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THE VALIDITY OF THE FISHER EFFECT FOR AN INFLATION TARGETING COUNTRY: THE CASE OF TURKEY

The aim of this paper is to investigate the relationship between interest and inflation rates. In this regard, the validity of the Fisher Effect under an inflation targeting regime country is examined by considering the possibility of non-linearities. To this aim, the Fisher Effect is analysed by using various types of interest rates to identify the short-, mid- and long-term dynamics. Autoregressive distributed lag (ARDL) and non-linear autoregressive distributed lag (NARDL) models were estimated for Turkish economy between 2006-2019 periods. The empirical findings of ARDL models reveal the validity of Fisher Effect both for short and long run. The results of NARDL models indicate a strong Fisher Effect in the long run, except for 5-year government bonds. For short-run, the Fisher Effect holds only when inflation rises and there is no significant result when inflation decreases.

Keywords: *Fisher Effect, inflation targeting, ARDL, NARDL*

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1. INTRODUCTION

The main objective of macroeconomic policy is to maintain economic stability. One of the preliminary conditions for maintaining economic stability is to provide moderate inflation. Increase in the overall price level affects the intertemporal decision-making of households and firms; thus, uncertainty on investment, consumption and saving decisions rises. In an economy with uncertainty, expenditures and investments tend to decrease, and this might hamper the economic activity. As Mishkin (2019) suggested, the fundamental objective of an economy in pursuit of moderate and stable inflation is maintaining price stability. Consequently, the main objective of the monetary policymakers is to achieve price stability, characterising with low and stable inflation.

Rise in price level has a significant impact on macroeconomic variables and it leads to an increase in the nominal interest rates. Interest and inflation rates are pivotal variables for conducting monetary policy (Anari & Kolari, 2019). The relationship between inflation and nominal interest rates was first demonstrated by Irving Fisher (1930). According to the Fisher hypothesis, nominal interest rate is the sum of expected inflation and real interest rate. Fisher (1930) revealed that nominal interest and inflation rates tend to move together in the long run. Real interest rates will fall if the Central Banks do not raise the nominal interest rates in response to the rise in inflation. The real interest rate shows the real cost of borrowing. Lower real interest rates will increase investments and consumption, thereby increasing the economic activity. This situation will further increase inflation when the economy is at the full employment level. To stabilize inflation, central banks must raise nominal interest rates by more than any rise in expected inflation. Therefore, it is essential for monetary policymakers to reveal the validity and characteristics of this relationship (nominal interest rates and inflation), especially for countries which adopt the inflation targeting strategy.

This study investigates the relationship between nominal interest rates and inflation, namely, the Fisher Effect, in an inflation targeting country—Turkey. One of the important features of the Turkish economy is that it experiences a persistently high inflation process (Köse, Emirmahmutoğlu & Aksoy, 2012). The Central Bank of the Republic of Turkey (CBRT) focused on reducing inflation in 2001 by implementing an implicit inflation targeting regime in 2002. Since 2006, an explicit inflation targeting regime has been implemented. Using an inflation targeting strategy, the CBRT sets a numerical target for future inflation rates. This target inflation rate is announced to the public, and the CBRT employs several policy measures to achieve this target. The CBRT conducts an inflation targeting strategy by using a policy rate (short-term interest rate). When the main goal of the CBRT is to achieve price stability and inflation targeting, the existence of the Fisher Effect procures more significance.

This study aims to investigate whether there exists a long run relationship between nominal interest and inflation rates in Turkey over 2006–2019 period. It also seeks to determine whether such a long run relationship exists, and if so, whether it is 'weak' or 'strong'. The study differs from previous studies, as it employs non-linear autoregressive distributed lag (NARDL) model for an inflation targeting country. NARDL and autoregressive distributed lag (ARDL) models are applied to determine the symmetric and possible asymmetric effects of inflation changes on the interest rates. The remaining part of the study proceeds as follows: Section 2 presents the theoretical framework and section 3 gives brief summary of the empirical review on Fisher Effect. Section 4 outlines the methodology and discusses the empirical results. Finally, the conclusion part presents the critique of the findings and policy implications.

2. THEORETICAL FRAMEWORK

The Fisher Effect suggests that in the case of an increase in the expected inflation, monetary policymakers should increase nominal interest rates so that decrease in real interest rates, which is equivalent to increase in the inflation rate, could be avoided. According to the quantity theory of money, fluctuations in the money supply result in changes in inflation but have no effect on real variables. In other words, real interest rates are determined by real factors in the long run.

According to the Fisher Effect, the nominal interest rate is the sum of real interest rate and expected inflation rate:

$$i_t = \alpha_0 + \alpha_1 E_t \pi_t \tag{2.1}$$

where α_0 denotes the real interest rate, and α_1 denotes the Fisher coefficient and expected inflation E_t. The Fisher Effect assumes that nominal interest rates should respond to the changes in inflation rates by one to one. Due to the one-to-one relationship between nominal interest rate and the expected inflation rate, real interest rates will not be affected by changes in inflation in the long run. Also Everaert (2014) implied that Equation 1 does not yield robust results about the validity of the Fisher Effect because π_t is an unobserved *ex-ante* variable. Assuming rational expectations and re-specifying Equation 2.1 in ex post terms yield:

$$i_t = \alpha_0 + \alpha_1 \pi_t + e_t^{\pi} \tag{2.2}$$

where π_t is the realised inflation. In most empirical studies (Westerlund, 2008; Tsong & Lee, 2013; Everaert, 2014; Omay, Yüksel & Yüksel, 2015), the actual inflation rate is often used as a proxy under the rational expectations assumption.

According to Feldstein and Eckstein (1970), the Fisher Effect has two important implications:

1) In the long run (prices and wages are flexible), real interest rate (approximately) will not be affected by the inflation rate.
2) In the short run, real interest rates fall as inflation increases.

The Fisher hypothesis is widely accepted in the economics literature, but different results emerge in the empirical literature. Moreover, Panopoulou and Pantelidis (2016) indicated that there is no consensus among economists about the true size of Fisher coefficient. According to Anari and Kolari (2019), the empirical estimates of the Fisher coefficient are typically less than one (Peng, 1995; Ahmad, 2010; Berüment & Jelassi, 2002; Arısoy, 2013; Ozcan & Ari, 2015). This situation is regarded as "Fisher Puzzle" and almost all econometric methods have been employed to explain this puzzle. In cases where the long run coefficient that represents the relationship between inflation and nominal interest rates is less than one, the Fisher Effect is regarded as 'weak'. On the contrary, some of the empirical works found that the estimated slope is significantly greater than or equal to one (Crowder & Hoffman, 1996; Gul & Acikalin, 2011; Alimi & Ofonyelu, 2013; Benazic, 2013) which is regarded as a 'strong Fisher Effect'. In economies displaying a strong Fisher Effect, fluctuations in the real interest rate are not a result of the monetary policy but are rather due to real factors. The classical dichotomy holds in such cases of long-run superneutrality of money.

3. LITERATURE REVIEW

After Fisher's (1930) seminal paper, many researchers tested his hypothesis (the Fisher hypothesis) by employing different econometric methodologies. Subject to variations in employed econometric methods, time intervals and data sets, different results have been drawn in the relevant literature even for the same countries. Fama (1975), one of the pioneering studies in which the Fisher hypothesis was tested, revealed that real returns remained stable for six-month U.S. Treasury bills between 1953 to 1971. Whereas Mishkin (1992), by using monthly data for the period from 1953 to 1990, found evidence that the Fisher Effect was valid in the long run but he could not find any results to support the effect in the short run. In another study in the case of the U.S., Crowder and Hoffman (1996), by using quarterly data from 1952 to 1991 found that nominal interest rates respond more than one-to-one changes in inflation rates therefore they recognized that a strong Fisher Effect holds between 1952 and 1991 period. Similarly, Fahmy and Kandil (2003) exhibited that there is a long run cointegration relationship between inflation rates and nominal interest rates in the U.S. for the 1980s and the early 1990s. However, their results do not support the short run Fisher Effect.

There are also several studies that test the Fisher Effect for developed countries. Junttila (2001) augmented the Fisher Effect with foreign interest rate and exchange rate variables for the Finnish economy, and the findings supported the Fisher Effect. In another study, Bajo Rubio, Roldan & Esteve (2010) supported the existence of a weak Fisher Effect for the UK economy by considering the structural breaks. Atkins and Serletis (2003), by using the ARDL model, tested the Fisher Effect for six different economies, namely, Canada, Italy, Norway, Sweden, the United Kingdom and the United States. The authors rejected the existence of a long run relationship between inflation and the nominal interest rate.

Studies on developing countries with high inflation problems also have not reached a definite conclusion about the validity of the Fisher Effect. Phylaktis and Blake (1993) have investigated the validity of the Fisher Effect for Brazil, Mexico and Argentina, by employing cointegration tests. They concluded that the Fisher Effect was valid for all the three countries in the long run. Thornton (1996) examined the Mexican economy for 1978 to 1994 period and observed a strong Fisher Effect. Asemota and Bala (2011) have investigated the validity of the Fisher Effect in Nigeria with the data covering the 1961–2009 period and found no evidence of a Fisher Effect. Similarly, Ghazali and Ramlee (2003) concluded that interest rates were not affected by inflation in the long run covering the 1974–1996 period for the Group of 7 countries.

Recently, some empirical arguments have focussed on non-linearities or structural breaks on the relationship between inflation and interest rates (Bierens, 2000; Lanne, 2006; Kapetanios, Shin & Snell, 2003; Koustas & Lamarche, 2006). Some of the studies have argued that changes in inflation rate could have asymmetrical effects on interest rates (Christopoulos & Leon-Ledesma, 2007; Ongan & Göçer, 2018). Non-linear models allow the decomposition of the changes (increase and decrease) in inflation. Another strand of studies that accounts for threshold levels and structural breaks also reported ambiguous results. Million (2004) tested the long run relationship between nominal interest rates and inflation, by employing Threshold Autoregression Model (TAR) under structural breaks and asymmetric mean reversion in the U.S. economy and found evidence for a strong Fisher Effect. However, Panapoulou and Pantelidis (2016) tested the Fisher effect in the presence of time-varying coefficients for 19 OECD countries and revealed that findings depend on the critical values. The empirical evidence is against the validity of the Fisher Effect when asymptotic critical values are used. On contrary, when simulated critical values are used, evidence strongly supports the validity of the Fisher Effect.

When literature on the Turkish economy is considered, ambiguous results could be encountered. Gul and Ekinci (2006) by using cointegration and Granger causality, investigated the relationship between nominal interest and inflation rates based on monthly data for the 1984-2003 period. However, the authors reported causal relationship occurs only from nominal interest rates to inflation. Incekara, Demez & Ustaoğlu (2012) showed that the Fisher Effect is valid in the long run by using cointegration method but concluded the opposite for the short run. Köse *et al*. (2012) examined the relationship between government bond rates and the consumer price index (CPI) for the period from 2002 to 2009, and they found evidence for the validity of a weak Fisher Effect. Arisoy (2013) employed cointegration tests and time-varying parameters approach from 1987 to 2010 in Turkey. According to the empirical results, a weak Fisher Effect holds in Turkey. Pınar and Erdal (2018) showed that Fisher effect is valid for various types of interest rates in the long run and there is a causal relationship from deposit rates to inflation rate for 2006-2016 period. Songur (2019) investigated the Fisher hypothesis by employing the cointegration test with smooth shifts and showed that the Fisher hypothesis is not valid in Turkey for the 2000-2018 period.

4. EMPIRICAL ANALYSIS

In this study, linear and non-linear ARDL models were employed to test the validity of the Fisher Effect. The ARDL (Pesaran & Shin, 1999; Pesaran, Shin & Smith, 2001) methodology enables the testing of the cointegration relation between the variables for both the short and long run. However the NARDL methodology (Shin, Yu & Greenwood-Nimmo, 2014) enables the asymmetric effects of changes in the independent variable on the dependent variable.

In linear ARDL models, the model assumes constant speed of adjustment to the equilibrium. Increases and decreases in inflation should yield the same effect in ARDL models. The NARDL model allows the decomposition of changes in inflation as two different variables—increase and decrease in inflation.

The linear unrestricted error correction model can be written in the form of an ARDL model (Tiryaki, Ceylan & Erdoğan, 2018) as follows:

$$\Delta y_t = \delta_0 + \sigma y_{t-1} + \vartheta x_{t-1} + \sum_{i=1}^{p-1} \mu_i \Delta y_{t-i} + \sum_{i=0}^{q-1} \beta_i X_{t-i} + \varepsilon_t \qquad (4.1)$$

where y_t is the dependent variable, and x_t is a kx1 vector of exogenous variables. The σ and ϑ parameters represent the long run coefficients, and μ_i and β_i parameters represent the short run coefficients. The ε_t is the disturbance term.

The NARDL model decomposes the vector of regressors into its positive and negative partial sums:

$$y_t = \beta^+ x_t^+ + \beta^- \mathrm{x}_+^- + \mu_t \tag{4.2}$$

$$x_t = x_0 + x_t^+ + x_t^- \tag{4.3}$$

where β^+ and β^- are the long run parameters associated with x_t^+ *and* x_t^-. The decomposition of x_t into its positive and negative partial sums is defined as:

$$x_t^+ = \sum_{i=1}^{t} \Delta x_i^+ = \sum_{i=1}^{t} \max(\Delta x_i, 0) \tag{4.4}$$

$$x_t^- = \sum_{i=1}^{t} \Delta x_i^- = \sum_{i=1}^{t} \min(\Delta x_i, 0) \tag{4.5}$$

On the basis of the above mentioned formulation, the asymmetric error correction model can be written as follows:

$$\Delta y_t = \delta_0 + \sigma y_{t-1} + \vartheta^+ x^+{}_{t-1} + \vartheta^- x^-{}_{t-1} \sum_{i=1}^{p-1} \mu_i \Delta y_{t-i} + \sum_{i=0}^{q-1} (\beta_i^+ \Delta x^+{}_{t-i} + \beta_i^- \Delta x^-{}_{t-i}) + \varepsilon_t \tag{4.6}$$

Adopting this model approach for the Fisher model, as shown in Shin *et al*. (2011), Pesaran and Shin (1999) and Pesaran *et al*. (2001), the non-linear ARDL model takes the following form:

$$\begin{aligned} \Delta interest\ rate_t = {} & \delta_0 + \sigma interest_{t-1} + \vartheta^+ inflation_{t-1} + \vartheta^- inflation_{t-1} \\ & + \sum_{i=1}^{p-1} \mu_i interest_{t-1} + \sum_{i=0}^{q-1} \beta_i^+ \Delta inflation^+{}_{t-1} \\ & + \sum_{i=0}^{q-1} \beta_i^- \Delta inflation^-{}_{t-1} + \varepsilon_t. \end{aligned} \tag{4.7}$$

It then decomposes the vector of regressors into its positive and negative partial sums. Hence, the NARDL model enables to examine the validity of the Fisher Effect in (inf +) and (inf–) separately.

4.1. Data

This study uses monthly data covering the period from January 2006 to March 2019. The period coincides with Turkey's adoption of the inflation targeting monetary policy framework. The expected inflation series is captured by ex post observed inflation rates and calculated as year-on-year percentage change in the Consumer Price Index, CPI. Several nominal interest rates, which represent short-, intermediate- and long-terms, are used to test and compare the validity of the Fisher Effect. Various types of short-term interest rates are captured by using one, three and six months deposit interest rates and also by the Central Bank policy rate and CBRT discount rates. So five different types of short term interest rates are used to compare the effect of inflation on interest rate. Intermediate (or mid-term) term is captured by using one year deposit interest rates and one year maturity government bonds. 3, 5 and 10 years maturity government bonds are used to proxy long-term nominal interest rates. The deposit rates are weighted average interest rates for deposits in Turkish lira, and they reflect the market interest rates. The series are obtained from the CBRT and International Financial Statistics (IFS). All the data are in level form. Details on the data used in the analysis and descriptive statistics are summarised in Tables 1 and 2, respectively.

Table 1:

DATA DESCRIPTION

Symbol	**Variable**
Short term interest rates	
1month	1 month weighted average deposit rate
3months	3 month weighted average deposit rate
6months	6 month weighted average deposit rate
CBpolicy	Central Bank of the Republic of Turkey policy rate
CBdiscount	Central Bank of the Republic of Turkey discount rate
Mid- term interest rates	
1yeardepo	1 year weighted average deposit rate
1yearbond	1 year maturity government bond
Long-term interest rates	
3yearsbond	3 years maturity government bond
5yearsbond	5 years maturity government bond
10yearsbond	10 years maturity government bond
Inf	Consumer Price Index

Source: Central Bank of The Republic of Turkey (CBRT)-International Financial Statistcis (IFS)-2019

Table 2:

DESCRIPTIVE STATISTICS

Interest Rates	Mean	Min	Max	Std Dev	Skewness	Kurtosis
Short term interest rates						
1 month	11.28	5.29	22.6	4.27	0.81	2.41
3 months	12.66	6.59	25.37	4.19	0.86	2.82
6 months	12.67	7.06	25.12	4.01	0.88	3.03
CBpolicy	9.29	1.5	22.5	5.29	0.79	2.55
CBdiscount	15.61	8.75	27	6.32	0.50	1.87
Mid- term interest rates						
1 yeardepo	12.55	7.53	23.24	3.75	0.66	2.21
1yearbond	12.35	5.06	27.1	5.14	0.94	2.72
Long-term interest rates						
3yearsbond	10.66	5.35	26.95	3.90	1.96	6.83
5yearsbond	12.11	5.86	25.94	4.24	0.96	3.07
10yearsbond	10.43	6.16	21.39	2.79	1.76	6.11
Inf	9.16	3.98	25.24	3.22	2.44	11.53

Source: own computations

Table 2 reports the minimum- maximum values and first four sample moments of the interest rates and inflation. The mean of the interest rates lies between 9.29 and 15. 61 and Central Bank discount rate (CBdiscount) has the largest long-run mean (15.61) over all interest rates while Central Bank policy rate (CBpolicy) has the smallest sample long-run mean (9.29). CBdiscount has also the largest sample standard deviation while the longest interest rate (10 yearsbond) has the smallest sample standard deviation as expected.

4.2. Unit Root Tests

The first step in the analysis was to perform the unit root tests to determine the order of integration of the variables. For this purpose, the conventional Augmented Dickey–Fuller (ADF) and Phillips and Perron (PP) tests were utilised (Table 3). Furthermore, the Zivot–Andrews (1992) unit root test with structural breaks was also applied to address the issue of possible structural breaks in the series since the period covered the financial crisis of 2007–2008. According to Perron (1989), ignoring the existence of structural breaks could lead us to false acceptance of unit roots. The ADF and PP tests lacked power in the presence of structural breaks in the series. The structural break unit root tests allowed us to find stationarity in time series in the case of the existence of structural breaks. The test results of Zivot–Andrews are reported in Table 4. Zivot–Andrews proposed three different models. Model A allows for a one-time structural change in the mean of the series. Model B allows for a change in the slope of the trend function, and Model C allows a change both in the mean and the slope of the trend (Nusair, 2016). In the study, following Sen (2003), Model C was applied[1].

Table 3:

ADF AND PP UNIT ROOT TESTS

Variables	**ADF**		**PP**	
	Level	**First diff.**	**Level**	**First diff.**
Short term interest rates				
1 month deposit	-0.607	-7.29*	0.07	-7.556*
3 months deposit	-0.529	-4.772*	-0.03	-5.610*
6 months deposit	-0.175	-6.236*	0.758	-4.640*
CBpolicy	-0.631	-5.709*	0.188	-11.532*
CBdiscount	-0.565	-12.471*	-0.811	-12.475*
Mid-term interest rates				
1 year depos	0.873	-3.387*	1.005	-5.543*
1 year bond	-0.427	-9.531*	-0.893	-10.113*
Long-term interest rates				
3 yearsbond	-2.58	-4.415*	-2.511	-9.666*
5 yearsbond	-1.62	-11.775*	-1.592	-11.77*
10 yearsbond	-2.432	-9.809*	-2.336	-10.393*
Inflation	0.553	-7.772*	-1.335	-9.353*

Note: ***, ** and * indicate significance at the 10%, 5% and 1% level, respectively. Constant and linear trend are included

Source: Output of Eviews 10 econometric software.

[1] Model A and Model B were also applied; however, the results were the same as those of Model C, although they were not reported.

The test results in Table 3 indicate that all variables are not stationary at their levels. However, the variables become stationary after their first differentiation. According to the structural break unit root test reported in Table 4, the results support the results obtained from the unit root tests without structural breaks. The ARDL and NARDL models require that the series must be purely I(1), purely I(0) or cointegrated, and the dependent variable has to be unit root process I(1). Following these assumptions to ensure to fulfill the requirements of the ARDL and NARDL models, various unit root tests were applied and the obtained results confirm the assumptions for the ARDL and NARDL models.

Table 4:

ZIVOT-ANDREWS ONE- BREAK STRUCTURAL UNIT ROOT TEST

Variables	**Levels Model C**	**Break- date**
Short term interest rates		
1 month deposit rate	-2.91	2009 M01
3 months deposit rate	-3.542	2008 M12
6 months deposit rate	-2.615	2012 M12
CB Policy rate	-3.63	2010 M11
CB Discount rate	-3.055	2017 M01
Mid-term interest rates		
1 year deposit rate	-1.394	2016 M01
1 year government bond	-3.809	2008 M12
Long- term interest rates		
3 years government bond	-4.577	2012 M03
5 years government bond	-3.788	2008 M12
10 years government bond	-4.002	2012 M04
Inflation rate	-2.994	2017 M03

Source: Output of Eviews 10 econometric software.

4.3. Bounds Testing

Bounds tests were conducted to reveal whether the series are cointegrated. This was done by testing the null hypothesis of 'no cointegration' against the alternative of 'cointegration'. The F-test proposed by Pesaran et al. (2001) have been utilized. The optimal number of lags was selected by the Hannan–Quinn criterion

(HQ) assuming a maximum of 12 lags. The heteroscedasticity and autocorrelation consistent (HAC) standard errors with the Newey–West estimator were used to ensure that the model has robust standard errors in the case of serial correlation. The Newey–West estimator corrects the standard errors of the parameter so that it might reach its robustness by capturing the problem of autocorrelation and heteroscedasticity (Aziz & Tri, 2017). The test results of the bounds testing for linear and non-linear models are reported in Table 5 and Table 6, respectively. Based on the linear ARDL results shown in Table 5, in the short-term interest rates, the evidence in favour of cointegration is quite strong, cointegration is rejected for only long-term interest rates and inconclusive for Model 5. However, in Model 5, the error correction term is significant and has a negative value, which indicates that dependent variable converges to long run equilibrium. Short-term interest rates are cointegrated with inflation rate in linear ARDL models. Government bonds with different maturities are not cointegrated with inflation for symmetric ARDL models. It is interesting that one- and five-year government bonds are not cointegrated with inflation in symmetric model, but cointegrated relationship have been found in asymmetric model. In some cases, bounds tests based on NARDL models are not significant. Therefore, findings related with 'no cointegration' models are not going to be interpreted.

Table 5:

BOUND TEST RESULTS FOR ARDL MODELS

Interest Rate Specification	**F-statistics**	**Conclusion**
Short Term Interest Rate Models		
Model 1: 1 month deposit rate	5.75**	Cointegration
Model 2: 3 months deposit rate	5.86**	Cointegration
Model 3: 6 months deposit rate	14.33*	Cointegration
Model 4: CB policy rate	6.99**	Cointegration
Model 5: CB discount rate	4.62***	Inconclusive
Mid-term Interest Rate Models		
Model 6: 1 year deposit rate	20.877*	Cointegration
Model 7: 1 year goverment bond	2.94	No- cointegration
Long- term Interest Rate Models		
Model 8: 3 years goverment bond	2.87	No- cointegration
Model 9: 5 years government bond	3.05	No- cointegration
Model 10: 10 years goverment bond	1.37	No- cointegration

Source: Output of Eviews 10 econometric software.

Table 6:

BOUND TEST RESULTS NARDL MODELS

Interest Rate Specification	**F-statistics**	**Conclusion**
Short Term Interest Rate Models		
Model 1: 1 month deposit rate	2.71	No-cointegration
Model 2: 3 months deposit rate	2.37	No-Cointegration
Model 3: 6 months deposit rate	9.13*	Cointegration
Model 4: CB policy rate	1.93	No- cointegration
Model 5: CB discount rate	1.65	No cointegration
Mid-term Interest Rate Models		
Model 6: 1 year deposit rate	9.03*	Cointegration
Model 7: 1 year goverment bond	4.54*	Cointegration
Long- term Interest Rate Models		
Model 8: 3 years goverment bond	2.61	No- cointegration
Model 9: 5 years government bond	5.70*	Cointegration
Model 10: 10 years goverment bond	1.54	No- cointegration

Source: Output of Eviews 10 econometric software

4.4. ARDL and NARDL Estimation Results

The short and long run analyses of the ARDL and NARDL models are presented in Tables 7 and 8, respectively. The long run results based on the linear ARDL model (Table 7) support a strong (full) Fisher Effect in the long run for all interest rates since their estimated coefficients are significant and greater than one except in the case of the Central Bank's discount rate (Model 5). The changes in inflation have a positive effect on interest rates in the long run. As regards short run results, changes in inflation have a significant effect on the interest rates (all types) for all models. However, unlike in the case of the long run results, there is a weak (partial) Fisher Effect for all models in the short run since the estimated coefficients are significantly positive and less than one. The results of the symmetric ARDL specification reveals a weak Fisher Effect in the short run and a strong one in the long run. On the other hand, lagged values of interest rates have a puzzling effect on itself since the coefficients of some of the lagged values have positive sign while others have a negative sign. These findings may suggest that non-linear ARDL should be employed. Residual diagnostics are reported below in Tables 7 and 8. Breusch–Godfrey serial correlation Lagrange multiplier (LM) test and Arch LM tests have been employed.

Table 7:

RESULTS OF ESTIMATION: LINEAR MODEL

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Short run						
i_{t-1}	-0.03 [0.02]**	-0.037 [0.00]*	-0.024 [0.01]**	-0.038 [0.03]**	-0.024 [0.09]***	-0.026 [0.00]*
inf_{t-1}	0.08 [0.01]**	0.064 [0.00]*	0.056 [0.00]*	0.110 [0.00]*	0.074 [0.00]*	0.063 [0.00]*
Δi_{t-1}	0.269 [0.00]*	0.649 [0.00]*	0.627 [0.00]*	-	-	0.454 [0.00]*
Δi_{t-2}	-0.13 [0.11]	-0.385 [0.00]*	-0.037 [0.68]	-	-	0.029 [0.73]
Δi_{t-3}	0.157 [0.05]**	0.245 [0.00]*	-0.267 [0.00]*	-	-	-0.043 [0.62]
Δi_{t-4}	-0.301 [0.00]*	-0.410 [0.00]*	0.155 [0.07]***	-	-	0.082 [0.33]
Δi_{t-5}	-	0.238 [0.00]*	-	-	-	0.302 [0.00]*
Δi_{t-6}	-	-	-	-	-	-0.208 [0.02]**
Δi_{t-7}	-	-	-	-	-	-0.233 [0.01]**
Δinf	0.298 [0.00]*	0.281 [0.00]*	0.111 [0.00]*	0.479 [0.00]*	0.07 [0.00]*	0.06 [0.00]*
Dummy	0.281 [0.28]	0.546 [0.01]**	0.204 [0.21]	0.097 [0.82]	0.08 [0.86]	0.242 [0.07]***
Constant	-0.378 [0.06]**	-0.125 [0.47]	-0.197 [0.14]	-0.631 [0.00]*	-0.327 [0.329]	-0.24 [0.01]**
ECT_{t-1}	-0.032 [0.00]*	-0.037 [0.00]*	-0.02 [0.01]**	-0.03 [0.00]*	-0.02 [0.00]*	-0.02 [0.00]*
Long Run	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
Inf	2.52 [0.04]**	1.71 [0.01]**	2.30 [0.01]*	2.87 [0.01]**	3.01 [0.12]	2.42 [0.00]*
Adj. R square	0.98	0.98	0.99	0.35	0.97	0.99
LM (2)	12.506 [0.405]	11.197 [0.512]	29.047 [0.00]	11.503 [0.486]	8.029 [0.782]	18.46 [0.102]
ArcH (2)	9.462 [0.663]	10.489 [0.573]	11.848 [0.457]	1.381 [0.999]	0.797 [1.00]	31.489 [0.005]

Source: Output of Eviews 10 econometric software

Table 8:

RESULTS OF ESTIMATION: NONLINEAR MODEL

	Model 3	**Model 6**	**Model 7**	**Model 9**
Short run				
i_{t-1}	-0.031 [0.01]**	-0.031 [0.00]*	-0.082 [0.01]**	-0.107 [0.00]*
İnf pos $_{t-1}$	0.047 [0.02]**	0.06 [0.00]*	0.11 [0.01]**	0.086 [0.08]***
İnf neg $_{t-1}$	0.05 [0.02]**	0.06 [0.00]*	0.123 [0.06]***	0.098 [0.08]***
Δi_{t-1}	0.612 [0.00]	0.459 [0.00]*	0.132 [0.10]	-0.066 [0.34]
Δi_{t-2}	-0.030 [0.73]	0.034 [0.69]	-0.211 [0.00]*	-0.174 [0.01]**
Δi_{t-3}	-0.237 [0.00]	-0.045 [0.60]	0.00 [0.91]	-0.173 [0.01]**
Δi_{t-4}	0.165 [0.05]**	0.081 [0.34]	-	-
Δi_{t-5}	-	0.303 [0.00]*	-	-
Δi_{t-6}	-	-0.202 [0.02]**	-	-
Δi_{t-7}	-	-0.223 [0.01]**	-	-
Δi_{t-8}	-	0.167 [0.05]***		-
Δinf –pos	0.124 [0.00]*	0.752 [0.00]*	0.612 [0.00]*	0.829 [0.00}*
Δinf –pos-1	0.228 [0.00]*		0.238 [0.11]	-
Δinf –neg	-	-		-
Dummy	0.209 [0.20]	0.231 [0.08]***	0.871 [0.09]***	1.591 [0.00]*
C	0.302 [0.14]	0.367 [0.04]**	0.930 [0.12]	1.167 [0.08]***
ECT_{t-1}	-0.03 [0.00]*	-0.03 [0.00]*	-0.08 [0.01]**	-0.107 [0.00]*
Long Run	**Model 3**	**Model 6**	**Model 7**	**Model 9**
Inf-pos	2.04 [0.08]***	2.15 [0.00]*	1.34 [0.00]*	0.80 [0.10]
İnf-neg	2.01 [0.10]	2.20 [0.00]*	1.49 [0.00]*	0.91 [0.07]***
Adj. R square	0.99	0.99	0.95	0.49
LM (2)	24.302 [0.01]	18.331 [0.106]	16.831 [0.156]	13.337 [0.345]
ARCH (2)	12.903 [0.115]	6.133 [0.189]	17.775 [0.122]	30.217 [0.057]

Source: Output of Eviews 10 econometric software

The test results of the NARDL model in Table 8 indicate a strong Fisher Effect in the long run except for 5-year government bonds. The results suggest that a one-unit increase in inflation causes 2.04, 2.15 and 1.34 unit increases in a six-month deposit rate (Model 3), one year deposit rate (Model 6), and one year government bond (Model 7), respectively. On the contrary, it is interesting that in Model 3, decrease in inflation have no significant impact, whereas an increase in inflation tends to increase interest rates in the long run. Decrease in inflation is significant for mid- and long-term interest rates. The Fisher Effect thus holds only when inflation rises, but there is no significant result while inflation decreases for short run interest rates. In relation to mid-term rates, the results suggest that increase in inflation lead to increases in interest rates and decrease in inflation lead to decrease in interest rates. Further, according to the results concerning the short run, increase in inflation causes increase in all types of interest rates and decrease in inflation causes decrease in interest rates as suggested by the Fisher Effect.

CONCLUSIONS

The Fisher Effect states that nominal interest rates react to changes in inflation by one-to one so as to leave real interest rates unchanged (Gylfason, Tomasson & Zoega, 2016). Thus, the impact of inflation on nominal interest rates has been investigated by many researchers. But still, empirical evidence is not favorable for the validity of the Fisher Effect, and the existing literature has inconclusive or mixed results.

In this paper, the validity of the Fisher Effect was investigated through a case study on Turkey by examining both symmetric and possible asymmetric effects of inflation on various types of nominal interest rates. According to the empirical findings, the linear ARDL model reveals a weak Fisher Effect in the short run and a strong one in the long run. In asymmetric ARDL models, a strong Fisher effect has been hold in the long run except in the case of 5-year government bonds. In fact, the Fisher Effect holds only when inflation rises, but there is no significant result while inflation decreases for short run interest rates. The studies which investigate the Fisher hypothesis for Turkish economy have inconclusive or mixed results due to their sample period, data and methodological issues. So the results of this study are similar with Köse et al (2012), Arisoy (2013), Pınar and Erdal (2018) while differ from Incekara, Demez & Ustaoğlu (2012) and Songur (2019).

Finally, the results based on the ARDL and NARDL models support the Fisher Effect in case of Turkey between 2006 and 2019. The weak Fisher effect in the short run reveals that changes in short term interest rates are mainly driven by the stance of the monetary policy rather than inflation. But in the long-run both inflation expectations and the stance of the monetary policy get important. Policymakers should emphasise the changes in inflation when they make their decisions regarding both short and long term interest rates if they imply inflation targeting strategy to control the inflation rates. Further detailed research that may extend the Fisher Effect is crucial for monetary policymakers implementing inflation targeting policies.

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VALJANOST FISHEROVOG UČINKA ZA ZEMLJU KOJA CILJA INFLACIJU: SLUČAJ TURSKE

Sažetak

Cilj ovog rada je istražiti odnos između kamatnih stopa i stopa inflacije. S tim u vezi, valjanost Fisherovog učinka u zemlji s režimom ciljanja inflacije ispituje se razmatranjem mogućnosti nelinearnosti. U tu se svrhu analizira Fisherov učinak korištenjem različitih vrsta kamatnih stopa za identifikaciju kratkoročne, srednjoročne i dugoročne dinamike. Modeli autoregresivnog distribuiranog zaostajanja (ARDL) i nelinearnog autoregresivnog distribuiranog zaostajanja (NARDL) procijenjeni su za tursko gospodarstvo u razdoblju 2006.-2019. Empirijski nalazi ARDL modela otkrivaju valjanost Fisherovog učinka i na kratki i na dugi rok. Rezultati NARDL modela ukazuju na snažan Fisherov učinak dugoročno, osim za petogodišnje državne obveznice. Kratkoročno gledano, Fisherov efekt vrijedi samo kada inflacija raste, a nema značajnog rezultata kada se inflacija smanji.

Ključne riječi: Fisherov učinak, ciljanje inflacije, ARDL, NARDL