INFLATION EXPECTATIONS DERIVED FROM BUSINESS TENDENCY SURVEY OF THE CENTRAL BANK

Ece Oral
Statistics Department
Central Bank of The Republic of Turkey
Ece.Oral@tcmb.gov.tr

ABSTRACT

The expectations obtained from surveys play an important role as leading indicators for the application of the monetary policies. The expectations can be either qualitative or quantitative. The qualitative inflation expectations are gathered from the Business Tendency Survey that is conducted by the Central Bank of the Republic of Turkey. Different methods like Carlson-Parkin method, Balance method, Nonlinear regression method are used to quantify the expectations. The quantification methods are compared with each other. The reliability of the Business Tendency Survey of the Central Bank is also reviewed. The Cronbach α coefficient is used to find the reliability and the survey is found to be highly reliable. Besides, the rationality of the inflation expectations is tested and the formations of the expectations are examined. The formation of inflation expectations is investigated and a proper model cannot be found.

Keywords: Inflation Expectations, Quantification of Survey Data, Reliability, Rationality of Expectations.

JEL classification: C42

1-Introduction

The expectations obtained from surveys place an important role as leading indicators for the application of the monetary policies. The Business Tendency Survey (BTS) of the Central Bank of the Republic of Turkey has been conducted monthly in order to get the opinions for the past and future economic conditions of the directors, managers of the firms that guide the decisions on economy since December 1987. The respondents are chosen on the basis of Istanbul Chamber of Industry's ranking of the 100 biggest firms and Ege Chamber of Industry's ranking of the 500 biggest firms. The respondents consist of the firms from the private and public sectors. The sectors comprise mining, food, textiles, wood, paper products, chemicals, stone, metals, machinery and energy. The respondent firms from the public sector are 7 percent of the total respondents. The number of respondents have been 1194 since November 2001. The survey consists of questions about the general course of business in the industry, investments, sales, productive capacity, capacity utilization, stocks, inflation rates and Turkish lira credit interest rates. BTS consists of 34 questions, 25 of which are dealed with the tendency of past and future economic conditions, 5 with the ordering of several factors and 4 with inflation rate and Turkish lira credit rates. The question on expected inflation (wholesale prices) over the next three months has been added to the questionnaire in May 1997 and the other questions about expected inflation and Turkish lira credit interest rates have been added in January 1999 and May 2000, respectively. The opinions of the firms can show the positive and negative effects of the economic policies and act as a guide for the determination of what should be done to improve the economy. Like the other tendency surveys, BTS helps to see the economic activity performance of the manufacturing industry.

There are different methods to quantify the qualitative survey results. The main aim of this paper is to quantify the inflation expectations of the private sector and to examine the formation of expectations. The study is composed of five sections. The aims of the study and the detailed knowledge about BTS are presented in the introduction part. The retest of the reliability of the BTS (Özcan, 1991) are given in the second section. The third section gives the explanation of the quantification methods. The quantified inflation expectations are given in the fourth section. The formation of inflation expectations is examined in the fifth section. Finally, the conclusion part gives the final results.

2- The Reliability of Business Tendency Survey (BTS)

It is desired that the test scores of surveys should be consistent. If the test (questionnaire) scores differ when the surveys are repeated under the same conditions, the reliability of the test will be low (Özgüven, 1998). The reliability analysis is performed in order to find the degree of association between questions of a test when one person's knowledge and attitude to an event is found by adding his test scores. Each question of a test should be useful to explain an event. This can happen when questions are highly correlated with each other. The reliability measures can be found by using the correlations and covariances. The measures of reliability are:

Split Half:

The questions in the test are divided into two parts and the correlation between these two parts are found.

Guttman Coefficient:

There are six coefficients to be found. These coefficients take values less than or equal to the real reliability coefficient. The reliability of the test is found by using covariances or variances.

Parallel:

The equality of the variances of the questions is assumed and the reliability coefficient of 'The Biggest Similarity' is estimated. The Chi-Square test is used to analyse the estimates to be significant or not.

Cronbach α Coefficient:

The coefficient is the weighted mean of standard deviation that can be found by taking the ratio of sum of the variances of questions to the overall variance. The coefficient takes values between zero and one. If the questions are standardized, the coefficient will be based on the mean of the correlations or covariances of the questions (Özdamar, 1997). The α coefficient is given below (Özcan, 1991; Özgüven, 1998):

$$R = \alpha = \left\{ \frac{n}{n-1} \right\} \left\{ 1 - \frac{\sum_{i=1}^{n} \sigma_i^2}{\sigma^2} \right\}$$

where

R= Reliability coefficient, α = Cronbach α Coefficient, n = The total number of questions

σ_i^2 = Variance of the ith question, σ^2 = Overall Variance

The intervals of the α coefficient and the degree of reliability can be given as follows:

$0.00 \leq \alpha \leq 0.40$ shows that test is not reliable.

$0.40 \leq \alpha \leq 0.60$ shows that test is less reliable.

$0.60 \leq \alpha \leq 0.80$ shows that test is quite reliable.

$0.80 \leq \alpha \leq 1$ shows that test is highly reliable (Özdamar,1997).

The reliability of BTS is tested on the data of 523 firms of the private sector in February 2002. The first 23 questions are used for the reliability analysis. The answers of the questions have the formation as qualitative and ordinal choices so Likert scale is used (Özcan, 1991; Moser & Kalton, 1972). The scaling is done by giving the biggest score to the most optimistic answer and the smallest to the most pessimistic answer.

Cronbach α coefficient is used for the reliability coefficient. The cronbach α coefficient is found as 0.8156 that shows BTS to be highly reliable. Item(question)-Total correlations are investigated and it is observed that the questions 5, 7, 8, 11, 18, 20, 21,22 and 23 have low correlations changing between -0.0847 and 0.2026. According to this result, it can be said that these questions are irrelevant and should be deleted. There is need to examine the reliability coefficient when item is deleted. If the reliability coefficient decreases, the item is important for the test; otherwise the item should be deleted. When all the analyses are done, it is seen that the questions that are found to have low correlations are irrelevant for the survey. When these questions are deleted, the reliability coefficient increases by the interval 0.0004-0.0151. The increment is too little so there is no need to delete these questions.

The questions added to the survey later (29^{th} and 32^{nd} questions) are added to the analysis to see the change afterwards in the reliability coefficient of the survey. The Cronbach α coefficient is used again to find the coefficient of reliability of BTS. Item-Total correlations are investigated and similar results are obtained. Cronbach α coefficient is found as 0.8166 which shows BTS to be highly reliable when new questions are added.

3-Quantification of the Qualitative Expectations From Surveys

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). The calculation of quantitative inflation expectations from the sample proportions of three-category responses (prices will fall, rise or remain unchanged) is based on the following assumptions:

- the proportion of positive price changes will be approximately equal to the proportion of 'rise' answers of firms.
- the proportion of no price changes will be approximately equal to the proportion of 'no change' answers of firms.
- the proportion of negative price changes will be approximately equal to the proportion of 'fall' answers of firms.

Let the proportion of answers are given as:

A_t=Proportion of 'rise' answers of firms

B_t=Proportion of 'no change' answers of firms

C_t=Proportion of 'fall' answers of firms

such that $A_t+B_t+C_t=1$.

Let X be the continuous random variable that shows the expected rate of price changes. There should be a 'no price change' interval which is called 'indifference interval'. This interval lies between small negative and positive values (Uygur, 1989). Seitz (1988) has this interval as nonsymmetric and defined δ_m (lower limit) and δ_p (upper limit). Carlson and Parkin (1975) have this interval as symmetric and defined as $\delta_m=\delta_p=\delta$, so the range of no change will be $-\delta$ and δ. It is thought that δ denotes the percentage that corresponds to a just perceptible expected price rise, $-\delta$ a just perceptible expected price fall and the interval $(-\delta,\delta)$ no change in prices.

Let X is standardized and Y be the transformed variable. Then,

$$A_t = 1-\int_{-\infty}^{\delta(t)} f(x)dx = 1-\int_{-\infty}^{z_2(t)} f(y)dy$$

$$C_t = \int_{-\infty}^{-\delta(t)} f(x)dx = \int_{-\infty}^{z_1(t)} f(y)dy$$

Let the expected value and the variance of the random variable X given as $E(X)=\mu$ and σ^2, respectively. These parameters can be estimated as shown below:

$$C_t = p(X<-\delta(t)) = p\left(\frac{X-E(X)}{\sigma} < \frac{-\delta(t)-E(X)}{\sigma}\right) = p(Y<z_1(t))$$

$$1-A_t = p(X<\delta(t)) = p\left(\frac{X-E(X)}{\sigma} < \frac{\delta(t)-E(X)}{\sigma}\right) = p(Y<z_2(t))$$

The equations above are used and the following equations are found:

$$z_1(t) = \frac{-\delta(t)-E(X)}{\sigma} \ , \ z_2(t) = \frac{\delta(t)-E(X)}{\sigma}$$

Then the equations $z_1(t)\sigma = -\delta(t) - E(X)$, $z_2(t)\sigma = \delta(t) - E(X)$ are solved and expected value and variance can be found as:

$$(E(X))_t = -\delta(t)\frac{[z_1(t)+z_2(t)]}{[z_2(t)-z_1(t)]}, \quad \sigma_t^2 = \left[\frac{2\delta(t)}{[z_2(t)-z_1(t)]}\right]^2 \tag{1}$$

It is important to decide on the distribution of X and the value of the indifference interval. The mostly used distributions for X are uniform, normal and logistic distribution. If X is normally distributed, then Y will be distributed as standard normal and $z_1(t)$, $z_2(t)$ will be found by using the inverse cumulative distribution function of the standard normal distribution (Uygur,1989). Assume that X is distributed uniformly with parameters u and v. Then, $z_1(t)$ and $z_2(t)$ are found as:

$$z_1(t) = \left(C_t - \frac{1}{2}\right)\sqrt{12} \text{ and } z_2(t) = \left(\frac{1}{2} - A_t\right)\sqrt{12}.$$

The expected value and the variance can be found as:

$$(E(X))_t = -\delta(t)\frac{[C_t - A_t]}{[1-A_t-C_t]} \ , \ \sigma_t^2 = \left[\frac{2\delta(t)}{[1-A_t-C_t]\sqrt{12}}\right]^2$$

Let X has the logistic distribution with parameters θ and η. Then, we get $z_1(t) = -\ln\left(\frac{1}{C_t}-1\right)\frac{\sqrt{3}}{\pi}$ and $z_2(t) = \ln\left(\frac{1}{A_t}-1\right)\frac{\sqrt{3}}{\pi}$. The expected value and the variance can be found as:

$$(E(X))_t = -\delta(t)\left(\frac{-\ln((1/C_t)-1)+\ln((1/A_t)-1)}{\ln((1/A_t)-1)+\ln((1/C_t)-1)}\right), \ \sigma_t^2 = \left[\frac{2\delta(t)}{\ln((1/A_t)-1)+\ln((1/C_t)-1)}\right]^2 * \frac{\pi^2}{3}$$

Carlson and Parkin (1975), Batchelor (1982, 1986) and Pesaran (1985), propose a value for $\delta(t)$ by using the assumption that over the whole sample period the averages of expectations and price change realizations are equal (unbiasedness). The estimated value of δ is given below:

$$\hat{\delta} = \frac{\sum_{t=1}^{T} p_t}{\sum_{t=1}^{T} \left(\frac{z_1(t) + z_2(t)}{z_1(t) - z_2(t)} \right)} \qquad (2)$$

where $p_t = \frac{P_t - P_{t-12}}{P_{t-12}} * 100$ and P_t is the retail price index reported for month t.

Danes (1973) has p_t as the one quarter percentage changes in price deflator for non-farm gross national product. Knöbl (1974) states to have an arbitrary value for δ. Peker and Tutuş (1999) use the standard deviation of of actual inflation rate in the private manufacturing sector for the value of δ. Pesaran (1987) proposes additional models for the value of δ when there are data on the present price movements. The quantification of the present price movements of the firms is found similar to the future expectations. Then $z_1(t)$, $z_2(t)$, p_t for the present prices are defined as $z_1'(t)$, $z_2'(t)$, p_t' and we get

$$p_t' = \delta(t) \left(\frac{z_1'(t) + z_2'(t)}{z_1'(t) - z_2'(t)} \right) \qquad (3)$$

The ordinary least squares are applied to equation in (3) and the estimated value of δ is obtained. Then, this value is used in equation in (1) to find the expectations. Let $d_t = \left(\frac{z_1'(t) + z_2'(t)}{z_1'(t) - z_2'(t)} \right)$, then δ can be estimated as the ratio of the average of p_t' to the average of d_t.

Uygur (1989) proposes a nonlinear model to find the expectations without using δ(t):

$$p_t' = \left[\frac{\alpha * (z'(t)/B_t') + \beta(z'(t) * (A_t' - A_{t-1}'))}{1 - \theta * z'(t)} \right]; \qquad z'(t) = -[z_1'(t) + z_2'(t)]/2 \qquad (4)$$

where A_t' is the proportion of 'rise' answers of firms for present prices and B_t' is the proportion of 'no change' answers of firms for present prices. θ, β and α are the parameters that have to be estimated.

Then, the expected inflation can be found as:

$$(E(X))_t = \left[\frac{\alpha * (z(t)/B_t) + \beta(z(t) * (A_t' - A_t))}{1 - \theta * z(t)} \right]; \qquad z(t) = -[z_1(t) + z_2(t)]/2 \qquad (5)$$

The final method is called Balance method. The results from qualitative surveys with three-category variables are quoted as balances (differences between proportions of positive and negative responses). It is equal to $A_t - C_t$ in this study. Then the inflation expectations are equal to $(E(X))_t = k(A_t - C_t)$, where k is a scaling factor, determined by applying unbiasedness assumption and equal to $\hat{k} = \frac{\sum_{t=1}^{T} p_t}{\sum_{t=1}^{T}(A_t - C_t)}$ (Fluri and Spoerndli, 1987).

4-Quantified Expectations

The expected inflation question of BTS is 'the expectation for inflation rate (wholesale prices) over the next three months'. This question is investigated to find the inflation expectations of the private firms. The methods described above are used to find the indifference interval for the data.

4.1- The Expectations by Using Standard Deviation of Realizations

The period of the BTS data is between May 1997 and February 2002. The data are monthly, but the inflation expectations over next three months are asked so the WPI (wholesale price index based on 1994=100) are taken monthly. Let the firms are asked for their next three month inflation expectations in February. The State Institute of Statistics (SIS) publishes the WPI for January in February, so the firms only have knowledge of WPI for January. The next three months can be thought to be February, March and April. Therefore, it is assumed that the firms can guess what the average of the WPI for the next three months will be. Then the percentage change of this average value from the WPI for January is assumed to be their next three months inflation expectations. There is need of forming realizations in order to compare them with expectations, so the realizations are found by using the procedure above. The standard deviations of the realizations are found and used as the estimate of δ. The expectations according to three distributions (normal, uniform and logistic) are found for inflation rate (whole sale prices) and given in Figure 1.

Figure 1

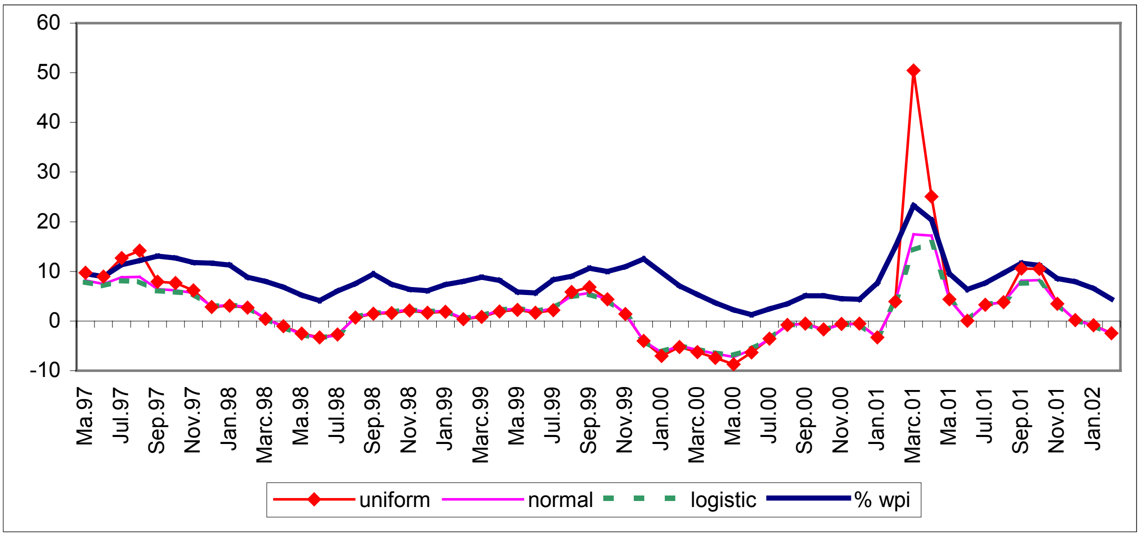

Figure 1 shows that the expectations obtained by using normal distribution are very close to the realizations compared with the expectations according to the other two distributions.

4.2- The Expectations Obtained by Nonlinear Regression

BTS contains only inflation expectations so z(t), B_t and A_t are used instead of $z'(t)$, B'_t and A'_t in equation (4).

The expectations obtained by using logistic distribution:

$$(E(X))_t = \underset{(0.000)}{7.4296} + \underset{(0.000)}{0.9923} * (z(t)/B_t) - \underset{(0.032)}{10.9134} * (z(t) * (A_t - A_{t-1}))$$

The values in the parentheses show the probabilities of the estimated values according to Newey-West HAC standard errors.

R^2:0.66, $\overline{R}^2$:0.64, Durbin-Watson stat.:0.96, White prob.:0.004, LM Test (12 lags) prob.: 0.003. ARCH LM Test (1 lag) prob.: 0.053, Jarque-Bera prob.: 0.000.

The expectations obtained by using normal distribution:

$$(E(X))_t = \underset{(0.000)}{7.4212} + \underset{(0.000)}{0.9527} * (z(t)/B_t) - \underset{(0.058)}{9.0204} * (z(t) * (A_t - A_{t-1}))$$

The values in the parentheses show the probabilities of the estimated values according to Newey-West HAC standard errors.

R^2:0.66, $\overline{R}^2$:0.65, Durbin-Watson stat.:0.94, White prob.:0.005, LM Test (12 lags) prob.: 0.002. ARCH LM Test (1 lag) prob.: 0.039, Jarque-Bera prob.: 0.000.

c) The expectations obtained by using uniform distribution:

$$(E(X))_t = \underset{(0.000)}{7.386} + \underset{(0.000)}{0.8364} * (z(t)/B_t)$$

The values in the parentheses show the probabilities of the estimated values according to Newey-West HAC standard errors.

R^2:0.67, $\overline{R}^2$:0.66, Durbin-Watson stat.:0.97, White prob.:0.132, LM Test (12 lags) prob.: 0.007. ARCH LM Test (6 lags) prob.: 0.083, Jarque-Bera prob.: 0.028.

The expectations are given in Figure 2.

Figure 2

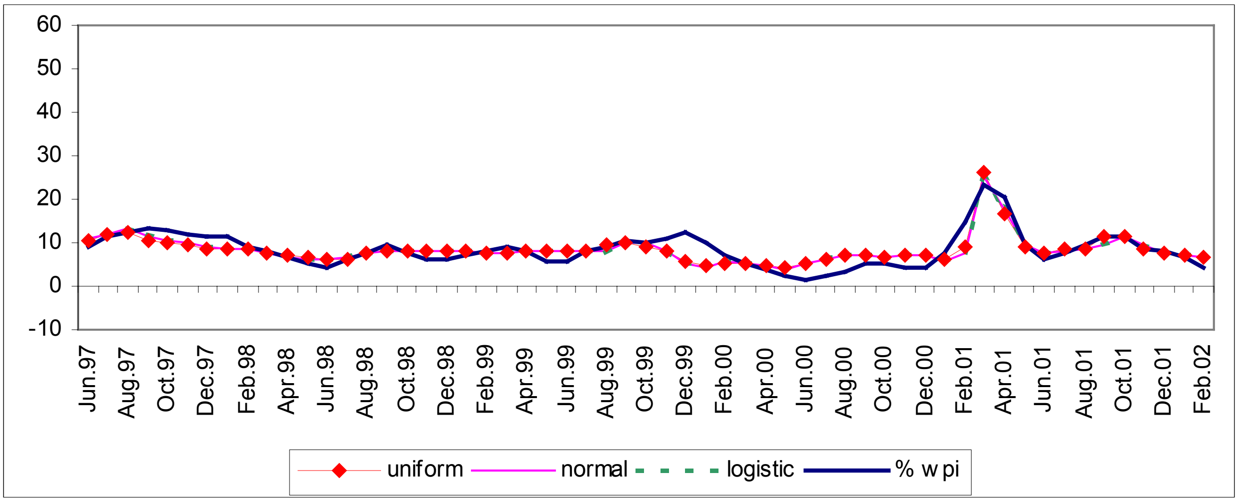

Figure 2 shows that the expectations obtained by using three distributions (uniform, normal and logistic) are all very close to the realizations.

4.3- The Expectations by Using Carlson-Parkin Method

The estimated values of δ are found as 11.95, 18.63 and 20.11 when the uniform, normal and logistic distribution are used to quantify the qualitative responses respectively. The expectations are given in Figure 3.

Figure 3

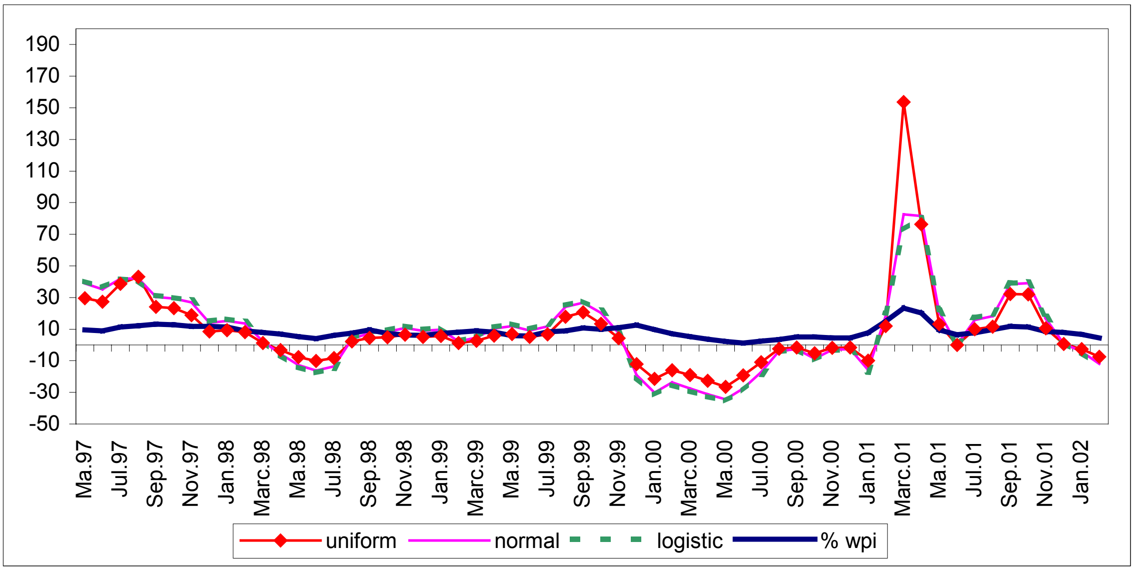

Figure 3 shows that the expectations obtained by using three distributions (uniform, normal and logistic) are all different from the realizations.

4.4- The Expectations by using Balance method

The estimated value of the scaling factor ‘k’ is found as 62.28. The expectations are given in Figure 4.

Figure 4

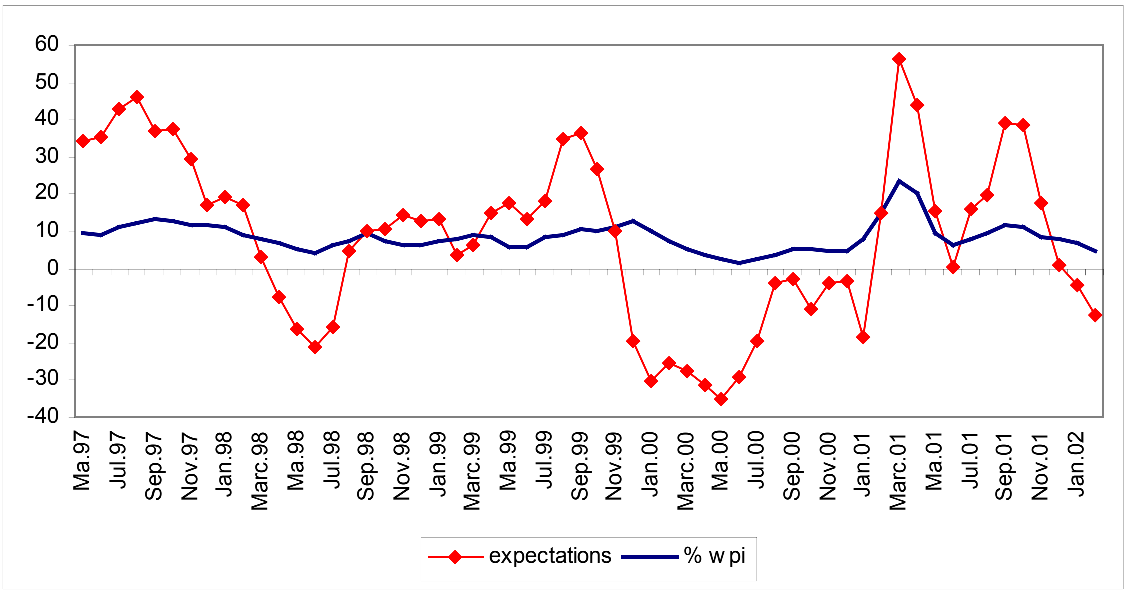

Figure 4 shows that the expectations and realizations are very different from each other.

The expectations obtained by nonlinear regression method have the best fit and the expectations by using balance method have the worst fit to the realizations for BTS. It is known that Carlson-Parkin and Balance Methods have disadvantages compared with all the other methods because they need unbiasedness assumption (Danes, 1973). Four statistical criteria are used to see the differences between these methods clearly. The results are given in Table 1 below. The minimum of the mean absolute error, mean square error, Theil’s inequality coefficient and the maximum determination coefficient are used to find the best fit of expectations to the realizations. The nonlinear regression method has the least mean square error and the highest determination coefficient. The mean square errors of Carlson-Parkin and Balance Methods are very high for BTS.

Table 1

	Standard Deviation			Nonlinear Regression			Carlson Parkin Method			Balance
	unif.	nor.	logis.	unif.	nor.	logis.	unif.	nor.	logis.	
MAE	6.873	6.637	6.768	1.704	1.683	1.696	13.323	15.789	16.413	16.447
MSE	65.727	52.941	54.080	5.020	5.205	5.305	527.525	435.389	442.943	395.386
TU1	0.875	0.785	0.793	0.242	0.246	0.249	2.478	2.251	2.271	2.145
R-Square	0.671	0.651	0.625	0.669	0.662	0.656	0.671	0.651	0.625	0.522

$MAE = \sum_{i=1}^{n} \left| P_t - P_t^e \right| / n$ (mean absolute error of prediction), $MSE = \sum_{i=1}^{n} (P_t - P_t^e)^2 / n$ (mean square error of prediction),

$TU1 = \left[\sum_{i=1}^{n} (P_t - P_t^e)^2 \Big/ \sum_{i=1}^{n} (P_t)^2 \right]^{1/2}$ (Theil's inequality coefficient), R^2 = Determination coefficient.

5-The Formation of Inflation Expectations

The expectations of economic agents has been an important issue in macroeconomics for many years. Since the way in which expectations are formed has important implications for economic behavior, many economists have used survey data to test hypotheses about expectation formation (Keane & Runkle, 1990).

There are three approaches of expectations: 'Extrapolative', 'Adaptive' and 'Rational'.

The rational expectations is based on the assumption that individuals, at least on average, optimally use all available relevant information when making their forecasts of future developments of economic variables.

Let P_t denote the actual inflation rate of period t, P_t^e the rate expected for t at the survey date (end of period t-1) and I_{t-1} represent the information set at t-1. Then, the following equality holds:

$$P_t^e = E(P_t / I_{t-1})$$

This equality implies that

$$E\left[P_t - E(P_t^e / I_{t-1})\right] = 0$$

meaning that forecast errors may not be correlated with any variable of the information set (otherwise the forecast would violate the assumptions of the rational expectations hypotheses). Forecast errors must be serially uncorrelated. The tests of the rational expectations are:

- Tests of unbiasedness and for absence of serial correlation of forecast errors
- Test of efficiency
- Test of orthogonality

A test of unbiasedness can be performed by making use of the following equation

$$P_t = \alpha + \beta P_t^e + \varepsilon_t \tag{6}$$

The unbiasedness can be tested by the null hypothesis $H_0 = \alpha = 0, \beta = 1$.

The predictions are needed to be uncorrelated with all variables in I_{t-1}. The current forecast error is regressed on a subset of I_{t-1}, namely on an number of past realizations of the forecast variable. There should be no significant relationship between P_{t-i} (i>0) and forecast error. If it is found to have no relationship, then it can be said that the predictions are efficient (Fluri & Spoerndli, 1987).

The orthogonality can be tested by using the following equation:

$$P_t = \alpha + \beta P_t^e + \gamma X_{t-1} + \varepsilon_t \tag{7}$$

where X_{t-1} is any variable in the information set at time t-1. The null hypothesis to test orthogonality will be equal to $H_0 = \alpha = 0, \beta = 1, \gamma = 0$. X_t can be realizations or expectations of past period, growth rate of money supply, price of oil, capacity utilization rate (Keane & Runkle, 1990).

Extrapolative Expectations Hypothesis can be given as:

$$P_t^e = b_0 * P_{t-1} + b_1 * P_{t-2} + \ldots \tag{8}$$

This hypothesis assumes that the inflation expectations depend on the actual rate of inflation in the past. A modification of the hypothesis in equation (8) would be:

$$P_t^e = b_0 * P_{t-1} + b_1 * (P_{t-1} - P_{t-2})$$

where b_1 shows the expectations about the trend. If b_1 is found to be greater than zero, it is expected that the trend of the actual rate of inflation continues. If it is less than zero, a change in the trend is expected.

Adaptive Expectations Hypothesis can be given as:

$$P_t^e - P_{t-1}^e = b * (P_{t-1} - P_{t-1}^e) \quad , 0<b<1 \tag{9}$$

If the expected and the actual rate of inflation are equal in the preceding period, it is assumed that no adjustment of price expectations is made. If the expected rate of inflation differs from the actual rate, then price expectations for the next period are corrected accordingly (Knöbl, 1974). The equation in (9) is called first order adaptive expectations hypothesis.

$P_t^e - P_{t-1}^e = \sum_{i=1}^{n} b_i * (P_{t-i} - P_{t-i}^e)$ is the n^{th} order adaptive expectations hypothesis.

Pesaran (1985) considers four additional models given as:

(a) $P_t^e - P_{t-1}^e = b_0 * (P_{t-1}^e - P_{t-2}^e) + b_1 * (P_{t-1} - P_{t-2}) + b_2 * (P_{t-2} - P_{t-2}^e)$

(b) $P_t^e - P_{t-1}^e = b_0 * (P_{t-1} - P_{t-2})$

(c) $P_t^e - P_{t-1}^e = b_0 * (P_{t-1} - P_{t-2}) + b_1 * (P_{t-1} - P_{t-1}^e)$

(d) $P_t^e = b_0 + b_1 * P_{t-1}^e + b_2 * P_{t-2}^e + b_3 * P_{t-1} + b_4 * P_{t-2}$

The equation in (a) is called adaptive-regressive scheme. It is a generalization of the first order adaptive model. The equation in (b) represents a simple acceleration hypothesis and embodies the idea that inflation expectations are changed only if a change in the actual rate of inflation is observed. The equation in (c) is the mixed-adaptive-acceleration hypothesis. The equation in (d) represents the union-intersection of models (a), (b), (c) and also first and second order adaptive expectations hypothesis.

According to the Table 1 above, it can be said that the expectations found by using the nonlinear regression method and having uniform distribution for price changes gives the best result, so the data from this approach are examined. The seasonality for all series is inspected before testing the formation of expectations by using the program called Demetra.

5.1 The Formation of Expectations of BTS

The expectations of BTS are examined to see the formation of the expectations. First of all, the rational hypothesis is tested and the results are given below:

The unbiasedness test is performed and the equation (6) is found as

$$P_t = \underset{(0.213)}{1.6354} + \underset{(0.000)}{0.8065} * P_t^e$$

The values in the parentheses show the probabilities of the estimated values according to Newey-West HAC standard errors.

R^2:0.67, $\overline{R}^2$:0.66, Durbin-Watson stat.:0.96, White prob.:0.000, LM Test (12 lags) prob.: 0.009. ARCH LM Test (4 lags) prob.: 0.011, Jarque-Bera prob.: 0.891.

The Wald test is used to test the null hypothesis $H_0 = \alpha = 0, \beta = 1$ and both F-statistic and Chi-square are found to have probability equal to 0.35. It shows that the expectations are unbiased, so the correlations of forecast errors are investigated. The Serial Correlation LM test is used with twelve lags and the probability is found as 0.009. This statistic shows that there is serial correlation up to twelve lags. Then, the efficiency and orthogonality are tested. The current forecast error is regressed on past realizations of the forecast variable. There should be no significant relationship between P_{t-i} (i>0) and forecast error. It is found that eight lags of price changes and forecast errors have no relationship in the following equation:

$$Res_t = \underset{(0.88)}{0.05}^* P_{t-1} + \underset{(0.84)}{0.11}^* P_{t-2} + \underset{(0.71)}{0.16}^* P_{t-3} - \underset{(0.58)}{0.25}^* P_{t-4} + \underset{(0.80)}{0.14}^* P_{t-5} - \underset{(0.88)}{0.10}^* P_{t-6} + \underset{(0.66)}{0.20}^* P_{t-7} - \underset{(0.07)}{0.31}^* P_{t-8}$$

The values in the parentheses show the probabilities of the estimated values according to Newey-West HAC standard errors. Rest is the residual term.

R^2:0.23, $\overline{R}^2$:0.11, Durbin-Watson stat.:1.37, White prob.:0.272, LM Test (1 lag) prob.: 0.044. ARCH LM Test (1 lag) prob.: 0.203, Jarque-Bera prob.: 0.005.

The predictions are found to be efficient. The orthogonality is tested by using the equation (7). The changes of the past prices and monthly changes in the dollar exchange rates are used for X_{t-1} and the equations are given as:

$$P_t = \underset{(0.089)}{1.7244} + \underset{(0.000)}{0.6894}^* P_t^e + \underset{(0.000)}{0.1817}^* usd_{t-2}$$

The values in the parentheses show the probabilities of the estimated values according to Newey-West HAC standard errors.

R^2:0.72, $\overline{R}^2$:0.71, Durbin-Watson stat.:0.83, White prob.:0.688, LM Test (12 lags) prob.: 0.000. ARCH LM Test (1 lag) prob.: 0.097, Jarque-Bera prob.: 0.413.

$$P_t = -\underset{(0.476)}{0.399} + \underset{(0.000)}{0.4464}^* P_t^e + \underset{(0.000)}{0.5891}^* P_{t-1},$$

The values in the parentheses show the probabilities of the estimated values according to Newey-West HAC standard errors.

R2:0.88, $\overline{R}^2$:0.87, Durbin-Watson stat.:1.18, White prob.:0.49, LM Test (12 lags) prob.: 0.004. ARCH LM Test (1 lag) prob.: 0.655, Jarque-Bera prob.: 0.000.

The null hypothesis $H_0 = \alpha = 0, \beta = 1, \gamma = 0$ is tested and the probability of F-statistic is found to be 0.000 for both models.

The results show that the expectations are not rational because only the unbiasedness and efficiency conditions are satisfied. Therefore, the adaptive and extrapolative expectation formations are tested. The equation (8) is applied:

$$P_t^e = \underset{(0.0006)}{2.0776}^* P_{t-1} - \underset{(0.011)}{1.8077} P_{t-2} + \underset{(0.003)}{0.6864}^* P_{t-3}$$

The White Heteroscedasticity-Consistent standard errors are used and the probabilities are given in the parentheses.

R^2:0.47, $\overline{R}^2$:0.45, Durbin-Watson stat.:1.59, White prob.:0.00, LM Test (1 lag) prob.: 0.233. ARCH LM Test (1 lag) prob.: 0.683, Jarque-Bera prob.: 0.000.

The determination coefficient is low. The past realizations up to lag 3 have significant effect on expectations.

The modified extrapolative expectations are tested:

$$P_t^e = \underset{(0.000)}{0.925}^* P_{t-1} + \underset{(0.052)}{0.7222}^* (P_{t-1} - P_{t-2})$$

The values in the parentheses show the probabilities of the estimated values according to Newey-West HAC standard errors.

R^2:0.39, $\overline{R}^2$:0.37, Durbin-Watson stat.:1.38, White prob.:0.00, LM Test (1 lag) prob.: 0.026. ARCH LM Test (1 lag) prob.: 0.477, Jarque-Bera prob.: 0.000.

The determination coefficient is very low.

The adaptive expectations are formed:

$$P^e_t - P^e_{t-1} = \underset{(0.176)}{0.5449}*(P_{t-1} - P^e_{t-1})$$

The values in the parentheses show the probabilities of the estimated values according to Newey-West HAC standard errors.

R^2:0.13, $\overline{R}^2$:0.13, Durbin-Watson stat.:1.64, White Prob.:0.066, LM Test (1 lag) prob.: 0.034. ARCH LM Test (1 lag) prob.: 0.5116, Jarque-Bera prob.: 0.000.

The determination coefficient is quite low. The coefficient is found to be insignificant. The model shows that the expectations are not adaptive.

The equations (a)-(d) are also examined:

(a) $P^e_t - P^e_{t-1} = -\underset{(0.1905)}{0.7117}*(P^e_{t-1} - P^e_{t-2}) + \underset{(0.1717)}{1.317}*(P_{t-1} - P_{t-2}) - \underset{(0.2831)}{0.6011}(P_{t-2} - P^e_{t-2})$

The values in the parentheses show the probabilities of the estimated values according to Newey-West HAC standard errors.

R^2:0.25, $\overline{R}^2$:0.22, Durbin-Watson stat.:1.74, White Prob.:0.000, LM Test (4 lags) prob.: 0.045. ARCH LM Test (3 lags) prob.: 0.076, Jarque-Bera prob.: 0.000.

(b) $P^e_t - P^e_{t-1} = \underset{(0.307)}{0.4128}*(P_{t-1} - P_{t-2})$

The values in the parentheses show the probabilities of the estimated values according to Newey-West HAC standard errors.

R2:0.05, $\overline{R}^2$:0.05, Durbin-Watson stat.:2.36, White Prob.:0.000, LM Test (12 lags) prob.: 0.017. ARCH LM Test (7 lags) prob.: 0.077, Jarque-Bera prob.: 0.000.

(c) $P^e_t - P^e_{t-1} = \underset{(0.173)}{0.6157}*(P_{t-1} - P_{t-2}) + \underset{(0.223)}{0.6792}*(P_{t-1} - P^e_{t-1})$

The values in the parentheses show the probabilities of the estimated values according to Newey-West HAC standard errors.

R^2:0.25, $\overline{R}^2$:0.23, Durbin-Watson stat.:1.75, White Prob.:0.000, LM Test (4 lags) prob.: 0.036. ARCH LM Test (3 lags) prob.: 0.07, Jarque-Bera prob.: 0.000.

(d) $P^e_t = \underset{(0.000)}{4.2178} + \underset{(0.912)}{0.0414}*P^e_{t-1} + \underset{(0.944)}{0.0078}*P^e_{t-2} + \underset{(0.132)}{1.3907}*P_{t-1} - \underset{(0.136)}{0.9377}*P_{t-2}$

The White Heteroscedasticity-Consistent standard errors are used and the probabilities are given in the parentheses.

R^2:0.58, $\overline{R}^2$:0.55, Durbin-Watson stat.:1.82, White Prob.:0.000, LM Test (1 lag) prob.: 0.202.
ARCH LM Test (1 lag) prob.: 0.979, Jarque-Bera prob.: 0.000.

The determination coefficients for the models ‘a’ to ‘d’ are quite low. All the models have insignificant coefficients.

A suitable model for the expectations cannot be found, so the variables that can affect the formation of inflation expectations are considered and a model is constructed. The monthly changes in money supplies (currency in circulation, M1, M2, sight deposits, time deposits, M2X, foreign exchange deposit accounts), exchange rates (German mark and US dollar) and weighted mean of the compound interest rates of Treasury auctions are taken to find a model for the formation of inflation expectations. All the variables are I(0) according to the ADF and Philips Perron unit root tests.

The model is given below:

$$P_t^e = \underset{(0.000)}{3.9058} + \underset{(0.000)}{0.3621}* P_{t-1} + \underset{(0.009)}{0.3154}* usd_{t-1} + \underset{(0.000)}{0.0625}* i_{t-1}$$

The values in the parentheses show the probabilities of the estimated values according to Newey-West HAC standard errors.

R^2:0.81, $\overline{R}^2$:0.80, Durbin-Watson stat.:1.43, White prob.:0.000, LM (4 lags) prob.:0.006. ARCH LM Test (4 lags) prob.: 0.617, Jarque-Bera prob.: 0.044. Sample Period: 1997:06-2002:02.

The determination coefficient is quite high and given as 81 percent. According to this model, the realizations of price changes, the changes in the dollar exchange rates and the changes in the weighted mean of the compound interest rates at lag 1 have significant effect on expectations.

6-Conclusion

This paper has attempted to analyse the qualitative inflation expectations gathered from the survey data.

The reliability analysis of the BTS survey data is examined. The Cronbach α coefficient is used to find the reliability and it is found to be highly reliable. The survey results are examined and the qualitative inflation expectations are quantified by using different methods. The methods are compared by using statistical criteria (mean square error, mean absolute error, determination coefficient and Theil's inequality coefficient). The uniform distribution for the price changes in the nonlinear regression method gives the best result. The worst method for BTS is found to be the Balance Method.

The formation of the expectations is examined. The rational hypothesis is tested for the survey and it is found that the inflation expectations derived from BTS are not rational. Adaptive expectations hypothesis is also examined and the expectations derived from BTS are not adaptive. Besides, the expectations are not extrapolative. The four additional models of Pesaran (1985) are constructed but no satisfactory result is found.

Finally, the formation of inflation expectations of BTS is investigated by constructing a model. According to the model, the realization of price changes, the changes in the dollar exchange rates and the changes in the weighted mean of the compound interest rates of the previous month have significant effect on the expectations derived from BTS.

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