

# The Causal Relationship between Inflation and Interest Rate in Turkey

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## Abstract

*The causal nexus of inflation and interest rate has a significant role in the application of monetary policy. Indeed, interest rate-inflation nexus is important for policy makers to be effective in selection of the monetary policy aims and tools. However, there is no consensus among the economists about the direction of the causality relationship between inflation and interest rate. Some economists, in the framework of Fisher Hypothesis, argue that there is a positive causal relationship from inflation rate to nominal interest rate. Contrarily, other economists assert that any increase in interest rate accelerates inflation rate by raising the cost-push inflation. This paper aims to examine the relationship between inflation and interest rate in the case of Turkey in order to make a new contribution to the discussions about the direction of causality among the interest rate and inflation. We examine the interest rate-inflation nexus for the term 2002-2016 in Turkey by employing the cointegration and causality tests. The empirical results confirm that there exists unidirectional causality from inflation to interest rate. From the policy perspective, it can be concluded that to provide price stability is essential for managing interest rate efficiently for Turkish economy.*

## 1. Introduction

Inflation and interest rate are two significant macroeconomic variables which are closely related each other. The inflation-interest rate nexus has been the subject of much empirical research in the literature. However, there exist a strong debate in the literature concerning with the causal direction of the relationship between interest rate and inflation. Most of the studies in the literature indicate the causality from inflation to interest rate, which advocate Fisher Hypothesis. Some researchers argue that any change in the interest rate caused to change in the inflation. Thus, how inflation and interest rate are related is one of the significant controversial issues in the literature.

Understanding the relation between inflation and interest rate is basic for policy maker in order to perform monetary policy effectively. Existing of causal relationship from interest rate to inflation let policy makers to control inflation rate by using policy interest rate. For example, when the price level increase, policy makers can reduce inflation rate by tighter monetary policies, so they will increase the level of interest rate. Accordingly, higher interest rate encourages people to save more and thus led lower level of consumption in the economy. As a result, prices come down since demand is less than the supply. Thus, it may be the best way to increase interest rate to stabilise the general price level if causal relationship runs from interest rate to inflation. That means directional relationship between interest rate and inflation affect the efficiency of monetary policy in achieving stable price.

Given the potency of the monetary policy in achieving stable price indicated above, greater attention has been paid to the nexus between interest rate and prices in recent decades.

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However, the causal direction of the relationship between inflation and economic growth still remains as one of the most debatable issue in the literature. In order to shed new lights on this controversial issue, this study examines the causal relationship between interest rate and inflation in Turkey. The organisation of the paper is as follows. Second Section briefly reviews the related literature. Third Section describes data and methodology and presents empirical results. Final section offers concluding remarks and makes some policy implications.

## 2. Literature Review

The direction of relationship between inflation and interest rate is closely related to effectiveness of stabilization programs. However, the causality between inflation and interest rate is a quite debatable matter in the literature. It is mostly, in the framework of Fisher Hypothesis, argued that increasing inflation rate results in increasing interest rate. Contrarily, some researchers assert that any change in the interest rate caused to change in the inflation which can be called as “interest rate-led inflation” hypothesis.

Supporters of Fisher hypothesis argue that increasing price level raises the level of interest rate by decreasing real money balance. Originally, Fisher (1930) hypothesized that the nominal interest rate is made up of two components: the expected rate of inflation and the real interest rate. Under the assumption of rational expectations, expected inflation rate equals to inflation rate in the end of the term. Consequently, Fisher hypothesis argue one-to-one relationship between the inflation and the nominal interest rate, assuming the real rate of interest rate unaffected. Thus, Fisher hypothesis provides theoretical basis for econometric analysis focusing particularly on the causal relationship from inflation to interest rate. Accordingly, the Fisher effect has been extensively examined and investigated in the literature.

Booth and Ciner (2001) analyze the bivariate relationship between Eurocurrency interest rate and inflation for nine European countries and US from 1978 to 1997. Empirical results reveal that there is a one-to-one relationship between Eurocurrency rates and inflation. Thus, findings support the Fisher Hypothesis that markets participants incorporate a predictable portion of the inflation rate into the nominal interest rate. Saymeh and Orabi (2013) investigate the interactions among interest rate, inflation and economic growth in Jordan over the period 2000-2010. Employing Johansen Cointegration and Granger Causality Test, it is concluded that inflation causes interest rate, which confirms Fisher Hypothesis. Büberkökü (2014) examines the relationship between nominal interest rates and inflation within the framework of Fisher’s hypothesis for seven emerging markets between 2003 and 2013. The cointegrating coefficients estimated according to panel group mean FMOLS and DOLS show that an increase in inflation rate raises nominal interest rate, which advocates Fisher hypothesis.

Concerning with the Turkish case, Şimşek and Kadılar (2006) investigates the relationship between nominal interest rate and inflation by using quarterly data from 1987 to 2004. Results of Autoregressive Distributed Lag model show that interest rate is determined by the inflation. Köksel and Destek (2015) analysis the relationship between inflation and interest rate for the period of 2002-2014. The results of Granger causality test show that nominal interest rate is increased by one-for-one in response to an increase in inflation rate. Thus, findings indicate that there is unidirectional causal relationship from inflation to nominal interest rate. İncekara et. al. (2015) test validity of Fisher Hypothesis by employing Johansen Cointegration and Granger Causality Test between 1989 and 2011. It is concluded that in the long run there is causal relationship from inflation to interest rate in Turkey, which advocates Fisher Hypothesis. Finally, Doğan et. al. (2016) examine the causality relation between the interest rates and inflation by using the data series between the 2003 and 2015 period. The results of Johansen cointegration and Granger causality tests reveal that there is a causality relation from inflation to interest rates.

Contrary to Fisher hypothesis, some groups of economists have argued that rates of interest play a significant role in determining of inflation level. Concerning with the causal relationship from interest rate to inflation rate, it can be argued that there are two channels through which a variety in interest rate can affect the level of prices. Accordingly, the influence mechanism of interest rate on inflation can be operated in supply and demand channels indicated below (Bhunia, 2016: 20-21).

In the demand channel, a change in interest rate affects the individual's preference to consume out of their income. For example, an increase in the interest rate probably leads to decline in consumption by spurring savings since a rise in the interest rate increases the opportunity cost of consumption today. Thus, individuals save much more part of their income in order to have interest bearing financial assets rather than spending on consumption. This will result in total demand contraction and thus decrease the price level. On the other hand, low interest rate put more borrowing power in the hands of people to consume much more. In this case the economy tends to grow inducing inflation if there is not enough supply to satisfy rising demand for goods and services. That means short fall in supply against to increasing demand causes to inflation. This kind of inflation can be categorized under demand pull inflation.

Prices can also be increased based on the impact of interest rate on supply side of economy. Indeed, interest rate plays a pivotal role in not consumption or total demand but also production or total supply. Higher the rate of interest, higher is the cost of finance for investment and production in the economy. To some extent, business may than pass on this higher marginal cost of capital to prices in order to protect their profit margin. In other words, since higher interest rate augments the financing cost of production for firms, producers pass their production cost on to consumers in the form of increased prices, which called as cost-push inflation. On the other hand, a rise in the interest rate increases the cost of credit for entrepreneurs, which would be expected to reduce investment demand. This results in decreasing production and, in turn, total supply of goods and services. In conclusion, rising interest rate increases price level by creating of total supply constriction resulting excessive demand in the goods market. Thus, the interaction between the interest rate and the supply side of the economy provide a clear indication of the impact of the interest rate on price level.

Asgharpur (2007) examines the causal relationship between the interest rate inflation in panel of 40 selected Islamic countries using panel causality methodology over the 2002-2005 period. The results of study show a unidirectional causality from interest rate to inflation in all of the countries. It is also concluded that interest rate must be reduced in order to decrease inflation. Mahdi and Masood (2011) analyze the causality relationship between interest rate and inflation for the period 1989-2007 in Iran. The results of Johansen's cointegration approach and vector error correction model (VECM) approach concludes that there is a bidirectional relationship between interest rate and inflation. However, the relation from interest rate to inflation is more powerful than inflation to interest rate in Iran. Finally, Amaefula (2016) investigates the causality between interest rate and inflation in Nigeria. He employs Johansen cointegration test and vector error correction model (VECM) of Granger causality on data between 1995 and 2014. The results of analysis show evidence of long run equilibrium relationship between the variables from interest rate to inflation rate.

Looking at the Turkish case, Gül and Ekinçi (2006) indicated the causal relationship from interest rate to inflation. They analyzed the interactions between nominal interest rates and inflation over the period of 1984-2003 and found that causality exist in only unidirectional relationship from nominal interest rate to inflation. Onur (2008) also examines the relationship between interest rate and inflation between 1980 and 2005 by using Cointegration and Granger Causality tests. Empirical results indicate that interest rate has an impact on inflation. Finally, Bari (2013) researches the impact of interest rate on inflation by using Vector Error Correction

Model over the period 2001-2012. According to empirical results, interest rate and output gap are main determinants of inflation in Turkey.

In conclusion, there are numerous studies indicating the validity of both Fisher Hypothesis (inflation-led interest rate) and “interest rate-led inflation” hypothesis in the literature. However, it seems that most of the studies confirm Fisher hypothesis along with the increasing application of inflation targeting monetary policy regime over the last decades. Therefore, economists recently devote much attention to analysing the developments of interaction between inflation and interest rate under the inflation targeting regimes in different countries. Turkey has also adopted Inflation Targeting as a monetary regime after 2001 – between 2001 and 2006 implicitly and then explicitly. Thus, economists also analyse the relationship between inflation and interest rate, in particular as Turkey moves to an inflation targeting regime. Findings concerning with the Turkish case suggest that there is a strong Fisher effect under inflation targeting monetary regime in a global trend-compatible manner. Accordingly, Köse et. al. (2012) and Tunalı and Erönel (2016) examine the relationship between inflation and interest rate and both studies indicate that Fisher effect is valid for Turkey since the beginning of the implementation of inflation targeting regime.

### 3. Data, Methodology and Empirical Results

In this section we examine the relationship between inflation (INF) and interest rate (IR) in Turkish economy between 2002 and 2016. We use monthly deposit rates and Consumer Price Index for the variables of interest rate (IR) and inflation (INF), respectively. Both data set sourced from the Electronic Data Distribution System (EVDS) of the Central Bank of Republic of Turkey. Empirical analysis begins by checking the stationary statute of data set. We check whether time series of inflation (INF) and interest rate (IR) are stationary by using Augmented Dickey Fuller (ADF) and Philips Peron (PP) tests. Then, the long run relationship between inflation and interest rate is analysed by using Cointegration Test. In this framework, we perform Engle-Granger (1987) and Johansen (1988) cointegration tests. Finally, we examine the causality relationship between inflation and interest rate by operating Granger (1988) Causality Test.

#### 3.1 Unit Root Test

The first step of the empirical methodology finds the order of integrations of the data. Accordingly, in order to indicate the stationary statute of data set we perform Augmented Dickey Fuller (ADF) and Philips Peron (PP) tests. The results of Unit Root Tests are presented in Table 1. Findings show that all variables are not stationary at level since test statistics is lower than critical values for both methods. However, by first differentiation all series become stationary since the calculated test statistics exceed the critical values. In conclusion, both inflation (INF) and interest rate (IR) series are integrated of the same order at I (1). That means data set is suitable for employing cointegration tests developed by Engle-Granger (1987).

**Table 1.** Results of Unit Root Tests

| Variables             | ADF<br>(Augmented Dickey Fuller) |                  | PP<br>(Philips Peron) |                  |
|-----------------------|----------------------------------|------------------|-----------------------|------------------|
|                       | Level                            | First Difference | Level                 | First Difference |
| INF (constant)        | -2,8343                          | -3,2509**        | -1,9090               | -6,6189*         |
| DINF (constant+trend) | -2,0007                          | -3,8072**        | -1,8510               | -6,6439*         |
| IR (constant)         | -1,5291                          | -7,7514*         | -1,3640               | -8,9176*         |
| DIR (constant+trend)  | -2,2919                          | -8,1113*         | -2,2967               | -9,4555*         |

Not: \* and \*\* indicate the significance level at 1 % and 5 %, respectively.

Maximum lag length is specified by considering Akaike Information Criterion (2).

### 3.2 Cointegration Tests

In this section we employ cointegration tests which are the standard tools in order to investigate the linear combination of time series variables. Thus, this method finds out the presence of number of cointegrating vectors indicating the long run relationship between variables. Accordingly, we perform Engle-Granger and Johansen Cointegration Tests to indicate whether inflation (INF) and interest rate (IR) have a long run relationship or not.

In the framework of Engle-Granger test for co-integration, we firstly run a regression of interest rate on inflation and then inflation on interest rate separately and save the residual for both regressions. Whether the residual series of regression equation are stationary or not are checked by Tau-statistic and Z-statistic. Second row of Table 2 shows the stationary statute of residual series of regression of nominal interest rate on inflation while third row of the Table 2 presents the stationary statute of residual series of regression of inflation on nominal interest rate. The tau-statistic and Z-statistic reject the null hypothesis of no cointegration (unit root in the residuals) at the 1% and 5% levels for both regressions. Thus, results clearly suggests that interest rate and inflation are cointegrated, which means that there is a long run relationship between them.

**Table 2** Engle-Granger Cointegration Tests Results

| Dependent Variable | Tau-Statistic | Prob.    | Z-Statistic | Prob.   |
|--------------------|---------------|----------|-------------|---------|
| INF                | -3.4646       | 0.0467** | -69.1130*   | 0.0000* |
| IR                 | -7.9927       | 0.0000*  | -65.9941*   | 0.0000* |

Not: \* and \*\* indicate the significance level at 1 % and 5 %, respectively.

Presence of the long-run association between inflation (INF) and interest rate (IR) is also checked by performing Johansen cointegration test. This methodology is based on maximum likelihood estimation in which it allows for testing the long-run relationship between the variables by using the maximum eigenvalue and trace statistics. Thus, in the framework of the Johansen Cointegration Analysis, we used two different tests called Trace Statistic and max-Eigen statistic for deciding whether there is a long run relationship among the variables.

Accordingly, the results of Johansen Cointegration analysis are divulged in Table 3. The null hypothesis examines the cointegrating vector number which is stated by the rank ( $r$ ) equals zero or equal less than one. Findings show that the computed value of the both Trace Statistic and max-Eigen statistic are more than the critical value at 5% level of significance. Therefore, the null hypothesis of no cointegrating relationship or no long-run relationship between inflation and interest rate ( $r = 0$ ) is rejected. That means there exists an equilibrium relationship between the variables. Thus, it can be concluded there is long run relationship between inflation and interest rate in Turkey.

**Table 3** Johansen Cointegration Tests Results

| Null Hypothesis | Trace Statistics |                    | Maximum Eigenvalue Statistics |                    |
|-----------------|------------------|--------------------|-------------------------------|--------------------|
|                 | Test Statistic   | % 5 Critical Value | Test Statistic                | % 5 Critical Value |
| $r = 0$         | 54.5116          | 16.4947            | 32.6641                       | 14.2646            |
| $r \leq 1$      | 21.8400          | 3.8414             | 21.8475                       | 3.8414             |

### 3.2 Causality Test

After indicating the presence of cointegration or long run relationship among the variables, in this part of study we analysed the causality between interest rate and inflation rate. Granger causality test based on the vector autoregression (VAR) model will be used in order to detect the direction of relation between the variables. The results of The Granger-causality tests are presented in Table 4. Findings reveal that causality runs from inflation rate to interest rate while the reverse causation is not confirmed. That means, unidirectional Granger causality is indicated from inflation to interest rate. In other words, the direction of the relationship between inflation and interest rate runs from inflation to interest rate. That means a variety in inflation affects the level of interest rate in Turkey.

**Table-4** Granger Causality Test

| Null Hypothesis               | F-Statistic | p-Value | Decision |
|-------------------------------|-------------|---------|----------|
| IR does not Granger cause INF | 0.8956      | 0.4490  | Accept   |
| INF does not Granger cause IR | 2.8500*     | 0.0453  | Reject   |

Not: \* indicates the significance level at 5 %. Maximum lag length is specified by Akaike Information Criterion (2).

In conclusion, empirical findings show evidence of long-run equilibrium relationship between interest rate and inflation. Furthermore, there is a unidirectional causality from inflation to interest rate. In short, the empirical results imply that inflation spurs interest rate in Turkey. These findings support Fisher hypothesis defining the inflation as a crucial integral part of nominal interest rate. Thus, empirical findings also give significant insights into monetary policy programmes for being effective in selection of the policy aims and tools. According to this, policy makers can manage the interest rate by controlling general price level in Turkey. In other words, to provide price stability is essential for managing interest rate well for Turkish economy.

### 4. Conclusion

The causality between inflation and interest rate has attracted substantial attention among economists. Accordingly, a lot of studies focusing on the link between inflation and interest rate have been made in the literature. However, the direction of relationship between inflation and interest rate has still been a quite controversial issue among the scholars. Some economists support Fisher hypothesis arguing that inflation is an important factor affecting the level of interest rate. Contrarily, other group of economists asserts that inflation is mainly influenced by the interest rate. This study aims to shed new lights on this controversial issue by examining the Turkish case. For this aim, we analyse the link between inflation and nominal interest rate by using cointegration and causality tests for the term of 2002-2016.

The findings from Engle-Granger and Johansen Cointegration tests indicate that there is a long run relationship between inflation and interest rate. Granger causality test result shows unidirectional causality running from inflation to interest rate while no causality from interest rate to inflation. The overall evidence proposes that inflation rate is a main factor affecting the integral part of nominal interest rate, which advocates Fisher Hypothesis. From the policy perspective, it can be concluded that stability of nominal interest rate firstly requires stability of price level in Turkey. Thus, policy makers should pay intensive attention to stability of general price level to control the level of interest rate. In other words, policy makers should follow a policy framework covering the measures supporting stability of price level in order to manage the rate of interest effectively in Turkey.

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