TURKISH EXPERIENCE WITH INFLATION TARGETING

Ismail H. GENC[a] and Mehmet BALCILAR[b]
[a]Department of Economics, American University of Sharjah, Sharjah, United Arab Emirates
igenc@aus.edu
[b]Department of Economics, Eastern Mediterranean University, Famagusta, North Cyprus
mehmet.balcilar@emu.edu.tr

THIS DRAFT: Sunday, August 29, 2010

Abstract: Inflation targeting (IT) has recently become a popular monetary policy tool to fight inflation in advanced as well as emerging market economies. IT is assumed to curtail inflationary expectations; aiding monetary authorities implement disinflationary policies. The evidence toward IT's role in anchoring expectations in practice can be at best described as mixed, if not confusing. In this paper, we take the case of an emerging country, i.e. Turkey, which adopted inflation targeting as a policy framework after the failure of orthodox policy in 2001. We quantitatively examine the IT's effectiveness in reducing inflation by comparing forecasted inflation levels based on pre-IT levels to the actual inflation levels following the adoption of IT. Furthermore, the possibility of a structural change following the adoption of IT is examined. We fail to find a structural break in inflation at the time of the adoption of IT in Turkey. We show that observed levels of inflation would not have been any different from the forecasted levels of inflation if IT had not been adopted. In other words, the 'success' in lowering chronic inflation in Turkey is turned into a 'failure' by not keeping inflation at the levels promised by the monetary authorities. However, we do not mean to put this finding as a negative judgment for IT as a policy framework. Under different conditions, it could be perfectly credible policy even for emerging markets.

Key Words: Inflation targeting, Structural break, Emerging markets, ARIMA, Inflation Stabilization
***JEL* Classifications**: C22, E31, E37

1. INTRODUCTION

Inflation targeting (IT) has recently become a popular monetary policy tool to fight inflation in advanced as well as emerging market economies. What lies behind switch to an IT scheme is the belief that expectations play an unquestionable significant role in private sector's attitude toward future inflation, and, therefore, the effectiveness of the policies adopted by the monetary authority in the country. The IT framework anchors inflation expectations through transparency (IMF 1999; Croce and Khan 2000; Bergo 2004; and Posen 2003),

credibility (Minella et al. 2003; Faust and Svensson 1998; and Carare and Stone 2003), and accountability (Walsh 1996 and 2003). In a sense, controlling private sector's expectation formation should top the agenda of the policy maker for a successful implementation of the disinflation policies and reaching the target level of inflation (Huh 1997; Kadioglu, Ozdemir and Yilmaz 2000; Bangko Sentral ng Pilipinas 2001; Bernanke 2003; Meyer 2004; Piger and Thornton 2004; and Woodford 2004). Therefore, advance announcements of the policy makers' intentions based on firm commitments would greatly help anchor private sector's attitude by eliminating uncertainty and, thus, the guessing game on the part of the private sector.

On the practical front, IT is a policy scheme that can be used to eliminate uncertainties and anchor inflationary expectations. Originally developed and adopted by New Zealand, IT's success in lowering inflation has been fiercely debated. The evidence by now can be at best described as mixed, if not confusing. While there are those who find IT successful as a policy to reduce inflation (Mishkin and Posen 1997; Corbo, Landerretche and Schmidt-Hebbel 2001; Johnson 2002; Choi, Jung and Shambora 2003; Kontonikas 2004; and Sabban, Rozada and Powell 2004), the opponents claim are often echoed (Ammer and Freeman 1995; Bernanke and Mihov 1998; Cecchetti and Ehrmann 1999; Lee 1999; Siklos 1999; Honda 2000; Ball and Sheridan 2003; Hu 2003; Rogoff 2003; Genc et al. (2007) and Genc 2009). Some papers, however, are inconclusive in their findings such as Almeida and Goodheart (1996). These studies consider a large array of countries and methods of analysis, yet, Levin, Natalucci and Piger (2004) specifically concentrates on emerging market economies with positive findings[1].

[1] For studies in relation with the emerging market economies readiness to move to inflation targeting regime or other experiences, see, inter alia, Hazirolan (1999), Kadioglu et al (2000), Tutar (2002), Basci, Ozel, and

We, too, take the case of an emerging country, i.e. Turkey, which adopted inflation targeting as a policy framework after the failure of orthodox policy in 2001. Turkey experienced long spills of high inflation. Coupled with depreciation, the Turkish currency, Lira collected a large number of zeros leading to a change in the denomination of the money by dropping six zeros in January 2005. Genc et al (2008) find that this change in currency denomination did not cause a structural break in the Turkish inflation in accordance with the "near rationality" model of Ball (2000) à la Akerlof and Yellen (1985). The central bank of Turkey switched from orthodox policies to IT in January 2006 to fight inflation. As shown in Table 1 and Figure 1 Turkish inflation decreased appreciably after the adoption of inflation targeting. Policy makers assigned the "success" to the switch to IT policy. But, before making firm claims, one needs to statistically identify a change in the inflation regime following the IT adoption.

Table 1 and Figure 1 approximately here

In this paper, we quantitatively examine the IT's effectiveness in reducing inflation by comparing forecasted inflation levels based on pre-IT levels to the actual inflation levels following the adoption of IT. Furthermore, the possibility of a structural change following the adoption of IT is examined. Thus, we attempt to achieve two goals: One is to contribute to the quantitative literature on the topic on inflation for emerging market economies; and the other is to make another case study with reliable evidence in hand before recommending any

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Sarikaya (2007), Culha, Culha and Gonenc (2008) and Aktas, Kaya and Ozlale (2010) for Turkey; Masson, Savastano and Sunil (1998), Mishkin (2000and 2004) and Goncalves and Salles (2008) for emerging economies; Woglom (2000), Van Der Merwe (2004) and Mitchell-Innes, Aziakpono and Faure (2007) for South Africa; Gottschalk and Moore (2001) for Poland; Corbo and Schmidt-Hebbel (2001) for Latin America; Blanchard (2004) and Favero and Giavazzi (2004) for Brazil; Dabla-Norris and Floerkemeier (2006) for Armenia; Bakradze and Billmeier (2007) for Georgia; Dabla-Norris et al (2007) for Armenia and Georgia; Naqvi and Rizvi (2009) for Indonesia, Philippines, South Korea and Thailand; Alichi et al. (2009) for Ghana; and Aliyu and Englama (2009) for Nigeria.

central bank join the IT bandwagon. We hope our study also sheds some light to the policy makers in other countries pondering a similar shift.

The rest of the paper is as follows: Section 2 describes the data and briefly explains the methodology used in the paper. The empirical findings are presented in Section 3. Finally, Section 4 discusses empirical findings and Section 5 concludes the paper.

2. DATA AND METHODS

Monthly data on consumer price index (CPI) are collected from Turkish Statistics Institute (TUIK). The base year is 1994. The inflation data, π, are calculated from the CPI as $\pi_t = \ln(CPI_t / CPI_{t-1})$. The complete study period is 1994M1-2006M12. This period is divided into two subperiods. The first subperiod contains the observations prior to the implementation of the inflation targeting in Turkey, i.e. 1994M1-2005M12. The second subperiod, i.e. 2006M1-2006M12, covers the post-IT implementation era. The end of the sample period is determined in order to avoid the likely impact of the global economic crisis since the central bank, indeed, changed its primary policy target from inflation to reducing the extent of recession.

As Figure 1 shows, Turkey adopted IT in an era where inflation was at low levels and quite stable, which is a much common practice in IT adopting countries. Furthermore, as shown in Table 1, the average inflation in the post-IT subperiod is lower than the pre-IT subperiod. So is the volatility of inflation as measured by the standard deviation. To support that contention, we make mean equality test with results given in Table 2. The result of the mean equality test shows that there is strong evidence that pre-IT inflation differs from post-IT inflation because both the standard ANOVA and the Welch adjusted ANOVA statistics carry probability values near zero.

Table 2 approximately here

However, neither the visual observation nor the evidence about the unequal means is necessarily a reliable tool to make inferences about the statistical behavior of data, and the *t* tests are not too conclusive for many well-known statistical reasons. Thus, we adopt an approach based on the autoregressive moving average (ARMA) model of the inflation series to conduct the statistical analysis.

In the first subperiod, i.e. the pre-IT adoption period, we estimate a statistically acceptable ARMA model of inflation. This estimation is then employed to forecast the post-IT period, which corresponds to the remaining part of the sample period. This yields the inflation levels that would have been expected if the IT had not been put in place. As a result, comparing the success of IT in Turkey is achieved via the comparison of the actual inflation levels obtained in the post-IT subperiod to the forecasted inflation levels obtained from the model in the pre-IT period. If the forecasted inflation level were found to be statistically significantly above the actual inflation level, the IT implementation would then be considered successful in lowering inflation. For the sake of robustness of our findings, we also estimate a form of the regime switching model, which incorporates pre- and post-IT subperiods in search of a structural break when the country moved from pre- and post-IT subperiods.

To be more specific, to achieve what is outlined above in general terms, in the first subperiod, we first estimate a "Mean Equation" for inflation in the form of an ARMA(p,q) models, where p and q represent the maximum autoregressive (AR) and moving average (MA) terms, respectively. In order to identify the appropriate model, we follow the so-called Box and Jenkins (1976) approach. We allow up to 12 lags for both p and q including the

possibility of p=q=0. This process generates 169 models in total, and we choose the best model with the help of Akaika Information Criterion (AIC). We also do the same analysis with the help of Schwartz Information Criterion, but the results did not differ qualitatively. We then run a battery of diagnostics checks on these estimations to ensure the statistical reliability of the results.

After obtaining a robust model, we forecast the remaining data for the post-IT subperiod. The forecast method we use here is the 1-step ahead (static) forecast. That is, after forecasting a single period, we use the known values of the forecasted variable to forecast the next period. This is an appropriate approach, assuming that economic agents have rational expectations and market flexibility allows them to readjust their positions concerning inflationary expectations. At this point, it is worth noting that we also conduct multi-step ahead (dynamic) forecasts, which do not produce statistically different results from the one-step ahead forecasts. Then, we compare the actual inflation data to the forecasted data in terms of levels and statistical significance.

The alternative method we follow is a form of the regime switching model. Specifically speaking, we jointly estimate pre- and post-IT data in the form of

$$\pi_t = \alpha_0 + \sum_{i=1}^{p=12} \alpha_i \pi_{t-i} + \tau\left(\beta_0 + \sum_{j=1}^{p=12} \beta_j \pi_{t-j}\right) + \varepsilon_t$$

where the dummy variable τ=0 before the IT adoption and τ=1 after the IT adoption to delineate pre- and post-IT subperiods. The α coefficients represent the pre-IT data while the β coefficients are based on the post-IT data. To be compatible with the above-mentioned methodology, we use AIC to pick the best model. The statistically significant β coefficients indicate a structural break in the data. In other words, we would consider IT having a statistical impact on the inflation level of the country.

3. ESTIMATION RESULTS

The results of the econometric analysis are presented in Tables 3-4 and Figure 2. Specifically, Table 3 shows results for the best ARMA(p,q) model estimated for the pre-IT subperiod. Initially, AIC selected an ARMA(12,7) model. However, we eliminated the most insignificant term at a time and continued to re-estimate the next best ARM(p,q) model. The constant term is excluded form this elimination process. The final model we determined is reported in Table 3.

Table 3 approximately here

As shown in Table 3, the best ARMA model identified using the iterative elimination of insignificant terms is free from serial correlation and having statistically significant coefficients for the terms remaining in the estimation process. We employ this model to forecast the inflation in the post-IT subperiod.

Figure 2 approximately here

Figure 2 shows actual and forecasted inflation levels as well as the lower and upper bounds of 2-standard error forecast intervals. The forecasted inflation levels are what otherwise might have occurred in the country. Not only are actual and forecasted inflation levels are indistinguishable from each other in the statistical sense, there is not a clear pattern between the two. Putting it differently, there is no statistical evidence to suggest that the actual inflation level might have been any different if IT had not been adopted.

Table 4 approximately here

To further investigate the robustness of our results, we conduct the regime switching model estimation as alluded to above. The estimation of the best model is shown in Table 4.

The terms in the estimation process are selected via Stepwise Regression with forward addition method.

In evaluating Table 4, one can see that no post-IT period coefficient appears in the estimation. In other words, all the post-IT coefficients are statistically significantly indistinguishable from zero. Thus, there is no statistical evidence to show that there is a structural break between the pre- and post- IT subperiods in the country. In order to further examine the possibility of a structural breaks due to IT introduced in January 2006, we re-estimate the ARMA model reported in Table 3 over the whole sample 1994M1-2006M12 period and test for structural breaks. Specifically, parameter stability tests developed by Andrews (1993) and Andrews and Ploberger (1994) are used to investigate the stability of the ARMA parameters. All these tests are computed from the sequence of Chow-*F* statistics that tests constant parameters against the alternative of a one-time structural change at each possible time in the sample. There are three tests of proposed by Andrews (1993) and Andrews and Ploberger (1994), namely Sup-F, Mean-F, and Exp-F. These tests require trimming at the ends of the sample. We trim 5 percent from both ends and calculate the tests for the fraction of the sample in [0.05, 0.95]. In Table 5, the results of the tests for the inflation equation along with the associated *p*-values are reported. These *p*-values are obtained from a bootstrap approximation to the null distribution of the test statistics, constructed by means of Monte Carlo simulation using 2000 samples generated from the estimated model with constant parameters.

Table 5 approximately here

Among the three parameter constancy tests we use for testing the stability of the inflation equation, the Sup-LR statistics tests parameter constancy against a one time swift

shift in parameters. On the other hand, if the regime shift is gradual, then the Mean-LR and Exp-LR, which assumes that parameters follow a martingale process, are appropriate. The results for the sequential Sup-LR, Mean-LR, and Exp-LR tests reported in Table 5 suggest that there is no evidence of parameter non-constancy or structural change in the estimated ARMA model of inflation. The *p*-values are all above 0.70, presenting strong evidence in favor of structural stability.

What the findings of both methods amounts to is that there is no statistical evidence to support a significant decrease in inflation level in Turkey after the adaptation of IT at the beginning of 2005. This is the same result obtained by Honda (2000) for New Zealand, Canada and the UK. Honda's method, which is similar to what we do in this study, was commended by Agenor (2000) as an empirical route to take in testing the effectiveness of inflation targeting.

4. DISCUSSION

Both ARMA and regime switching models estimated in the above section point to a failure to find a structural break in inflation at the time of the adoption of IT in Turkey. As a matter of fact, a Chow breakpoint test for January 2006 points to a lack of a break on the specified date as shown in Table 6. Furthermore, a series of Chow breakpoint tests run on a period of 2002M1-2006M6 indicate the closest structural break date in 2002M4[2]. This result is complementary to the structural stability tests we reported above. In other words, if there was a structural break in Turkish inflation, this had taken place way before the actual IT adoption date. This is consistent with the observation that the Central Bank started to implement an undeclared inflation targeting framework starting the beginning of 2002 (Aktas, Kaya and Ozlale 2010).

[2] Note that this is different from the parameter stability tests presented above.

Table 6 approximately here

Obviously, we cannot identify the causes of the failure of the IT process in this sense. However, as mentioned before, the monetary authorities tend to adopt an IT framework only after they have already achieved relatively low levels of inflation. On the other hand, if people believe find the monetary authority's inflation policy credible, then they will probably adjust their inflationary expectations accordingly. So an announcement of inflation level to go along with the IT policy will already bear its fruit in lowering inflationary expectations ahead of time even before the country moves into the IT era. Thus, we are not likely to see a structural break in the inflation levels immediately before and immediately after the IT era due to the behavior of the policy makers and other economic agents. In fact, annual inflation level in Turkey decreased from the mids of 50 percent in 1990s to around 10 percent in 2004-2006 (see Table 7 below). Indeed, the decline is even steady. This can definitely designated as a successful policy. Yet, the Turkish monetary authorities announced a 7 per cent upper level of inflation for 2006. Nevertheless, actual inflation was realized as 9.22 percent. (Central Bank itself reports a 9.56 percent realized inflation in 2006). This is approximately 31.65 percent off the mark. Needless to say, the error in judgment is much higher in comparison to the mean inflation targeted by the Central Bank, which is a more appropriate figure to compare. The judgmental error is yet a huge one. To put it differently, the amazing achievement of the Central Bank in fighting inflation has been turned into a political blunder. It is our opinion that the IT was not the right policy framework for Turkey at the time of adoption.

Table 7 approximately here

5. CONCLUSIONS

Inflation targeting is an important monetary policy issue, which is debated in many countries, if not outright adopted, as a means to attain lower levels of inflation. In this study, we analyze the case of Turkey, which adopted inflation targeting in January 2006 as a policy tool after a successful effort of fighting extremely high levels of inflation.

Methodically speaking, first, we divide the study period into estimation and forecasting subperiods. In the estimation subperiod, we model the inflation using he ARMA models estimated using the Box-Jenkins (1979) approach. A statistically adequate model of inflation is obtained to forecast the inflation levels for the forecast period pretending that no IT policy was adopted. Finally, we compare the actual and forecasted data. To make our conclusions more robust, we also estimate a form of the regime switching models, which jointly estimates pre- and post-IT period data to detect the possibility of a structural break indicating the impact of IT adoption.

We find that that the observed reductions in inflation levels cannot be attributed to the adoption of IT from the statistical viewpoint since the actual and forecasted inflation levels do not appear to be distinguishable from each other. Neither do we detect a regime switch in the data.

Our research does not provide answers as to why this was the case, but our results are complementary to prior studies suggesting this outcome. We speculate that if policy makers and economic agents who take future inflation levels into account while making decisions believe that targeted inflation levels are credible, then the self-fulfilling prophecies will set in to generate low levels of inflation even before an IT policy is formally adopted. Thus, we conclude that it is no surprise that no structural break exists between the pre- and post-IT policy adoption inflation levels.

Another crucial issue in this discussion is whether Turkey did the right thing by adopting IT in January 2006. We show that the monetary authorities in Turkey failed to keep their promise with regards to the announced inflation levels as the actual inflation way surpassed what the Central Bank had promised to happen. The reason, we believe, the Central Bank tied its hands by promising to adhere a policy they obviously failed to maintain. Unfortunately, 'success' has been transferred to 'failure.' Otherwise, we do not mean to put this finding as a negative judgment for IT as a policy framework. Under different conditions, it could be perfectly credible policy as shown by Levin, Natalucci and Piger (2004) even for emerging markets. The future studies can use multivariate models to determine the causes of the failure of IT in Turkey as the actual inflation levels exceeded preannounced levels.

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TABLES

Table 1. Descriptive Statistics of Inflation

	Pre-IT	Post-IT	Whole
Mean	0.036	0.008	0.028
Maximum	0.210	0.019	0.210
Minimum	-0.004	-0.004	-0.007
Std. Dev.	0.026	0.007	0.026
Obs	144	12	156

"Pre-IT" refers to the period before the IT is adopted by the country. This is the estimation period for AR(p) models in the paper. "Post-IT" corresponds to the period after the IT is adopted. This is the forecast period for the AR(p) models. The results corresponding to full sample are given under the heading "Whole." "Obs" shows the number of observations in each sub-period.

Table 2: Mean Equality Tests

Method	df	Value	Probability
Anova F-test	(2, 350)	8.810	0.0002
Welch F-test*	(2, 61.813)	51.837	0.0000

*Test allows for unequal variances

Table 3: ARMA(*p*,*q*) Estimations

	Coefficient	Standard Error	t-Statistics
Constant	0.017	0.016	1.051
AR(1)	0.588	0.064	9.158
AR(9)	0.104	0.059	1.755
AR(12)	0.195	0.050	3.863
MA(6)	0.225	0.088	2.549
Adj. R2	0.647		
AIC	-5.871		
AUTO	17.910	p-value of AUTO = 0.118	

"Coef" and "p" stand for the estimated coefficients and their *p*-values, respectively in the ARMA models. "AUTO" is the serial correlation LM (Breusch-Godfrey) test on residuals with 12 lags. The null hypothesis of the test is that "there is no serial correlation in the residuals up to 12 lags."

Table 4: Regime Switching Estimations

Variable	Coefficient	Std. Error	t-Statistic	Prob
Constant	0.001	0.001	0.554	0.580
α_1	0.555	0.053	10.401	0.000
α_6	0.169	0.054	3.113	0.002
α_{12}	0.193	0.044	4.361	0.000
Adj. R2	0.728	AIC		-6.089
AUTO	14.665	Prob. χ^2 (12)		0.260

"Coef" and "p" stand for the estimated coefficients and their *p*-values, respectively in the regime switching models. "α" and "β" refer to the coefficients of the estimated model as specified in the paper. "AUTO" is the serial correlation LM (Breusch-Godfrey) test on residuals with 12 lags. The null hypothesis of the test is that "there is no serial correlation in the residuals up to 12 lags."

Table 5: Parameter Stability Tests

	Statistics	Bootstrap *p*-value
Mean-F	5.752	0.867
Exp-F	1.462	0.791
Sup-F	2.441	0.755

p-value is calculated using 2000 bootstrap repetitions.

Table 6: Chow Breakpoint Test for 2006M01

	Statistics	df	Prob.
F-statistic	0.592	5,133	0.706
Log likelihood ratio	3.145	5	0.678
Wald Statistic	1.529	5	0.910

Equation sample is 1995M02-2006M12. The null hypothesis is "No breaks in 2006M01."

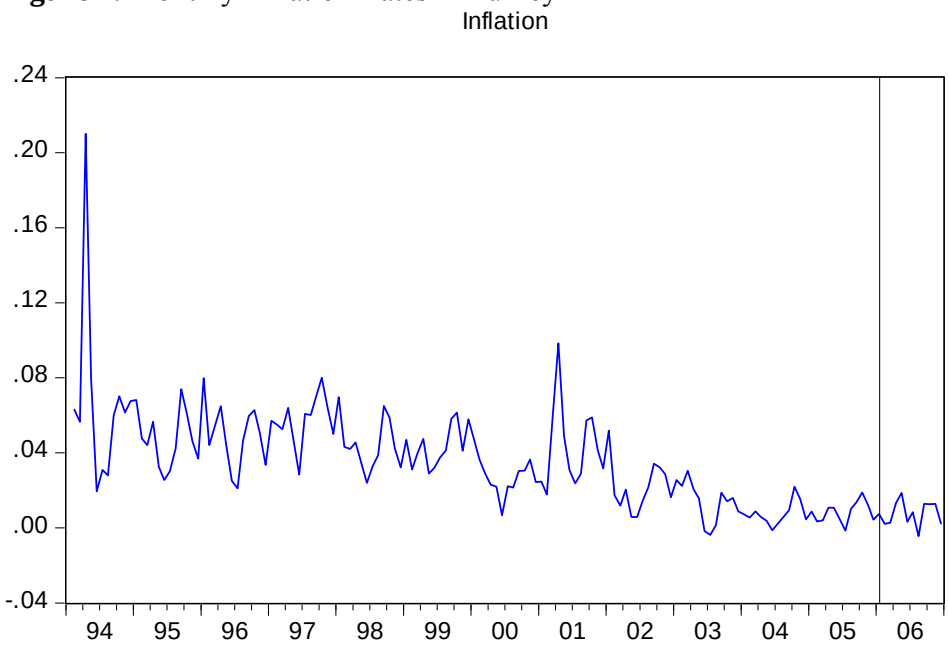
Table 7: Annual Inflation

Date	Inflation
1995M12	56.56
1996M12	58.64
1997M12	68.86
1998M12	52.90
1999M12	52.35
2000M12	32.95
2001M12	52.20
2002M12	26.04
2003M12	16.85
2004M12	8.91
2005M12	10.01
2006M12	9.22

Annual rate is calculated from the monthly rates.

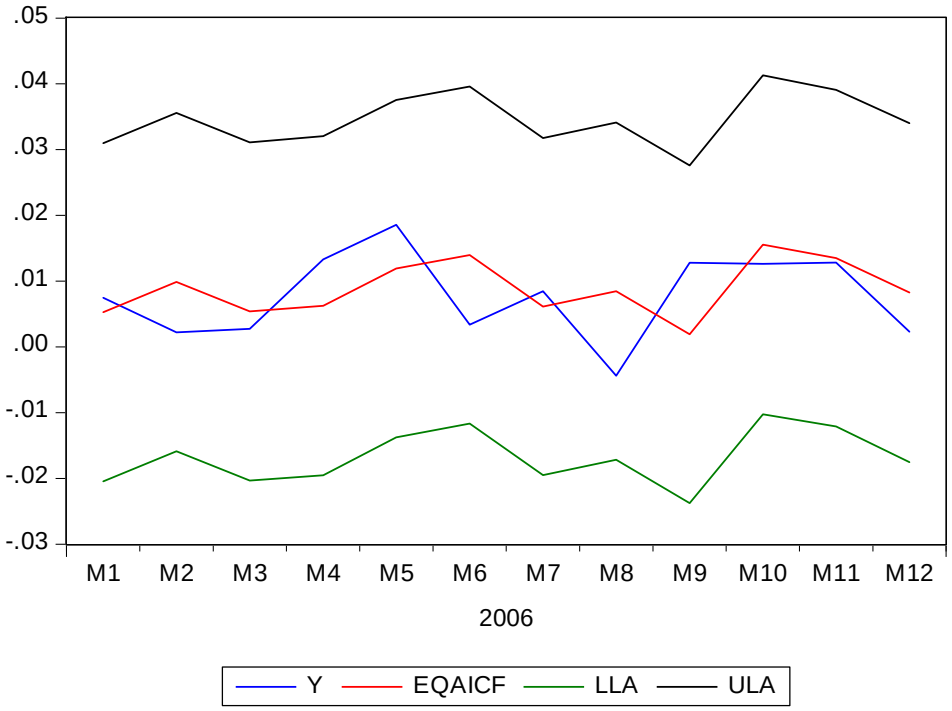
FIGURES

Figure 1. Monthly Inflation Rates in Turkey



The date IT is adopted is marked by the vertical line.

Figure 2. Actual and Forecasted Inflation



In this figure, "Y" refers to the actual inflation, "EQAICF" is the forecasted inflation, and "LLA" and "ULA" stand for the lower and upper bounds of 2-standard error forecast intervals, respectively.