Forecast disagreement and the anchoring of inflation expectations in the Asia-Pacific Region

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Abstract

This paper explores the behaviour of inflation forecasts from a variety of sources (ie Consensus and other professional forecasters, international and domestic financial institutions, central banks) with the aim of measuring the size and evolution of forecast disagreements and their proximate sources (ie economic versus institutional determinants). An additional objective is to ascertain the extent to which inflationary expectations are anchored, the role played by domestic versus international shocks on changes in inflation forecasts, and whether developments since the global financial crisis have resulted in noticeable changes in the behaviour of inflationary expectations.

Keywords: Forecast disagreement, inflation expectations

JEL classification: E52, E58, C53

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Introduction

Central banks in the Asia-Pacific region are concerned that rising inflation might be an unintended consequence of attempts by some of the major central banks around the world, notably the US Federal Reserve and the ECB, to maintain historically low policy rates while permitting their balance sheets to swell to unheard of proportions.[2] The worry, of course, is that the build-up of liquidity by the major central banks will eventually spill over into the world economy, once normal levels of real economic growth resume, with an eventual run-up in inflation. Promises by central bankers to reign in the excess liquidity once crisis conditions are passed have not prevented some from worrying about the blurring of fiscal and monetary policies and about the temptation to resort to inflation as a way out of the current economic crisis. As Charles Plosser, President of the Federal Reserve Bank of Philadelphia, recently remarked: "…unless governments are constrained..., they often resort to the printing press...this can often lead to high inflation" (Plosser (2012)).

Even if these worries appear misplaced for the time being, there may be unpredictable consequences as central banks increasingly replace the private sector as a source of credit. As the BIS's General Manager has recently pointed out "These emergency measures could have undesirable side effects if continued for too long. A worry is that monetary policy would be pressured to do still more because not enough action has been taken in other areas. While central bank actions can buy time, they cannot substitute for balance sheet repair or reforms to raise productivity and growth" (Caruana 2012).[3]

Central banks around the world understandably take pride in their record at maintaining low and stable inflation over the past decade or so. Indeed, the independence and accountability of central banks may well have helped prevent a worse economic outcome in the wake of the so-called global financial crisis which began in 2007, which has since shifted from the United States to the euro zone. Even if it is now widely acknowledged that price stability is no longer enough, the challenge remains of maintaining low and stable inflation while the private sector and sovereigns in some parts of the world repair their balance sheets.

Therefore, it is essential for central banks in the region to ascertain how households and professionals, to name just two groups, view the short-term outlook for inflation. In this paper I suggest that policymakers need to move away from reliance on point forecasts of inflation and examine why forecasters disagree. This requires thinking in terms of the degree of forecast disagreement and its evolution over time.[4] In addition, and especially in the Asia-Pacific region, there needs to be more data collected from households and businesses concerning their views about future inflation. It is only by considering the distribution of views about the outlook for inflation that policymakers in the region will be able to determine the conditions under which inflation expectations may become unanchored.

The rest of the paper is organised as follows. After a brief overview of the concept of forecast disagreement in the next section, I then describe the data and provide a few stylised facts

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[2] The phenomenon of the "exploding" central bank balance sheet is now well known. A visualisation of this phenomenon for the United States is regularly updated by the Federal Reserve Bank of Cleveland (http://www.clevelandfed.org/research/data/credit_easing/index.cfm).

[3] Academics have also suggested that the usual textbook device for inflating the economy may be counterproductive. "…there is a good case to be made for monetary expansion, given the current low rate of inflation and high rate of unemployment. But if fear of inflation puts off the American public, such a policy will again underperform, relative to what we have learned in textbooks. There won't be a credible commitment to see the monetary stimulus through, as people panic that resulting inflation will be used to redistribute wealth." (Cowen (2012))

[4] While the focus, in what follows, is on inflation, all of the arguments made here extend to the outlook of other major macroeconomic variables such as real GDP growth.

prior to discussing the behaviour of forecast disagreement in the Asia-Pacific. The paper concludes with a short summary and some suggestions for further research.

Methodology and related literature

When examining the inflation outlook it is common to rely on point forecasts, ordinarily prepared by professionals such as the well known forecasts published by Consensus Economics. However, it has also been known for some time that such an approach is problematic for a variety of reasons. Kahneman and Tversky (1979, p 316) forcefully argued that "…..disregard of distributional information ...is perhaps the major source of error in forecasting..." Forecasters "...should therefore make every effort to frame the forecasting problem so as to facilitate utilizing all of the distributional information that is available". This notion was also understood by central bankers. For example, Greenspan (2004) noted that "…a central bank needs to consider the distribution of possible outcomes...decision-makers need to reach a judgment about the probabilities...of the various outcomes under alternative choices for policy". Further reinforcing the argument that forecasts from a single source are inadequate is the finding that econometric models used to generate inflation forecasts are unstable (Stock and Watson (2010)), that the behaviour of inflation is asymmetric thereby complicating the ability of conventional models to successfully predict inflation over the business cycle (eg Filardo and Gordon (1998), Dotsey, Fujita, and Stark (2011)), as well as the growing body of evidence suggesting that "subjective"' forecasts (eg Survey of Professional Forecasters, Blue Chip) outperform forecasts from econometric models, often by a wide margin (Faust and Wright (2011)). Consequently, it would appear desirable to measure the degree to which forecasters disagree or consider a metric that provides clues about how forecasts are distributed across forecasters. While several approaches along these lines have been developed the focus below is on the concept of forecast disagreement.

There is no universally agreed upon measure of forecast disagreement. A popular indicator is the squared deviations among individual forecasts (eg Lahiri and Sheng (2008)). Alternatively, one can ask whether the distribution of views about future inflation may have shifted over time. Filardo and Guinigundo (2008) apply the so-called Kulback-Liebler (K-L) divergence metric to examine how professional forecasters' views about future inflation in the Asia-Pacific region have moved as inflation targeting was adopted by some countries in the region. Each existing measure has advantages and disadvantages but space constraints prevent a fuller discussion here. Readers are asked to consult Siklos (2012), and references therein, for additional details. In what follows, forecast disagreement in 12 Asia-Pacific economies is examined based on the (modified) squared deviation measure.[5]

Briefly, forecast disagreement at time *t*, over a forecast of horizon *h*, for economy *j* is evaluated as follows. Define,

$$d_{th}^{j} = \frac{1}{N_j - 1}\sum_{i=1}^{N_j}(F_{ith}^{j} - \overline{F}_{\bullet th}^{j})^2 \tag{1}$$

where F is the inflation forecast, N_j is the number of forecasts, i identifies the forecast, while $\overline{F}^{j}$ represents the mean forecast value across forecasters in economy j. Forecast disagreement can be aggregated according to the source of the forecast. Central bank forecasts, survey-based forecasts conducted among households and businesses, a set of

[5] Measures based on the K-L metric are relegated to an Appendix.

widely followed or core forecasts (ie OECD, IMF, Consensus), as well as a group consisting of all non-survey-based forecasts, represent the principal group of forecasters. The mean value of *d* is then calculated for each economy *j* in the dataset. Grouping of forecasts can be useful. For example, some of the data used in this study are projections, others are actual forecasts. Moreover, the assumptions and models (whether of the implicit or explicit variety) used to generate inflation forecasts are also likely to differ across the available sources. Space constraints prevent additional discussion of relevant technical issues. Readers are asked to consult Siklos (2012) for all the details.

Prior to discussing the results, it is worth asking briefly: is greater forecast disagreement desirable? Unfortunately, there is no consensus about the answer to this question. To the extent that greater forecast disagreement is due to a loss of credibility, or poor central bank communication, the answer is no. If, on the other hand, more central bank transparency encourages attentiveness to monetary policy decisions and fosters a greater diversity of opinion about the economic outlook, then higher levels of forecast disagreement can be desirable.[6]

Stylised facts and empirical results[7]

The evidence presented below consists of data from 12 Asia-Pacific economies. They are: Australia, China, Hong Kong SAR, India, Indonesia, Japan, Korea, Malaysia, New Zealand, the Philippines, Singapore and Thailand. The economies in this region examined here are a diverse group in terms of the monetary policy regimes in place over the past several years. Half of the economies in the sample considered possess a numerical inflation target (IT). They are: Australia, Indonesia, Korea, New Zealand, the Philippines and Thailand. The remaining economies cover the range of policy regimes from Hong Kong SAR's pegged exchange rate to China's managed floating regime. Indeed, at least according to Ilzetzki, Reinhart and Rogoff's (2008) classification of exchange rate regimes, not all of the IT regimes can be said to adhere to the textbook's pure floating variety. Finally, the economies considered here also differ in terms of the degree to which their central banks are transparent. Figure 1 plots the index of central bank transparency due to Dincer and Eichengreen (2008), subsequently updated by Siklos (2011), and the data reveal that a wide range exists in the amount of information the region's central banks publicly disclose. For example, there is still a wide gap between the transparency of the US Federal Reserve (Fed), or the European Central Bank (ECB), and the People's Bank of China (PBOC). Overall, however, transparency has either remained stable or has shown marked improvement over time.

The analysis of inflation forecast disagreement is based on current year and one year ahead inflation forecasts from a variety of sources.[8] These include: Consensus forecasts, survey-based forecasts, and central bank forecasts. The number of forecasters surveyed from Consensus Economics ranges from 11 to 20, while the number of non-Consensus forecasts considered ranges from three to 10 separate forecasts. Included in the non-Consensus forecasts are those published by central banks. Eight of the 12 central banks

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[6] The theoretical debate over the consequences of more publicly available information is germane but remains unsettled. See Morris and Shin (2002), and Svensson (2006).

[7] Space constraints prevent an extensive description of the institutional background of each economy. Accordingly, some details are relegated to an Appendix.

[8] Forecasts are either of the fixed event (ie a forecast for inflation for a particular calendar year) or fixed horizon (eg one quarter or one year ahead) variety. It is common in the literature to convert fixed event data into a fixed horizon using an admittedly *ad hoc* procedure. See Siklos (2012) for the conversion details.

surveyed here publish inflation forecasts. They are: Australia, Japan, Korea, Malaysia, New Zealand, the Philippines, Singapore and Thailand. In most cases, but not all (eg Japan, Thailand), these are staff forecasts. Finally, in the results presented below, the sampling frequency is quarterly, usually from the mid-1990s to Q1 2012.[9]

Figure 2 plots inflation for several groupings of the economies in the sample. The groupings are somewhat arbitrary. Nevertheless, there is an attempt to separate the emerging Asia-Pacific economies (ie India, Indonesia, Malaysia, Philippines, and Thailand) from their more industrialised counterparts in the region (ie, Australia, New Zealand, Hong Kong SAR, Korea, and Singapore). Finally, by way of illustration, one of the figures plots inflation in the large economies in the dataset (ie China and Japan) vis-à-vis the US and the euro area. Generally speaking, inflation has tended to fall worldwide and has remained stable. Moreover, the newly industrialised countries (NICs: ie Hong Kong SAR, Korea, and Singapore), together with their so-called emerging market counterparts, have tended to experience similar inflation rates in recent years. The only exception is India which, more recently, has seen a surge in inflation. Japan continues to be an outlier of sorts, persistently mired in a low-level deflation, while China's inflation rate is persistently higher than that of the United States and the euro zone economies.

An indication of how well inflation expectations are anchored is provided in Table 1 which shows the degree of inflation persistence as estimated by fitting a first-order autoregressive model to realised inflation for two samples. The first column displays the persistence parameter for the full sample, generally from 1990 to early 2012, while the second column estimates the same parameter for a sample that begins in 2001. The latter sample approximates the period when low and stable inflation became the norm in much of the region. The final column asks whether, in a statistical sense, inflation persistence changed significantly over the two samples. The first thing to note about the results is that persistence is high although it has shown signs of falling in the lower and more stable inflation subsample. While the fall in persistence is very much a feature of inflation targeting regimes (eg see Siklos (1999)), the same phenomenon is repeated in most non-IT economies. Nevertheless, only four economies (ie China, Japan, Korea and the Philippines) is the change statistically significant. Since only two of the four economies in question adhere to a numerical inflation target the reduction in inflation persistence is not exclusive to IT-type regimes.

Prior to a discussion of forecast disagreement it is worthwhile briefly examining forecast performance across economies and over time. Table 2 provides some summary statistics about forecast errors as well as highlighting the cases where non-Consensus forecasts over or under-perform the Consensus forecasts. In seven of the 12 economies in the region, non-Consensus forecasts (these also include central bank forecasts) outperform Consensus forecasts, at least based on the mean forecast error metric. Indeed, much the same conclusion is reached even if we examine forecast errors when inflation is rising or falling. As previously noted, the literature finds that forecast performance is highly asymmetric. Finally, if we subdivide the sample according to periods when there are inflation or deflation scares it is found that Consensus forecasters often *under*estimate inflation (ie realised inflation tends to exceed the one year ahead inflation forecast) while virtually all non-Consensus forecasts *over*estimate future inflation. Clearly, forecasters not only disagree substantially according to the group they belong to but also across inflation cycles. Finally, Figure 3 plots the forecasting record for the eight central banks for which we have data. Generally speaking, central bank forecast errors are just as persistent as the other forecasts considered and there seems to be little to distinguish the IT central banks' forecasting record from the performance of the non-IT monetary authorities. It is also interesting to note that the Bank of

[9] This necessitates some conversion of the data. See Siklos (2012) for the relevant issues.

Japan's Monetary Policy Committee's forecasting record reveals a persistent under-estimation of realised inflation. Forecasting inflation may well be different, or more difficult, in a deflationary environment.

The analysis concludes with a discussion of forecast disagreement. Figure 4 gives the estimates of forecast disagreement. The most obvious result is that forecast disagreement rises during times of economic uncertainty or stress, as is plainly evident from an examination of the behaviour of the series during the 2007–10 period. Even if the US-euro area crisis did not immediately affect the Asia-Pacific region there was an impact on forecast disagreement. However, it is also the case that the rise in forecast disagreement is far less noticeable during the latest financial crisis than during the Asian financial crisis of 1997-98, in certain cases such as Hong Kong SAR. Next, it appears that forecast disagreement rises before a particular financial crisis peaks. This implies that measures of forecast disagreement can possibly be useful as a kind of leading indicator of the severity of a crisis on inflationary expectations. Finally, while inflation has been relatively subdued throughout the region, in spite of the global events since 2007, the data for India do capture a sharp and sustained rise in forecast disagreement. Finally, it is equally important is to consider the source of forecasts. If policymakers are worried about the possibility of expectations becoming unanchored then non-Consensus forecasts may well be a good source to look at. For example, notice the differences in forecast disagreement as between Consensus and non-Consensus forecasts for Indonesia, Malaysia and Thailand, shown in Figure 5. If Faust and Wright's (2011) conclusion is correct, and "subjective" type forecasts outperform model-based forecasts (eg as in ones used in central banks), then it is important not only to examine forecast disagreement but, where possible, to disaggregate the data by groups of forecasters.

Conclusions

This paper has examined the performance of one year ahead inflation forecasts in the Asia-Pacific region with a threefold aim. First, to examine the performance of these forecasts over time and determine the extent to which inflation expectations remain anchored. Second, the paper argues that point forecasts will not provide sufficient clues to policymakers about the fragility of markets and the public's belief about the inflation outlook unless these decision-makers consider how much forecast disagreement exists across economic agents. Finally, forecast disagreement can vary considerably according to the group examined. Hence, forecast disagreement between central banks and professional forecasters may well differ from the public's view about the future outlook. As other research has shown (eg Siklos (2012)), the public may respond to a different information set than do professional forecasters. Hence, institutional devices such as inflation targeting and central bank transparency may matter more to some groups than to others.

Table 1

Inflation persistence in the Asia-Pacific region

Economy	Full sample	Post-2001	Are they different?
AU	.81	.66	Yes
CN	.97	.88	Yes
HK	.97	.95	No
ID	.97	.82	No
IN	.88	.93	No
JP	.87	.79	Yes
KR	.88	.72	Yes
MY	.81	.74	No
NZ	.82	.74	No
PH	.87	.72	Yes
SG	.91	.92	No
TH	.85	.76	No

Note: The full sample usually consists of quarterly data from 1995. The last observation is Q1 2012. Estimates shown are based on the following regression: $\pi_t = \beta_0 + \beta_1 \pi_{t-1} + \varepsilon_t$ where β_1 is the estimate of inflation persistence and π_t is (annualised) inflation at time t. No special adjustment was made for the adoption of inflation targeting. As shown in the Appendix, Indonesia, Philippines and Thailand adopted inflation targeting after 2000. Only Australia, Korea, and New Zealand adopted IT before 2000 and IT was in place for the full sample in Australia and New Zealand.

Table 2

Analysis of forecast errors: Consensus versus non-Consensus forecasts

Consensus forecasts

Economy	Rising inflation	OBS	Falling inflation	OBS	Inflation scare	OBS	Deflation scare	OBS	Median
AU	-0.26 (1.48)	40	-0.43 (1.20)	41	0.02 (0.05)	40	0.01 (0.02)	12	-0.28 (1.22)
CN	-0.28 (1.99)	35	-3.00 (2.60)	31	0.14 (0.05)	28	0.12 (0.08)	12	-1.37 (2.67)
HK	-1.00 (1.71)	33	-1.44 (1.92)	32	0.12 (0.07)	28	0.13 (0.21)	12	-1.36 (1.34)
ID	0.22 (2.31)	30	1.69 (6.83)	36	0.24 (0.34)	28	0.38 (5.46)	12	-0.63 (7.62)
IN	-0.35 (2.58)	41	-1.46 (2.11)	35	0.20 (0.10)	28	0.09 (0.07)	12	-0.65 (2.78)
JP	-0.06 (0.68)	33	-0.35 (0.65)	43	0.02 (0.01)	43	0.01 (0.01)	12	-0.22 (0.67)
KR	-0.17 (1.26)	33	-0.36 (1.31)	33	0.05 (0.03)	28	0.02 (0.10)	12	-0.29 (1.30)
MY	-0.62 (1.2)	33	-0.86 (1.27)	32	0.05 (0.03)	28	0.04 (0.04)	12	-0.70 (1.25)
NZ	0.24 (0.80)	32	-0.46 (1.03)	32	0.03 (0.01)	28	0.03 (0.01)	12	-0.02 (0.98)
PH	-0.46 (0.47)	4	-0.93 (0.36)	3	INS		INS		-0.75 (0.58)
SG	-0.39 (1.52)	38	-1.14 (1.51)	27	0.07 (0.07)	28	0.03 (0.02)	12	-0.60 (1.04)
TH	0.06 (1.90)	31	-0.83 (1.83)	35	0.08 (0.04)	28	0.08 (0.18)	12	-0.35 (1.92)

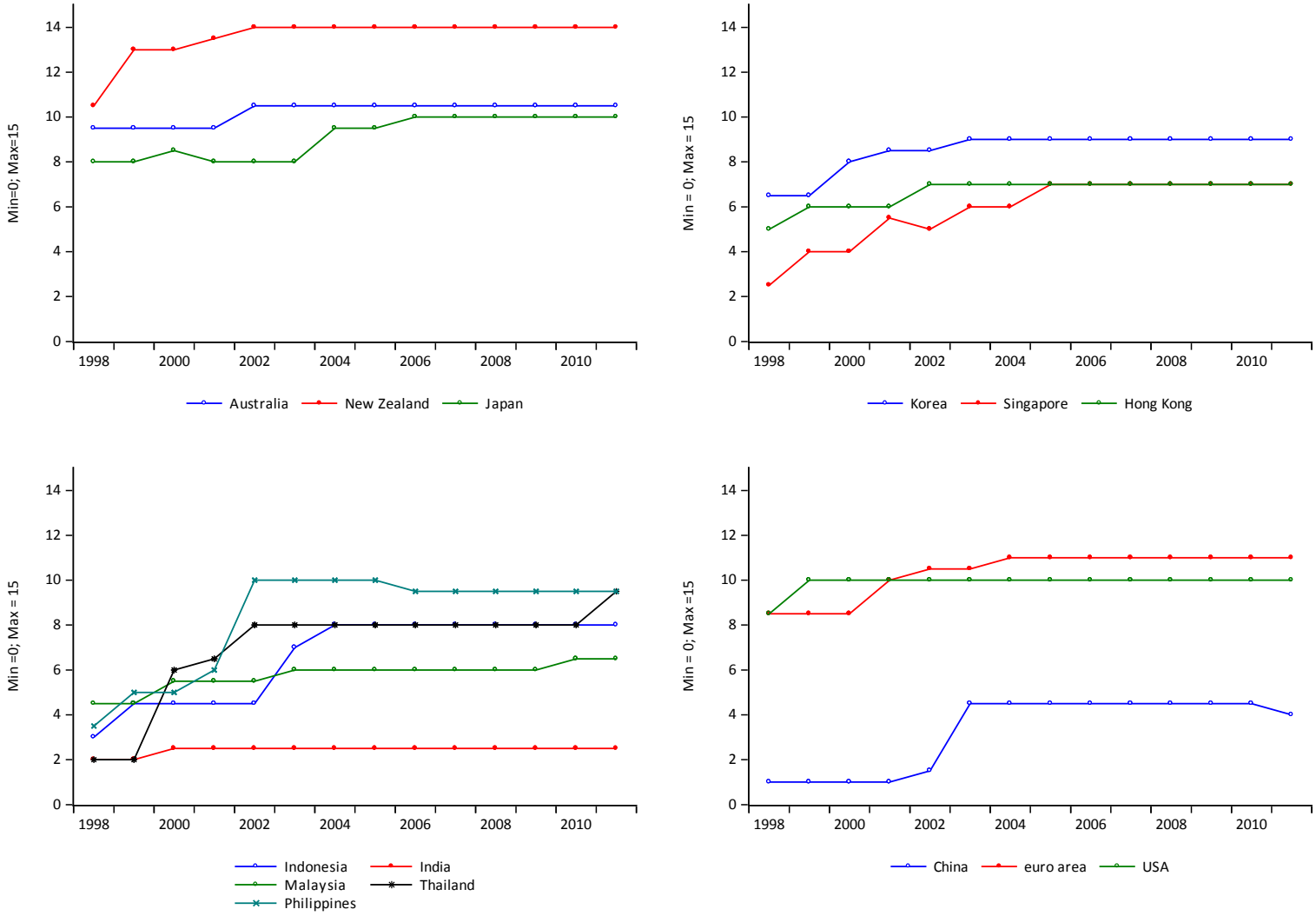
Non-Consensus forecasts

Economy	Rising Inflation	OBS	Falling inflation	OBS	Inflation scare	OBS	Deflation Scare	OBS	Median
AU	-0.04 (1.31)	15	-0.40 (1.09)	30	-0.53 (1.22)	44	-0.15 (1.11)	12	-0.26 (1.16)
CN	0.68 (1.74)	9	-1.97(1.95)	11	-0.18 (2.28)	29	-0.89 (1.75)	12	-0.71 (2.25)
HK	-0.68 (2.25)	9	-0.82 (2.50)	20	-0.81 (1.47)	29	-1.44 (2.28)	12	-0.72 (2.41)
ID	-0.46 (3.66)	7	-1.99 (3.86)	15	-0.65 (2.08)	29	-1.56 (5.65)	12	-0.64 (3,55)
IN	0.48 (1.61)	10	-1.10 (3.04)	12	-0.13 (2.43)	29	-0.04 (2.04)	12	-1.02 (2.40)
JP	0.27 (0.67)	23	-0.13 (0.38)	22	-0.14 (0.63)	44	-0.56 (0.32)	12	0.04 (0.60)
KR	-0.18 (2.53)	7	-0.34 (1.66)	23	-0.02 (0.81)	29	-0.85 (0.71)	12	-0.27 (1.85)
MY	-0.40 (1.83)	10	-0.93 (1.21)	14	-0.66 (1.52)	29	-0.90 (1.17)	12	-0.67 (1.98)
NZ	-0.24 (1.31)	16	-0.92 (1.33)	28	-0.02 (1.07)	28	-0.02 (0.70)	12	-0.39 (1.38)
PH	-0.25 (2.59)	8	-2.46 (2.40)	14	-0.75 (0.52)	8	INS		-0.74 (2.67)
SG	-0.60 (1.57)	13	-0.97 (1.95)	16	-0.05 (2.05)	29	-0.43 (0.81)	12	-0.82 (1.81)
TH	INS	0	-1.43 (1.93)	23	0.04 (2.02)	29	-0.90 (1.48)	12	-1.43 (1,33)

Note: Forecast errors are defined as $\pi_t - \pi^f$ where π_t, π^f are, respectively, (annualised) inflation less the one year ahead inflation forecast. Periods of rising inflation are defined by the condition $\Delta\pi_t \geq 0$ while periods of falling inflation represent cases where $\Delta\pi_t < 0$. Inflation scares follow the US definition (1992–95, 2002–04, 2008–11). Deflation scares are 2000, 2006–07. OBS are the number of observations. INS means insufficient data. The highlighted parts indicate cases where non-Consensus forecasts outperform Consensus forecasts.

Figure 1

Central bank transparency



Sources: Dincer & Einchengreen (2007), Siklos (2011), and http://www.central-bank-communication.net/links/.

Figure 2

Inflation performance

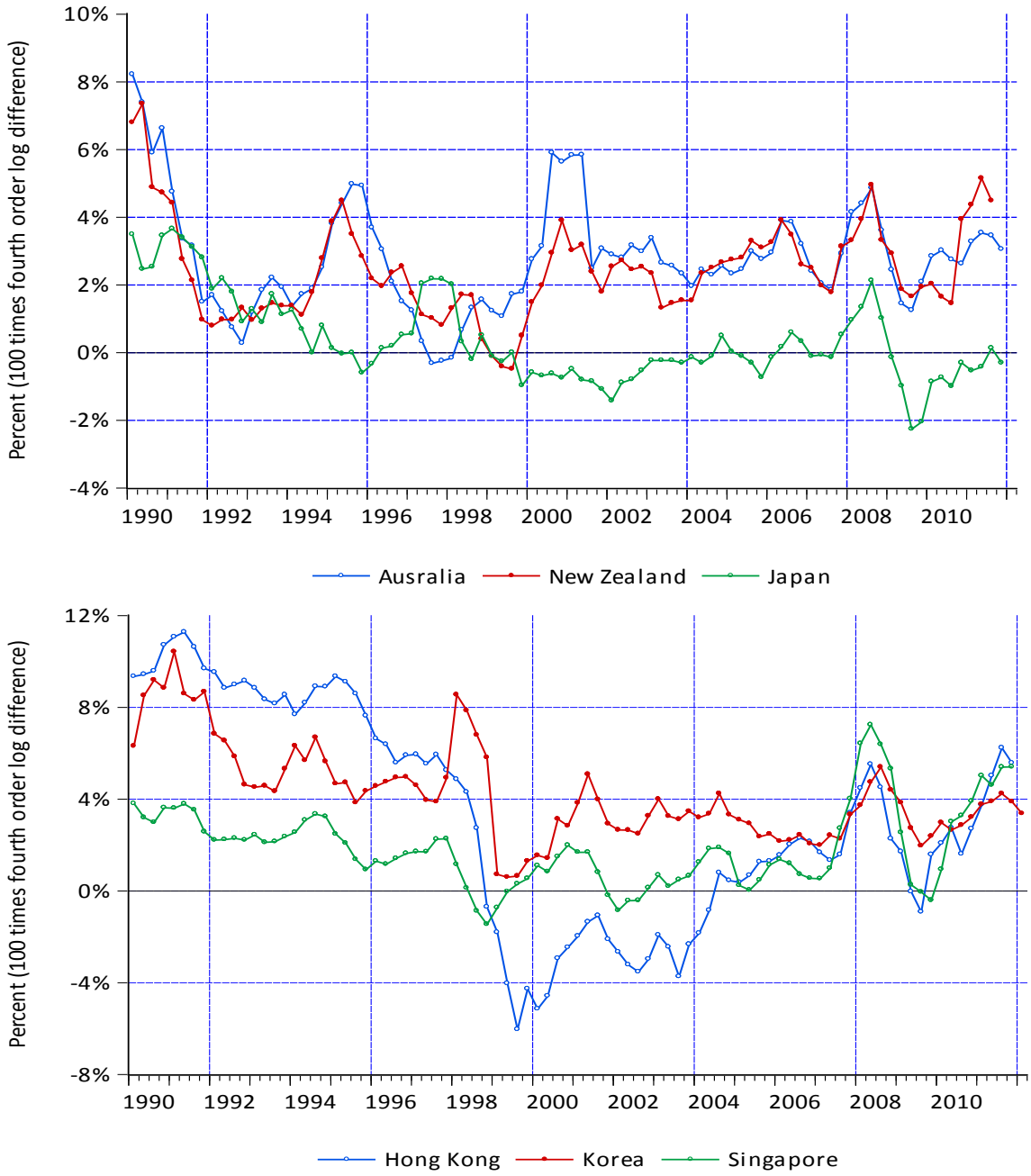
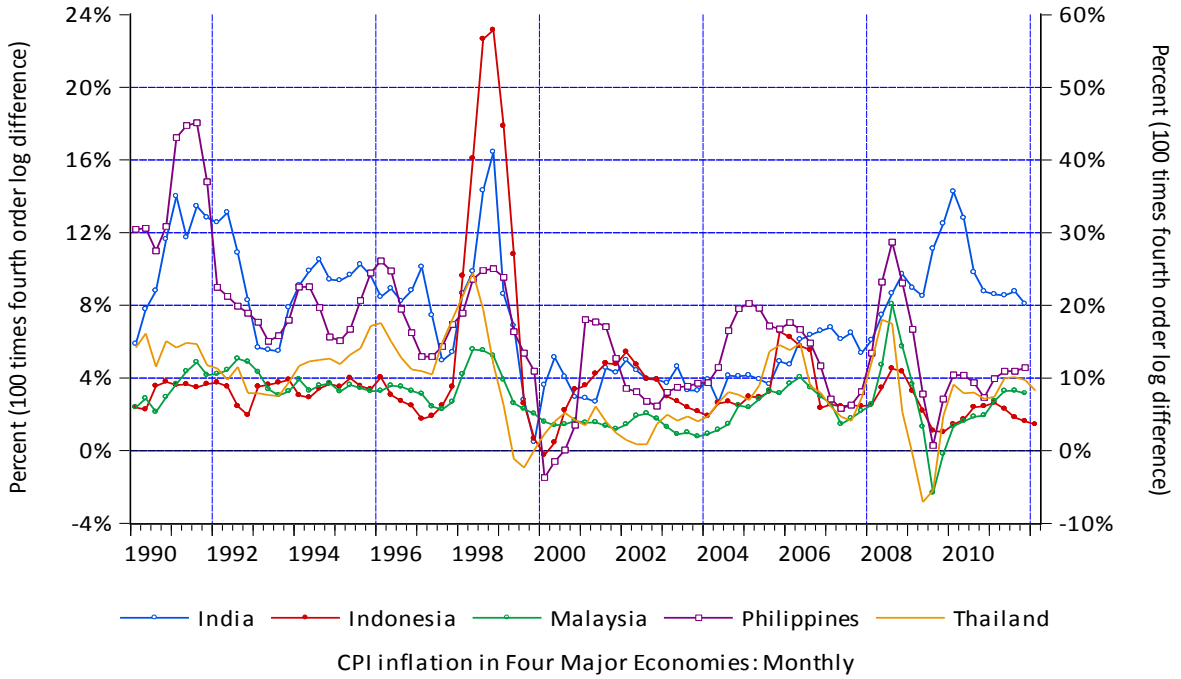
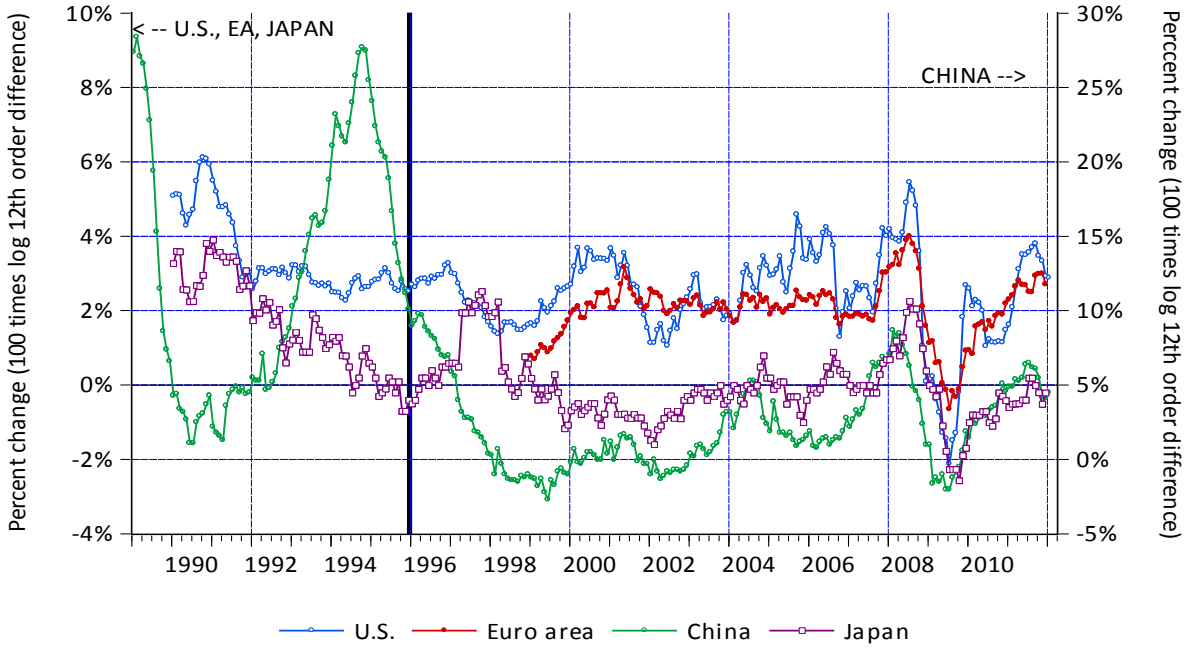


Figure 2 (cont)

Inflation performance



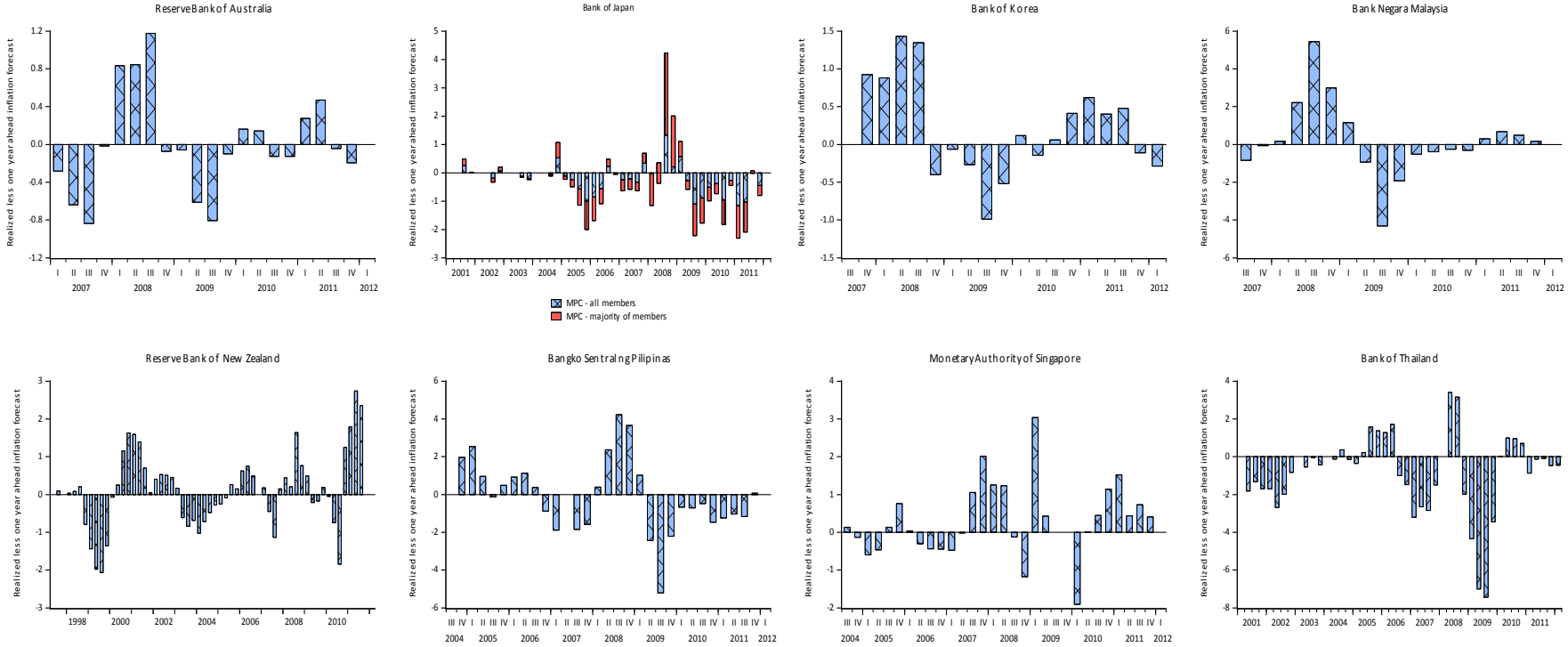
CPI inflation in Four Major Economies: Monthly



Note: Except for the euro area (harmonised index of consumer prices), CPI is used. Inflation is annualised inflation based on quarterly data. Data are from International Monetary Fund International Financial Statistics CD-ROM (May 2012 edition).

Figure 3

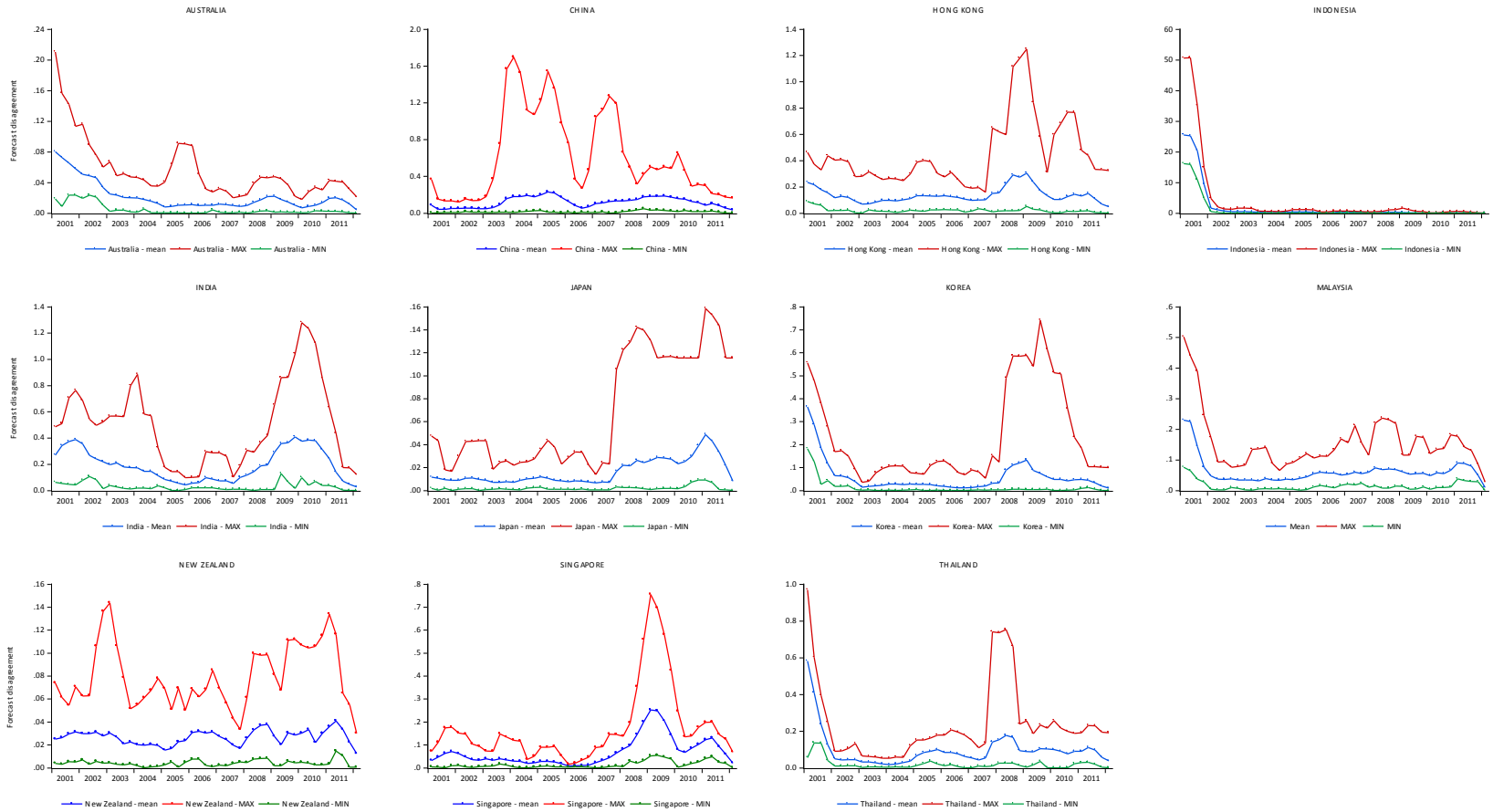
The forecasting record of central banks in the Asia-Pacific region



Note: errors are defined as $\pi_t - \pi^f$ where π_t, π^f are, respectively, (annualised) inflation less the one year ahead inflation forecast. Source: Author's calculations.

Figure 4

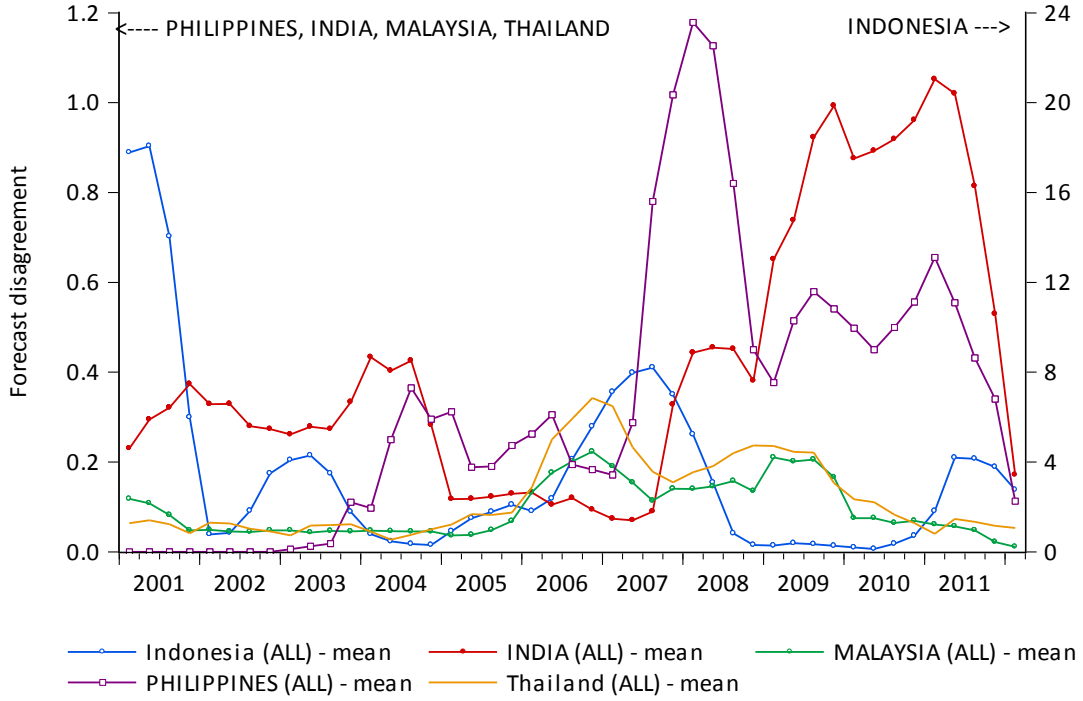
Forecast disagreement since 2001

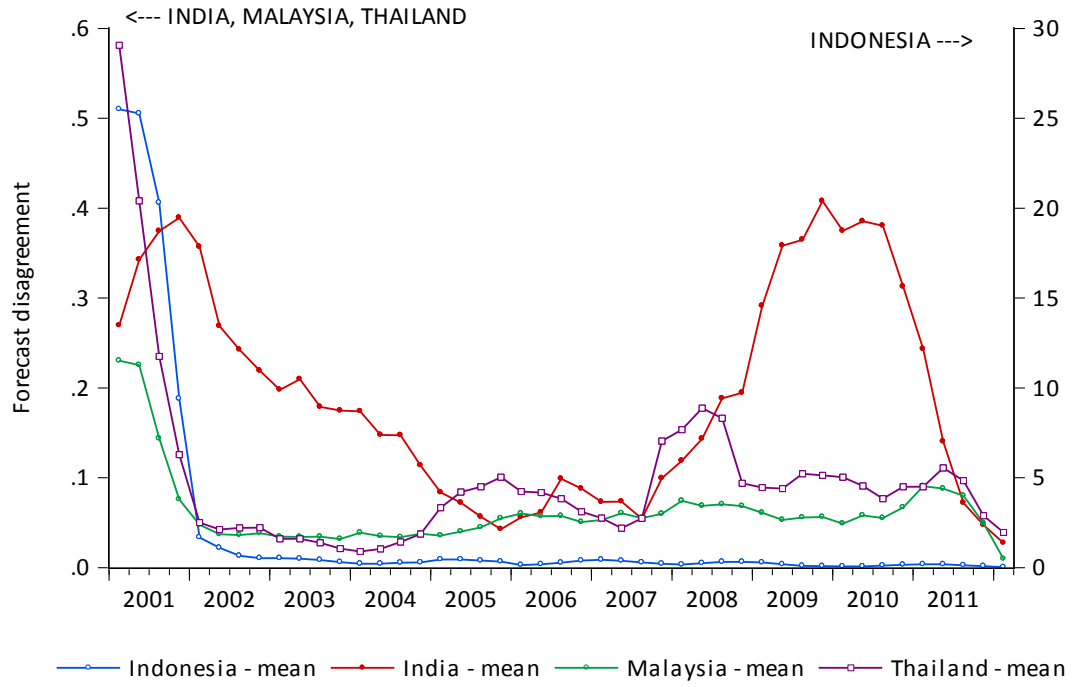


Note: Forecast disagreement among Consensus forecasters, evaluated according to equation (1). There were too few observations for the Philippines. See, however, Figure 5.

Figure 5

Forecast disagreement: Consensus and non-Consensus forecasts, selected economies





Note: See note to Figure 4.

References

Caruana, J (2012): "It's time to address the root causes", speech delivered at the BIS Annual General Meeting, 24 June.

Cowen, T (2012): "Broken trust takes time to mend", *New York Times*, 16 June.

Dincer, N and B Eichengreen (2008): "Central bank transparency: where, why, and with what effects?", in J Touffut (ed), *Central Banks as Economic Institutions*, Cheltenham, UK, and Northampton, Mass: Edward Elgar, pp 105–41.

Dotsey, M, S Fujita and T Stark (2011): "Do Phillips Curves conditionally help forecast inflation?", working paper, Federal Reserve Bank of Philadelphia.

Faust, J and J Wright (2011): "Forecasting inflation", unpublished, Johns Hopkins University.

Filardo, A and S Gordon (1998): "Business cycle durations", *Journal of Econometrics* 85, pp 99–123.

Filardo, A and D Guinigundo (2008): "Transparency and communication in monetary policy: a survey of Asian central banks", paper prepared for the Bangko Sentral ng Pilipinas – Bank for International Settlements (BSP-BIS) Research Conference on Transparency and Communication in Monetary Policy, Manila, 1 February.

Greenspan, A (2004): "Monetary policy twenty-five years after October 1979", Conference on Reflections on Monetary Policy Twenty-Five Years after October 1979, Federal Reserve Bank of St. Louis, St. Louis, Missouri, available at http://www.federalreserve.gov/boarddocs/speeches/2004/200410073/default.htm.

Ilzetzki, E, C Reinhart and K Rogoff (2008): "Exchange rate arrangements entering the 21st century: which anchor will hold?", working paper, Harvard University.

Kahneman, D and A Tversky (1979): "Intuitive prediction: biases and corrective procedures", in S Makridakis and S Wheelwright (eds), *Studies in the Management Sciences: Forecasting*, 12, Amsterdam: North Holland.

Lahiri, K and X Sheng (2008): "Evolution of forecast disagreement in a Bayesian learning model", *Journal of Econometrics* 144: pp 325–40.

Morris, S and H Shin (2002): "Social value of public information", *American Economic Review*, 52 (5), pp 1521–34.

Plosser, C (2012): "When a monetary solution is a road to perdition", *Financial Times*, 17 May.

Siklos, P (2012): "Sources of disagreement in inflation forecasts: an international empirical investigation", *Journal of International Economics* (forthcoming).

Siklos, P (2011): "Central bank transparency: another look", *Applied Economics Letters*, 18, July, pp 929–33.

Siklos, P (1999): "Inflation target design: changing inflation performance and persistence in industrial countries", *Review of the Federal Reserve Bank of St Louis*, 81, March/April, pp 47–58.

Stock, J and M Watson (2010): "Modelling inflation after the crisis", in *Macro-economic policy: post-crisis and risks ahead*, Proceedings of the Jackson Hole Conference, Federal Reserve Bank of Kansas City.

Svensson, L (2006): "Social value of public information: comment – Morris and Shin is actually pro-transparency, not con", *American Economic Review*, 96(1), pp 448–52.