ANCHORING OF INFLATION EXPECTATIONS: THE CASE OF TURKEY

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Abstract

It may be observed from the existing monetary economics literature that none of the previous papers that examine the degree to which inflation expectations are anchored in Turkey takes structural breaks into account. However, it is widely accepted that an economy is likely to be exposed to some considerable events/structural breaks. Hence, the previous research may have provided inefficient and biased output about anchoring of inflation expectations in Turkey. To fulfil this gap to some degree, the purpose of this paper is to investigate whether inflation expectations are well anchored in Turkey considering the structural breaks. To this end, the paper first uses the original model of Bomfim and Rudebusch (2000) and then extends this model with the exchange rate. Monthly data over the period 2004:2-2019:7 are used. In the paper, first, the stationarity levels of the variables are examined, and it is found that all variables are stationary at first differences. Subsequently, considering the recent developments in cointegration analysis, the paper employs the Tsong et al. (2016) cointegration test based on the Fourier approximation and the dynamic ordinary least squares estimator suggested by Saikkonen (1991) and Stock and Watson (1993) to examine whether there is a cointegration relationship among the variables in the empirical model. Finally, after detecting the presence of cointegration, the paper estimates the long-run coefficients. The findings show that the sensitivity of inflation expectations to the inflation rate in the previous period is higher than that to the inflation target for the original model. Besides, the findings obtained from the extended model imply that inflation expectations are most affected by the exchange rate. These results provide evidence that inflation expectations are not well anchored in Turkey.

Keywords: inflation expectations, inflation target, anchoring of inflation expectations, the Central Bank of the Republic of Turkey, cointegration test based on the Fourier approximation

JEL Classification: C22, E52, E58

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1. Introduction

The rules versus discretion debate in the monetary policy has about a two-hundred-year origin (see *e.g.*, Bofinger *et al*., 2001; Schwartz, 2008). The discussion is essentially as follows: Should a central bank actively use policy instruments to stabilize the economy or follow a predetermined rule in a passive attitude (Telatar, 2002)? While the discretion is considered to be synonymous with flexibility and activist policies (Barro, 1984, 1986), rules in monetary policy lead to the loss of flexibility of central banks. While the main advantage of discretion is that monetary policy can respond to shocks in the economy, the main advantages of the rule are that rules protect monetary policy from human errors and prevent the possible problem of time inconsistency (Belke and Polleit, 2009). According to the problem of time inconsistency, even if a central bank behaves optimally to expand the volume of economic activity, the new equilibrium of the economy will be worse than the equilibrium under rules.[3] Until the 1970s, most policy makers and economists supported activist monetary policies focused on increasing production and reducing unemployment. Afterwards, (i) the predominant view that the effects of monetary policy have long and variable lags on output and inflation (Friedman, 1968), (ii) theories on no trade-off between inflation and unemployment (long-term Phillips curve), (iii) the problem of time inconsistency, and (iv) high costs of inflation[4] led to the views against activist policies and the view that the primary objective of monetary policy should be price stability became prominent (Mishkin, 1997; Mishkin and Posen, 1997). Within this frame, Bernanke *et al.* (2001) denote that the distinction between rules versus discretion makes no sense in today's world and only discretion is used in practice. Accordingly, all different monetary policy strategies that central banks can use to ensure price stability, which is the primary objective of central banks today, include discretion. In this environment, a conceptual structure and discipline are imposed on central banks without eliminating all flexibility.

As the European Central Bank (1999, hereafter ECB) defines, a monetary policy strategy/regime shows how monetary policy decisions are made in the light of behaviours of economic indicators to ensure price stability. To avoid inflation caused by time inconsistency, the strategy is usually based on a nominal anchor, which is an intermediate target and prevents the central bank from attempting to increase output through unexpected expansionary monetary policy (Mishkin and Posen, 1997; Mishkin, 2004). In other words, the nominal anchor imposes restrictions on discretion and prevents the emergence of the time inconsistency problem (Mishkin, 2004). Monetary policy is considered to be more efficient in the presence of the nominal anchor, and a well-understood nominal anchor by public increases the efficiency of monetary policy in achieving price stability (Bernanke *et al*., 2001). A central bank adopting a monetary policy strategy tries to influence its intermediate target by means of monetary policy instruments and expects this intermediate target to affect the ultimate target. While the ultimate target is the inflation rate with the purpose of achieving price stability, the intermediate target is the variable that the central bank tries to control (Froyen, 1999). As Belke and Polleit (2009) remark, the reasons why monetary policy needs an intermediate target are that (i) the central bank cannot directly control inflation and (ii) monetary policy measures can affect inflation with a lag. Therefore,

[3] *See Kydland and Prescott (1977) and Barro and Gordon (1983) for time inconsistency.*

[4] *See Mishkin and Posen (1997), Mishkin (1997), Bernanke et al. (2001), and Kara and Orak (2008) for the costs of inflation.*

monetary policy is usually based on an intermediate target. More specifically, the central bank tries to control the intermediate target because it considers that the intermediate target may affect inflation when it controls this variable.

The three monetary policy strategies that use nominal anchors and have been implemented by different central banks to date are monetary targeting, exchange rate targeting, and inflation targeting. The intermediate target for monetary targeting, which is essentially based on the quantity theory of money, is the monetary base or money supply, such as M1, M2 or M3. As one may see from the above explanations, in order for a central bank that implements monetary targeting to be successful, it must be able to control the target monetary magnitude and there must be a strong relationship between the target monetary magnitude and inflation. However, fluctuations in the velocity of money in many countries as a result of new financial instruments and financial liberalization in the 1980s made it difficult for central banks to control monetary aggregates and weakened the relationship between monetary aggregates and inflation (Mishkin and Posen, 1997; Mishkin, 1997). Afterwards, many central banks which implemented monetary targeting in the 1970s gave up monetary targeting in the 1980s (Mishkin and Posen, 1997). The exchange rate targeting strategy, on the other hand, has significant disadvantages, such as ending independent monetary policy and resulting in speculative attacks to national currencies. As Obstfeld and Rogoff (1995) note, central banks adopting a fixed exchange rate regime are forced to raise interest rates severely against a major speculative attack. The rise in interest rates puts the banking system to great stress and has serious negative effects on investment expenditures, unemployment, economic growth, budget deficit, and income distribution.

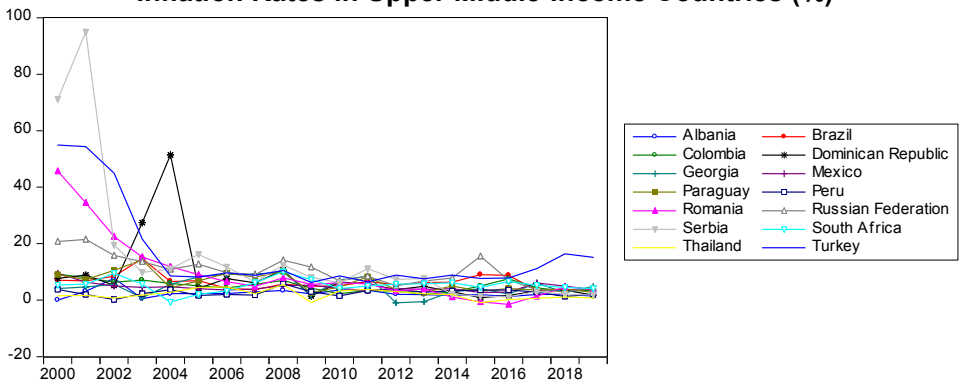
The views that monetary policy will be more effectively conducted with the existence of a nominal anchor has caused inflation targeting to be considered as an alternative monetary policy strategy. The first central bank in the world to adopt the inflation targeting strategy was the Central Bank of New Zealand, and the bank began to implement this monetary policy strategy in 1990. Over time, many central banks in the world have chosen inflation targeting as the monetary policy strategy. Inflation targeting is a monetary policy strategy for which an explicit numerical target for inflation is determined and the central bank tries to achieve this target on medium term (Svensson, 2000). It is known that inflation expectations have a very important role in price adjustments and wage bargaining (Soybilgen and Yazgan, 2017). In addition, the main determinants of current inflation are past decisions and contracts, and central banks can affect only future inflation as monetary policy instruments have a lagged effect on inflation (Svensson, 1997). For these reasons, the intermediate target for the central bank endorsing the inflation targeting strategy is the inflation expectation of the public. Accordingly, the inflation target of a transparent, reputable, and reliable central bank will be able to shape inflation expectations of the public. In this way, the high correlation between inflation expectations and inflation will induce inflation to be close to the central bank's inflation target. Put differently, as long as inflation expectations are close to the inflation target, the risk of missing the inflation target will be relatively low (Bofinger *et al.*, 2001). Therefore, a central bank will be successful in terms of achieving inflation targets if the economic actors consider inflation targets rather than past inflation rates while they are shaping inflation expectations (Kara and Orak, 2008). Therefore, communication with the public is of vital importance for the inflation targeting strategy. In this framework, a central bank will achieve the inflation target if inflation expectations of the public are close to the inflation target. It means that inflation expectations are well anchored when inflation expectations are close to the inflation target (Gürkaynak *et al*., 2010). Hence, if the credible and reputable central bank's objective function, which theoretically includes the

square of the difference between the inflation rate and the inflation target and of output gap, is known by the public, the public will have information about the goal of monetary policy and inflation expectations will not be sensitive to incoming data (Bernanke, 2007). Unanchored inflation expectations tend to highly correlate with not only new information but also the past inflation rates (Chen, 2019).

As revealed by Morozumi *et al.* (2020), there are thirty-nine central banks that endorse the inflation targeting strategy currently. Accordingly, inflation targeting is a monetary policy strategy that is adopted not only in high-income economies but also in low-income and middle-income economies. Figure 1 exhibits the inflation rates which are calculated based on the consumer price index (CPI) during the 2000-2019 period in upper middle-income countries where the inflation targeting strategy is used.

Figure 1

Inflation Rates in Upper Middle-Income Countries (%)



Source: World Bank (2021).

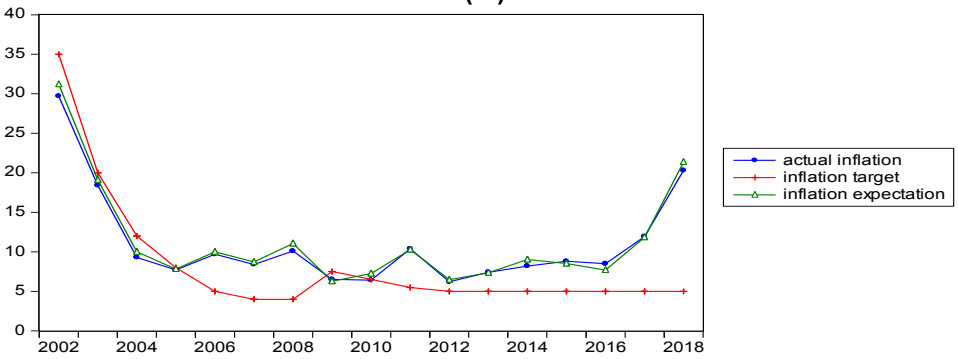
Figure 1 shows that inflation rate has seriously decreased over the last years in most of the upper middle-income countries. However, the inflation rate in Turkey has been usually higher than the inflation rates in other upper middle-income countries during the observed period and has sharply increased lately. Accordingly, the inflation rates in Turkey were 16.33% and 15.17% in 2018 and 2019, respectively. On the other hand, the average inflation rate in the countries not including Turkey in Figure 1 was 3.47% and 3.24%, respectively, in 2018 and 2019. Hence, the Turkish experience with the inflation targeting strategy may be intriguing in terms of the reasons why price stability has not been achieved in Turkey. Within this scope, analysing the evolution of inflation expectations and the inflation targets may provide valuable information about the high inflation rates in Turkey when it is considered that the intermediate target is inflation expectation for the inflation targeting strategy.

After the economic crises in November 2000 and February 2001, the Central Bank of the Republic of Turkey (CBRT) announced that Turkey moved to the floating exchange rate regime by giving up the exchange rate targeting strategy. The CBRT also declared that it would adopt inflation targeting strategy in the following years. As some preconditions must

be fulfilled to follow the inflation targeting strategy[5], the CBRT endorsed an intermediate regime, namely implicit inflation targeting, for the period 2002-2005. The main difference between the implicit inflation targeting regime and the inflation targeting regime was that the CBRT had a monetary target, *i.e.*, monetary base, along with the inflation target (Kara, 2008). Then, in 2006, the CBRT adopted the inflation targeting strategy. While the CBRT used both monetary base and public's inflation expectation as the intermediate targets until the year 2006, the only intermediate target of the CBRT has been inflation expectation since then. Figure 2 demonstrates actual inflation, inflation targets, and end-year inflation expectations based on CPI in Turkey over the period 2002-2018.

Figure 2

Actual Inflation, Inflation Targets, and End-Year Inflation Expectations (%)



Source: CBRT.

From Figure 2, one may notice that the implicit inflation targeting and the inflation targeting periods indicate highly different outcomes in terms of actual inflation, inflation targets, and inflation expectations. On one hand, actual inflation was lower than the inflation target during the implicit inflation targeting regime that prevailed in the period 2002-2005. Besides, inflation expectation was lower than the inflation target during the same period. On the other hand, actual inflation was always higher than the inflation target during the inflation targeting period from 2006 to 2018, except for 2009 and 2010, while inflation expectation was lower than the inflation target only in 2009. Additionally, actual inflation and inflation expectation rapidly increased and the inflation outlook seriously worsened in 2017 and 2018. One may also notice that there is a co-movement between actual inflation and inflation expectation during the observed period.

After detecting serious deviations of actual inflation rates and inflation expectations from inflation targets during the inflation targeting period, this paper suggests some questions about anchoring of inflation expectations in Turkey. These questions are as follows: Does the CBRT have a credibility problem while it is steering inflation expectations toward inflation targets? Put differently, is there a difficulty in anchoring of inflation expectations in Turkey?

[5] *The basic preconditions of inflation targeting are as follows: (i) no fiscal dominance in the country, (ii) a central bank that has advanced analytical capacity and technical infrastructure to forecast future inflation, (iii) low sensitivity to changes in exchange rates and in commodity prices, and (iv) a strong financial system (Masson et al. 1998; Mishkin, 2000; Batini et al., 2006; Kara and Orak, 2008).*

From this point of view, the current paper examines the degree to which inflation expectations are anchored in Turkey through the model proposed by Bomfim and Rudebusch (2000). The paper also extends this model with the exchange rate as (i) the exchange rate channel is a considerable monetary transmission channel that focuses on the impacts of changes in exchange rates on aggregate demand and inflation (Kruskovic, 2017), (ii) an important part of Turkey's imports is priced in USD, which is the reserve currency (Bulut, 2018), (iii) trade openness in Turkey has dramatically increased in the last years, implying the impact of exchange rates on inflation and inflation expectations may boost.[6] The paper uses monthly data for the period 2004:M02-2019:M07. This paper contributes to the monetary economics literature in two ways. First, it employs the above-mentioned model because of the serious advantages it has. Accordingly, the empirical findings that will be obtained through the estimation of the model will not only indicate whether inflation expectations are well anchored but also imply why inflation expectations are not well anchored if the findings indicate weak evidence about anchoring of inflation expectations. Second, the paper regards recent developments in cointegration analysis and employs a cointegration test with structural breaks. While doing that, this paper considers not only sharp breaks but also gradual breaks and employs a cointegration test which is capable of presenting efficient output in the presence of both sharp and gradual breaks. The paper employs a cointegration test with structural breaks as the degree of anchoring of inflation expectations may have changed due to some important developments in the Turkish economy, namely the great effect of the 2007-2008 global financial crisis on the Turkish economy, the adaptation of the inflation targeting strategy in 2006, the extension of the framework of the CBRT's monetary policy in the last quarter of 2010 to preserve financial stability, etc. To our knowledge, none of the previous papers that examined anchoring of inflation expectations in Turkey took structural breaks into account. For this reason, the previous papers in the existing literature may have presented inefficient and biased findings about anchoring of inflation expectations in Turkey. Hence, a key strength of this paper is that it is the first paper that considers structural breaks while investigating the degree to which inflation expectations are anchored in Turkey.

The rest of the paper is organized as follows. Section 2 gives the empirical literature. Model and data are presented in Section 3. Estimation methodology and findings are exhibited in Section 4. Section 5 concludes the paper.

2. Literature Review

From the previous literature, one may observe that there is a limited number of studies focusing on anchoring of inflation expectations in Turkey. This paper classifies these studies into three groups. The first group of the studies finds that inflation expectations are not well anchored in Turkey. For instance, Baskaya *et al*. (2008), using data for the period 2003-2007 and employing the rolling regression method, yield that the sensitivity of inflation expectations to the inflation target and to the past inflation rate, respectively, decreases and increases over time. Hence, they document a low degree of anchoring of inflation expectations beginning from the first quarter of 2006. Cicek and Akar (2014) use data spanning the period 2002-2013 and carry out the quantile autoregression approach to investigate whether inflation expectations converge to the inflation targets or the past

[6] *As per World Bank (2021) data, while the ratio of foreign trade to GDP was 17% in 1980, it was 42.3% in 2000. Besides, it reached 62.7% in 2019.*

inflation rates. Their findings indicate that inflation expectations converge to both inflation targets and past inflation targets at smaller quantiles, whereas inflation expectations converge to only past inflation rates at larger quantiles. The second group of the studies documents that inflation expectations are better anchored in process of time. For example, Baskaya *et al*. (2010) examine the influence of the revision of inflation targets in June 2008 on the degree of anchoring of inflation expectations by using data over the period 2003-2009 and performing the rolling regression method. They show that the target revision increased the sensitivity of inflation expectations to the inflation target and decreased the sensitivity of inflation expectations to the past inflation rate, indicating that the degree of anchoring of inflation expectations increased due to the target revision. Cicek *et al*. (2011) use data spanning the period 2003-2010 and test the degree of anchoring of inflation expectations to the inflation targets by performing the time-varying vector autoregressive model. They yield that the sensitivity of inflation expectations to the inflation target is high in most of the observed period, indicating inflation expectations are well anchored. Baskaya *et al.* (2012), utilizing data over the period 2006-2012 and using the rolling regression method, find that the sensitivity of inflation expectations to the inflation targets is relatively higher in high-inflation periods as compared to low-inflation periods. They also show that the sensitivity of inflation expectations to the past inflation rates tends to decrease in time. There is one study which yields highly different outputs in terms of different time horizons in the third group. Accordingly, Bulut (2018) employs the autoregressive distributed lag approach and uses data spanning the period 2006-2016 to examine the sensitivity of inflation expectations to inflation targets and past inflation rates. The findings suggest that inflation targets have a greater effect on 12 month-ahead inflation expectations than past inflation rates have, meaning that the 12 month-ahead inflation expectations are well anchored, while the 24 month-ahead inflation expectations are sensitive to only past inflation rates, implying that the 24-month ahead inflation expectations are not anchored.

As one may see from the previous empirical literature, none of the papers considered structural breaks while examining the degree of anchoring of inflation expectations in Turkey. In addition, these papers, except for Bulut (2018), did not take time series properties, such as unit root and cointegration of the variables, into account. Hence, these papers may be exposed to the spurious regression problem. Therefore, this paper stresses the distinctive features from the previous papers in the literature once more. Accordingly, the key strengths of the present paper are that (i) it examines the time series properties of the variables under consideration and (ii) it is the first paper that takes structural breaks into account while examining whether inflation expectations are well anchored in Turkey.

3. Model and Data

As it was previously remarked, the degree to which inflation expectations follow inflation targets is the basic measure of the credibility of an inflation-targeting central bank. This paper follows the methodology suggested by Bomfim and Rudebusch (2000) and defines monetary policy credibility via the relationship between inflation expectations and inflation targets. This deterministic model is described as follows:

$$\pi_t^e = \alpha_t \pi_t^{tar} + (1 - \alpha_t)\pi_{t-1} \quad (1)$$

where: π_t^e is the expected inflation rate in the current period, π_t^{tar} is the inflation target rate in the current period, and π_{t-1} is the inflation rate in the previous period. The α_t parameter indicates the credibility of inflation target of the central bank. Put differently, the degree of anchoring of inflation expectations is measured by α_t. If $\alpha_t = 1$, there is perfect credibility,

inflation expectations are completely anchored and are equal to the inflation target. On the other hand, if $\alpha_t = 0$, there is no credibility, the inflation target is ignored in the formation of expectations, and inflation expectations are equal to the inflation rate in the previous period. To empirically estimate this model, this paper converts this deterministic model into a stochastic model depicted as follows:

$$\pi^{e}_{t+12/t} = \beta_0 + \beta_1 \pi^{tar}_{t+12/t} + \beta_2 \pi_{t-1} + \varepsilon_t \quad (2)$$

where: $\pi^{e}_{t+12/t}$, $\pi^{tar}_{t+12/t}$, π_{t-1}, and ε_t stand for 12 month-ahead expected inflation rate in the t period, 12 month-ahead target inflation rate in the t period, the inflation rate in the t-1 period, and the error term, respectively. This paper investigates whether the CBRT can shape short-term inflation expectations and uses 12 month-ahead inflation expectations as the dependent variable in the empirical model. Besides, as was denoted in the first part of the paper, this paper extends the original model of Bomfim and Rudebusch (2000) with the exchange rate, because Turkey is an open economy and the exchange rates may affect inflation through the exchange rate channel. Hence, the extended model is described as below:

$$\pi^{e}_{t+12/t} = \beta_0 + \beta_1 \pi^{tar}_{t+12/t} + \beta_2 \pi_{t-1} + \beta_3 exc_t + \varepsilon_t \quad (3)$$

where: exc_t is the exchange rate (Turkish Lira (TRY) units per unit of USD). In Equations (2-3), β_1, β_2, and β_3 parameters measure the degree of anchoring of inflation expectations. Accordingly, if $\beta_1 = 1$, $\beta_2 = 0$, and $\beta_3 = 0$, there is perfect credibility and inflation expectations are completely anchored. If $\beta_1 = 0$, $\beta_2 = 1$, and $\beta_3 = 0$, there is no credibility and the economic actors do not consider the inflation target while they are forming their inflation expectations. If $0 < \beta_1 < 1$, $0 < \beta_2 < 1$, and $0 < \beta_3 < 1$, there is partial credibility and inflation expectations are not completely anchored. In the third case, the magnitude of coefficients gives crucial evidence about the credibility of the central bank and the degree of anchoring of inflation expectations. For instance, if $\beta_1 > \beta_2$ and $\beta_1 > \beta_3$, the sensitivity of inflation expectations to the inflation target is higher than that to the past inflation rate and the exchange rate, whereas the sensitivity of inflation expectations to the inflation target is lower than that to the past inflation rate and the exchange rate if $\beta_1 < \beta_2$ and $\beta_1 < \beta_3$.

One may calculate monthly, quarterly, and/or annual inflation rates from 2004 in Turkey as the inflation rates are calculated using the CPI with the base year 2003. Furthermore, the empirical models in Equations (2-3) include the inflation rate for the previous period. Therefore, this paper exploits monthly data spanning the period 2004:2-2019:7 to examine the influences of the inflation target, the inflation rate in the previous period, and the exchange rate on inflation expectations. All inflation data and the exchange rate data are sourced from the CBRT (2021).

Table1

Descriptive Statistics and Correlation Matrix for the Variables

	$\pi^{e}_{t+12/t}$	$\pi^{tar}_{t+12/t}$	π_{t-1}	exc_t
Descriptive statistics				
Mean	7.941	5.561	9.320	2.242
Median	7.210	5.000	8.657	1.767
Maximum	17.380	11.667	25.240	6.367
Minimum	5.480	4.000	3.986	1.170
Standard deviation	2.316	1.409	3.375	1.210
Number of obs.	186	186	186	186

	$\pi^{e}_{t+12/t}$	$\pi^{tar}_{t+12/t}$	π_{t-1}	exc_t
Correlation matrix				
$\pi^{e}_{t+12/t}$				
$\pi^{tar}_{t+12/t}$	0.170			
π_{t-1}	0.870	-0.132		
exc_t	0.776	-0.256	0.718	

Table 1 reports descriptive statistics and correlation matrix for the variables under consideration. As shown, all descriptive statistics, except for minimum of π_{t-1} are higher than those of $\pi^{e}_{t+12/t}$, $\pi^{tar}_{t+12/t}$, and exc_t. Furthermore, $\pi^{e}_{t+12/t}$ is positively correlated with all the variables in the empirical models. Descriptive statistics provide researchers with some preliminary inspections about variables, yet, to obtain efficient output, researchers need to consider some statistical and/or econometric methodologies, namely unit root and cointegration tests.

4. Methodology and Findings

To avoid the possible spurious regression problem, this paper first examines the stationarity properties of the variables in the empirical model. Accordingly, the paper performs the unit root test developed by Dickey and Fuller (1981, hereafter ADF) without breaks and the unit root test propounded by Lee and Strazicich (2013, hereafter LS) with one break to determine the order of integration of the variables under consideration. Both methods test the null hypothesis of a unit root against stationarity.

Table 2

Results of the Unit Root Tests

Variable	Level		First difference	
	ADF	LS	ADF	LS
$\pi^{e}_{t+12/t}$	-0.182	-3.692 (Mar. 2014)	-6.524*	-5.625*
$\pi^{tar}_{t+12/t}$	-0.943	-3.903 (Feb. 2009)	-2.806*	-4.343**
π_{t-1}	-0.595	-2.961 (Aug. 2017)	-10.147*	-6.708*
exc_t	3.456	-1.565 (Nov. 2016)	-6.460*	-5.588*

*Note: * and **, respectively, indicate 1% and 5% significance levels. Break dates are reported in parentheses.*

Table 2 reports the result of the ADF and LS unit root tests. As one may see in the table, for all the variables in the empirical models, the null hypothesis of a unit root cannot be rejected at level, whereas it can be rejected at first difference. Hence, the paper gives evidence that all variables are integrated of order one and that the cointegration relationship among the variables can be investigated.

The cointegration tests developed by Engle and Granger (1987), Johansen (1988), Johansen and Juselius (1990), Pesaran *et al.* (2001) are commonly performed in empirical analyses. The main shortcoming of these tests is that they assume there are no structural breaks in the economy that lead to changes in the relationships between variables. However,

an economy may be exposed to some considerable events/structural breaks, such as wars, economic crises, great changes in economic and political policies, etc., during the observed period. Starting from this point of view, some researchers, namely Gregory and Hansen (1996), Hatemi-J (2008), and Maki (2012), propounded cointegration tests that take these structural breaks into account and allow for the relationships between variables to vary. On one hand, these tests allow for slope coefficients to change after the structural breaks. In other words, these tests posit that the structural breaks occur instantaneously. As these methods examine the relationships between variables before and after the structural break, they assume a shift in the relationships between variables occurs, inducing these methods to denominate as cointegration test with regime shifts. In addition, the number of the structural breaks is predetermined for these tests. For instance, while the Gregory and Hansen (1996) and the Hatemi-J (2008) cointegration methods, respectively, assume there are one and two regime shifts, the Maki (2012) cointegration test considers regime shifts up to five. On the other hand, the performances of these tests strongly depend on the assumption of sharp breaks and on the precision of the estimated break dates (Tsong *et al*., 2016). Tsong *et al*. (2016) develop a relatively new cointegration test that is able to exhibit efficient output regardless of the number and the form of the structural breaks, *i.e.,* sharp or gradual. Additionally, this method suggests a pretesting to examine whether the model must include the Fourier component.

Tsong *et al.* (2016) first estimate the model below:

$$y_t = d_t + x_t'\beta + \eta_t, \quad d_t = \delta_0 + f_t, \quad \eta_t = \gamma_t + \upsilon_{1t}, \gamma_t = \gamma_{t-1} + u_t, \quad x_t = x_{t-1} + \upsilon_{2t} \tag{4}$$

where: u_t denotes the error term, while f_t stands for the Fourier function that is described as

$$f_t = \alpha_k \sin\left(\frac{2k\pi t}{T}\right) + \beta_k \cos\left(\frac{2k\pi t}{T}\right) \tag{5}$$

where: k, t, and T, respectively, are the Fourier frequency, trend, and the number of observations. The null hypothesis of the presence of cointegration can be defined as

$$H_0: \sigma_u^2 = 0 \text{ versus } H_1: \sigma_u^2 > 0 \tag{6}$$

To test for the null hypothesis that there is cointegration, the model is demonstrated as follows:

$$y_t = \sum_{i=0}^{m} \delta_i t^i + \alpha_k \sin\left(\frac{2k\pi t}{T}\right) + \beta_k \cos\left(\frac{2k\pi t}{T}\right) + x_t'\beta + \upsilon_{1t} \tag{7}$$

For the Tsong *et al*. (2016) cointegration test, the cointegration test statistic is calculated as follows:

$$CI_f^m = T^{-2}\hat{\omega}_1^{-2}\sum_{t=1}^{T} S_t^2 \tag{8}$$

where: $S_t = \sum_{t=1}^{T} \hat{\upsilon}_{1t}$ indicates the partial sum of the ordinary least squares (OLS) residuals in Equation (7) and $\hat{\omega}_1^2$ denotes the estimator of the long-run variance of υ_{1t}.

Tsong *et al*. (2016) test for the null hypothesis of the absence of the Fourier component, defined as H_0: $\alpha_k = \beta_k = 0$, through the F test below:

$$F^m(k^*) = \max_{k\in\{1,2,3\}} F^m(k) \tag{9}$$

where:

$$F^m(k) = \frac{\left(SSE_0^m - SSE_1^m(k)\right)/2}{\frac{SSE_1^m(k)}{(T-q)}} \tag{10}$$

where: SSE_0^m is the sum of squares residuals obtained from the estimation of Equation (7) under the null hypothesis while $SSE_1^m(k)$ denotes the sum of squares residuals taken from the estimation of Equation (7) under the alternative hypothesis.

Tsong *et al*. (2016) employ the dynamic OLS (DOLS) estimator produced by Saikkonen (1991) and Stock and Watson (1993) to estimate Equation (7).

Table 3

Results of the Cointegration Tests and Long-Run Coefficients

Panel A: The original Bomfim and Rudebusch (2000) model			
Panel A1: Cointegration test			
Optimal frequency	Min. SSR	Test stat.	F stat.
1	79.122	0.103	4.724**
Panel A2: DOLS results			
Variable	Coefficient	Std. error	t-stat.
$\pi^{tar}_{t+12/t}$	0.449*	0.157	2.860
π_{t-1}	0.694*	0.119	5.842
Panel B: The extended model with the exchange rate			
Panel B1: Cointegration test			
Optimal frequency	Min. SSR	Test stat.	F stat.
1	55.134	0.038	10.068*
Panel B2: DOLS results			
Variable	Coefficient	Std. error	t-stat.
$\pi^{tar}_{t+12/t}$	0.622*	0.083	7.449
π_{t-1}	0.466*	0.039	11.931
exc_t	0.781*	0.141	5.516

*Note: * and **, respectively, indicate 1% and 5% significance levels.*

Table 3 reports the results of the cointegration test along with the long-run coefficients. Panel A and Panel B, respectively, show the results for the original model and the extended model. Accordingly, the null hypothesis that there is no need to add the Fourier component to the empirical models is rejected at 5% and 1% levels by F statistic for the first and the second models, respectively. These results imply that the cointegration testing procedure must be based on the Fourier approach and so the Tsong *et al*. (2016) cointegration test must be performed to investigate whether there is a cointegration relationship in the models. Moreover, the null hypothesis of cointegration cannot be rejected with the optimal frequency 1 for both models. These findings mean that there is a cointegration in both models and that the long-run coefficients can be estimated via the DOLS estimator. As shown, for the first model, $\pi^{tar}_{t+12/t}$ and π_{t-1} , respectively, have the estimates of 0.449 and 0.694 at 1% level of significance. Besides, for the second model, $\pi^{tar}_{t+12/t}$, π_{t-1}, and exc_t , respectively, have the estimates of 0.622, 0.466, and 0.781 at 1% level of significance. Hence, the DOLS estimator provides some considerable implications about the influences of the inflation target, the past inflation rate, and the exchange rate on inflation expectations. First, inflation expectations are positively related to the inflation target, the past inflation rate, and the exchange rate. Second, there is partial credibility toward the inflation target of the CBRT and, thus, the inflation expectations are not completely anchored in Turkey as the coefficients of $\pi^{tar}_{t+12/t}$, π_{t-1}, and exc_t range between 0 and 1. Third, for the original model, the coefficient of $\pi^{tar}_{t+12/t}$ is lower than that of π_{t-1}, meaning the sensitivity of inflation expectations to the inflation target is lower than that to the past inflation rate. Besides, for the extended model, exc_t has the highest coefficient, while the coefficient of $\pi^{tar}_{t+12/t}$ is higher than that of π_{t-1}. This result implies inflation expectations are highly sensitive to the exchange rate and the sensitivity of

inflation expectations to the inflation target is higher than that to the past inflation rate. Hence, the findings of the DOLS estimator signify that (i) the past inflation rate appears to be more important than the inflation target while inflation expectations are being formed for the original model and (ii) inflation expectations are most affected by the exchange rate for the extended model. Overall, the results for both models indicate that inflation expectations are not well anchored in Turkey. Therefore, the empirical evidence of the present paper concurs with those of Baskaya *et al*. (2008) and Cicek and Akar (2014), who yield inflation expectations are not well anchored in Turkey.

5. Conclusion

Using monthly data spanning the period 2004:02-2019:07, this paper investigates whether inflation expectations are well anchored in Turkey. After performing some unit root tests and determining all variables are integrated of order one, the paper performs the Tsong *et al.* (2016) cointegration test and the DOLS estimator to examine whether there is a cointegration relationship in the empirical models, and if such a relationship exists, to estimate the long-run coefficients. The main advantage of this cointegration test is that it takes structural breaks into account while searching for cointegration in the model. Therefore, this paper is the first one that considers structural breaks while examining whether inflation expectations are well anchored in Turkey. For the baseline model, the empirical findings indicate that inflation expectations are positively related to both the inflation target and the past inflation rate. In addition, the outputs imply that the sensitivity of inflation expectations to the inflation rate in the previous period is higher than that to the inflation target. Additionally, for the model extended with the exchange rate, the findings imply that inflation expectations are positively related to the inflation target, the past inflation rate, and the exchange rate. Moreover, the results show that inflation expectations are most influenced by the exchange rate. Hence, the paper explores a partial credibility to the inflation target of the CBRT and thus yields inflation expectations are not well anchored in Turkey.

As revealed by Heenan *et al.* (2006), a well-designed inflation target should anchor inflation expectations. The empirical findings of this paper provide evidence that the inflation targets of the CBRT cannot control inflation expectations. Within this scope, it can be argued that the reputability and credibility problems of the CBRT have a critical role in the missed inflation targets. On the other hand, as Mishkin (2007) and Gerlach *et al.* (2011) show, a shock to aggregate demand, exchange rates, or energy prices will have little or no effect on the expected inflation rates if inflation expectations are well anchored. Within this scope, one of the preconditions of inflation targeting is the low sensitivity of the economy to changes in exchange rates (Masson *et al*., 1998; Mishkin, 2000; Batini *et al*., 2006; Kara and Orak, 2008). However, the empirical output yields that the exchange rate has a considerable impact on inflation expectations in Turkey. Some recent papers support this finding and reveal a high exchange rate pass-through to domestic prices (see, *e.g*., Ertug *et al*., 2018; Tunc and Kilinc, 2018). Accordingly, an increase in the exchange rate leads to an increase in inflation expectations and the inflation rate in Turkey.

It should also be noted that the CBRT, which adopted the inflation targeting strategy in 2006, extended the framework of monetary policy to pursue both price stability and financial stability because of the considerable appreciation of the Turkish Lira against foreign currencies and high credit growth rates in Turkey in October 2010. In an economic environment with high financial imbalances, this dramatical change in monetary policy might be useful for the Turkish economy to achieve macroeconomic stability. However, needless

to say, one of the most important aspects of macroeconomic stability is price stability. When one observes inflation data in Turkey (see Figure 2), he/she will notice that monetary policy of the CBRT appears to be highly away from achieving price stability. Furthermore, the primary objective of the CBRT is to achieve and maintain price stability by the law. Therefore, this paper argues that the CBRT should (i) primarily focus on well anchoring of inflation expectations to achieve price stability and (ii) pursue financial stability so long as the objective of financial stability does not contradict with the objective of price stability.

Finally, despite its contributions to the existing literature, this paper has some limitations. Accordingly, future papers can focus on a longer horizon and examine whether the inflation target of the CBRT can shape medium- and long-term inflation expectations. Besides, these papers can consider energy prices in the empirical model as Turkey is an energy-importing country. Finally, the present paper focuses on a linear model with structural breaks for the empirical analysis. Future papers can consider nonlinearity for the estimation technique as linearity can be considered as a strong assumption for an empirical analysis.

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