Measuring Consumer Inflation Expectations in Turkey

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Abstract
The ability to measure inflation expectations is an integral part of central bank policy especially for central banks that are implementing inflation-targeting regime. A forward-looking perspective is essential to the success of inflation targeting. Therefore, a central bank having the primary objective of price stability is interested in inflation expectations. The main aim of this paper is to construct direct measures of the consumer inflation expectations and to examine the nature of consumer inflation expectations in Turkey. Qualitative data on inflation expectations obtained from surveys can be quantified into numerical indicators of the expected inflation. This paper presents the results of different quantification techniques such as Carlson-Parkin, balance and regression methods. These methods are compared with each other and the regression method is found to be the closest one to realizations. In addition, unbiasedness assumption is tested and rejected. After rejecting a rational model, hybrid model of expectations formation is considered. The "pure" backward and forward looking expectations hypotheses are rejected. There exists the strong backward looking nature of expectations in the long run.

Keywords: Consumers, Inflation Expectations, Survey Data, Quantification Methods

JEL codes : C1, C83, D84, E31, N3

Introduction

Inflation expectations have special significance for the Central Bank, as they may play an important role in economic decisions such as the setting of interest rates, prices, wages, consumption and investment decisions. The effects of monetary policy are also influenced by inflation expectations. Many of the actions of economic agents, households, corporates and financial sector, depend on their expectations about future economy. As inflation plays a crucial part in economic development,

price developments, sustainable economic growth and investments in long run, the expected inflation creates a key role for monetary policy purposes (Tyagi, 2009). Inflation expectations are determined in large part by how people believe the central bank will conduct monetary policy. Therefore, central banks communicate explicit or quasi-explicit inflation targets to help "anchor" the public's long-run expectations about inflation.

Berk and Hebbink (2009) find three possible aims for inflation expectations. The first one is to think expectations as a factor to be taken into account for determining the monetary policy stance that helps to reach the target. The second aim can be to take expectations as a tool to continuously monitor the credibility by comparing them with the inflation target; and the last aim can be as a valuable input to the inflation forecast process carried out by central banks (Rodriguez and Uriz, 2013).

Although inflation expectations are of key importance to central banks, their measurement is not an easy task. The information of inflation expectations formed by various economic agents is obtained by extracting implicit expectations contained in financial instruments or by conducting surveys among professional forecasters or consumers. In order to better understand the inflation expectations of the general public, the expectations of Turkish consumers are analyzed in this document.

Central Bank of the Republic of Turkey (CBRT) conducts monthly survey called "Survey of Expectations" which monitors the expectations of experts and decision makers from financial sectors mostly related to various economic variables. The survey results are quantitative. It has been conducted since August 2001.

The Business Tendency Survey (BTS) of CBRT is a monthly survey carried out to produce indicators that will reflect the short-term tendencies in the manufacturing industry. The survey compiles the assessments of the senior managers, whose decisions are important for the economy, on the recent past, current situation and their expectations regarding the future course of business environment. BTS has been conducted since December 1987. The survey results are qualitative.

A lot of research has been done on inflation expectations gathered from these two surveys. A recent study by Kara and Tuger (2005), which is based on data from three different surveys (namely the SOE, the Business Tendency Survey of CBRT and the Manufacturing Industry Monthly Tendency Survey of Turkish Statistics Institute) argues that inflation expectations, except for one-month ahead forecasts, are biased

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and inefficient. They find that agents ignore the lagged effects of exchange rates on inflation while forming their expectations. Another study that uses Turkish inflation expectations data is Karadas and Ögünç (2005). Their study analyzes the inflation expectations of the private manufacturing sector by converting qualitative survey responses into quantitative inflation expectation data. They evaluate the form of expectations (extrapolative versus adaptive expectations) using a sequential testing procedure. They find that the rationality hypothesis cannot be rejected, at least for the 1989Q4-1998Q4 period, and there are some forward-looking elements in the formation of expectations. Later, Başkaya et al (2008) analyze the behavioral aspects of inflation expectations in Turkey by utilizing data from a panel of survey respondents, and draws implications for the formulation of monetary policy and communication strategy. They state that the survey respondents take the inflation targets and the official forecasts of the Central Bank of Turkey into account in forming their expectations. Besides, they also show that inflation expectations during the rapid disinflation episode of 2002-2005 were firmly anchored by the announced targets. There is also significant heterogeneity in the expectation formation process such as real sector attaches a greater weight to past inflation than the financial sector. Furthermore, the financial sector seems to be comparatively more sensitive to variations in variables such as exchange rates, risk premium, suggesting that communication to financial markets should keep emphasizing the medium-term policy perspective of the monetary policy. Oral et al (2009) investigate the rationality of financial and real sectors' CPI inflation expectations in Turkey using the multivariate panel cointegration method. The use of panel techniques strengthened their empirical results by not only increasing sample size but also allowing heterogeneity across groups of respondents. Having found the expectations irrational in the stricter sense, they proceed to analyze the significance of both past and future inflation rates as determinants of agents' future inflation forecasts. Both recursive and rolling estimates show that forecasters' weight on future/target inflation rates versus past actual and expected inflation rates changes over time as unexpected shocks derail inflation from its disinflationary path. Lastly, they find asymmetry in expectations such that the response of inflation expectations to an increase in the inflation rate is twice the size of the response to a decrease in the inflation rate. This may indicate long delays

in restoring credibility of central banks after a positive shock on the inflation rate. Başkaya et al (2012) consider how inflation expectations respond to inflation targets, forecasts, and realizations. They find that forecasts, targets, and past inflation are important determinants of inflation expectations. Additionally, expectations are more sensitive to inflation realizations at higher levels of inflation. They also discover that sensitivity of expectations to inflation has decreased over time, especially since the end of 2011 despite a very rapid and sizable increase in CPI inflation. Employing aggregated time series data from the Survey of Expectations for the period between 2001 and 2007, Kara and Küçük-Tuğer (2010) recently show that despite the rejection of the classical rationality tests, time-varying parameter estimates indicate that mean inflation forecasts of private agents in Turkey has improved over time in terms of their unbiasedness and efficiency.

However, there has been no detailed analysis on inflation expectations of consumers derived from Consumer Tendency Survey. Therefore, unlike previous studies, this study focuses on the inflation expectations of consumers derived from Consumer Tendency Survey.

This paper gives emphasis to inflation expectations obtained from Consumer Tendency Survey (CTS) of the CBRT and Turkish Statistical Institute (TurkStat). Expectations obtained from the Consumer Tendency Survey are not directly observable due to qualitative survey data. Qualitative survey can only provide a direction of change for a given variable instead of an exact figure. Therefore, expectations collected as qualitative survey data are converted into quantitative estimates of the variables under consideration. There are different methods to quantify the qualitative survey results. The main aim of this paper is to construct direct measures of the consumer inflation expectations via quantification methods and to examine the nature of consumer inflation expectations in Turkey. The study is composed of four sections. The aims of the study are presented in the introduction part. The detailed knowledge about the survey and the explanation of the quantification methods are given in the second section. The quantified inflation expectations are given in the third section. The fourth section gives brief knowledge about the formation process of consumer inflation expectations. Finally, the conclusion part gives the final results.

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Consumer Tendency Survey and Quantification Methods

Consumer Tendency Survey

Consumer Tendency Survey (CTS), has been carried out with the cooperation of Turkish Statistical Institute and Central Bank of the Republic of Turkey since December 2003.

CTS aims to measure present situation assessments and future period expectations of consumers' on personal financial standing and general economic course and to determine consumers' expenditure and saving tendencies for near future.

Consumer Confidence Index is calculated by the following sub-items: Financial situation expectation of household over the next 12 months, General economic situation expectation over the next 12 months, Number of people unemployed expectation over the next 12 months and The probability of saving over the next 12 months. Indices are compiled in accordance with the balance method of European Union. The balance is calculated as the difference between the percentages of positive and negative responses and 100 is added to this difference, thus forming a separate diffusion index for each question. Then, the general index is calculated by taking arithmetic means of diffusion indices of the questions included in consumer confidence index. The index is evaluated between 0 and 200. If it is above 100, it means consumer confidence is optimistic, if it is below 100, consumer confidence is pessimistic.

CTS started to be applied in accordance with the Joint Harmonized European Union Programme of Business and Consumer Surveys in 2012. CTS and the Consumer Confidence Index have been built-up according to the EU coverage in 2013. New harmonized survey covers households at the age of 16 and above in urban and rural areas of Turkey. The person is selected randomly by the data entry programme and the target area is the whole country. CTS is conducted on a monthly basis with an independent survey. The survey results are weighted by age and gender categories. Address Based Population Registration System is used as frame. A computer-based, face-to-face interview method is applied. The fieldwork period of the survey is the 1st-15th day of each month. The survey results concerning the reference month are published on the last week of the month as is in the National Data Release Calendar. Detailed information and survey questions can be found on the Turkish Statistical Institute's (Turkstat) web site http://www.turkstat.gov.tr.

The price question in CTS can be given as follows:

In comparison to the realizations, how do you expect that prices will develop over the next 12 months?

1. Increase more rapidly
2. Increase at the same rate
3. Increase at a slower rate
4. Stay about the same
5. Fall
6. No idea

Quantification Methods

Inflation expectations have an important role in modern macroeconomic theory. The importance of expectations has been emphasized by the recent inflation experiences of most countries. Direct measurement of expectations can be made through the tendency survey data. The quantitative expectations data are gathered in some surveys. However, the respondents indicate whether prices will fall, rise or remain unchanged for some months ahead in the other surveys. The data gathered from these surveys do not have a mean value because they are qualitative. There are several techniques to quantify the qualitative survey data (Batchelor, 1982). Different quantification methods such as Carlson-Parkin method, balance method, regression method have been considered with the aim of quantifying survey data on inflation expectations.

Carlson-Parkin method used in the pentachotomous case as in this study has two advantages such that it does not impose unbiasedness and response thresholds are permitted to vary over time. One disadvantage is that the expectations via this method give different results due to the choice of probability distribution. On the other hand, regression method doesn't require probability distribution. However, there are two shortcomings of the regression method. One of them is that long time series of survey data is needed in order to implement this method. The other shortcoming is that estimating the regression model of perception with the official current inflation on its left side and survey responses to the question on inflation perception on its right hand side, regression method imposes unbiasedness of inflation perceptions. When balance method is considered, although this method doesn't measure expectations directly, it is not influenced by the assumptions imposed in other two methods.

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Probability Method

The probability method which is well known as Carlson-Parkin method (Carlson and Parkin, 1975) was first employed by Theil (1952). The original method has been derived for a trichotomous survey, i.e. the survey participants have three possible answer categories. In this context, the price expectations having three categories such as 'price will increase', 'price will decrease' and 'no change in price' (Batchelor and Orr, 1988) are used. However, in this study, the price question that is used from CTS has five possible answer options. Therefore the pentachotomous case will be considered (Berk, 1999).

The CP method assumes that respondents standing at time t (month) have formed an expectation π^e_{t+1} about inflation in the t+1 months when answering the survey. The individual subjective probability distributions can be aggregated to give the joint probability distribution $f(x_{t+1}|\ \Omega_t)$, where x_{t+1} is the future percentage change of prices at time t for the period t + 1 and Ω_t the information set at time t. It is assumed that this distribution has finite first and second order moments and that $E[x_{t+1}|\ \Omega_t] = \pi^e_{t+1}$, where π^e_{t+1} is the expected value of x at time t for the period t+1. Another assumption on the pentachotomous case can be given as follows:

There exists an interval $(-\delta^L_t\ ,\ \delta^U_t)$ around 0, with $\delta^L_t, \delta^U_t > 0$, such that the participants report 'no change' in prices if the price change expected by them lies within this interval. There exists also an interval $(\pi^p_t - \varepsilon^L_t, \pi^p_t + \varepsilon^U_t)$ around the subjective mean perceived inflation rate π^p_t , with ε^L_t and $\varepsilon^U_t > 0$, such that the individuals report that prices 'increase at the same rate' if the expected price change is covered by this interval.

The participants answer therefore in the following manner:

Prices will

fall, if $x_{t+1} \leq -\ \delta^L_t$

stay about the same, if $-\ \delta^L_t < x_{t+1} \leq \delta^U_t$

increase at slower rate, if $\delta^U_t < x_{t+1} \leq \pi^p_t - \varepsilon^L_t$

increase at same rate, if $\pi^p_t - \varepsilon^L_t < x_{t+1} < \pi^p_t + \varepsilon^U_t$

increase more rapidly, if $\pi^p_t + \varepsilon^U_t \leq x_{t+1}$.

The proportions of the total response, denoted as ${}_tA_{t+1}$ 'fall', ${}_tB_{t+1}$ 'stay about the same', ${}_tC_{t+1}$ 'increase at slower rate', ${}_tD_{t+1}$ 'increase at same rate' and ${}_tE_{t+1}$ 'increase more rapidly' are written in terms of the aggregated probability distribution.

A standardized variable is used with a specified distribution function. It is assumed that the indifference intervals are symmetric, i.e. $\delta_t^L = \delta_t^U = \delta_t$ and $\varepsilon_t^L = \varepsilon_t^U = \varepsilon_t$. However, time-variation is allowed for the intervals. The equations above give solution to the unknown parameters:

$$\pi_{t+1}^e = \pi_t^p \ ({}_ta_{t+1} + {}_tb_{t+1})\ {}_tq_{t+1}$$

$$\sigma_{t+1} = -2\,\pi_t^p \ {}_tq_{t+1}$$

$$\delta_t = \pi_t^p \ ({}_ta_{t+1} - {}_tb_{t+1})\ {}_tq_{t+1}$$

$$\varepsilon_t = \pi_t^p \ ({}_tc_{t+1} - {}_td_{t+1})\ {}_tq_{t+1}$$

where ${}_tq_{t+1}^{-1} = {}_ta_{t+1} + {}_tb_{t+1} - {}_tc_{t+1} - {}_td_{t+1}$. The parameters depend on the choice of the distribution and the perceived inflation rate, π_t^p. The distribution function can be chosen as Normal (Carlson and Parkin, 1975). However, the normal distribution may not be appropriate for the price expectations. Some empirical studies, based on financial market data or quantitative data on expectations, recommend that the actual distribution of expectations can be positively skewed in times of high inflation and heavier tails compared to normal. Thus, alternatively other types of distributions are applied in the literature, such as the uniform distribution (Pesaran (1987)), the logistic distribution (Batchelor and Orr (1988), Nielsen (2003)), the central and non-central t distributions (Berk (1999), Nielsen (2003)). To capture the deviation from normality; logistic, uniform, central-t which are more peaked than the normal distribution and chi-square distribution which is positively skewed are employed (Nielsen, 2003). In addition to these well-known distributions, Stable distribution is also applied in order to quantify qualitative data. There are several reasons for using a stable distribution to describe a system. The most important reason is the Generalized Central Limit Theorem which states that the only possible non-trivial limit of normalized sums of independent identically distributed terms is stable. This theorem states that regardless of the existence of the variance, the limiting distribution of a sum of independent and identically distributed random variables is stable (Borak, Härdle and Weron, 2005). In addition to this intriguing statistical property, stable distributions are preferred

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with respect to the Student's-t or the GED since they are a rich class of probability distributions that also allow skewness. Therefore, although the lack of closed formulas for most stable densities and distribution functions has been a major drawback to their use, they have been widely employed in modeling non-normal economic & financial data because of their flexibility. Stable distributions, also called "Levy-Pareto distributions", are used to describe complex systems in physics, biology, sociology and economics as well (Zolotarev, 1986). In general, the upper and lower tails of stable distributions decrease like a power function which generates the heavy tails.

Stable distributions are a rich class of probability distributions that allow skewness and heavy tails and have many intriguing mathematical properties. Since densities and distributions are not known in closed form for most stable distributions (exceptions being the normal, Cauchy and Levy distributions), they are usually defined by their characteristic functions (Mitchell, 2002):

$$\phi_x(t) = E(e^{itx}) = \exp\left(i\delta t - |ct|^{\alpha}\left[1 + i\beta\,\mathrm{sgn}(t)w(t,\alpha)\right]\right) \quad (1)$$

$$\text{where } w(t,\alpha) = \begin{cases} -\tan\left(\dfrac{\pi\alpha}{2}\right) & , \alpha \neq 1 \\ (2/\pi)\ln|t| & , \alpha = 1 \end{cases}$$

$-\infty < t < \infty$, $0 < \alpha \leq 2$, $|\beta| \leq \min(\alpha, 1-\alpha)$, $c > 0$, $-\infty < \delta < \infty$.

A stable distribution has four parameters; α, β, δ and γ ($\gamma = c^{\alpha}$). α is called characteristic exponent and interpreted as a shape parameter. The Normal distribution is stable with $\alpha=2$ and is the only stable distribution which second and higher absolute moments exist. When $\alpha<2$, absolute moments of order equal to and greater than α do not exist while those of order less than α do. The distribution becomes heavy tailed. The tail thickness increases as α decreases. δ and c are the location and scale parameters respectively. When β (skewness parameter) is positive (negative), the distribution is skewed to the right (left). If β is zero, the distribution becomes symmetric about δ (location parameter). As α

approaches to 2, the distribution approaches to a Normal distribution regardless of β (Fama and Roll, 1968).

A variety of measures for the scaling parameter, π_t^p, have been used in the literature. As it should reflect the observed inflation rate, the most recent rate available to the survey participants, i.e. π_{t-1}, where π_t is the officially published inflation rate, can be used for the scaling parameter. Due to the delay in publication the lagged inflation is considered rather than π_t. A second possibility is the mean of the actual inflation rate over the whole observed period, but this would imply that the participants base their decisions in part on information that is not available at the time the decision is made. Therefore not the mean over the whole sample can be used, but instead the mean over the period that precedes the time of the decision. This is the running mean of inflation from the beginning of the sample to the point where expectations are surveyed. Another choice can be the linear interpolation between the average value of inflation over the first half of the sample and that over the second half of the sample after those values are assigned to the first and last months in the sample, respectively (Millet, 2006).

In contrast to original Carlson-Parkin approach, where the scaling parameter is estimated by imposing unbiased expectations, an important advantage is that it does not impose unbiasedness. Second advantage is that the response thresholds are permitted to vary over time (Forsells and Kenny, 2002).

Regression Method

Pesaran (1984, 1987) developed the 'regression approach' that originates in Anderson (1952). The quantified expectations are a function of a specific regression model rather than a function of a specific probability distribution. This method is based on the estimation of the relationship between current inflation as measured by official statistics and its survey perception by respondents. It is assumed then that the same relationship holds between qualitative opinions of respondents concerning future price changes and expected inflation, so it serves as a yardstick for quantification of respondents' expectations (Lyziak, 2010).

If the percentage change in prices, π_t, is composed of a weighted combination of respondents having experienced increasing or falling prices, then

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$$\pi_t = \alpha R_t - \beta F_t + \varepsilon_t$$

Pesaran (1987) assumes that during inflationary periods, there exists an asymmetrical relationship between the rate of change of individually experienced prices and overall inflation, depending on the direction of change reported.

Asymmetric behaviour means that all respondents reporting an increase give additionally more increase up to a random distance whereas these reporting a decrease give the same decrease up to a random distance. After substituting these relations, we get

$$\pi_t = \frac{\alpha R_t - \beta F_t}{(1 - \lambda R_t)} + \varepsilon_t \tag{2}$$

where R_t and F_t denote the percentages of respondents reporting price rises or falls in their answer to the perceptions question, respectively. Once the coefficients from equation (2) have been recovered, it is possible to apply them to the survey proportions relating to expectations this time, thereby deriving a measure of inflation expectations:

$$\pi^e_{t+1} = \frac{\hat{\alpha} R^e_t - \hat{\beta} F^e_t}{(1 - \hat{\lambda} R^e_t)} \tag{3}$$

The assumption is that the estimated relationship between survey data and inflation holds not only for realizations, but also for expectations. This can be thought to be a strong assumption. Pesaran (1987) points out that a regression like (2) "is not a causal explanation of price changes but simply identifies the relationship between two different sources of information (namely official statistics and survey results), and serves as a 'yardstick' by means of which categorical responses concerning the direction of future changes in prices can be converted into quantitative measures". Pesaran (1984) further recommended correcting for the residual autocorrelation in equation (2) by imposing an AR structure on the error term:

$$\pi_t = \frac{\alpha R_t - \beta F_t + \rho_1((1 - \lambda R_{t-1})\pi_{t-1} - \alpha R_{t-1} - \beta F_{t-1}) + \rho_2((1 - \lambda R_{t-2})\pi_{t-2} - \alpha R_{t-2} - \beta F_{t-2})}{(1 - \lambda R_t)} + \varepsilon_t \tag{4}$$

Balance Method

Balance method is the easiest technique to quantify qualitative data. The calculation of the balance statistic is compiled in accordance with the balance method of European Union (User Guide, 2003). The possible outcomes are -1, -0.5, 0, 0.5 and 1 for a pentachotomous survey. These outcomes are associated with the sample proportions ${}_tA_{t+1}$, ${}_tB_{t+1}$, ${}_tC_{t+1}$, ${}_tD_{t+1}$, ${}_tE_{t+1}$ respectively.

The expected mean of this random variable, denoted as π^b_{t+1} is then for a pentachotomous survey defined as:

$$\pi^b_{t+1} = -1 * {}_tA_{t+1} - 0.5 * {}_tB_{t+1} + 0 * {}_tC_{t+1} + 0.5 * {}_tD_{t+1} + 1 * {}_tE_{t+1}$$
$$= {}_tE_{t+1} + 0.5 * {}_tD_{t+1} - 0.5 * {}_tB_{t+1} - {}_tA_{t+1}$$

Quantified Expectations

The expected inflation question of CTS is quantified in order to get quantitative inflation expectations of the consumers. The methods described above are used to obtain the quantified expectations series (Oral, 2013). The latest officially published inflation rate belongs to March 2011, so the survey period used in the study covers the period from December 2003 to April 2010. Then inflation expectations can be calculated for the period from November 2004 to March 2011 and compared with the realizations.

The probability method is employed to the inflation expectations gathered from CTS by using different distribution functions. Normal distribution is used in many studies since it is easy to handle. However, normal distribution may not be suitable with the empirical findings. Therefore, chi-square distribution, central t-distribution and Stable distribution are also applied in addition to normal, logistic and uniform distributions.

To account for the peakedness of the actual price changes, logistic and central-t distributions are used. To model the asymmetric behaviour of price changes, chi-square distribution is used. To capture not only the asymmetric behaviour but also the heavy tailed pattern, Stable distribution is applied. A grid search is used in order to derive quantified expectations series via different Stable distribution across different α and β values (α in the range 0.1 to 2 and β in the range -1 to 1 at intervals of

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0.05). The accuracy of each estimated series is calculated by comparing against the realization.

Four different choices for the scaling parameter are applied. First one is the most recent officially published inflation rate available to the survey participants. The second choice used is the linear interpolation. The third option is the running mean of inflation. The final choice is the mean of the actual inflation rate over the whole observed period. The forecasting performances of different models can be seen in Table 1. Four measures of scaling parameter are analyzed for each distribution and running mean of inflation has the least error values for all distributions except for chi-square distribution.

When the performances are compared with each other for the probability method, Stable distribution having parameter values 0.30 for α and -0.25 for β with the linear interpolation as threshold parameter shows the best performance due to low mean absolute error (MAE), mean square error (MSE) and theil U (TU1) statistics.

Quantification Methods		**MAE***	**MSE****	**TU1*****
Probability Method	**Threshold Parameter**			
Normal Distribution	Most recent inflation rate	3.2898	15.8759	0.4582
	Linear interpolation	2.4995	8.4202	0.3337
	Running mean of inflation	2.3537	8.3760	0.3328
	Mean of the actual inflation rate	2.7740	10.2919	0.3689
Uniform Distribution	Most recent inflation rate	3.3737	16.7022	0.4700
	Linear interpolation	2.5662	8.8733	0.3426
	Running mean of inflation	2.4242	8.9778	0.3446
	Mean of the actual inflation rate	2.8429	10.7996	0.3779
Logistic Distribution	Most recent inflation rate	3.2250	14.5285	0.4383
	Linear interpolation	2.5735	8.7223	0.3396
	Running mean of inflation	2.2611	7.2071	0.3087
	Mean of the actual inflation rate	2.7933	10.0175	0.3640
Central-t distribution	Most recent inflation rate	3.2126	15.2122	0.4485
	Linear interpolation	2.4310	8.0111	0.3255
	Running mean of inflation	2.2954	7.9299	0.3238
	Mean of the actual inflation rate	2.7054	9.8449	0.3608
Chi-square distribution	Most recent inflation rate	1.6905	5.6456	0.2732

	Linear interpolation	1.8500	5.0477	0.2584
	Running mean of inflation	1.9360	6.3207	0.2891
	Mean of the actual inflation rate	1.5259	3.4798	0.2145
Stable Distribution		1.3933	2.9161	0.0504
Balance Method		17.7834	480.3493	2.5204
Regression Method		1.1807	2.0375	0.1635

Table 1. Three Statistical Criteria to compare the Quantification Methods

$$*MAE = \sum_{t=1}^{n} \left| P_t - P_t^e \right| / n \ ,$$

$$** MSE = \sum_{t=1}^{n} \left(P_t - P_t^e \right)^2 / n \ ,$$

$$** TU1 = \left[\sum_{t=1}^{n} \left(P_t - P_t^e \right)^2 \Big/ \sum_{t=1}^{n} (P_t)^2 \right]^{1/2} \ ,$$

where P_t and P_t^e denote actual inflation and inflation expectations respectively.

Figure 1 illustrates the expectations derived via different distributions. It can be concluded that the best fit to actual values of inflation can be attained by the expectations derived from Stable distribution. Table 1 supports this claim.

The question of price expectations in CTS has five categories. The proportions are added in order to get three-category options. 'Fall' option is equal to ${}_tA_{t+1}$, 'Same' option is equal to ${}_tB_{t+1}$ and 'Rise' option is equal to ${}_tC_{t+1}+ {}_tD_{t+1}+ {}_tE_{t+1}$. After having three-option categories, the model given in equation (4) is applied. The question of inflation perceptions does not exist in CTS, so the regression model is constructed for the expected inflation question. The results are given in Table 2 and Figure 2.

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Fig. 1. Quantified Expectations by Carlson-Parkin Method

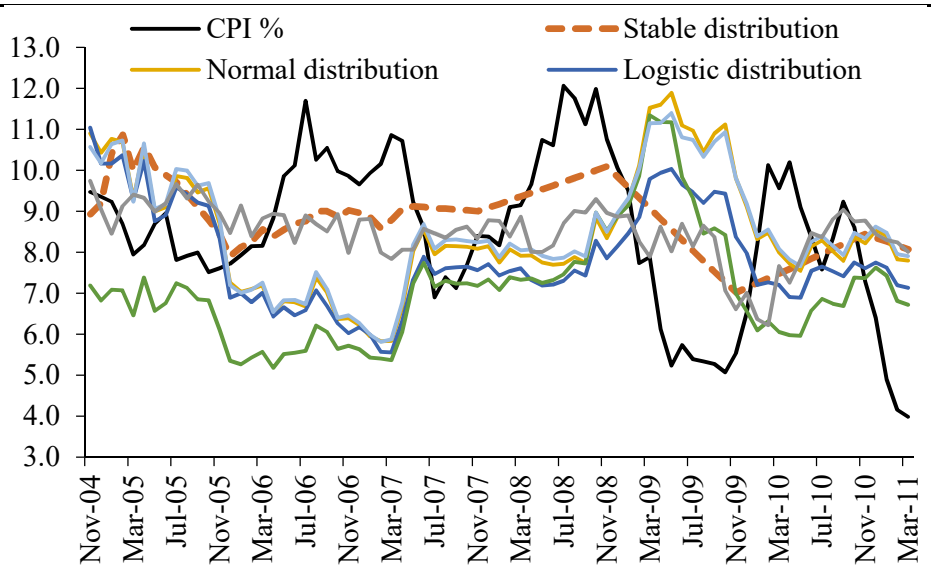

Table 2. Regression Model

Coefficient	Pesaran AR(12) Correction
α	-0.076*
β	-0.164*
λ	2.033*
ρ	-0.624*
R^2	0.49

* Significant at 5 % level.

12-month lagged inflation rate is used in order to avoid overlapping of periods for the error term. All the parameters in the model are found to be significant.

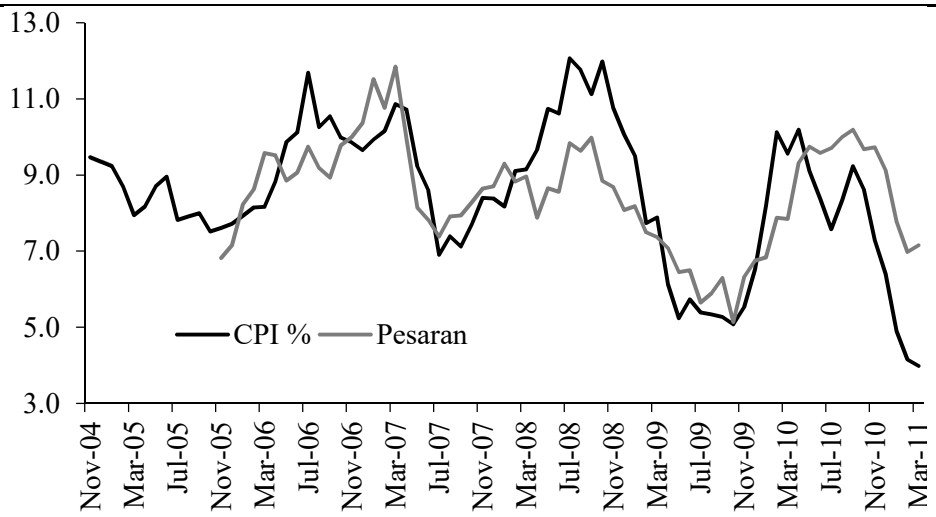

Fig. 2. Quantified Expectations by Regression Method

The balance method can be seen in Figure 3. The figure indicates that there is no similar pattern with realizations in tendency. However, it should be mentioned that this statistic can only give information about tendency instead of quantity of inflation expectations.

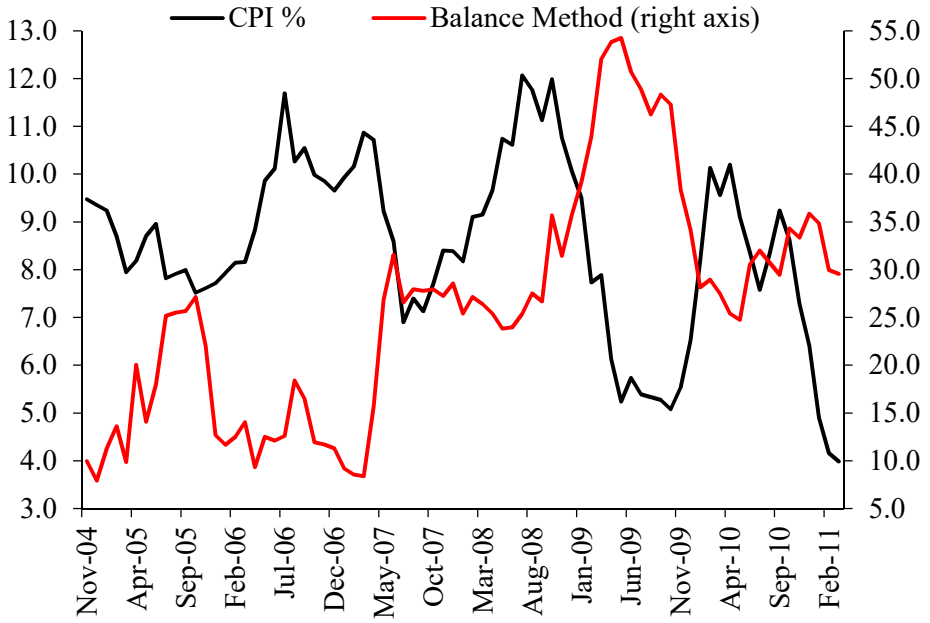

Fig. 3. Quantified Expectations by Balance Method

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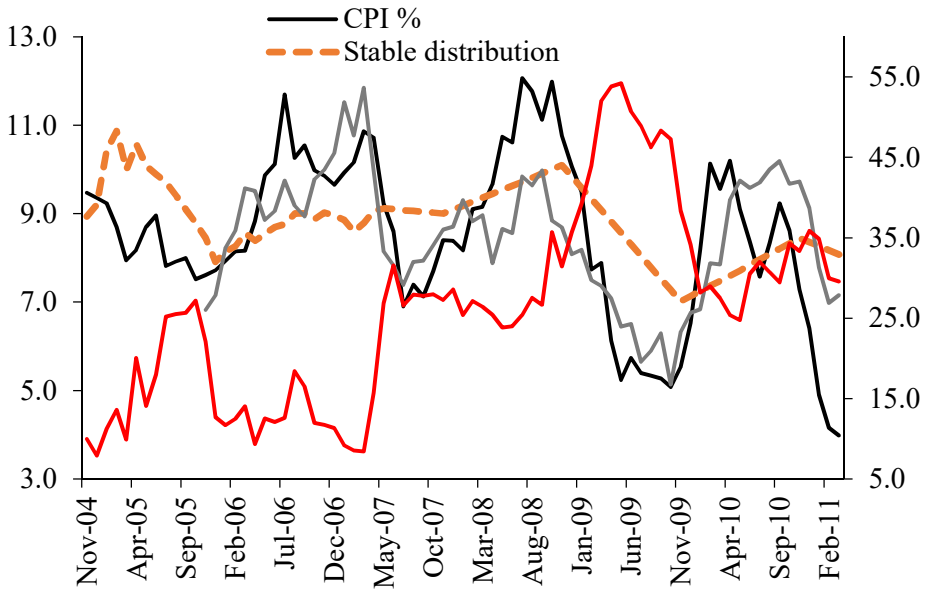
The comparisons of the models can be seen in Figure 4. The best model for quantified price expectations can be said to be the regression model.

Fig. 4. Comparisons of Expectations obtained by Different Methods



The official inflation rate for the period between November 2004 and March 2011 is considered with the aim of investigating the performances of the quantification methods at different time periods. I divide the data into two parts such as the first 20 observations and the remaining ones. I calculate the standard deviations of each portion and take the differences of the standard deviations. Then I roll the sample and keep calculating the differences for the other following samples. After calculating for entire sample, I choose the split date as "April 2008" according to the comparison of the differences. This month has the maximum value for difference. The 1st period to be analyzed now becomes November 2004-April 2008 and the 2nd period is May 2008-March 2011. I compare each method due to these two periods separately.

Table 3a. Comparisons of Quantification Methods for the 1st Period

Quantification Methods		**MAE**	**MSE**	**TU1**
Probability Method	**Threshold Parameter**			
Normal Distribution	Most recent inflation rate	2.4113	9.8457	0.3500
	Linear interpolation	2.4561	9.1789	0.3379
	Running mean of inflation	1.8955	5.4857	0.2612
	Mean of the actual inflation rate	2.1930	7.1621	0.2985
Uniform Distribution	Most recent inflation rate	2.4489	9.9670	0.3521
	Linear interpolation	2.4668	9.2093	0.3385
	Running mean of inflation	1.9175	5.5777	0.2634
	Mean of the actual inflation rate	2.2014	7.1506	0.2983
Logistic Distribution	Most recent inflation rate	2.5331	10.5943	0.3630
	Linear interpolation	2.6447	10.1792	0.3559
	Running mean of inflation	1.9500	5.9357	0.2717
	Mean of the actual inflation rate	2.3623	8.0503	0.3165
Central-t distribution	Most recent inflation rate	2.3653	9.6710	0.3469
	Linear interpolation	2.4238	9.0448	0.3354
	Running mean of inflation	1.8777	5.3933	0.2590
	Mean of the actual inflation rate	2.1674	7.0731	0.2966
Chi-square distribution	Most recent inflation rate	2.3795	9.7245	0.3478
	Linear interpolation	2.4344	9.0885	0.3362
	Running mean of inflation	1.8825	5.4195	0.2597
	Mean of the actual inflation rate	2.1761	7.1031	0.2973
Balance Method		9.6913	153.9728	1.3840
Regression Method		0.6970	0.6779	0.0900
Stable Distribution		1.4002	2.2608	0.0502

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Table 3b. Comparisons of Quantification Methods for the 2nd Period

Quantification Methods		**MAE**	**MSE**	**TU1**
Probability Method	**Threshold Parameter**			
Normal Distribution	Most recent inflation rate	4.3438	23.1122	0.5751
	Linear interpolation	3.2794	13.5539	0.4404
	Running mean of inflation	2.9036	11.8443	0.4117
	Mean of the actual inflation rate	2.8750	10.2969	0.3838
Uniform Distribution	Most recent inflation rate	4.4834	24.7845	0.5955
	Linear interpolation	3.4202	14.9645	0.4627
	Running mean of inflation	3.0323	13.0578	0.4322
	Mean of the actual inflation rate	2.9976	11.1971	0.4003
Logistic Distribution	Most recent inflation rate	4.0552	19.2497	0.5248
	Linear interpolation	3.1037	11.8053	0.4110
	Running mean of inflation	2.6344	8.7327	0.3535
	Mean of the actual inflation rate	2.7218	9.6969	0.3725
Central-t distribution	Most recent inflation rate	4.2293	21.8615	0.5593
	Linear interpolation	3.1641	12.4928	0.4228
	Running mean of inflation	2.7966	10.9738	0.3962
	Mean of the actual inflation rate	2.7762	9.5970	0.3706
Chi-square distribution	Most recent inflation rate	4.2616	22.2051	0.5637
	Linear interpolation	3.1966	12.7846	0.4277
	Running mean of inflation	2.8269	11.2093	0.4005
	Mean of the actual inflation rate	2.8042	9.7910	0.3743
Balance Method		27.4939	872.0010	3.5322
Regression Method		1.0074	1.3709	0.1621
Stable Distribution		2.0585	5.7129	0.0738

The comparison results given in Tables 3a and 3b make us rely on that regression method outperforms the remaining methods for each period.

Therefore, it can be concluded that for different periods, we can still choose regression method as best for quantification purposes.

I also calculate 1-step ahead (static) forecasts for the expectations derived by regression method. I compare these forecasts with forecasts of Naive Expectations which are the expected inflation series equal to the current rate of inflation. I measure 1-step ahead forecasts in both ways such as rolling and recursive windows for the regression method. The comparisons of different methods are given in Table 4. In line with the results, recursive window forecasts via regression method performs better than naive expectations for 1-step ahead forecast.

Table 4. Comparisons of 1-step ahead forecasts

Methods	**MAE**	**MSE**	**TU1**
Regression Method (rolling window forecast)	3.07	12.19	0.42
Regression Method (recursive window forecasts)	3.03	11.75	0.41
Naive Expectations	3.52	15.59	0.47

Formation of Turkish Consumer Inflation Expectations

The expectations have been important issue in macroeconomics for many years. Since the way in which expectations are formed has important implications for economic behaviour, many economists have used survey data to test hypotheses about expectation formation (Keane & Runkle, 1990). What is of concern for monetary policy makers are signs that expectations have become de-anchored, which we can interpret as being the case if the public reacts to a short period of higher-than-expected inflation by increasing their long-run expectations. Measuring when inflation expectations have become de-anchored is undoubtedly not easy. One of the problems is that how individuals form expectations is not known. Indeed, it is probably impossible to generalize, as individuals are likely to form their expectations using different information sets, relying on different models. Driver and Windram (2007) found that some households may form their expectations based on a structural relationship, such as the trade-off between inflation and unemployment or demand; others may use an empirical approach, such as their recent memories of inflation data. Furthermore, people may be entirely forward looking or entirely backward looking, or a combination of both.

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The expectation formation models in the literature range from simple, purely backward-looking to explicitly modeling learning processes to the hypothesis of perfectly rational expectations (Pesaran, 1989). Backward-looking models assume that agents use only past price developments and earlier forecast errors to form expectations while other influences are disregarded. Muth (1961) assumes that the subjective expectations of economic agents match the predictions of the relevant economic theory in his "rational expectations" hypothesis. Thus, a crucial feature of his definition of rational expectations is that economic agents do not make systematic errors. Many critics have pointed to the importance of information problems and have stressed the need to take into account the costs of making optimal forecasts and also to explicitly model learning processes. However, since its adoption by Lucas (1972, 1975), Sargent (1973), Barro (1977) and others, the rational expectations hypothesis has become one of the broadly accepted paradigms of macroeconomic analysis.

The non-linear regression model is found to be the best model to measure inflation expectations; hence the analyses in this section will be based on the expectations attained via this model.

As an initial point before the econometric analyses, detailed information about inflation expectations and official inflation can be given as follows: CBRT followed an implicit inflation targeting regime starting from 2002 until the end of 2005 and announced a year-end upper limit for the inflation target. These applications made the credibility and transparency of the new regime increase and the actual yearly inflation was able to be kept below the level of the targets for the years 2004 and 2005 (Figure 5). The bank started to have fully-fledged inflation targeting in 2006 and announced its 3-year inflation target. The announced inflation targets are on annual basis. Thus, linear interpolation is used for calculating credibility gap on monthly basis which is the difference between inflation expectations and inflation targets. According to the graph of the credibility gap, it can be seen that the inflation expectations was close to the target values during this period (Figure 6). However, they started to deteriorate due to supply shocks and unfavorable international and domestic conditions after 2006. International financial turmoil at the period May-June 2006 had the most noticeable influence on expectations. Consumers seemed to believe in the target inflation until 2006, but after that time, their expectations deteriorated. The credibility gap started to increase and attained the

highest value in March, 2007. That indicates that the consumers were affected by the actual inflation which was 9.7 percent quite above the target value of 5 for the year 2006. The financial crisis of 2007-2008, also known as the global financial crisis hit harder Turkey's economy. The credibility gap was fairly large during that period due to this financial crisis. Then it declined starting from September 2008. The reason for this decline was the decrease in actual inflation for the years 2009-2010. It can be seen that the inflation was kept below the targets again for these years. As a result, it can be said that when the targets were hit, consumers had a tendency to believe in the targets. On the other hand, those periods when the targets could not be achieved, consumers became pessimistic and expected high rates of inflation. It can be concluded that increase in inflation rate has impact on not only the credibility of CBRT but also the inflation expectations. An increase in the inflation rate deteriorates the credibility of the bank and the diminished credibility worsens the inflation expectations.

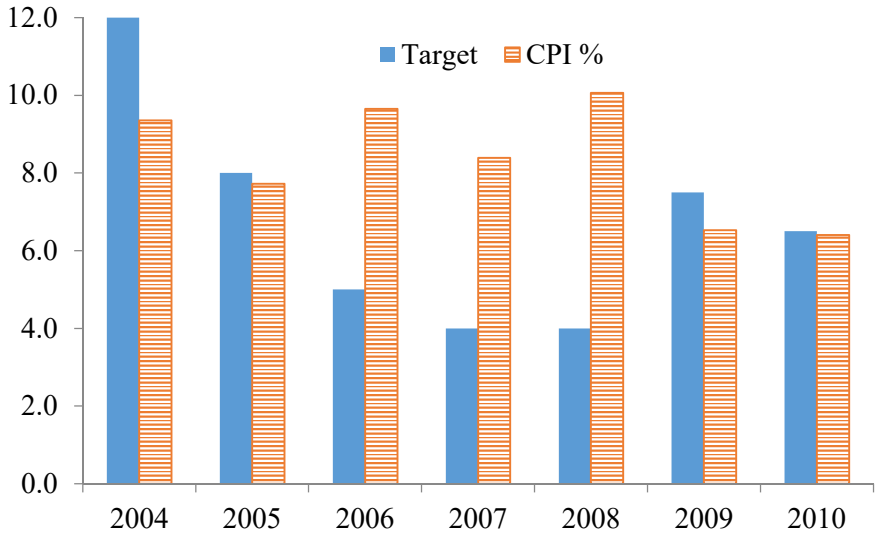

Fig. 5.
Actual Inflation and Inflation Targets

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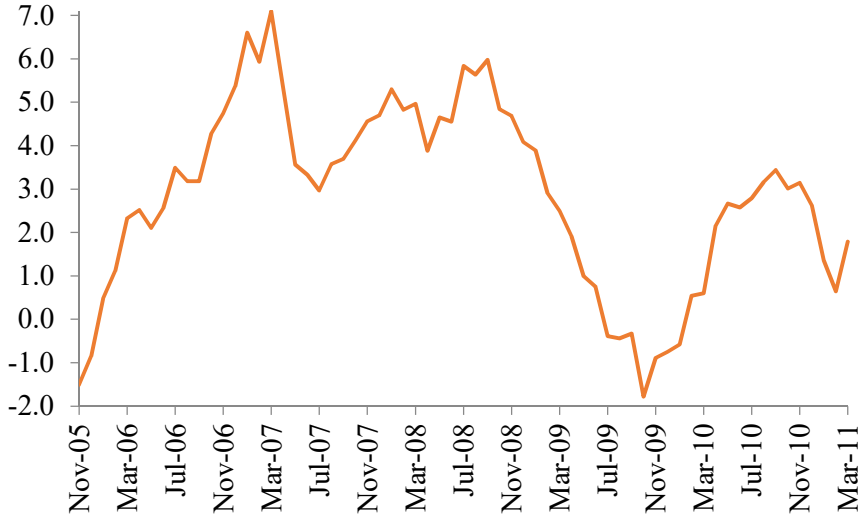
Fig. 6.
Credibility Gap



To begin with the econometric analyses, the time series have to be tested for a unit root before further analysis. Standard Augmented-Dickey-Fuller (ADF) tests are applied. Lag lengths are chosen according to Schwarz Information criterion (SIC). The results of these tests are presented in Table 5. It can be concluded that actual year on year inflation and expected inflation have unit root (they are both I(1)).

Table 5.
Unit root tests for analyzed time series

Variable	lags	Test-statistic	Probability*	Result
π_t^e	0	-2.152	0.2257	I(1)
π_t	2	-2.798	0.0679	I(1)
$\Delta\pi_t^e$	1	-4.339	0.0009	I(0)
$\Delta\pi_t$	0	-4.851	0.0002	I(0)

* MacKinnon one-sided p-values.

Since both actual inflation and consumer inflation expectations are non-stationary, the cointegration between these variables is tested. Before the cointegration test is applied, I obtain the optimal lag-lengths for the VAR process via VAR lag order selection criteria. Lags 1, 2 and 11 can be chosen due to different criteria such as Likelihood-Ratio Test (LR), Final Prediction Error (FPE), Hannan-Quinn (HQ), Akaike (AIC) and

Schwarz information (SC). The results of the Johansen test are given in Table 6:

Table 6. Results of the Johansen test

Lag length	Criterion	Null hypothesis	Trace-statistic	Prob.*
1	SC, HQ	r=0	10.55	0.585
		r=1	3.06	0.569
11	LR, FPE	r=0	30.52	0.001
		r=1	6.51	0.155
12	AIC	r=0	12.32	0.420
		r=1	4.79	0.308

* MacKinnon-Haug-Michelis p-values. The null hypothesis that the cointegration rank r is zero.

The null hypothesis that the cointegration rank r is zero can be rejected at lag 11 showing that there is one cointegrating equation at 5% significance level.

In an effort to determine the short run causality among the two variables, Granger Causality/Block Exogeneity Wald Tests based upon VEC model is applied. The results of Table 7 show that short run causality is from the inflation to inflation expectations.

Table 7. VEC Granger Causality/Block Exogeneity Wald Tests

Dependent Variable	Excluded	Chi square statistic	Degrees of freedom	Prob.
$\Delta\pi_t$	$\Delta\pi_t^e$	10.50	11	0.486
$\Delta\pi_t^e$	$\Delta\pi_t$	40.48	11	0.000

I also perform Granger causality tests between change in inflation expectations and unobserved future change in the inflation rate (Table 8). The results show that the changes in future inflation rate Granger cause inflation expectations but not the other way. In other words, expectations are actually somewhat forward looking. However, past changes in inflation expectations do not have any significant effect on changes in the inflation rate.

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Table 8. Granger Causality Tests*

Expectation Versus Future Inflation	F-statistic	Probability
Change in inflation expectations formed at time t-11 ($\Delta\pi_t^e$) does not Granger Cause change in the inflation rate at time t ($\Delta\pi_t$)	1.128	0.379
Change in the inflation rate at time t ($\Delta\pi_t$) does not Granger Cause change in inflation expectations formed at time t-11 ($\Delta\pi_t^e$)	8.453	0.000

* Lag length is chosen as 12.

Additionally, the variables are tested for weak exogeneity in order to test whether the cointegration relation is significant for both endogeneous variables or not. The results can be seen in Table 9.

Table 9. Weak Exogeneity Test

Analyzed Variable	Lag length	Chi square statistic	Prob.
$\Delta\pi_t$	11	0.85	0.356
$\Delta\pi_t^e$	11	17.49	0.000

The test-statistics point out that the hypothesis of weak exogeneity can be rejected for the expected inflation rate, but not for the actual inflation rate. Consequentially, error correction model can be estimated for the expected inflation rate as dependent variable.

The long-run relationship between consumer inflation expectations and actual inflation (standard errors in parentheses) can be given as:

$$\pi_t^e = \underset{(3.773)}{-13.093} + \underset{(0.429)}{2.464}\,\pi_t + \varepsilon_t \quad \text{(Sample: 2006:11-2011:03)}$$

Trace test indicates 1 cointegrating equation(s) at 5% level

Max-eigenvalue test indicates 1 cointegrating equation(s) 5% level

The cointegrating vector should have a null constant term and opposite coefficients for expected and actual inflation under the rational expectations hypothesis (unbiasedness assumption). The joint restriction of a unit coefficient and zero constant within VECM is rejected with Chi-Square statistic and probability value equal to 12.11 and 0.0005

respectively. It can be concluded that the expectations are not unbiased. Consequently, the expectations are said to be not rational.

After rejecting a rational model of the formation of inflation expectations, hybrid model of expectations formation is considered for the purpose of measuring the formation, where expectations are comprised of not only forward-looking but also backward-looking portions (Lyziak, 2012).

Following the inflation expectation equation presented in Heinemann and Ullrich (2006), which is an extended version of Carlson and Valev (2002) and Gerberding (2001), the inflation expectations model can be represented in such a way as to contain both forward (rational) and backward-looking elements as in equation below:

$$\pi_t^e = \beta_1\pi_t + (1-\beta_1)\left[\pi_{t-12}^e + \beta_2(\pi_{t-12}^e - \pi_{t-12}) + \beta_3(\pi_{t-12} - \pi_{t-23}) + \beta_4(\pi_{t-1}^e - \pi_{t-12}^e)\right] + \varepsilon_t \quad (5)$$

In this formulation, expectation formation can be partially characterized as rational, while the backward looking perspective still plays a role. The relative importance of the rational versus adaptive components of expectations is measured by β_1, where expectations are considered fully rational if β_1=1. This equation is rather flexible in incorporating adaptive nature of expectations such that β_2 measures agents' speed of adjustment to their past forecast errors, while β_3 and β_4 measure the weights of the regressive part of expectations formation.

Equation (5) which was presented in constrained form is re-estimated in unconstrained form in equation below by allowing the sum of the rational and adaptive terms to be different from one.

$$\pi_t^e = \beta_1'\pi_t + \beta_2'\pi_{t-12}^e + \beta_3'(\pi_{t-12}^e - \pi_{t-12}) + \beta_4'(\pi_{t-12} - \pi_{t-23}) + \beta_5'(\pi_{t-1}^e - \pi_{t-12}^e) + \varepsilon_t \quad (6)$$

It is seen in Table 10 that the estimated coefficient for the future inflation is 0.11 in the 1st column. The hypothesis of pure backward-looking expectations is therefore rejected. The coefficient of the past inflation expectation however is much bigger (0.89) representing the strong backward looking nature of expectations in the long run. Therefore, the pure forward-looking expectations hypothesis is also rejected. In addition, expectations are found to be highly regressive with the

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coefficient 0.73. The impact of the change in past inflation on the formation of expectations is, however, unexpectedly small and has a negative sign. The structure of the expectations does not change when we constrain the sum of the coefficients of forward and backward looking elements to be equal to one (Table 11).

Table 10. Structure of Expectations (Unconstrained Model)

Coefficients		
π_t	0.11** (1.824)	0.12** (1.944)
π^e_{t-12}	0.89* (16.526)	0.87* (16.078)
$(\pi^e_{t-12} - \pi_{t-12})$	0.07 (0.712)	-
$(\pi_{t-12} - \pi_{t-23})$	-0.11 (-1.423)	-0.12** (-1.837)
$(\pi^e_{t-1} - \pi^e_{t-12})$	0.73* (8.682)	0.72* (9.337)
R^2	0.82	0.82

* Significant at 5 % level.
** Significant at 10 % level.

Table 11. Structure of Expectations (Constrained Model)

Coefficients		
π_t	0.11** (1.984)	0.13* (2.322)
$(\pi^e_{t-12} - \pi_{t-12})$	0.10 (1.074)	-
$(\pi_{t-12} - \pi_{t-23})$	-0.11 (-1.609)	-0.13** (-1.978)
$(\pi^e_{t-1} - \pi^e_{t-12})$	0.83* (8.285)	0.83* (8.270)
R^2	0.82	0.81

* Significant at 5 % level.
** Significant at 10 % level.

Conclusion

A new era began in Turkey in terms of fiscal and monetary policies following the financial and currency crisis in 2001. On the fiscal front,

Turkey initiated a set of policies aiming to reduce the public deficit to acceptable levels. On the monetary front, policy switched from a fixed exchange rate to an inflation targeting regime. In this new regime, inflation expectations play a valuable dual role. On the one hand, the new monetary policy emphasizes the need to manage public expectations to curtail inertia in inflation dynamics by switching economic agents' inflation expectations from a backward to a forward-looking perspective, in order to reduce the inflation rate rapidly. By monitoring the credibility gap of the monetary policy, the gap between the inflation target and inflation expectations, the central bank may see how successful it is in anchoring inflation expectations that were damaged by a past history of high inflation rates. On the other hand, agents' inflation expectations may contain some information regarding a future path of inflation that is unknown to the central bank. The success of the inflation-targeting regime crucially depends on a central bank's ability to foresee changes in inflation rates due to long lags in the monetary transmission channel. Thus, inflation expectation surveys may be a valuable source for central banks to collect information regarding the prospect of inflation rates (Oral et al., 2011).

This paper has attempted to analyze the qualitative inflation expectations gathered from the Consumer Tendency Survey data. The survey results are examined and the qualitative inflation expectations are quantified by using different methods such as Carlson-Parkin method, balance method, regression method. These methods are compared by using several statistical criteria, like mean square error, mean absolute error and Theil's inequality coefficient.

Carlson-Parkin method is applied for the pentachotomous survey question. In this approach, one advantage is that the scaling parameter is not estimated by imposing unbiased expectations. Another advantage is that the thresholds are permitted to vary over time. Different distributions are applied and expectations obtained by Stable distribution show the best performance due to statistical criteria. The balance method is applied and it is found that consumers are backward-looking. Thirdly, nonlinear regression model is constructed to get the inflation expectations series.

Finally, the expectations derived from three different techniques are analyzed and the nonlinear regression model is found to be the closest one to realizations. The inflation expectations derived from the nonlinear regression model is used in order to analyze the formation of inflation

expectations. Actual inflation and inflation expectations are found to have a cointegration relation. Unbiasedness assumption under Rational Expectations Hypothesis is rejected within VECM. Hence, hybrid model of expectations formation is constructed. One important result attained from the model is that the hypothesis of pure backward-looking expectations is rejected. The coefficient of the past inflation expectation however is much bigger that indicates the strong backward looking nature of expectations in the long run. Therefore, the pure forward-looking expectations hypothesis is also rejected. In addition, expectations are found to be highly regressive. As a remark, the impact of the change in past inflation on the formation of expectations is quite small. However, it can be concluded that an increase in inflation rate has direct effect on the credibility of CBRT and indirect effect on the inflation expectations. An increase in the inflation rate deteriorates the credibility of the bank and the weakened credibility worsens the inflation expectations.

Notes

1. All the views expressed in the study are those of the author and should not be attributed to the Central Bank of the Republic of Turkey.

2. Target inflation rate is also used instead of future inflation rate in Equations (5) and (6). In the unconstrained form, the target inflation rate is found to be statistically significant with a coefficient 0.20. It is available upon request from the author.

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