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Original Research Article

Investigation of the Impact of Structural Break on the Relationship between Inflation and Inflation Uncertainty in the Turkish Economy

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This article examines the relationship between inflation and inflation uncertainty in the Turkish economy in this period 2004:01-2014:12. This relationship is explored in two ways: a) with the effect of structural breaks; b) without the effect of structural breaks. In fact, with regard to the main structural break have occurred over this period, we examine whether structural break has affected the causal relationship between these two variables or not. Conditional Heteroscedasticity Models are used to obtain inflation uncertainty. The EGARCH model has been identified as the most appropriate model for inflation uncertainty. Lee-Strazicich test is applied for checking any structural break in inflation and inflation uncertainty series. Then, the relation between inflation and its uncertainty is tested using Granger causality Test. This study shows that the structural break has no effect on the Friedman-Ball hypothesis. This hypothesis is supported whether with the structural break or without the structural break. But Cukierman-Meltzer's view is affected by the structural break. Since this hypothesis imply that inflation uncertainty causes inflation, so politicians need to implement policies that pay more attention to inflation uncertainty.

Keywords: Inflation, Inflation Uncertainty, Structural Breaks, Causality Test, Turkish Economy.
JEL Classification*:* C01, C12, C22

1 Introduction

At the macro level, inflation as one of the main variables has an undesirable effect on economic performance. Changing this variable causes uncertainty over future prices, and thus it reduces economic efficiency. Inflation uncertainty is known as the cost of inflation. This cost arises through two channels. First, inflation uncertainty causes consumers not to detect the

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relative price exactly. Second, increased uncertainty decreases the going into long-time contracts. These costs also reduce the efficient allocation of resources which causes the output to decrease. Some know this decline in output as a major cost of inflation (Davis and Kanago, 1996). The Linkage between inflation and inflation uncertainty is a serious issue for policymakers because this relation can be an indicator in determining the monetary policy. Although it was accepted that there was a relationship between inflation and inflation uncertainty, there were several opinions about the direction of the mentioned relationships. The relationship between inflation and inflation uncertainty is explained by the following two hypotheses: Friedman (1977)-Ball's (1992) hypothesis implies that high inflation leads to more inflation uncertainty and another hypothesis is Cukierman and Meltzer's (1986) hypothesis implies that inflation uncertainty causes inflation. Cukierman and Meltzer construct an economic model to explain how inflation uncertainty causes inflation. According to their model, over the period of high inflation uncertainty, Central Bank wants to increase output growth by making surprise inflation. In this condition, the continuation of the surprise inflation policy leads to the creation of higher inflation. Friedman and Ball argue that economic agents need information about relative prices in order to decide what to produce and how to produce it or how to employ owned resources but in a period of high inflation they are uncertain about relative prices. Thus, in this hypothesis, the volatility of inflation or its uncertainty is indicated as the cost of inflation because of uncertainty concerning future monetary policy.

The difference between real inflation and estimated inflation is called inflation uncertainty. Inflation uncertainty arises from expected high inflation. Several methods are used to obtain the inflation uncertainty including consumer surveys and econometric estimation methods. In literature inflation, uncertainty was calculated as absolute values of the error term derived from the autoregressive equation of inflation rate or the moving average of absolute change in the inflation rate. With the advancement of econometric techniques, most of the literature employs the Autoregressive Conditional Heteroscedasticity (ARCH) family models to capture inflation uncertainty. In this study, we also use the ARCH family models (EGARCH) to estimate the inflation uncertainty.

This article aims to research the direct linkage between inflation and inflation uncertainty for Turkey in the period 2004–2014 using monthly data. In fact, this study investigates the effect of the structural break on this relationship. For this reason, we explore the possibility of breakpoints in inflation and inflation uncertainty series. These breakpoints based on the Lee

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and Strazicich Structural Break Unit Root Test are estimated. Then, these estimated breakpoints are removed from inflation and inflation uncertainty, and the influence between the two mentioned series is tested using Granger causality. These results show strong causality from inflation to inflation uncertainty with and without the estimated breakpoints. In other words, in both cases, the results support the Friedman-Ball model. But in opposite direction, while taking into account detected breakpoints Cukierman and Meltzer's hypothesis is strongly supported, without the detected breakpoints this hypothesis is not supported.

The investigation of the influence between these two variables has attracted much attention in recent years in some studies, there has been a huge debate on the effect of a structural break on the relation between these two variables. As for the studies focusing on the structural break, Caporale and Kontonikas (2009) have explored the impact of the Euro which was introduced in 1999 on this relationship by imposing a break time corresponding to the introduction of the Euro on 1 January 1999. They used GARCH models for 12 EMU countries to measure short-run inflation uncertainty and then examined the linkage of inflation and its uncertainty. The result showed that the Euro has had an important effect on this relationship.

Bhar and Mallik (2012) examined the relationship between inflation and its uncertainty using multivariate EGARCH modeling for Australia. They examined this relationship with and without interactive dummies such as inflation targeting and oil price which are considered in the mean equation of inflation. They concluded that inflation uncertainty has a negative and important impact on inflation. They also found that the fluctuation in oil price is an important factor related to inflation uncertainty and increases it.

Daniela et al. (2014) employed the Granger test to investigate the linkage between this variable and its uncertainty in the case of Turkey, Romania, Poland, the Czech Republic, and Hungary by using monthly inflation data over the period 1996-2012. Inflation uncertainty was estimated by utilizing GARCH family models. They also considered the structural breaks and employed the Zivot-Andrews unit root test and PELT Algorithm to determine any possible structural break. Then determined structural breaks are taken away using dummy variables in the GARCH models. They found that for all countries under review, inflation caused inflation uncertainty whereas, for Turkey, Romania, and the Czech Republic inflation uncertainty caused inflation.

Erdem and Yamak (2014) used the Granger-causality test to examine the relationship between inflation and its uncertainty for high and low inflation periods in the Turkish Economy. This study covered the period 1988-2010. The inflation uncertainty series was obtained by using the Kalman Filter analysis technique. The 2004 year was taken into consideration as a breakpoint. The results obtained for both periods were different.

Göktaş and Dişbudak (2014) used both symmetric and asymmetric GARCH models to obtain inflation uncertainty for the period of 1994-2013 in the Turkish Economy. Two different breakpoints in mean and variance have been determined by the Bai-Perron test. By including these breaking points in the related equations, an appropriate model is obtained. In addition, the relationship between inflation and inflation uncertainty was examined before and after the period of the breakpoint. This relationship for every period was different.

Sharaf Fathy (2015) found a bi-directional positive relationship between inflation and its uncertainty for the Egyptian Economy during the period January 1974–April 2015. The Zivot- Andrews (2002) and the Clemente–Montanes–Reyes (1998) unit root tests were used to control any possible structural break in the inflation time series. This study included a two-step procedure. At first ARMA-GARCH model was estimated in order to measure inflation uncertainty and then Granger causality was used to determine the direction of the relationship between the two series.

Falahi and Hajamini (2015) used SETAR-GARCH models to investigate inflation behavior and the relationship between inflation and inflation uncertainty in Iran. The Obtained result from this study showed that there was no evidence in favor of Cukierman-Meltzer's and Friedman-Ball's Hypotheses. It's observed that the inflation behavior was asymmetry and it was specified by the low- and high-inflation regimes. Thus, the type of monetary policy rules should be consistent with this form of nonlinear behavior.

Balaji et al. (2016) used GARCH and Stochastic Volatility (VS) model to measure inflation uncertainty. Empirical evidence from monthly data for the Indian Economy showed that the measure of inflation uncertainty obtained from the SV model is more reliable. In this study, the breakpoints of the inflation series were determined by using Bai and Perron test. The structural break test divided the inflation series into four parts over the sample period. The causality between inflation and inflation uncertainty is different in each episode.

Bamanga (2016) investigated the relationship between inflation and inflation uncertainty by using the ARIMA-EGARCH model with the dummy for Nigeria. The dummy variable in that model was related to structural break.

In this model, Friedman's hypothesis was strongly supported. According Granger-causality test inflation caused inflation uncertainty. In this study, the breakpoints of the inflation series were determined by using Bai and Perron test. The structural break test divided the inflation series into four parts over the sample period. The causality relationship between inflation and inflation uncertainty has been different in each episode.

Gülşen and Kara (2019) derived various uncertainty measures based on survey information for Turkey. They concluded that rising inflation was associated with higher inflation uncertainty. Moreover, their finding was consistent with indicators of inflation risk.

Eregha and Ndoricimpa (2019) applied a BEKK GARCH-M model to examine the effect of uncertainty on the levels of inflation and output growth in Nigeria. The results show a significant positive effect of inflation uncertainty on the level of inflation, supporting the Cukierman and Meltzer hypothesis. In addition, the evidence in this study suggests that Nigeria should put in place policies minimizing inflation uncertainty to avoid its adverse effects on the economy.

Altınbaş and Toptaş (2019) used the PELT method to capture the changes in variance distribution parameters in inflation series. Based on these changes, the 1985:01- 2017:09 periods were divided into three sub-periods. For three sub-periods the ARMA-GARCH model was used as an inflation uncertainty measure. According to the Granger causality test, different results are obtained. Friedman-Ball's hypothesis is predominantly supported.

Çekin (2020) analyzed the relationship between inflation and its volatility for the period of 2002-2020 for BRICS economies and the Euro area. Two different inflation measures were obtained for the periods before and after the 2008 crisis. Friedman-Ball's hypothesis is supported when a long-term inflation measure was used and this hypothesis is partly rejected when a short-term inflation measure is used.

Barnett et al. (2020) considered five developed countries/regions (the US, the UK, the euro area, South Africa, and China) to explored whether there is a relationship between inflation and inflation uncertainty over the past fifty years. They implemented a time-varying inflation uncertainty based on stochastic volatility by considering unpredictable shocks. Then they used two semi-parametric approaches to examine this relationship. It was found that there was a significant relationship between inflation and its uncertainty, which varied over time and frequency. According to the results the Friedman–Ball theory was supported during crisis periods.

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In the existing literature, there are some studies that examine the linkage between inflation and inflation uncertainty by focusing on structural breaks. In these studies, according to breakpoints, the sample period has been divided into some parts. Most of these studies have supported Friedman's hypothesis, whereas the result of some of them shows that this relationship for every period is different.

This paper is different from the previous papers because it considers structural breaks in the variance. It is clear that the conditional variance of a variable is indicated as its uncertainty. Estimating the breakpoint in the inflation uncertainty means the estimation of the breakpoints in the conditional variance of the inflation. This study contributes to the literature on the link between inflation and inflation uncertainty for Turkey by considering the structural break in inflation and its uncertainty and investigating this relationship with and without breaks.

This article is organized as follows: Section 1 presents unit root tests and data descriptions. Section 2 describes a brief review EGARCH model and measuring inflation uncertainty. Section 3 provides the Granger Causality Test results. Section 5 contains concluding remarks.

2 Data and Unit Root Test

This paper covers the inflation series in the Turkish economy in this period 2004M01-2014M12. The reason we chose this period is that the important economic events had taken place during this period, especially inflation targeting, which is an important structural break related to inflation uncertainty. Our data is monthly on CPI (the consumer price index) to construct the rates of inflation. The data are taken from the Central Bank of Turkey. The variable of inflation is shown by INF, the annualized monthly difference of the natural logarithm of CPI: INF = [(Ln CPI_t - Ln CPI_{t-1}) 1200]. Eviews 9 and Rats econometric programs were used for the implementation of econometric tests.

Before applying the unit root test, it is necessary to determine the maximum lag. The following formula is used to obtain the maximum lag, proposed by Schwert (1989).

$$P_m = [12\,(\frac{n}{100})^{\frac{1}{4}}]$$

In this study, the sample size is n=132. Thus, the maximum lag length is 12. We use different unit root tests to examine the stationary properties of the inflation series. The conventional unit root tests used are the Augmented

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Dickey-Fuller (ADF) test, the Phillips–Perron (PP) test, and the Kwiatkowski–Phillips–Schmidt–Shin (KPSS) test. The ADF, PP, KPSS tests don't consider any possible structural breaks in the time series. We employ the Lee and Strazicich (2003) test to detect breaks within the selected period. This test allows for the endogenous two breaks under the null and the alternative hypothesis. Thus, rejection of the null hypothesis implies trend stationary. There are two models, Model A includes two-time changes in level, Model B includes two-time changes in trend, and Model C has two-time changes in the intercept and the trend.

Given the data generating process, $y_t = \delta' Z_t + e_t$, $e_t = \beta e_{t-1} + \varepsilon_t$ in Model A the null and alternative hypothesis with two breaks are defined as follows:

Null Hypothesis $\quad y_t = \mu_0 + d_1 B_{1t} + d_2 B_{2t} + y_{t-1} + \nu_{1t}$
Alternative Hypothesis $\quad y_t = \mu_1 + \gamma t + d_1 D_{1t} + d_2 D_{2t} + \nu_{2t}$

For Model C, is applied the same argument.

Table 1
The Conventional Unit Root Test for INF.

	ADF		**PP**		**KPSS**	
	intercept	intercept & Trend	intercept	intercept & Trend	intercept	intercept &Trend
Test statistics	-8.23 (0.00)	-8.22 (0.00)	-13.26 (0.00)	-21.07 (0.00)	0.24	0.15

Notes: Numbers in parentheses are probability values.
Source: Research Findings

Table 1 shows the result of unit root tests with an intercept and a deterministic trend. ADF and PP tests reject the null hypothesis. While in the KPSS test the null hypothesis that implies stationery cannot be rejected. Therefore, the INF series is I (0), meaning that the inflation series is stationary.

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Table 2
Lee-Strazicich Unit Root Test for INF and INFU.

	Model C – Breaks in Intercept and Trend		
	$\tilde{\tau}$ −statistic	Break Time	
INF	-7.5848	2008.09	2011.05
INFU	-6.7763	2006.02	2011.10

Source: Research Findings

According to the result of the Lee-Strazicich Unit Root Test in Table 2, for both INF and INFU two breakpoints in intercept and trend are identified. Depending on which model is appropriate for inflation and its uncertainty series, we can obtain these series without the effect of the estimated breakpoints by utilizing the regressions just as Altinay and Karagol (2004) applied.

Based on the significant breakpoints, Model C is the best model to use in capturing inflation series without the estimated breakpoints. So, the INF series is the trend stationary with two break points in intercept and trend. Given this information and Model C, we can obtain inflation series without the estimated breakpoints. In order to obtain such a series; the following regression is used.

$$Y_t = \mu + \beta t + d_1 D_{1t} + d_2 D_{2t} + \omega_1 DT_{1t} + \omega_2 DT_{2t} + \tilde{y}_t$$

Where $\tilde{y}_t$ is the detrend stationary without the estimated breakpoints. D_{1t}, D_{2t}, DT_{1t} and DT_{2t} are dummy variables that are indicative of the breakpoints and are defined as follows:

$$D_{1t} = \begin{cases} 1 & t > BD1 \\ 0 & t \leq BD1 \end{cases} \qquad DT_{1t} = \begin{cases} t - TB1 & t > BD1 \\ 0 & t \leq BD1 \end{cases}$$

$$DT_{2t} = \begin{cases} t - TB2 & t > BD2 \\ 0 & t \leq BD2 \end{cases} \qquad D_{2t} = \begin{cases} 1 & t > BD2 \\ 0 & t \leq BD2 \end{cases}$$

BD1 and BD2 represent the first (2008.09) and second (2011.05) breakpoints respectively. The Break occurring in the inflation series in September 2008 stems from the 2008 Global Financial crisis because Turkey's economy had been affected by the 2008 Global Financial Crisis. In Turkey, this crisis has become particularly noticeable in September 2008. Another estimated breakpoint is May 2011. The inflation rate fell to 3.99 percent (in March) on an annual basis after showing a rapid decline in the first months of

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2011. Then it entered into a rapid escalation process due to fluctuations in exchange rates, from the beginning of the second quarter of the year.

In 2011, the consumer price index was deeply affected by increases in the prices of food, beverages, and tobacco products, which have a basis weight of 1/3 of the total household expenditures. Thus, in the structural break unit root test, the rapid escalation in inflation in 2011 is seen as a breakpoint (Çetinoğlu, 2018). The breakpoints of the INFU series have taken place in February 2006 and October 2011. The breakpoint in February 2006 is an indicator of implemented inflation targeting in Turkey since 2006. Inflation targeting is defined as a certain numerical value of inflation that the government, the central bank, or both, trying to keep in the future. The breakpoint in October 2011 likely stems from the high inflation in May 2011.

3 Measuring the Inflation Uncertainty

Autoregressive Conditional Heteroscedastic (ARCH) processes were introduced by Engle (1982). These processes are defined as mean zero and serially uncorrelated processes with non-fixed variances based on the past, however, they are constantly unconditional variances. The ARCH process is specified as:

$$y_t|\psi_{t-1} \sim N\ (x_t\beta, h_t)$$
$$h_t = \alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \alpha_2\varepsilon_{t-2}^2 + \cdots + \alpha_p\varepsilon_{t-p}^2$$
$$y_t = x_t\beta + \varepsilon_t$$

h_t is the conditional variance and ε_t is the error term, which could have normal or non-normal distribution properties. The value of α_0 and α_i must be positive, and where $0 \leq \alpha_i < 1$. Later, Bollerslev (1986) proposed the Generalized Autoregressive Conditional Heteroscedasticity (GARCH) model. This model is generated by adding the lagged conditional variance to the ARCH model. GARCH process is expressed as:

$$h_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i\varepsilon_{t-i}^2 + \sum_{j=1}^{q} \beta_j h_{t-j}$$

Where the α_0 is positive, the α_i and the β_j are nonnegative. ARCH and GARCH models are symmetric models; generated volatility of bad news is more than good news. Nelson (1991) introduced the asymmetric Exponential GARCH (EGARCH); it handles bad and good news differently and does not limit negativity on the parameters of the model. The logarithm of the conditional variance is as follows:

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$$\ln(h_t) = \alpha_0 + \alpha_1 \ln(h_{t-1}) + \theta\left(\frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}}}\right) + \gamma \left| \frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}}} \right|$$

In this model, the effect of shocks on conditional variance is measured through coefficients θ and γ.

Table 3
Estimates of EGARCH (1, 1) Model for Two Inflation Uncertainty Series.

Coefficient	preliminary inflation uncertainty	inflation uncertainty without the breakpoints
α_0	2.83 (4.03) *	2.88 (-5.42) *
γ_1	-0.56 (-2.30) *	-0.71 (-3.03) *
θ_1	0.28 (2.65) *	0.26 (2.39) *
β_1	0.44 (2.88) *	0.45 (4.29) *
Obs*R-squared	25.30 [0.01]	25.31 [0.01]
F statistic	3.67 [0.00]	3.45 [0.00]

Note: (a) The numbers in parentheses indicate t statistic. (b) The numbers in brackets indicate the Probability. (c) * significance at the 10% level.
Source: Research Findings

In this study, we use ARCH family models to obtain inflation uncertainty. Before estimating the volatility of inflation, it is important to test the existence of the ARCH effect. To do so, the Lagrange Multiplier procedure (ARCH-LM test) is employed. The result of this test is reported in Table 3. The Obs*R-squared test statistics and F statistics indicate the null hypothesis representing constant variance can be rejected. Thus, both of the inflation series follows an ARCH process. Because of the monthly data, the lag value is determined 12 in the ARCH test.

We have two inflation series; a preliminary inflation series and inflation series without the estimated breakpoints, and we need to set up two models for estimating two inflation uncertainty. The parameters of the EGARCH model are estimated with the normality assumption of error terms.

The EGARCH model does not impose non-negativity constraints, thus this model does not require a non-negative coefficient. As can be seen, the θ coefficients as the asymmetric parameters are positive and significantly different from 0. This indicates that the impact of positive and negative shocks of inflation on its uncertainty is not the same.

The positive sign of the θ coefficients implies an increase in inflation generates more uncertainty, while a decrease in inflation causes less uncertainty in inflation. According to these results, the EGARCH model of inflation are well estimated and we can use this model for inflation uncertainty. To capture the breakpoints in inflation uncertainty, the Lee-Strazicich unit root test is employed too. As represented in Table 2 this inflation uncertainty is the trend stationary with two break points in October 2011 and February 2006. The detected breakpoints are statistically significant. We need to remove the effect of these breakpoints from inflation uncertainty. To do this, we apply the same approach used for inflation. In the Lee-Strazicich test, for inflation uncertainty, Model C also is the appropriate model. Therefore, we can obtain inflation uncertainty without estimated breakpoints based on Model C of the Lee Strazicich Test.

4 Granger Causality Test

The causality tests are used to examine whether there is a casual relationship between two variables, and if there is any relationship, these tests can determine the direction of the relationship. Granger Causality Test is the most commonly used method for determining the relationship between time-series variables developed by Granger (1969). Granger Causality Test is employed in the Vector Autoregression (VAR) Model for testing the relationship between INF and INFU as follows:

$$\mathrm{INF}_t = \alpha_{10} + \sum_{i=1}^{p} \alpha_{1i}\mathrm{INF}_{t-i} + \sum_{i=1}^{p} \beta_{1i}\mathrm{INFU}_{t-i} + \varepsilon_{1t} \quad (1)$$

$$\mathrm{INFU}_t = \alpha_{20} + \sum_{i=1}^{p} \alpha_{2i}\mathrm{INFU}_{t-i} + \sum_{i=1}^{p} \beta_{2i}\mathrm{INF}_{t-i} + \varepsilon_{2t} \quad (2)$$

In equation (1), the null hypothesis is that inflation uncertainty does not Granger-cause inflation whereas in equation (2) null hypothesis is that inflation does not Granger-cause its uncertainty. Before estimating these models, we need to determine the appropriate lag length. This test is sensitive to the number of lagged terms. So, the direction of causality depends on the number of lagged terms included. Therefore, Akaike and Schwarz İnformation Criterions are used to determine the number of lags.

Table 4
Granger Causality Tests.

Series	Ho: INF does not cause INFU	Ho: INFU does not cause INF	optimal lag length
Preliminary Series	9.94404 (6.E-08)	2.63441 (0.027)	5
Series without the breakpoint	4.06395 (0.0005)	2.08823 (0.06)	7

Note: The numbers in parentheses show the probability.

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Source: Research Findings

The result of the Granger Causality Test in Table 4 shows that the causality between inflation and its uncertainty with the estimated breakpoints are bi-directional whereas, in the case of without the estimated breakpoints, this relationship is un-directional. Therefore, in both cases, inflation causes uncertainty, while inflation uncertainty causes inflation only when there are structural breaks. Hence, the structural breaks have an impact on the causality from inflation uncertainty to inflation.

In this paper, in both cases, the Friedman-Ball hypothesis is supported and inflation is the main factor to determine the inflation uncertainty. According to this hypothesis, reducing the inflation rate is the most effective way to reduce inflation uncertainty. In periods of high inflation, some policies are implemented to reduce the inflation rate. These policies are applied randomly, so the uncertainty of these policies leads to inflation uncertainty.

The other side of this relationship is defined by the Cukierman–Meltzer hypothesis. Based on the Cukierman-Meltzer hypothesis (1986), if there is a political change in the economy, inflation uncertainty will lead to inflation. In this study, with the effect of structural break, the causality from inflation uncertainty to inflation is stronger. Implementation of inflation targeting is one of the most important events in the Turkish economy in this period. Since inflation targeting as a monetary policy affects inflation uncertainty, then it may have an effect on the linkage between inflation and its uncertainty.

5 Conclusion

Although the relationship between inflation and inflation uncertainty has attracted much interest, there is no consensus on this relationship. Previous studies on this issue generally confirmed that inflation leads to inflation uncertainty without attempting to investigate the effect of the structural break on this relationship. Whereas some studies focused on structural breaks in different ways. Some of them revealed that the structural break has had an important effect on this relationship. This study is different from the previous papers because of the consideration of structural break in the variance. The conditional variance of a variable is indicated as its uncertainty. That's why we determined the breakpoints in the variance of inflation (inflation uncertainty).

In the present study, we have examined the linkage between inflation and its uncertainty by considering the possibility of structural breaks in these two variables for the monthly period between 2004 and 2014 in Turkey. First, we investigate the relationship between inflation and its uncertainty with the effect of structural break and then we explore this linkage without the effect of a structural break. The investigation of the relation between inflation and its uncertainty with the effect of structural break means the investigation of the relation between preliminary inflation and inflation uncertainty series. The possibility of breakpoints is determined by the Lee-Strazicich test. The estimated breakpoints are removed from both preliminary series. Then, the relationship between them is tested by the Granger causality test.

According to the results, inflation causes inflation uncertainty whether with the structural break or without the structural break. In both cases, the Friedman-Ball hypothesis is supported and this hypothesis is not affected by the structural break. Thus, inflation has the main effect on inflation uncertainty, and on the other hand, inflation uncertainty is determined as the cost of inflation. Whereas the causality from inflation uncertainty to inflation is affected by the structural break. Therefore, the structural break can impact on Cukierman-Meltzer's view. Based on this hypothesis if policy changes occur in the economy, inflation uncertainty will cause inflation. In this study, inflation targeting and the global financial crisis are determined as the main breakpoints. Concerning our study, we can conclude that crisis and economic policies as the reasons for structural break have likely some effects on the causality from inflation uncertainty to inflation. As inflation uncertainty causes inflation, politicians need to implement policies that take into account inflation uncertainty.

References

Altinay, G. and Karagol E. (2004). Structural break, unit root, and the causality between energy consumption and GDP in Turkey. Energy Economics, 26, 985– 994.

Altınbaş , H., and Toptaş, B.A. (2019). Türkiye'de Enflasyon ve Enflasyon Belirsizliği İlişkisi. Belirsizlik Altında Ekonomik Kararlar ve Politikalar Sempozyumu, May, 1-36, https://www.researchgate.net/publication/333396408. Date of access: 10.09.2020.

Balaji, B., Raja, S., Sethu D. and Ramachandaran, M. (2016). The Dynamics between Inflation and Inflation Uncertainty: Evidence from India. *Journal of Quantitative Economics*, 14, 1-14.

Ball, L. (1992). Why does high inflation raise inflation uncertainty? *Journal of Monetary Economics*, 29, 371-88.

Bamanga, M.A., Umar, M., and Audu, S. (2016). Inflation and Inflation Uncertainty in Nigeria: A Test of the Friedman's Hypothesis. *CBN Journal of Applied Statistics*, 7, 147-169.

Barnett, W. A., Javadi, F., and Ftiti, Z. (2020). Causal relationships between inflation and inflation uncertainty. *Studies in Nonlinear Dynamics & Econometrics*, 24(5), 38-56.

Bhar, G., and Mallik, R. (2012). Inflation, Inflation Uncertainty and Macroeconomic Performance in Australia. *Economic Analysis & Policy*, 42(3), 305 - 318.

Bollerslev, T. (1986). Generalized Autoregressive Conditional Heteroskedasticity. *Journal of Econometrics*, 31, 307-327.

Caporale, G. A., and Alexandros, K. (2009). The Euro and inflation uncertainty in the European Monetary Union. *Journal of International Money and Finance*, 28, 954–971.

Cukierman, A. and Meltzer, A. (1986). A theory of ambiguity, credibility, and inflation under discretion and asymmetric information. *Econometrica*, 54, 1099–1128.

Daniela, Z., Mihil-Ioan, C., and Sorina, P. (2014). Inflation uncertainty and inflation in the case of Romania. *Procedia Economics and Finance*, 15, 1225 – 1234.

Davis, G., and Kanago, B. (1996). On Measuring the Effect of Inflation Uncertainty on Real GNP Growth. *Oxford Economic Papers*, 48(1), 163-175.

Çekin, E. S. (2020). Gelişmekte Olan Ülkelerde Enflasyon ve Enflasyon Oynaklığı Arasındaki İlişki Üzerine İnceleme. *Uluslararası Ekonomi, İşletme ve Politika Dergisi*, 4(2), 461-476.

Çetinoğlu, O. (2018). Türkiye'de ve dünya'da 2011 yılı olayları kronolojisi. Once Vatan, http://www.oncevatan.com.tr/turkiyede-ve-dunyada-2011-yili-olaylari. Date of access: 25.9.2019.

Engle, R. F. (1982). Autoregressive Conditional Heteroscedasticity with Estimates of the Variance of United Kingdom Inflation. *Econometrica*, 50(4), 987-1007.

Erdem, H. F., and Yamak, R. (2014).The Relationship between Inflation and Inflation Uncertainty in Turkey. *Kohomnka Petnoha*, 4, 246-255.

Eregha, P. B., and Ndoricimpa A. (2019). Inflation, Output Growth and their Uncertainties: A Multivariate GARCH-M Modeling Evidence for Nigeria. *African Governance and Development Institute*, 6, 1-15.

Falahi, M. A., and Hajamini M. (2015). Relationship between Inflation and Inflation Uncertainty in Iran: An Application of SETAR-GARCH Model. *Journal of Money and Economy*, 10, 2, 69-98.

Friedman, M. (1977). Inflation and Unemployment. *Journal of Political Economy*, 85(3), 451-472.

Göktaş, P., and Cem, D. (2014). Modelling Inflation Uncertainty with Structural Breaks Case of Turkey, *Mathematical Problems in Engineering*, 5, 1-19.

Granger, C. W.J. (1969). Investigating Causal Relations by Econometric Models and Cross-Spectral Methods. *Econometrica*, 37(3), 424-438.

Gülşen, E., and Kara, H. (2019). Measuring Inflation Uncertainty in Turkey. *Central Bank Review*, 19, 33-43.

Lee, J., and Strazicich, M. C. (2003). Minimum Lagrange Multiplier Unit Root Test with Two Structural Breaks. *The Review of Economics and Statistics*, 85(4), 1082-1089.

Nelson, D. B. (1991). Conditional Heteroskedasticity in Asset Returns: A New Approach. *Econometrica*, 59(2), 347-370.

Schwert, G.W. (1989). Tests for Unit-Roots: A Monte Carlo investigation. *Journal of Business and Economic Statistics*, 7, 147-159.

Sharaf Fathy, M. (2015). Inflation and Inflation Uncertainty Revisited: Evidence from Egypt. *Economies*, 3, 128-146.

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