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DO INFLATION EXPECTATIONS CONVERGE TOWARD INFLATION TARGET OR ACTUAL INFLATION? EVIDENCE FROM EXPECTATION GAP PERSISTENCE

Serkan Çiçek and Cüneyt Akar*

ABSTRACT Anchoring inflation expectations to inflation targets rather than actual inflation implies a credible monetary policy. We utilized a quantile autoregression approach developed by Koenker and Xiao (2004) in order to analyse whether the inflation expectations converge toward inflation targets or actual inflation in Turkey. Our analysis suggested that inflation expectations have been anchored to both inflation targets and actual inflation. Furthermore, no convergence toward inflation targets in larger quantiles exists, although inflation expectations have globally followed actual inflation. These findings provide strong evidence favouring imperfect credibility in Turkey.
JEL C32, E52, E58
Keywords Credibility, Anchoring, Quantile Autoregression, Turkish Economy

ÖZ Enflasyon beklentilerinin gerçekleşen enflasyondan ziyade enflasyon hedefine yakınsaması para politikasının güvenilir olduğunu ima etmektedir. Bu çalışmada Koenker ve Xiao (2004) tarafından geliştirilen dilim otoregresyon yöntemi ile enflasyon beklentilerinin enflasyon hedefine veya gerçekleşen enflasyona yakınsayıp yakınsamadığı incelenmiştir. Analiz sonucunda enflasyon beklentilerinin hem enflasyon hedefine hem de gerçekleşen enflasyona yakınsadığı bulgusuna ulaşılmıştır. Ayrıca, enflasyon beklentilerinin tüm dilimlerde gerçekleşen enflasyonu takip etmesine karşın yüksek dilimlerde enflasyon hedefine yakınsamadığı da tespit edilmiştir. Bu bulgular Türkiye'de tam olmayan güvenilirliğin mevcut olduğuna destek teşkil etmektedir.
ENFLASYON BEKLENTİLERİ ENFLASYON HEDEFİNE Mİ YOKSA GERÇEKLEŞEN ENFLASYONA MI YAKINSIYOR? BEKLENTİ AÇIĞI SÜREĞENLİĞİ ÜZERİNDEN BİR DEĞERLENDİRME
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Anahtar Kelimeler Güvenilirlik, Çapalama, Dilim Otoregresyon, Türkiye Ekonomisi

* **ÇİÇEK (Corresponding Author):** Mugla Sitki Kocman University, Fethiye Business Faculty, Department of Economics and Finance, 48300, Fethiye, Mugla, Turkey, serkan.cicek@mu.edu.tr ■ **AKAR**: Balikesir University, FEAS, Department of Business Administration, Bandirma-10230, Balikesir, Turkey, cuneyt@balikesir.edu.tr

1. Introduction

Monetary policy theory argues that a commitment to a nominal anchor helps stabilize inflation. Inflation targeting (IT) central banks use inflation targets as a nominal anchor to form economic agents' expectations. Bomfin and Rudebusch (2000) indicated that long-run inflation expectations are a weighted average of the current target and last period's inflation rate; monetary policy is credible if inflation expectations perfectly follow inflation targets rather than actual inflation. In this context, Demertzis et al. (2010) proposed that a credible monetary policy provides a disconnection between inflation expectations and actual inflation.

In IT regimes, monetary authority announces the inflation targets; the private sector evaluates the future reliability of this commitment and then forms their expectations. Monetary policy credibility can be measured by the persistence of the expectation gap in terms of (1) the inflation target which is denoted by inflation expectations minus inflation target and (2) actual inflation which is represented by inflation expectations minus actual inflation. Monetary policy is credible if inflation expectations fully converge toward the inflation targets, but do not converge toward actual inflation, after a shock. In other words, monetary policy is credible if the expectation gap in terms of inflation targets is not fully persistent (i.e., effect of a shock decays instantly) and if the expectation gap in terms of actual inflation is fully persistent (i.e., indicating a random walk process). In addition to persistence, types, and magnitudes of shocks are important as it is more likely that asymmetry exists in the convergence of inflation expectations toward the inflation targets or actual inflation.

Thus, in this paper, we investigate the dynamic behaviours of expectation gaps in order to capture the credibility of monetary policy by utilizing a quantile autoregression approach developed by Koenker and Xiao (2004) which allows for different and asymmetric speeds of expectation gaps adjustment across different quantiles of their distributions.[1] The existence of such a difference and asymmetry indicates that the speed of adjustment toward the inflation target or actual inflation might differ with the magnitude of the shock. This model further allows us to measure the tendency of

[1] Although the quantile autoregression method was previously tailored for estimating the dynamic behaviour of many economic variables such as inflation rate, unemployment rate, short-term interest rate, and gasoline prices, it has not been used for the analysis of the convergence of inflation expectations to actual and targeted inflation. Hence, this method is likely to bring a new perspective for evaluating the credibility of a central bank.

convergence based on the size of the shock that causes inflation expectations to deviate from inflation target or actual inflation.

The paper is organized as follows: Section 2 outlines the quantile autoregression framework. Section 3 describes the data and empirical results. Section 4 concludes the paper.

2. Empirical Methodology

Our empirical methodology is based on the quantile autoregression test developed by Koenker and Xiao (2004).[2] A simple higher-order autoregressive model can be written as an ADF regression model:

$$\mathrm{y_{it}} = \alpha_1 y_{i,t-1} + \sum_{j=1}^{q} \alpha_{j+1} \Delta y_{i,t-j} + \varepsilon_t \qquad i = 1,2 \tag{1}$$

where $y_{1t} = \pi^e_{t+12} - \pi^T_{t+12}$, $y_{2t} = \pi^e_{t+12} - \pi_{t-1}$, and π^e_{t+12} reflects the inflation expectations for twelve months ahead-horizon while π^T_{t+12} and π_{t-1} reflect inflation target for twelve months ahead-horizon and inflation rate of previous month, respectively, and ε_t is an independently distributed error term with zero mean and constant variance of σ^2. In the model, the persistence behaviour of our dependent variable in each quantile is investigated using the following t-ratio statistic.

$$t_n(\tau) = \frac{f\big(\widehat{F^{-1}(\tau)}\big)}{\sqrt{\tau(1-\tau)}} (Y'_{-1} P_x Y_{-1})^{\frac{1}{2}} (\hat{\alpha}_1(\tau) - 1) \tag{2}$$

where $f\big(\widehat{F^{-1}(\tau)}\big)$ is a consistent estimator of $f(F^{-1}(\tau))$, Y_{-1} is the vector of lagged dependent variables (y_{t-1}), and P_x is the projection matrix onto the space orthogonal to $X = (1, \Delta y_{i,t-1}, \dots, \Delta y_{i,t-q})$.

According to Koenker and Xiao (2004), $f\big(\widehat{F^{-1}(\tau)}\big)$ can be referred to as follows:

$$f\big(\widehat{F^{-1}(\tau)}\big) = \frac{(\tau_i - \tau_{i-1})}{x'_t\big(\hat{\alpha}(\tau_i) - \hat{\alpha}(\tau_{i-1})\big)} \tag{3}$$

In Equation 3, $x_t = (1, y_{i,t-1}, \Delta y_{i,t-1}, \dots, \Delta y_{i,t-q})'$ and $\hat{\alpha}(\tau_i)$ is an estimated parameter vector of $\alpha(\tau_i) = (\alpha_0(\tau_i), \alpha_1(\tau_i), \dots, \alpha_{q+1}(\tau_i))$ with $\alpha_0(\tau_i)$ expressing the τ_i ($\tau_i \in \Psi$) quantile of ε_t .[3] In this study, we selected $\Psi = (0.10, 0.20, \dots, 0.90)$.[4] In addition, we calculated the half-lives (HLs)

[2] We presented a very brief explanation about the methodology. For detailed information, see Koenker and Xiao (2004) and Koenker and Xiao (2006).

[3] For the estimation procedure, please see Koenker and Xiao (2003).

[4] QKS statistic is sensitive to the selection of ($\tau_i \in \Psi$). Because QKS statistics test the unit root property over a range of quantiles $\tau_i \in \Psi$ instead of focusing only one selected quantile. Koenker and Xiao (2004) suggest ($\tau_i \in \Psi = \tau_0, 1 - \tau_0$) for some small $\tau_0 > 0$. But there is no exact way of choosing τ_0. In the paper, we select

of a shock within each quantile with the formula based on $\log(0.5) / \log(\alpha_1(\tau))$. In order to test the null of a constant unit root process over a range of quantiles, we considered the Quantile Kolmogorov-Smirnov (QKS) test proposed by Koenker and Xiao (2004).

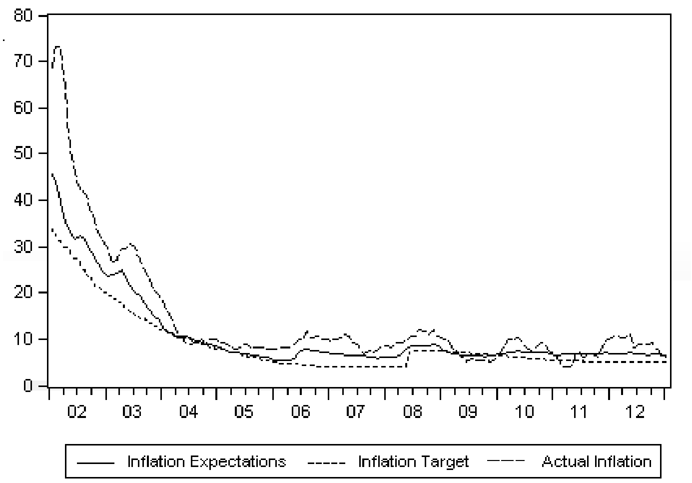
$$QKS = \sup |t_n(\tau)| \tag{4}$$

In Equation 4, $t_n(\tau)$ is calculated at $\tau \in \Psi$ and then the QKS statistic is constructed by taking maximum over Ψ. In the study, we used resampling procedures which Koenker and Xiao (2004) recommend to approximate the small-sample distributions of $t_n(\tau)$ and QKS tests.[5]

3. Data and Empirical Results

Our data, as shown in Figure 1, consisted of the monthly actual inflation, inflation expectations and inflation target for the Turkish economy covering the period from 2002:M1 through 2013:M1.[6]

Figure 1. Inflation Expectations, Inflation Target, and Actual Inflation



Source: CBRT.

$\tau_0 = 0.10$ by following Koenker and Xiao (2004) and Tsong and Lee (2011). We think that selected quantiles can explain the main characteristics of the data.

[5] To calculate the p-values, we followed Koenker and Xiao's (2004) testing procedure. For detailed information, please see Koenker and Xiao (2003), Koenker and Xiao (2006) and Tsong and Lee (2011).

[6] Actual inflation is calculated in terms of the previous year's level of the Consumer Price Index (CPI). Inflation expectation is 12 months ahead of CPI inflation expectations. Monthly inflation targets are obtained by linear interpolation between year-end inflation targets following Başkaya et al. (2012). All data are obtained from CBRT.

The QKS test, which delivers a general perspective of the behaviours of expectation gaps, rejects the unit root null hypothesis for both series at the 1% significance level and provides strong evidence in favour of stationary inflation expectations.[7] This finding implies that inflation expectations have been anchored to both inflation targets and actual inflation, in line with the finding of imperfect credibility in Çiçek et al. (2011).[8]

The estimated values of the constant term [$\alpha_0(\tau)$] captures the magnitude of the observed inflation shock within each quantile. The negative (positive) signs of $\alpha_0(\tau)$ suggest negative (positive) shocks where inflation expectation is smaller (larger) than the inflation target or actual inflation. The expectation gap in terms of actual inflation has a straight line with a positive slope passing through zero point at the 0.7 quantile, while the expectation gap in terms of the inflation targets has a straight line with a positive slope passing through zero point at the 0.3 quantile, which implies that the expectation gap in terms of the inflation target is generally hit by positive shocks, although the expectation gap in terms of actual inflation is generally hit by negative shocks.

Table 1. Estimation Results

	Expectation gap in terms of inflation targets $\pi^e_{t+12} - \pi^T_{t+12}$			**Expectation gap in terms of actual inflation** $\pi^e_{t+12} - \pi_{t-1}$		
τ	α_0	α_1	**HLs**	α_0	α_1	**HLs**
0.10	-0.149***	0.860*	4.596	-1.183*	0.765*	2.588
0.20	-0.023**	0.866*	4.818	-0.694*	0.884*	5.622
0.30	0.081**	0.869*	4.937	-0.692*	0.821*	3.514
0.40	0.085**	0.914*	7.708	-0.589*	0.801*	3.124
0.50	0.102*	0.935*	10.313	-0.219**	0.819*	3.471
0.60	0.089*	0.969	22.011	-0.100	0.819*	3.471
0.70	0.098*	0.990	68.968	0.122	0.812*	3.328
0.80	0.137*	1.019	∞	0.444*	0.846*	4.145
0.90	0.344*	1.009	∞	0.654*	0.793*	2.989
QKS	4.586 (0.002)			5.482 (0.002)		
			QKS Test Bootstrap Critical Values			
%1		3.752			4.896	
%5		3.209			3.836	
%10		2.859			3.345	

(1) * significant at 1%, ** significant at 5%, *** significant at the 10% level.
(2) Optimal lag length selected by the AIC and p-values are in parenthesis.
(3) For $\alpha_0(\tau)$, the null of zero is tested with the student-t test,
(4) For $\alpha_1(\tau)$, the unit-root null is tested with the $t_n(\tau)$ statistic.

[7] Given that the shocks to an expectation gap in terms of inflation targets are long-lived in large quantiles (for $\tau \geq 0.6$), the QKS test results indicate that the stationary behaviour of the inflation gap in terms of inflation targets in the low quantiles facilitates the whole process to follow inflation targets.
[8] For details see also Başkaya et al. (2008), Kara and Küçük-Tuğer (2010), Başkaya et al. (2010), and Başkaya et al. (2012).

The estimated values of $\alpha_1(\tau)$ provide significant details about the anchoring process. Table 1 reveals an asymmetry in the convergence of inflation expectations toward inflation targets. Inflation expectations have been anchored to inflation targets in relatively smaller quantiles ($\tau \leq 0.5$) but follow unit root processes at higher quantiles ($\tau > 0.5$). If we evaluate the results of $\alpha_0(\tau)$ and $\alpha_1(\tau)$ together, we can determine that inflation targets are considered while forming inflation expectations in the presence of negative and relatively small positive shocks, but they are not successful when followed by inflation expectations as larger positive shocks exist. Furthermore, no asymmetry exists in the convergence process of inflation expectations toward actual inflation across quantiles, and inflation expectations have been anchored to actual inflation regardless of the size of the shocks. This finding provides strong evidence in favour of imperfect credibility which implies that economic agents have been considering actual inflation in addition to inflation targets to form their expectations.

HLs help us interpret the speed of anchoring inflation expectations: the higher the values of HLs, the longer time of anchoring process.[9] In relatively smaller quantiles (0.1 and 0.2), HLs are too small for the expectation gap in terms of inflation targets, so inflation expectations have been rapidly anchored to inflation targets, whereas in relatively larger quantiles (0.8 and 0.9) inflation expectations have no tendency to follow inflation targets due to infinite HLs. On the other hand, the speed of anchoring inflation expectations to actual inflation is very fast in each quantile for expectation gaps in terms of actual inflation. Regarding these findings, we can argue that the signs and magnitudes of shocks play a crucial role in determining the speed of the anchoring process.

4. Conclusion

Monetary policy suggests that the convergence of inflation expectations toward inflation targets rather than actual inflation helps stabilize inflation. Our results suggest that inflation expectations have been anchored to both inflation targets and actual inflation, suggesting imperfect credibility. Inflation targets are considered when forming inflation expectations in the presence of negative and relatively small positive shocks, but not in larger positive shocks.

[9] Following Tsong and Lee (2011) and Çiçek and Akar (2013), HLs are calculated if $\alpha_1(\tau)$ is smaller than 1 and set at infinity otherwise.

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