AN EVALUATION OF INFLATION EXPECTATIONS IN TURKEY

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An Evaluation of Inflation Expectations in Turkey*

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Abstract

Expectations on the future state of the inflation play a critical part in the process of price level determination in the market. Therefore, central banks closely follow the developments in inflation expectations to able to pursue a successful monetary policy. In Turkey, the Central Bank of the Republic of Turkey (CBRT) asks experts and decision makers from financial and real sectors about their expectations/predictions on the current and the future state of inflation every month to obtain market expectations on inflation. This paper examines these predictions of inflation using techniques of forecasting literature. We analyze both point and sign accuracy of these predictions. Point predictions from CBRT surveys are compared with those obtained from AR models, and tested whether they are statistically different. Sign predictions are tested whether they are valuable to a user. We also test predictions for unbiasedness.

Keywords: Inflation expectations; Evaluation procedures; Sign forecast accuracy
JEL: E37, E31

1 Introduction

During 90s, Turkey constantly suffered from chronic high inflation. 2001 crisis, one of the severest crises of Turkish history, forced Turkish government of that period to embrace an

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ambitious plan to restructure Turkish economy and reduce inflation. According to government's plan, the CBRT adopted implicit inflation targeting[1] in 2002 to combat inflation more efficiently. As observing and shaping inflation expectations are critical under an inflation targeting regime, the CBRT introduced bi-monthly Survey of Expectations (SE) in August 2001 just before switching to implicit inflation targeting to closely monitor various economic indicators as well as current month, 2-months ahead and 12-months ahead Consumer Price Index (CPI) inflation expectations in the economy. These surveys hadn't been understood by the market immediately. It took more than one year for the market to grasp that SE presents expectations of economic actors not the forecasts of the CBRT, and the introduction of new CPI in 2005 further confused the market as the information conveyed by new and old index were different (Kara, 2008). When macroeconomic and technical pre-conditions were satisfied, the CBRT embraced full-fledged inflation targeting in 2006. To meet the information requirements of the explicit inflation targeting regime, new questions were added into SE in April 2006 including questions related to one-month ahead and 24-months ahead CPI inflation expectations.

Even though the history of the CBRT's SE relatively short, there are a quite number of studies that analyze inflation expectations in Turkey. Main bulk of studies test rationality of inflation expectations (Abdioğlu and Yılmaz, 2013; Kara and Küçük, 2005, 2010; Oral et al., 2011), and studies usually show that inflation expectations are not rational.[2] Another strand of literature focus on determinants of inflation expectations (Başkaya et al., 2008, 2010, 2012), and other recent studies evaluate the credibility of the CBRT by analyzing whether inflation expectations are anchored (Çiçek et al., 2011; Çiçek and Akar, 2014).

Unlike previous studies, our main aim in this paper is thorough evaluation of both point and sign forecasting performances of current month, next month, 2-months ahead, 12-months ahead and 24-months ahead CPI inflation expectations.[3] We check point forecasting performances of inflation expectations by comparing root mean square errors (RMSE) of inflation expectations with RMSEs of AR models, and we evaluate sign forecasting performances of inflation expectations by using Fisher's exact test and Pesaran and Timmermann (1992) test. Another notable feature, that differs us from other studies, is that we use both SEs

[1]Implicit inflation targeting was a stepping stone to full-fledged inflation targeting. The CBRT believed that adopting explicit inflation targeting with premature initial conditions posed a serious threat to the credibility of the CBRT (Kara, 2008).

[2]Notable exception is that Kara and Küçük (2005) show that current month CPI is rational.

[3]Oral et al. (2009) examine point forecasting performance of 12-months ahead inflation expectations, but they mainly compare forecasting accuracies of different sectors' inflation expectations with each other.

collected in the 1st week and the 3rd week of each month, and try to understand if economic actors gain additional information in this 2 weeks. In this study, we also test unbiasedness of inflation expectations similar to other papers on rationality of inflation expectations.

The remainder of this paper is as follows. Section 2 explains Survey of Expectations. Section 3 presents results of unbiasedness tests. Section 4 shows point forecasting performances of inflation expectations. Section 5 analyzes sign forecasting performances of inflation expectations, and section 6 concludes.

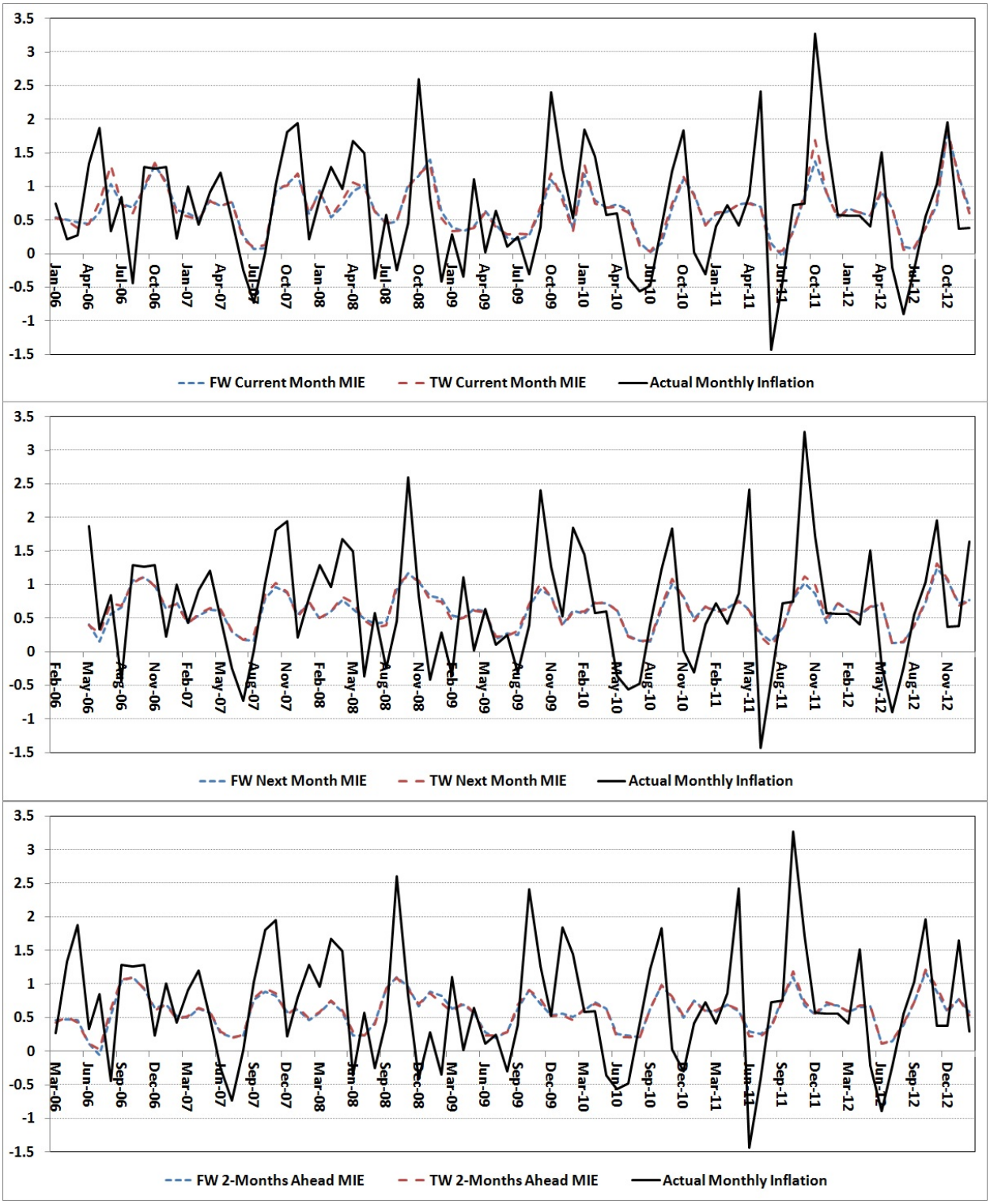
2 Survey of Expectations

SE was introduced to the public in August 2001 by the CBRT. This survey collects expectations of decision makers in financial and real sectors on inflation, interest rates, exchange rates, the current account deficit, and the GDP growth rate. In the original SE, there were 4 different questions about inflation expectations. These questions ask "current month monthly CPI inflation", "2-months ahead monthly CPI inflation", "End of the year annual CPI inflation", and "12-months ahead annual CPI inflation". In April 2006, new questions were added into SE to meet the information requirements of the explicit inflation targeting regime. Regarding inflation expectations, these new questions ask "next month monthly CPI inflation", and "24-months ahead annual CPI inflation". In this study, we evaluate all these inflation expectations except "End of the year annual CPI inflation" because analysis of "fixed-event" forecasts require different techniques compared to "rolling-type" forecasts.

Until the end of 2012, SE conducted bi-monthly, in the first and the third week of each month. In the beginning of 2013, the frequency of SE reduced to once per month. We want to understand if there is much difference in inflation expectations collected in the 1st and the 3rd week of each month, so we drop data after December 2012. We also start our evolution period from January 2006, because there is much uncertainty about CPI and SE in implicit inflation targeting period. Therefore, our data set covers current month, 2-months ahead, 12-months ahead CPI inflation expectations between January 2006 and December 2012, and next month and 24-months ahead CPI inflation expectations between April 2006 and December 2012.

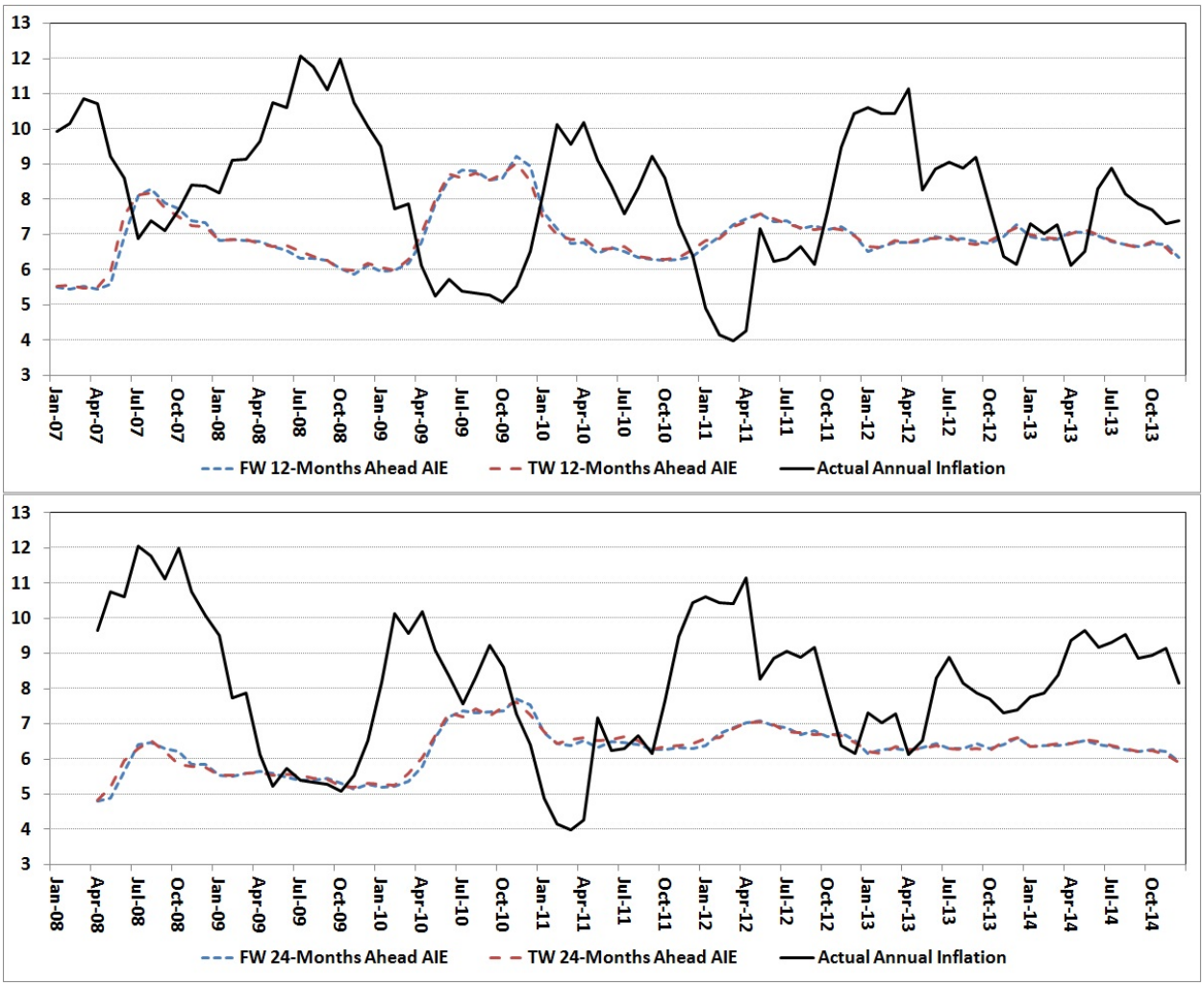
Figures 1 and 2 show actual inflation at time $t+h$ and inflation expectations for time $t+h$ collected at time t. h is forecast horizon and can be 0,1,2,12 or 24. It's time to

Figure 1: Monthly Inflation Expectations and Actual Inflation



Note: FW and TW refer to 1st week and 3rd week, respectively. MIE refers to monthly inflation expectations.

Figure 2: Annual Inflation Expectations and Actual Inflation



Note: FW and TW refer to 1st week and 3rd week, respectively. AIE refers to annual inflation expectations.

issue a certain caveat here. CPI is released around the third day of each month following the reference month. When forming inflation expectations for $t+h$ at time t, survey participants only posses inflation figures up to $t-1$. Therefore, current month, next month, 2-months ahead, 12-months ahead and 24-months ahead inflation expectation can be also defined as one-step ahead, 2-steps ahead, 3-steps ahead, 13-steps ahead and 25-steps ahead inflation forecasts, respectively. Nevertheless, we use the definition of SE for inflation expectations throughout the paper. It's clear from figures that expectations formed in the 1st week and the 3rd week are very close. As expected, current month inflation expectations follow actual inflation closely. Next month and 2-month ahead inflation expectations also seem to have good predictive powers, but they can not capture spikes as good as current month inflation

expectations. According to figure 2, 12-months ahead and 24-months ahead annual inflation expectations have very low predictive powers. Başkaya et al. (2012) show that they are mainly governed by past inflation realizations and inflation targets of the CBRT.

3 Unbiasedness

To understand if inflation expectations are unbiased, in other words if inflation expectations systematically overestimate or underestimate the actual inflation, we perform a Mincer and Zarnowitz (1969) test. To obtain test statistics, we perform a regression as follows:

$$y_{t+h} = \alpha + \beta y^{ie}_{t+h|t} + \varepsilon_{t+h}; \quad h = 0, 1, 2, 12, 24, \tag{1}$$

where y_{t+h} is actual inflation rate in time $t+h$, and $y^{ie}_{t+h|t}$ is the inflation expectation for time $t+h$ based on information set at t. If inflation expectations are unbiased, then the joint hypothesis of $\alpha = 0$ and $\beta = 1$ can not be rejected. Usually prediction errors are heteroskedastic, so regression covariance matrix is calculated with Newey and West (1987) procedure. Finally, joint hypothesis is tested by Wald test. Table 1 presents regression coefficients and Wald test statistics. Null hypothesis of unbiasedness is rejected for all inflation expectations. We can conclude that all inflation expectations exhibit systematic forecast errors.

Table 1: Mincer-Zarnowitz Test Results

	1st Week			3rd Week		
	coefficients			coefficients		
	α	β	χ^2 (p-value)	α	β	χ^2 (p-value)
Current Month MIE	-0.45	1.68	14.24 (0.00)	-0.47	1.68	17.39 (0.00)
Next Month MIE	-0.55	1.99	14.46 (0.00)	-0.60	2.04	20.13 (0.00)
2 Months Ahead MIE	-0.46	1.91	6.67 (0.04)	-0.49	1.94	7.93 (0.02)
12 Months Ahead AIE	18.56	-1.50	149.65 (0.00)	19.50	-1.63	173.98 (0.00)
24 Months Ahead AIE	6.78	0.21	22.81 (0.00)	6.81	0.21	22.36 (0.00)

Note: MIE and AIE refer to monthly inflation expectations and annual inflation expectations, respectively.

4 Point Forecast Accuracy of Inflation Expectations

First, we calculate the forecasting accuracy of inflation expectations in terms of root mean square errors (RMSE). To compare the accuracy of inflation expectations against a benchmark model, we also construct an AR model as follows:

$$y_t = \alpha + \beta \sum_{i=1}^{n} y_{t-i} + \sum_{k=1}^{11} \delta_k d_{kt} + \varepsilon_t, \tag{2}$$

where y_t is monthly CPI inflation. CPI exhibits seasonality[4], so we use also monthly seasonal dummies (d_{kt}). First estimation period is between January 2003[5] and December 2005. Forecast period begins in January 2006, and last data we use is December 2012 CPI inflation. We compute out of sample forecasts up to 25 months ahead in each iteration using expanding estimation window. The lag is selected by Akaike Information Criteria (AIC) in every iteration. Using equation 2, we obtain monthly inflation forecasts. However, 13-months ahead and 25-months ahead annual inflation forecasts are needed to compare with 12-months ahead and 24 months ahead inflation expectations, respectively. These annual forecasts are computed as follows:

$$(\prod_{i=1}^{h}(1 + \hat{y}_{t+h|t}))/(1 + \hat{y}_{t|t}) - 1; \quad h = 12, 24, \tag{3}$$

where $\hat{y}_{t+h|t}$ is monthly inflation forecast of AR model for $t+h$ based on information set at t. $h = 12$ and $h = 24$ are for 13-months ahead and 25-months ahead annual inflation forecasts of AR model, respectively.

Table 2 presents RMSEs of inflation expectations and AR model. RMSEs of inflation expectations formed in the 3$^{\text{rd}}$ week and the 1$^{\text{st}}$ are very close. It can be one of the reasons why the CBRT reduce the frequency of SE from twice per month to once per month. Interestingly, only current month inflation expectations perform better than AR(AIC) model. RMSEs of all other inflation expectations are worse than RMSEs of AR(AIC) model. Biggest differences in terms of RMSE are seen between annual inflation expectations and AR(AIC). RMSEs of 12-months ahead inflation expectations are approximately 23-24 percent worse than those of AR(AIC) model, and RMSEs of 24-months ahead inflation expectations are approximately 28 percent worse than RMSEs of AR(AIC) model.

[4]In Turkey, only non-seasonally adjusted CPI is released.

[5]New CPI index begins in January 2003.

Table 2: RMSEs of Inflation Expectations and AR(AIC)

	Monthly Inflation Predictions			Annual Inflation Predictions	
	Current Month	Next Month	2 Months Ahead	12 Months Ahead	24 Months Ahead
1st Week-IE	0.65	0.73	0.74	2.77	2.70
3rd Week-IE	0.63	0.72	0.73	2.74	2.69
AR(AIC)	0.66	0.66	0.64	2.11	1.94

Note: IE refers to inflation expectations.

To understand if these differences between inflation expectations and AR(AIC) model are statistically significant, we perform Diebold-Mariano (DM) test. Null hypothesis of DM test is that two forecasts have equal forecast accuracy. Null hypothesis of DM test is stated as follows:

$$E(L(e_t^{ie}) - L(e_t^f)) = 0$$

where $L(e_t^{ie})$ and $L(e_t^f)$ are time-t quadratic loss functions for inflation expectations and AR forecasts, respectively. We use squared errors as loss function in our study. DM statistic can be calculated easily by regressing difference of loss functions on an intercept using Newey-West corrected standard errors (Diebold, 2012).

Table 3 presents DM test statistics that compare forecasting accuracy of inflation expectations and AR(AIC) model. Results show that we can not reject the null hypothesis of equal predictive ability between inflation expectations and AR(AIC) for current month, next month and 24 months ahead at 5 percent significance level. However, table 3 indicates that AR(AIC) significantly outperforms next month and 12 months ahead inflation expectations.

Table 3: Diebold-Mariano Test Results

	Monthly Inflation Predictions			Annual Inflation Predictions	
	Current Month	Next Month	2 Months Ahead	12 Months Ahead	24 Months Ahead
1st Week	-0.29 (0.77)	1.81 (0.07)	2.84 (0.01)	2.14 (0.04)	1.81 (0.07)
3rd Week	-1.32 (0.19)	1.51 (0.13)	2.91 (0.00)	2.06 (0.04)	1.79 (0.08)

Note: p-values are in parantheses. In the first (second) row forecasting accuracies of 1st (3rd) week-inflation expections and AR(AIC) are compared.

5 Sign Forecast Accuracy of Inflation Expectations

Like point forecasts, sign forecasts also provide important information for decision makers. Inflation expectations' sign forecast performances are tested by Fisher's exact test (Merton, 1981; Schnader and Stekler, 1990; Sinclair et al., 2010) (FE test) and Pesaran and Timmermann (1992) test (PT test).

Table 4: Contingency Table

	A>0	A<=0	Row Total
F>0	n_{00}	n_{10}	$n_{00}+n_{10}$
F<=0	n_{01}	n_{11}	$n_{01}+n_{11}$
Column Total	$n_{00}+n_{01}$	$n_{10}+n_{11}$	N

To compute FE and PT test statistics, 2x2 contingency table is constructed as shown in Table 4. In table 4, A equals $y_{t+h}-y_t$ and F equals $y^{ie}_{t+h|t}-y_t$. y_{t+h} is actual inflation in $t+h$ and $y^{ie}_{t+h|t}$ is inflation expectation for time $t+h$ based on information set at t. Each cell shows how many observations satisfy conditions defined in corresponding rows and columns. Using table 4, probability of independece for FE test is calculated as follows:

$$p=\left(\frac{n_{00}+n_{10}}{n_{00}}\right)\left(\frac{n_{01}+n_{11}}{n_{01}}\right)/\left(\frac{N}{n_{00}+n_{01}}\right). \tag{4}$$

Null hypothesis of FE test is that there is no relationship between inflation expectations and actual inflation. We also estimate PT test statistics for 2x2 case as follows:

$$S_n=\frac{\hat{p}-\hat{p}_*}{(\hat{var}(\hat{p})-\hat{var}(\hat{p}_*))^{1/2}}\sim N(0,1), \tag{5}$$

where $\hat{p}=(n_{00}+n_{11})/N$ is the probability of correct predicted signs; $\hat{p}_*=\hat{p}_y\hat{p}_x+(1-\hat{p}_y)(1-\hat{p}_x)$ is the estimator of $\hat{p}$ under null hypothesis; $\hat{p}_x=(n_{00}+n_{10})/N$ is the probability of positive predicted changes; $\hat{p}_y=(n_{00}+n_{01})/N$ is the probability of positive actual changes; $\hat{var}(\hat{p})=N^{-1}\hat{p}_*(1-\hat{p}_*)$ and $\hat{var}(\hat{p}_*)=N^{-1}(2\hat{p}_y-1)^2\hat{p}_x(1-\hat{p}_x)+N^{-1}(2\hat{p}_x-1)^2\hat{p}_y(1-\hat{p}_y)+4N^{-2}\hat{p}_y\hat{p}_x(1-\hat{p}_y)(1-\hat{p}_x)$. Null hypothesis of PT test is that inflation expectations have no predictive power.[6]

Table 5 shows continengcy table values and probabilities of FE and PT test statistics. Results

[6]For 2x2 special case, the null hypotheses of FE test and PT test are equal (Tsuchiya, 2013).

Table 5: Continengcy Table, FE Test and PT Test Results

	Week	A>0 F>0	A>0 F≤0	A≤0 F>0	A≤0 F≤0	Correct Predictions	p-values FE	p-values PT
Current Month MIE	1st	39	8	10	27	78.6%	0.00	0.00
	3rd	39	8	11	26	77.4%	0.00	0.00
Next Month MIE	1st	37	6	9	29	81.5%	0.00	0.00
	3rd	37	6	9	29	81.5%	0.00	0.00
2 Months Ahead MIE	1st	33	8	8	35	81.0%	0.00	0.00
	3rd	34	7	8	35	82.1%	0.00	0.00
12 Months Ahead AIE	1st	17	23	1	43	71.4%	0.00	0.00
	3rd	17	23	1	43	71.4%	0.00	0.00
24 Months Ahead AIE	1st	14	27	0	40	66.7%	0.00	0.00
	3rd	15	26	0	40	67.9%	0.00	0.00

Note: MIE and AIE refer to monthly inflation expectations and annual inflation expectations, respectively.

indicate that the null hypothesis of FE and PT tests is rejected for all inflation expectations. Therefore, all sign predictions of inflation expectations have value to a user. Similar to point forecasts, sign forecasting performances of inflation expectations collected in the 3rd week and the 1st week are very close. As expected monthly inflation expectations have have higher number of correct predictions than annual inflation expectations. One striking feature is that 12-months ahead and 24-months ahead inflation expectations have very high percentage of underestimation. In an environment of rising inflation period, 12-months and 24 months ahead inflation expectations underestimate the actual inflation more than 50 percent of the time.

6 Conclusion

In this study we test unbiasedness of current month, next month, 2-months ahead, 12-months ahead and 24-months ahead CPI inflation expectations both formed in the 1st and the 3rd week of the month as well as their point and sign forecasting performances between January 2006 and December 2012. First, we test unbiasedness of inflation expectations. Results show that all of inflation expectations are biased. After that, we analyze forecasting performances of inflation expectations. We show that forecasting accuracies of inflation expectations formed in the 3rd week and the 1st are very close. Also, we compare predictions of inflation expectations against a benchmark model. Our analysis indicates that only cur-

rent month inflation expectations perform better than AR(AIC) model. Then, we perform Diebold-Mariano (DM) test to understand if these differences between inflation expectations and AR(AIC) model are statistically significant. Results show that we can not reject the null hypothesis of equal predictive ability between inflation expectations and AR(AIC) for current month, next month and 24 months ahead at 5 percent significance level. On the other hand, AR(AIC) significantly outperforms other inflation expectations. Finally, we analyze sign forecasting performances of inflation expectations, and find that all sign predictions of inflation expectations have value to a user.

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