Price Index	Daily	120 professional forecasters	Setting policy, monitoring credibility, checking anchoring of expectations, gauging information about confidence
Chile	Economic Expectation Survey (EEE)	CPI	Monthly	60 professional forecasters	Checking anchoring of expectations
Chile	Survey of financial operators (EOF)	CPI	Twice per month	62 financial corporations	Checking anchoring of expectations
Chile	Index of Economy Perception (IPEC)	CPI	Monthly	1,100 households	Gauging information about confidence
China	Rural household depositors survey	CPI	Quarterly	20,000 households	Setting policy, monitoring credibility, checking anchoring of expectations, gauging information about confidence, condition analysis and policy reference
China	Purchasing Manager's Index	PPI	Monthly	3,000 non-financial corporations	Setting policy, monitoring credibility, checking anchoring of expectations, gauging information about confidence, condition analysis and policy reference
Colombia	National Quarterly (NQ)	CPI	Quarterly	70 non-financial corporations, nine financial corporations and three unions	Setting policy, monitoring credibility and checking anchoring of expectations
Colombia	Financial Analysts (FA)	CPI, CPI Core (without food)	Monthly	40 professional forecasters	Setting policy, monitoring credibility and checking anchoring of expectations
Colombia	Sectoral Quarterly (SQ)	CPI	Quarterly	137 non-financial corporations, 30 financial corporations and 8 unions	Setting policy, monitoring credibility and checking anchoring of expectations

Central bank surveys on inflation expectations

Table A1 (cont)

Economy	Survey name	Inflation measure	Frequency	Population and number of respondents	Primary use
Czech Republic	Financial market inflation expectations	CPI	Monthly	15–20 professional forecasters	Monitoring credibility, checking anchoring of expectations and gauging information about confidence
Czech Republic	Statistical Survey of the CNB and Confederation of Industry of the CR in Non-financial Companies	CPI, PPI, wages	Quarterly	150–200 non-financial corporations	Monitoring credibility, checking anchoring of expectations and gauging information about confidence
Czech Republic	European Commission Business and Consumer Survey	CPI	Monthly	1,000 households	Monitoring credibility, checking anchoring of expectations and gauging information about confidence
Hong Kong SAR	The Hong Kong Monetary Authority does not conduct any surveys on inflation expectations				
Hungary	Quantitative survey of households and corporations by Táarki-MNB	CPI	Quarterly	1,000–1,200 households and 350 non-financial corporations	Monitoring credibility and checking anchoring of expectations
Hungary	Qualitative survey for households' inflation by European Commission	CPI	Monthly	1,000 households	Setting policy and checking anchoring of expectations
Hungary	Expectations Reuters: market analysts' expectations	CPI	Monthly	42 professional forecasters	Monitoring credibility
Hungary	Consensus Economics: market analysts' expectations	CPI	Monthly	200 professional forecasters	Monitoring credibility
Hungary	Expected retail sales prices	CPI	Monthly	Min 600–700 non-financial corporations	Guideline for inflation processes
India	Survey of Professional Forecasters	CPI and WPI	Bi-monthly	Around 30 professional forecasters	Policy input
India	Inflation Expectations Survey of Households	Respondents' own consumption basket	Quarterly ¹	5,000 households	Policy input
India	Industrial Outlook Survey	Qualitative response on cost of raw material, selling price	Quarterly	1,200–1,300 (out of panel of 2,500) non-financial corporations	Policy input
Indonesia	Consumer Survey	CPI	Monthly	4,600 households	Gauging information about confidence

Central bank surveys on inflation expectations

Table A1 (cont)

Economy	Survey name	Inflation measure	Frequency	Population and number of respondents	Primary use
Indonesia	Retail Sales Survey	CPI	Monthly	700 retailers	Gauging information about confidence
Indonesia	Business Survey	CPI	Quarterly	Approximately 3,000 financial and non-financial corporations	Checking anchoring of expectations and gauging information about confidence
Indonesia	Macroeconomic Indicators Forecasting Survey	CPI	Quarterly	25–35 professional forecasters	Checking anchoring of expectations and gauging information about confidence
Indonesia	Consensus Forecasts	CPI	Monthly	Approximately 25 professional forecasters	Checking anchoring of expectations and gauging information about confidence
Israel	Professional forecasters	CPI	Monthly ²	About 15 professional forecasters	Checking anchoring of expectations
Israel	Consumer survey	CPI. Survey conducted by the CBS.	Monthly	About 9,000 households	Not currently in use due to short history
Israel	Business tendency survey	CPI. Survey conducted by the CBS.	Monthly	N/A	Not currently in use due to short history
Korea	Consumer survey index(BOK)	Household's expected inflation for CPI(1 year)	Monthly	2,200 households	Setting policy, monitoring credibility, checking anchoring of expectations and gauging information about confidence
Korea	Consensus Economics survey	Financial corporations' expected inflation for CPI(1 year)	Monthly	15 financial corporations + four research institutes	Setting policy, monitoring credibility, checking anchoring of expectations and gauging information about confidence
Korea	Consensus Economics survey	Financial corporations' expected inflation for CPI(5 year)	Other ³	15 financial corporations + four research institutes	Setting policy, monitoring credibility, checking anchoring of expectations and gauging information about confidence
Korea	Consensus Economics survey	Financial corporations' expected inflation for CPI(10 year)	Other ⁴	15 financial corporations + four research institutes	Setting policy, monitoring credibility, checking anchoring of expectations and gauging information about confidence

¹ Additional two bimonthly on pilot basis are being tried for internal use.

² Forecasters send data at least once a month.

³ Semiannual from April 1995 to October 2013 and quarterly from April 2014 onwards.

⁴ Semiannual from April 1995 to October 2013 and quarterly from April 2014 onwards.

Central bank surveys on inflation expectations

Table A1 (cont)

Economy	Survey name	Inflation measure	Frequency	Population and number of respondents	Primary use
Malaysia	BNM Consumer Sentiment Survey ⁵	General prices and prices of selected categories, one-year-ahead	Monthly	1,000 households	Monitoring credibility, checking anchoring of expectations, gauging information about confidence and assessing growth and inflation outlook
Malaysia	BNM Quarterly Survey of Firms ⁶	One-quarter-ahead CPI, average operating cost and selling prices	Quarterly and annual	Approximately 130 non-financial corporations	Monitoring credibility, checking anchoring of expectations, gauging information about confidence and assessing growth and inflation outlook
Malaysia	BNM Consumer Sentiment Survey ⁷	General prices and prices of selected categories, one-year-ahead	Monthly	1,000 households	Monitoring credibility, checking anchoring of expectations, gauging information about confidence and assessing growth and inflation outlook
Malaysia	BNM Quarterly Survey of Firms ⁸	One-quarter-ahead CPI, average operating cost and selling prices	Quarterly and annual	Approximately 130 non-financial corporations	Monitoring credibility, checking anchoring of expectations, gauging information about confidence and assessing growth and inflation outlook
Malaysia	Analysts' Consensus forecast ⁹	One-year-ahead CPI	Monthly	Approximately 30 professional forecasters	Monitoring credibility, checking anchoring of expectations, gauging information about confidence and assessing growth and inflation outlook
Mexico	Bank of Mexico's survey	CPI, core CPI, short and long terms	Monthly	Professional forecasters, non-financial corporations and financial corporations	Monitoring credibility, checking anchoring of expectations and gauging information about confidence
Mexico	Banamex's survey	CPI, core CPI, short and long terms	Biweekly	Financial corporations	Monitoring credibility, checking anchoring of expectations and gauging information about confidence

⁵ Survey conducted since 2013 and the data is not published.

⁶ Survey covers firms in the manufacturing, construction and services sector and also includes firms' expectation of their performance and outlook.

⁷ Survey conducted since 2013 and the data is not published.

⁸ Survey covers firms in the manufacturing, construction and services sector and also includes firms' expectation of their performance and outlook.

⁹ Published by Consensus Economics Inc.

Central bank surveys on inflation expectations

Table A1 (cont)

Economy	Survey name	Inflation measure	Frequency	Population and number of respondents	Primary use
Poland	NBP Quick Monitoring, enterprises	CPI, prices of final products and services, prices of materials and raw products used for production	Quarterly	More than 1,500 non-financial corporations	Checking anchoring of expectations and testing formation
Poland	NBP SPF, professional forecasters	CPI	Quarterly	Approximately 20 professional forecasters (avg)	Monitoring credibility, checking anchoring of expectations, gauging information about confidence and testing formation
Russia	Public Opinion Foundation	CPI	Monthly	2,000 households	Setting policy, monitoring credibility, checking anchoring of expectations and gauging information about confidence
Russia	Russian economic barometer	PPI	Monthly	200 non-financial corporations	Setting policy, monitoring credibility, checking anchoring of expectations and gauging information about confidence
Russia	Bloomberg consensus	CPI	Monthly	More than 20 professional forecasters	Setting policy, monitoring credibility, checking anchoring of expectations and gauging information about confidence
Russia	Reuters consensus	CPI	Monthly	More than 20 professional forecasters	Setting policy, monitoring credibility, checking anchoring of expectations and gauging information about confidence
Russia	Interfax consensus	CPI	Monthly	More than 20 professional forecasters	Setting policy, monitoring credibility, checking anchoring of expectations and gauging information about confidence
Russia	Manufacturing, Services PMI	PPI, CPI	Monthly	N/A	Setting policy, monitoring credibility, checking anchoring of expectations and gauging information about confidence
Saudi Arabia	The Saudi Arabian Monetary Agency does not conduct any surveys on inflation expectations				
Singapore	Singapore Index of Inflation Expectations (SInDEX)	CPI (All Items and Core)	Quarterly	400 randomly selected individuals from Singapore households	Checking anchoring of expectations and gauging information about confidence
Singapore	MAS Survey of Professional Forecasters	CPI	Quarterly	About 20–30 respondents from the financial sector	Checking anchoring of expectations and gauging information about confidence
Singapore	Asia Pacific Consensus Forecasts	CPI	Monthly	17 analysts, as of October 2015	Checking anchoring of expectations and gauging information about confidence

Central bank surveys on inflation expectations

Table A1 (cont)

Economy	Survey name	Inflation measure	Frequency	Population and number of respondents	Primary use
South Africa	Bureau for Economic Research	CPI	Quarterly	30 professional forecasters, 3,000 households, 1,500 non-financial corporations and 15 trade unions	Setting policy, monitoring credibility, checking anchoring of expectations and gauging information about confidence
South Africa	Reuters consensus	CPI, PPI	Monthly	30 professional forecasters	Setting policy, monitoring credibility, checking anchoring of expectations and gauging information about confidence
Thailand	Asia Pacific Consensus Forecast	CPI (two to eight quarters ahead)	Quarterly	15–20 professional forecasters	Gauging information about confidence and gauging short-term inflationary pressure
Thailand	Asia Pacific Consensus Forecast	CPI (five to 10 years ahead)	Semi-annual	15–20 professional forecasters	Setting policy, monitoring credibility, checking anchoring of expectations and gauging information about confidence
Turkey	Survey of Expectations	CPI	Monthly	110 professional forecasters from financial and real sectors	Setting policy, monitoring credibility, checking anchoring of expectations and gauging information about confidence
Turkey	Business Tendency Survey	CPI, PPI	Monthly	2,659 senior managers of the manufacturing industry	Gauging information about confidence
Turkey	Consumer Tendency Survey	CPI	Monthly	4,848 households	Gauging information about confidence
United Arab Emirates	The Central Bank of the United Arab Emirates does not conduct any surveys on inflation expectations				

Market-based measures of inflation expectations used by central banks¹

Table A2

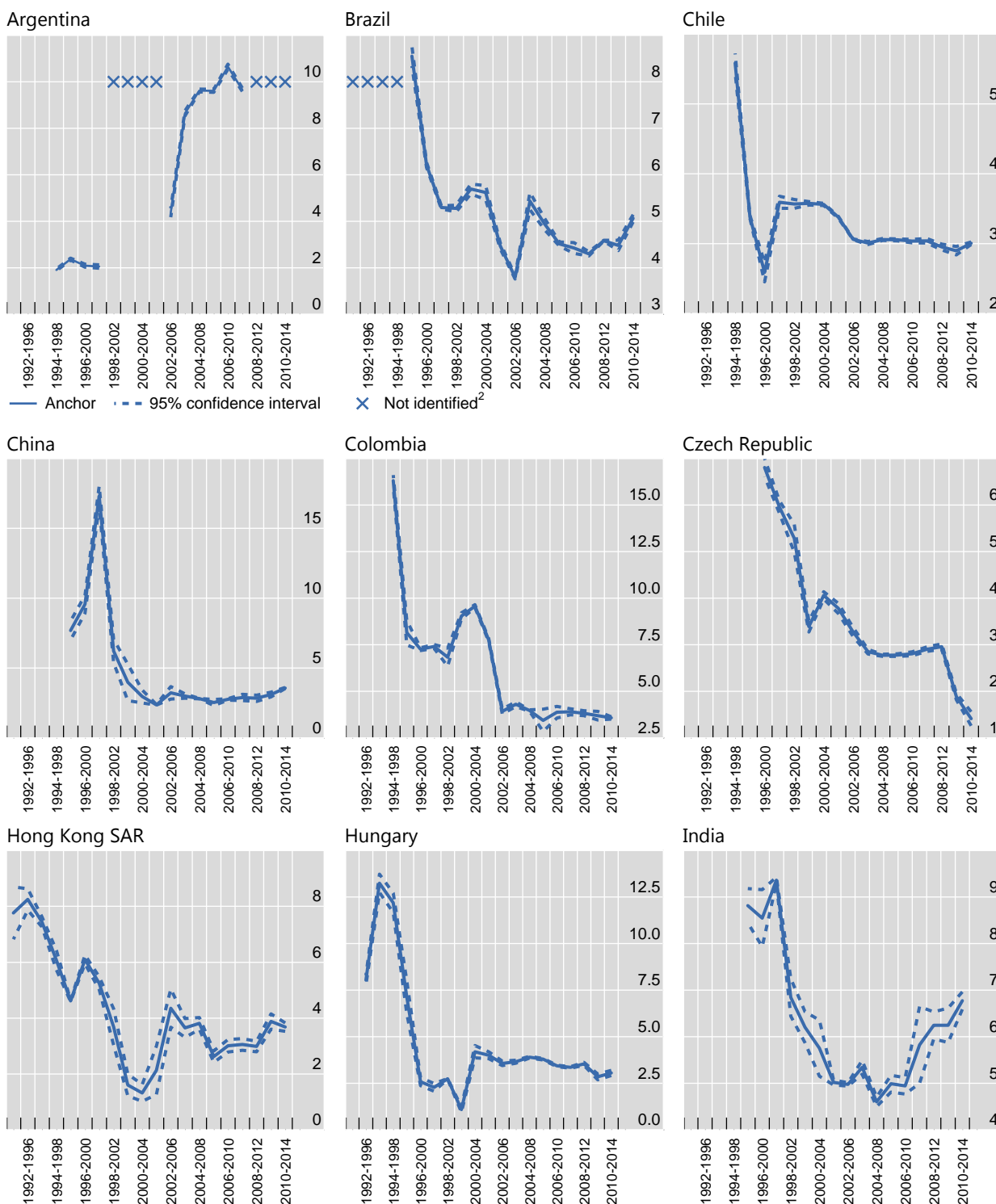
Economy	Measure
Brazil	Inflation-indexed government bonds
Chile	Inflation-indexed government bonds issued by the central bank; Insurance against inflation
China	None
Colombia	Inflation-indexed government bonds (break-even inflation and forward break-even inflation)
Czech Republic	None (no inflation-indexed instruments on the Czech financial market)
Hong Kong SAR	There are inflation-indexed government bonds (iBonds). However, data limitation makes it difficult to infer inflation expectations using these bonds
Hungary	None
Indonesia	None
Israel	Inflation-indexed government bonds; Commercial banks' internal interest rates-difference between non-indexed and indexed interest rates
Korea	Inflation-indexed government bonds (break-even inflation)
Malaysia	None
Mexico	Inflation-indexed government bonds
Peru	Inflation-indexed government bonds
Philippines	Yield curve for government securities in the secondary market
Poland	Inflation-indexed government bonds
Russia	Inflation-indexed government bonds (OFZ-IN № 52001, with par value indexed to inflation)
Saudi Arabia	None
Singapore	None
South Africa	Inflation-indexed government bonds
Thailand	Inflation-indexed government bonds; Inflation expectations extracted from yield curve (for assessing central bank credibility and monitoring anchoring of expectations)
Turkey	Inflation-indexed government bonds (no publicly available data are published)
United Arab Emirates	None

¹ A dot indicates missing data.

Estimated inflation anchors and confidence bands¹

In per cent

Graph A1



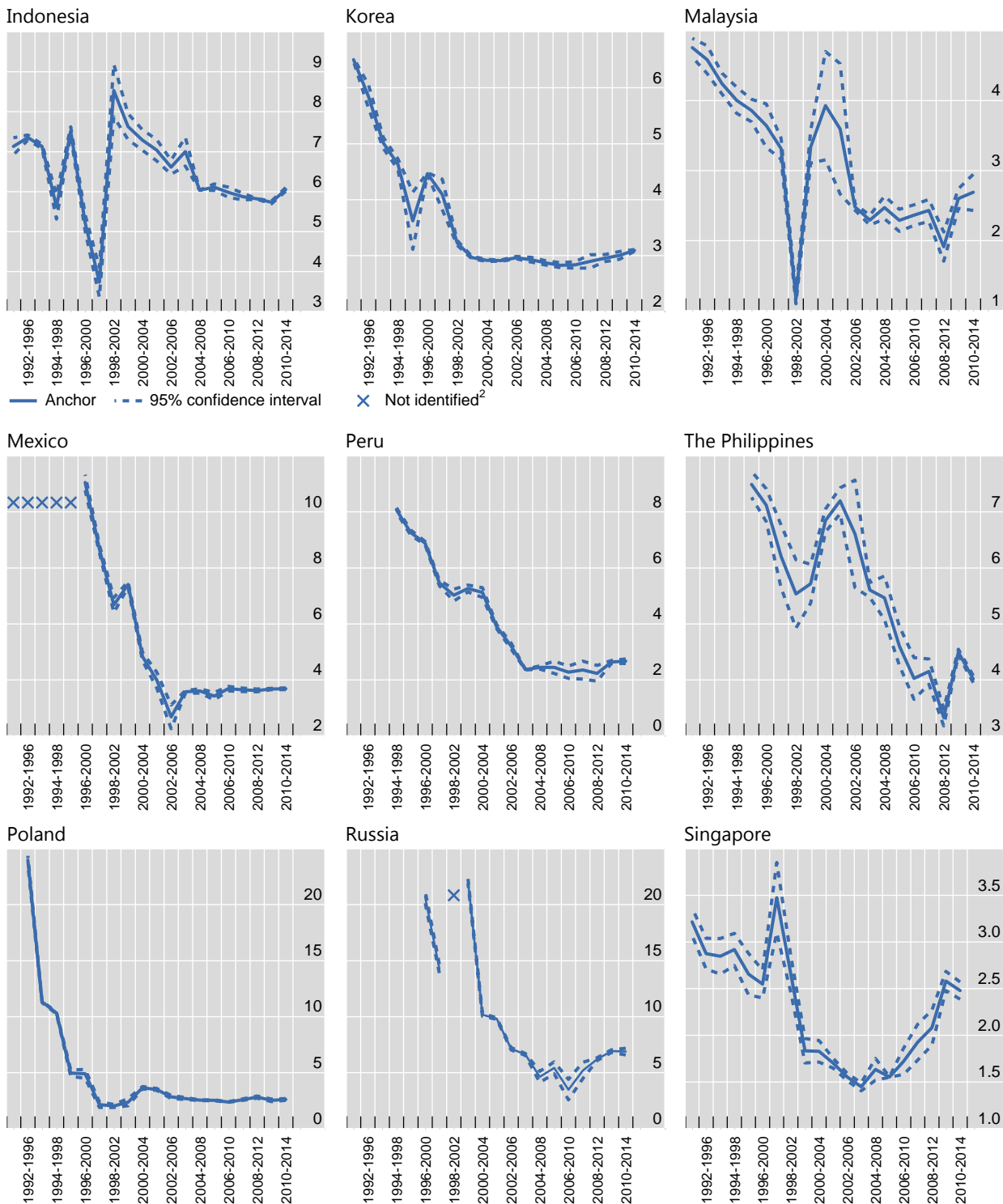
¹ Based on five-year rolling samples, using the methodology in Mehrotra and Yetman (2014). All economies except India: dates refer to calendar years; for India, March years (ie.. 2015 refers to the April 2015–March 2016 period). ² "Not identified" indicates that the estimates imply little or no weight on an anchor; instead, a model where forecasts only reflect recent inflation fits the data best.

Sources: Consensus Economics; authors' calculations.

Estimated inflation anchors and confidence bands¹

In per cent

Graph A1 (cont)



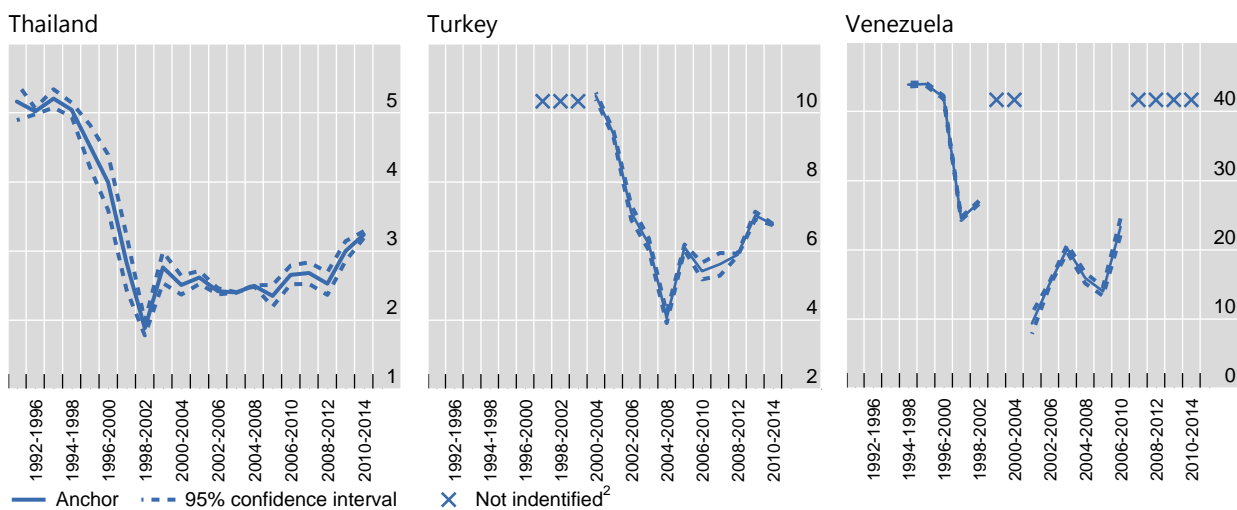
¹ Based on five-year rolling samples, using the methodology in Mehrotra and Yetman (2014). All economies except India: dates refer to calendar years; for India, March years (ie 2015 refers to the April 2015–March 2016 period). ² “Not identified” indicates that the estimates imply little or no weight on an anchor; instead, a model where forecasts only reflect recent inflation fits the data best.

Sources: Consensus Economics; authors’ calculations.

Estimated inflation anchors and confidence bands¹

In per cent

Graph A1 (cont)



¹ Based on five-year rolling samples, using the methodology in Mehrotra and Yetman (2014). All economies except India: dates refer to calendar years; for India, March years (ie 2015 refers to the April 2015–March 2016 period). ² “Not identified” indicates that the estimates imply little or no weight on an anchor; instead, a model where forecasts only reflect recent inflation fits the data best.

Sources: Consensus Economics; authors’ calculations.

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