Central Bank Review
Vol. 12 (January 2012), pp.53-62
ISSN 1303-0701 print / 1305-8800 online
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http://www.tcmb.gov.tr/research/review/

IS DISAGREEMENT A GOOD PROXY FOR INFLATION UNCERTAINTY? EVIDENCE FROM TURKEY

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ABSTRACT This study uses inflation expectation errors to measure inflation uncertainty in Turkey by analyzing the CBRT Survey of Expectations data and investigates whether the disagreement among the survey participants can be used as a proxy for inflation uncertainty. Results reveal the importance of the inflation targeting regime. In particular, disagreement seems to be a good proxy for inflation uncertainty for the 2001-2006 period while this relationship vanishes with the full-fledged inflation targeting regime after 2006.
JEL C22, C82, E31
Keywords Inflation, Uncertainty, Disagreement, Survey data

ÖZ Bu çalışmada TCMB Beklenti Anketi enflasyon beklentileri ile gerçekleşmeler arasındaki farklar kullanılarak Türkiye için bir enflasyon belirsizliği ölçütü oluşturulmuş ve anket katılımcıları arasındaki uyuşmazlığın oluşturulan bu ölçüt için bir gösterge olarak kullanılıp kullanılamayacağı araştırılmıştır. Bulgular, Türkiye'de enflasyon hedeflemesine geçiş öncesi dönem için uyuşmazlığın enflasyon belirsizliği göstergesi olarak kullanılabileceğini ancak enflasyon hedeflemesi rejimiyle beraber bu ilişkinin kaybolduğunu ortaya koymaktadır.
UYUŞMAZLIK ENFLASYON BELİRSİZLİĞİ İÇİN BİR GÖSTERGE MİDİR? TÜRKİYE ÖRNEĞİ
JEL C22, C82, E31
Anahtar Kelimeler Enflasyon, Belirsizlik, Uyuşmazlık, Anket verisi

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1. Introduction

Inflation uncertainty is an important source of inflation cost since it affects investment and saving decisions of individuals and firms. From monetary policy perspective, it is crucial to measure and reduce inflation uncertainty for central banks whose overriding objective is price stability. The aim of this paper is to find an implementable proxy for inflation uncertainty in Turkey which could be timely used by policy makers.

Most studies in the literature use estimated conditional variance using autoregressive conditional heteroskedasticity (ARCH) and generalized autoregressive conditional heteroskedasticity (GARCH) models or volatility of past inflation to measure inflation uncertainty.[1] However, since inflation uncertainty is a notion of future inflation, it should be measured by using survey data on expectations rather than techniques that solely depend on past inflation series. Specifically, following Bomberger (1996), we use mean square error of inflation expectations from Central Bank of the Republic of Turkey (CBRT) Survey of Expectations to measure inflation uncertainty and name this measure as "*total uncertainty*".

As an identity, total uncertainty can be expressed as the sum of "*disagreement*" among the participants and "*consensus uncertainty*", the square of the deviation of mean expectation from actual inflation realization. Disagreement measure has the advantage of being timely available with the announcement of the survey results, whereas total uncertainty and consensus uncertainty can be calculated only after the realization of the actual inflation series. However, if there exists a meaningful relationship between disagreement and total uncertainty, disagreement can be used as an implementable proxy for inflation uncertainty (Bomberger, 1996). In this respect, this study investigates the relationship between total uncertainty and disagreement. We provide evidence on the importance of the inflation targeting regime in this context. In particular, our results suggest that inflation uncertainty decreases during the 2001-2006 disinflation process in Turkey. Disagreement also decreases in that period which is in line with the findings of Friedman (1977), Ball (1992) and Mankiw et al. (2003) suggesting that disagreement and the level of inflation have a positive relationship. Hence, disagreement seems to be a good proxy for inflation uncertainty for the 2001-2006 period. However, this relationship vanishes with the full-fledged inflation targeting regime after 2006.

[1] See, for example, Engle (1982) or Bollerslev et al. (1992) for a survey on this literature.

The literature about the relationship between disagreement and uncertainty in the context of forecasting inflation has mixed results. Using the Livingston data for the US, Bomberger (1996) suggests that disagreement is a good proxy for inflation forecast uncertainty[2] while D'Amico and Orphanides (2006) claims the opposite, uncertainty is more correlated with the mean inflation forecast in the Survey of Professional Forecasters data rather than with the dispersion of the forecasts across individuals.[3] Moreover, Boero et al. (2008) finds that disagreement is not an adequate substitute for inflation uncertainty in the UK. Rich and Tracy (2006), on the other hand, provides mixed evidence by using the latter dataset. Depending on their definition of disagreement, that relationship differs in significance. Our study is another example of mixed evidence which changes according to the monetary policy framework as explained above.

2. Data and Methodology

With the aim of measuring inflation uncertainty, this study uses one-year-ahead[4] consumer price inflation expectations from the Survey of Expectations, which collects data to find out the expectations of experts and decision makers from the financial and real sector professionals.[5] Total number of survey respondents by time is depicted in Figure 5. An average of 74 participants has responded since the beginning of the survey. On the other hand, a total of 74, 28 and 9 participants have responded the survey 50, 75 and 90 percent of the time, respectively. Financial sector respondents constitute an average of 73.6 percent of all respondents while 22.7 percent of responses come from real sector participants.

The survey has been conducted in the first and the third weeks of every month since August 2001. By construction, inflation expectations do not cover the month which the survey is conducted and therefore we use the second period results which are closer to the expectation period.

One can assume that the survey participants form their expectations according to their information set at the beginning of a period. In particular, let participant i use his information set, I_{it-1}, and forecast function, f_{it}, to forecast inflation, p_{it}, for time t. That is, we have:

$$p_{it} = f_{it}(I_{it-1}) \tag{1}$$

[2] See also Zarnowitz and Lambros (1987) and Giordani and Söderlind (2003).
[3] Using the same dataset, Lahiri and Liu (2006) provides strong evidence that disagreement is not a good proxy for inflation uncertainty. See also Lahiri and Sheng (2010).
[4] We performed the same analysis for one-month-ahead expectations and reached similar results. Due to space limitations, those results are not presented but are available upon request from the authors.
[5] For more details about the survey, see CBRT website.

Let π_t denote the actual inflation for this period. Then the expectation error of the individual can be represented as

$$e_{it} = p_{it} - \pi_t \tag{2}$$

The variance of inflation expectations (D_t) about the consensus expectation (p_t) has been used extensively in the literature as a measure of inflation uncertainty.

$$D_t = \frac{1}{N_t} \sum_{i=1}^{N_t} (p_{it} - p_t)^2 \tag{3}$$

where

$$p_t = \frac{1}{N_t} \sum_{i=1}^{N_t} p_{it} \tag{4}$$

However, as suggested by Bomberger (1996), this measure does not reflect uncertainty; it rather shows the disagreement among the participants. Considering an extreme case, if all the participants have the same inflation expectation, this measure takes a value zero and implies no inflation uncertainty. But if the actual inflation turns out to be different than that expected inflation level, it means everyone made the same expectation error and this should point to an environment with a positive level of inflation uncertainty. Thus, mean square error of inflation expectations (total uncertainty, U_t) is more appropriate in measuring inflation uncertainty. We can define U_t as:

$$U_t = \frac{1}{N_t} \sum_{i=1}^{N_t} (p_{it} - \pi_t)^2 \tag{5}$$

Total uncertainty covers the disagreement among the participants, D_t, and the square of consensus error (namely, consensus uncertainty, C_t). Formally, one can write:

$$C_t = (p_t - \pi_t)^2 \tag{6}$$

and by identity,

$$U_t = C_t + D_t \tag{7}$$

One of the crucial points here is that one can observe D_t when the survey results are revealed, but U_t and C_t cannot be calculated until the realization of the actual inflation series, π_t. That is, inflation uncertainty regarding a specific period can only be calculated after that period has ended. This timeliness issue is especially important for policy makers, U_t would have no information value once the relevant time period has passed. However, following Bomberger (1996), if there exists a meaningful relationship between D_t and C_t, then D_t can be used as a proxy for U_t. Put in another way, one need to check that relationship beforehand to be able to use disagreement as a measure of uncertainty. Otherwise, false usage of signals in disagreement measure may lead to misguided policy decisions. In this study, we investigate the relationship between D_t and C_t with maximum likelihood estimation (MLE). Specifically, to determine the effects of changes in disagreement on consensus uncertainty and/or its own dynamics (ARCH effects), we estimate the following model with different specifications using MLE:

$$\theta_t^2 = a_0 + a_1 D_t + a_2 e_{t-1}^2 + a_3 \theta_{t-1}^2 + \lambda \pi_{t-1} \tag{8}$$

$$e_t \sim N(0, \theta_t^2) \tag{9}$$

where e_t is filtered[6] consensus error and θ_t^2 is the conditional variance of e_t. In Equation 8, a_1 shows the effect of disagreement on consensus uncertainty, which is our main parameter of interest. If a_1 is estimated to be positive and significant, then we can infer that one can use disagreement as a proxy of inflation uncertainty. On the other hand, e_{t-1}^2 and θ_{t-1}^2 are included in the model to control for ARCH and GARCH effects, respectively. Furthermore, Friedman (1977) and Ball (1992) argue that higher inflation creates higher inflation uncertainty and that inflation uncertainty adversely affects economic activity. According to this view, there should be a positive and strong relationship between inflation and inflation uncertainty. In order to asses this hypothesis empirically, π_{t-1} is included in the model to control for inflation level.[7]

3. Results

The Central Bank of Turkey has been implementing full-fledged inflation targeting regime since 2006. Because inflation targets are nominal anchors for expectations, disagreement is expected to decrease in this regime. For the purpose of controlling this effect, we divide data into two sub-periods referring to the starting year of the adoption of the full-fledged inflation targeting regime. The full sample series are from 2001M8 to 2009M9. First

[6] Since estimation periods are overlapping, consensus errors show serial autocorrelation (Cumby and Huizinga, 1992; Rich and Butler, 1998). Harvey ve Newbold (2003) argue that standard tests of ARCH are no valid in the presence of autocorrelation. To overcome this problem, consensus errors are filtered by an AR model. The filter is chosen by Schwarz criterion.

[7] Another approach to control for inflation level effect is to normalize forecasts with inflation level. In particular, we performed the same analysis on normalized forecasts, $p_t = \frac{p_t}{\pi_t}$, and obtained results that lead to very similar conclusions. Again, due to space limitations, those results are not presented here but are available upon request from the authors.

period indicates the period before the adoption of inflation targeting (2001M8–2005M12) and second period represents the period of the adoption of inflation targeting regime (2006M1–2009M9).

Figure 1. Inflation Expectations and Realizations (Full Sample)

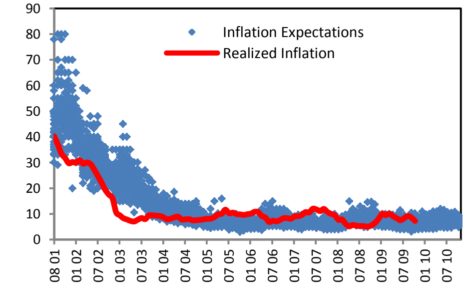


Figure 2. Inflation Expectations and Realizations (Post-2006 Sample)

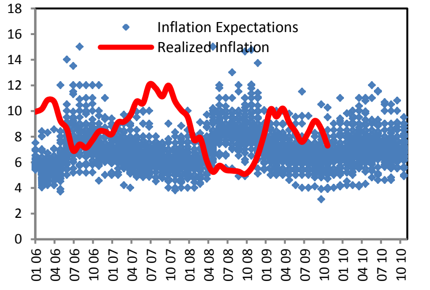


Figure 3. Consensus Uncertainty and Disagreement (Full Sample)

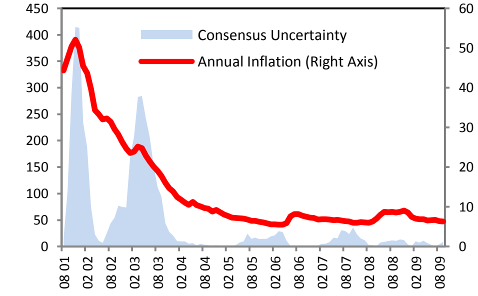
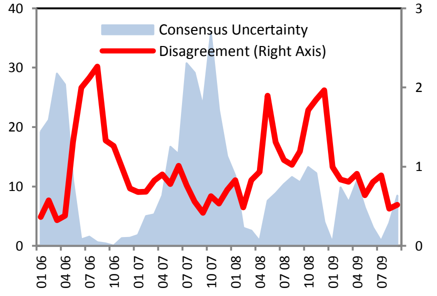


Figure 4. Consensus Uncertainty and Disagreement (Post-2006 Sample)



Figures 1 and 2 compare inflation expectations of participants with inflation realizations for the full sample and post-2006 sample, respectively. Moreover, the difference between inflation expectations and realizations shows the expectation errors.[8] As can be seen, expectation errors are generally positive and do not keep up with inflation during the disinflation period. However, this changes with the implementation of the inflation targeting in 2006.

On the other hand, Figures 3 and 4 compare disagreement with consensus uncertainty for the full sample and post-2006 sample, respectively. A quick glance at these figures shows that, there is a positive relationship between disagreement and consensus uncertainty for the whole sample whereas this relationship vanishes after 2006. On the other hand, one can see by

[8] For example, in December 2004 of Figure 1, the points show the 2005 year-end inflation expectations of participants whereas the line shows the realized 2005 year-end inflation. Hence, the difference between the two is the expectation error regarding annual inflation in 2005.

comparing Figures 3 and 4 that inflation uncertainty (the sum of two components shown) decreases for the post-2006 period.

Different specifications of Equation 8 are estimated by maximum likelihood method to have consistent and efficient parameter estimates and the significance of the coefficients are tested with Chi-square test statistic.[9] Table 1 shows the estimation results (coefficient estimates and p-values). As can be seen from the table, there exists a non-proportional relationship between disagreement and consensus uncertainty for the full sample ($a_0 \neq 0$ and $a_1 \neq 0$, comparing columns 1, 2 and 3) and this relationship is preserved even when we control for the inflation level (comparing columns 4 and 5). On the other hand, Bomberger (1996) examines ARCH-GARCH effects for the possibility that disagreement might mimic them. We can see in the tables that ARCH-GARCH effects are insignificant (comparing columns 1 and 7, 7 and 8, 2 and 6). That is, consensus errors are distributed with a variance that is uncorrelated with lagged consensus errors and current disagreement provides useful information about consensus uncertainty for the whole period.

On the contrary, the estimation results shown in Tables 2 and 3 reveal that all the relationships summarized above are preserved only for the pre-2006 period, but they disappear for the post-2006 period. Because the model which includes only the constant term (column 1) is significant for the post-2006 period, we can say that the conditional variance of the error term is constant and hence there is no heteroskedasticity in consensus errors. Moreover, the insignificance of λ coefficient in the post-2006 period indicates that the inflation level has lost its significance on uncertainty in this period.

4. Conclusion

Results of this study claim that using disagreement as a proxy for inflation uncertainty might not be suitable for the Turkish data and they reveal the importance of the inflation targeting regime. In particular, we provide evidence suggesting that inflation uncertainty decreases with the implementation of the new regime since inflation targets are nominal anchors for expectations and individuals start not to perceive inflation level as an indicator of inflation uncertainty with the adoption of full-fledged inflation targeting regime in Turkey. Furthermore, while disagreement seems to be a good proxy for inflation uncertainty for the 2001–2006 period,

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[9] We can infer the significance of any independent variable in the model by analyzing the log likelihood values. Twice the difference between log-likelihoods of different specifications is distributed as χ^2_p , where p is the number of parameters tested.

this relationship vanishes with the new regime. Finally, full sample estimation results suggest that inflation uncertainty increases with the inflation level as stated by Friedman (1977) and Ball (1992) hypotheses, but similar to results above, inflation level loses its significance on uncertainty in the inflation targeting regime period.

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Appendix

Table 1. Estimation Results (Full Sample)

	1	2	3	4	5	6	7	8	9
a_0	1.01 (0.000)	0.68 (0.000)		0.44 (0.067)	0.44 (0.050)	0.80 (0.000)	1.04 (0.000)	1.08 (0.584)	1.19 (0.034)
a_1		0.12 (0.005)	0.79 (0.000)		0.15 (0.005)	0.10 (0.009)			0.14 (0.053)
a_2						-0.08 (0.298)	-0.04 (0.835)	-0.04 (0.834)	-0.08 (0.286)
a_3								-0.04 (0.984)	-0.05 (0.496)
λ				0.04 (0.005)	0.04 (0.005)				
No. of Obs.	84	84	84	84	84	84	84	84	84
LogL	-119.7	-116.6	-126.3	-117.4	-113.8	-116.6	-119.3	-119.3	-116.2

All models are estimated with maximum likelihood. $a_0, a_1, a_2, a_3, \lambda$ represent the coefficients of constant term, disagreement, ARCH, GARCH and inflation level, respectively. Values in parentheses are p-values. LogL is the logarithm of the likelihood.

Table 2. Estimation Results (Pre-2006 Sample)

	1	2	3	4	5	6	7	8	9
a_0	1.16 (0.000)	1.15 (0.000)		0.03 (0.927)	-0.08 (0.776)	1.12 (0.000)	1.13 (0.000)	1.04 (0.027)	1.10 (0.000)
a_1		0.01 (0.035)	- -		-0.005 (0.236)	0.01 (0.001)			0.01 (0.002)
a_2						-0.08 (0.030)	-0.07 (0.645)	-0.06 (0.683)	-0.08 (0.047)
a_3								0.00 (0.999)	0.00 (0.999)
λ				0.07 (0.011)	0.08 (0.003)				
No. of Obs.	39	39	-	39	39	39	39	39	39
LogL	-58.3	-56.6	-	-54.0	-53.7	-52.7	-57.3	-57.3	-52.5

All models are estimated with maximum likelihood. $a_0, a_1, a_2, a_3, \lambda$ represent the coefficients of constant term, disagreement, ARCH, GARCH and inflation level, respectively. Values in parentheses are p-values. LogL is the logarithm of the likelihood.

Table 3. Estimation Results (Post-2006 Sample)

	1	2	3	4	5	6	7	8	9
a_0	0.76	0.76		1.53	2.08	0.85	0.85	0.33	0.35
	(0.000)	(0.000)		(0.307)	(0.174)	(0.000)	(0.000)	(0.448)	(0.516)
a_1		0.00	-		0.00	0.00			0.00
		(0.999)	-		(0.921)	(0.957)			(0.968)
a_2						-0.14	-0.14	-0.16	-0.17
						(0.538)	(0.501)	(0.164)	(0.233)
a_3								0.71	0.68
								(0.175)	(0.292)
λ				-0.09	-0.14				
				(0.579)	(0.367)				
No. of Obs.	42	42	-	42	42	42	42	42	42
LogL	-53.8	-53.8	-	-53.0	-53.0	-52.6	-52.6	-51.8	-51.8

All models are estimated with maximum likelihood. $a_0, a_1, a_2, a_3, \lambda$ represent the coefficients of constant term, disagreement, ARCH, GARCH and inflation level, respectively. Values in parentheses are p-values. LogL is the logarithm of the likelihood.

Figure 5. Total Number of Survey Respondents by Time