The Causal Relationship Between Nominal Interest Rates and Inflation: The Case of Turkey

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Abstract:

This paper analyzes empirically the relationship between nominal interest rates and inflation by using high-frequency data of nominal interest rates and inflation of Turkey. With time-series techniques, this study provides evidence that a long-run relationship between nominal interest rates and inflation exist. However, our results indicate that a causal relationship occurs only one direction from nominal interest rates to inflation.

Keywords: Nominal interest rates, inflation, causality.

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1. Introduction

The interest rates and price changes are important variables in the macroeconomy that are often monitored by economists and policy makers. The relationship between these variables has been subject to substantial research. Most of this research has focused on the influence of prices on the interest rate (Wilcox, 1983)[1]. Only a few studies have considered the impact of changes in the interest rate on price (Barsky and DeLong, 1991). Despite intensive empirical studies and an extensive literature, the results of these studies have been contradictory and confusing. This contradiction is attributed, in part, to the complexity of the theoretical channels that explain the impact of the interest rate on price (Kandil, 2005).

Upward changes in prices namely inflation is intensely undesidered. A high rate of inflation is considered as one of the most important problems facing a country.

The basic reason for adopting price stability as the primary object of monetary policy is to create a stable and non-inflationary environment for resource allocation and to stabilize price expectations. Maintaining low inflation is seen as a necessary part of an effective anti-poverty strategy.

As a developing country Turkey has experienced high and variable inflation rates ranged from 30% to 110% for over twenty years. Many stabilization programs have addressed the problem of high inflation in Turkey over the years, yet all have failed in reducing inflation to acceptable levels. In this manner, the objective of this paper is to investigate the causal relationship between nominal interest rates and inflation for Turkey over the period of 1984-2003, using monthly observations.

The article structured in the following way. The next section briefly

[1] More recently see Benhabib, Schmitt-Grohe, and Uribe. (2002), Berument and Jelassi (2002), Cochrane and Piazzesi (2002), and Fahmy and Kandil (2002).

discusses some of the approaches that have been in the literature to explain the relationship between interest rates and price changes. In section 3, Granger causality test method is briefly presented. Section 4 describes the data and provides the empirical analysis. The last section concludes the paper.

2. Theoretical Frame of the Relationship

The channels through which a change in the interest rate is likely to impact the price level in standard macro models can be distinguished into demand and supply channels. The demand side of the economy is determined by equilibrium conditions in the money and goods market. First, consider the impact of a rise in the interest rate on the money market. A rise in the interest rate increases the opportunity cost of holding cash balances which has a negative impact on money demand. The reduction in money demand creates excess supply of credit and stimulates a rise in aggregate demand. Consequently, price must increase so that individuals can be satisfied to hold the existing stock of money rather than spending it on commodities or interest-bearing assets (Bose, 2002).

On the other hand, changes in the interest rate are likely to affect the equilibrium condition in the goods market and, in turn, price. A rise in the interest rate is expected to impact on disposable income and the public's preference to consume out of this income. While net interest gets added to the disposable income of lenders in the economy, it decreases the income available for borrowers to spend. Hence, a rise in the interest rate is expected to increase consumption for the lenders and decrease consumption for the borrowers. If marginal propensity to consume for borrowers is higher than that for lenders, an increase in the interest rate would likely lead to decline in consumption demand. In addition, a change in the interest rate is expected to affect the desire to consume out of income for both borrowers and lenders (i.e., marginal propensity to consume). Higher interest rate makes consumption cheaper tomorrow than today. Hence, economic agents tend to defer consumption, which is consistent with a higher marginal propensity to save. Through this channel, the negative impact of a rise in the interest rate on consumption spending is expected to be further reinforced. In addition to that, a change in the interest rate is expected to impact negatively on investment spending in two directions. First, an increase in the interest rate has a negative impact on the net present value of the expected return on investment. Second, a rise in the interest rate increases the cost of credit, which would also be expected to reduce investment demand. This channel further decreases aggregate demand and, in turn, price. Thus, the interaction between the interest rate and the demand side of the economy does not provide a clear prediction of the impact of the interest rate on price level (Kandil, 2005).

The interaction between the interest rate and the supply side of the economy is also complicated by the presence of conflicting factors. An increase in the interest rate means a higher cost of the output produced and, therefore, a rise in prices. However, as suggested by Ball (1990), an increase in the interest rate has an intertemporal substitution effect on labor supply. Workers prefer to work more today to increase their saving at the higher interest rate. The increased labor supply increases the output supplied and, in turn, decreases prices. In short, the combined effect of the demand and supply channels suggests an ambiguous impact of the interest rate on price.

3. Granger Causality Test Method

To analyze the relationship between nominal interest rates and inflation, this paper focuses on causality among these variables using the method developed by Granger (1969). Granger causality test is one of the most interesting and widely used VAR applications. The intuition behind it is simple: If previous values of variable X significantly influence current values of variable Y, then one can say that X causes Y. Since this technique is used in a number of economic studies, only brief explanations of these method is provided below.

A general specification of the Granger causality test in a bivariate (X, Y) context can be expressed as:

$$Y_t = \alpha_0+\alpha_1 Y_{t-1}+...........+\alpha_i Y_{t-i} +\beta_1 X_{t-1}+........ + \beta_i X_{t-i} + \varepsilon \qquad (1)$$

$$X_t = \alpha_0+\alpha_1 X_{t-1}+...........+\alpha_i X_{t-i} +\beta_1 Y_{t-1}+........ + \beta_i Y_{t-i} + \varepsilon \qquad (2)$$

Since the independent variables are identical for each equation this specification assures us that the error term is not correlated between the two equations and allows us to use OLS (Ordinary Least Square) rather than the more sophisticated procedure SURE (Seemingly Unrelated Regression).

In the model, the subscripts denote time periods and ε is a white noise error. The constant parameter α_0 represents the constant growth rate of X in the first equation and Y in the second equation, and thus the trend in these variables can be interpreted as general movements of these financial time-series in response to, say, changes in economic fundamentals. This specification is appropriate in the existence of cointegration between X and Y that follows the unit root process, and thus can be used for our data as we will show in the next section.

We can obtain two tests from this analysis: the first examines the null hypothesis that the nominal interest rate does not Granger-cause inflation, and the second test examines the null hypothesis that the inflation does not Granger-cause the nominal interest rate. If we fail to reject the former null hypothesis and reject the latter, then we conclude that the nominal interest rate changes are Granger-caused by a change in inflation. Therefore this test involves the examination of the statistical significance of the parameters of X in Eq.(1) and those of Y in Eq.(2). For example, the null hypothesis of X not Granger-causing Y is tested using the joint parameter restrictions, $\beta_1 = \beta_2 =\ldots\ldots\beta_i = 0$. Acceptance of this restriction raises evidence for the above null of noncausality.

4. Data Description and Empirical Analysis

The data consist of monthly nominal Turkish Lira interest rates obtained from the Central Bank of the Republic of Turkey and monthly inflation rates for Turkey. The sample period is from January 1984 to December 2003. Inflation rates are proxied by monthly changes in the

Wholesale Price Index (WPI) obtained from State Institute of Statistics. All rates are annualized percentages.

Before analyzing the relationship between nominal interest rates and inflation, it is important to carry out a univariate analysis. Mishkin (1992) had noted that the economic series like those of inflation and yields tend to possess unit roots. The presence of unit roots in the underlying series points toward the non-stationarity of the underlying series. If both the independent and the dependent variables show the presence of unit roots, the regression results do not hold much meaning. This is referred to as spurious regression, whereby the results obtained suggest that there are statistically significant relationships between the variables in the regression model when in fact all that is obtained is the evidence of contemporaneous correlation rather than a meaningful causal relation. The stationarity of each series was investigated by employing the unit root tests developed by Dickey and Fuller (1981). The test consists of regressing each series on its lagged value and lagged difference terms. The number of lagged differences to be included can be determined by the Akaike Information Criterion(AIC). Table 1 reports the Dickey-Fuller test statistics under the null hypothesis of a unit root. The table also presents the number of lagged difference terms included in the regression. The hypothesis of unit root against the stationary alternative is not rejected at the both 1% and 5% levels for interest rates and inflation rates with or without deterministic trend. However, the first differences of these variables are stationary under the test. Hence, we conclude that these variables are integrated of order 1. The results of these tests are reported in Table 2.

Table 1. Unit Root Tests (levels)

	Interest Rate	Inflation Rate
Constant ADF Test Statistics Lag	1.2767 2	-0.7678 1
Constant and Trend ADF Test Statistics Lag	-0.9843 2	-0.7925 3

Note: 1%(5%) critical value for ADF test with constant is -3.4592 (-2.8737) while it is -3.9996 (-3.4298) for the test with constant and trend.

Table 2. Unit Root Tests (First differences)

	Interest Rate	Inflation Rate
Constant ADF Test Statistics Lag	-11.6563 2	-5.1124 3
Constant and Trend ADF Test Statistics Lag	-11.7366 1	-5.2088 3

Note: 1% (5%) critical valve for ADF test with constant is -3.4592 (-2.8737) while it is -3.9996 (-3.4298) for the test with constant and trend.

On the basis of the above unit – root tests, we performed the Johansen's cointegration test to see whether any combinations of the variables are cointegrated. This approach uses a maximum likelihood procedure that tests for the number of cointegration relationships and estimates the paramaters of those cointegrating relationships. Likelihood Ratio (LR) test statistics and 5% critical values are reported in Table 3. The results suggest that there is a cointegrating relationship between interest rate and inflation.

Table 3. Johansen maximum likelihood cointegration tests.
(Intercept (no trend) in CE and test VAR)

Maximum Eigenvalue test				Trace test			
Null	Alternative	Statistic	95% Critical Value	Null	Alternative	Statistic	95% Critical Value
Interest Rate							
r = 0	r = 1	80.44*	14.07	r = 0	r ≥ 1	84.39*	15.41
r ≤ 1	r = 2	3.95	6.65	r ≤ 1	r ≥ 2	3.95	6.65

* Indicates significance at 5% level.
Note: r stands for the number of cointegrating vectors.

The existence of a long-run relationship between interest rate and inflation means that both variables are causally related at least one direction. But, whether change in interest rates is causing change in inflation or change in inflation is causing change in interest rates is still unkown. In order to learn the direction, we implemented the Granger causality test. Taking into account that the results derived from this test may be sensitive to the selection of the lag length, the minimum final prediction error suggested by Akaike (1969) has been used.

F-statistics and probability values constructed under the null hypothesis of noncausality are reported in Table 4. It can be observed that there is a causal relationship between interest rate and inflation. However, our results show that one-way causality exists only from interest rates to inflation.

Table 4. Pairwise Granger Causality Tests (1984-2003)

Null Hypothesis	F-Statistics	Probability	Lags
Interest rate does not Granger Cause Inflation	19.5207	0.0015	4
Inflation does not Granger Cause Interest rate	0.00109	0.97368	4

One may think that recent economic crisis in Turkey might have affected the results. In order to see whether there is such an effect we have re-run Granger causality test for period of 1984-2000. It can be seen from the below Table 5, results support our findings which indicate that our results are not affected by the recent economic crisis.

Table 5. Pairwise Granger Causality Tests (1984-2000)

Null Hypothesis	F-Statistics	Probability	Lags
Interest rate does not Granger Cause Inflation	5.63963	0.00026	4
Inflation does not Granger Cause Interest rate	0.49452	0.73977	4

To verify the existence of a long-run relationship between nominal interest rate and inflation, we also implemented the Granger causality test within an error-correction framework. Estimation results are presented in Table 6 and Table 7 for two periods (1984-2003 and 1984-2000). Chi-Square statistics and probability values constructed under the null hypothesis of noncausality show that there is a causal relationship between nominal interest rate and inflation. The direction of the causality is only from interest rates to inflation. For further evidence, impulse-response and variance decomposition graphs are presented in Appendix 1.

Table 6. VEC Pairwise Granger Causality Test (sample period 1984-2003)

Null Hypothesis	χ^2	Probability	df
Interest rate does not Granger Cause Inflation	10.94707	0.0429	4
Inflation does not Granger Cause Interest rate	1.168464	0.9479	4

χ^2 table value= 9.49, 95% upper at the 5-percent.

Table 7. VEC Pairwise Granger Causality Test (sample period 1984-2000)

Null Hypothesis	χ^2	Probability	df
Interest rate does not Granger Cause Inflation	12.30259	0.0309	4
Inflation does not Granger Cause Interest rate	2.419391	0.7886	4

χ^2 table value= 11.44, 97.5% upper at the 2.5-percent.

5. Policy Implications and Conclusion

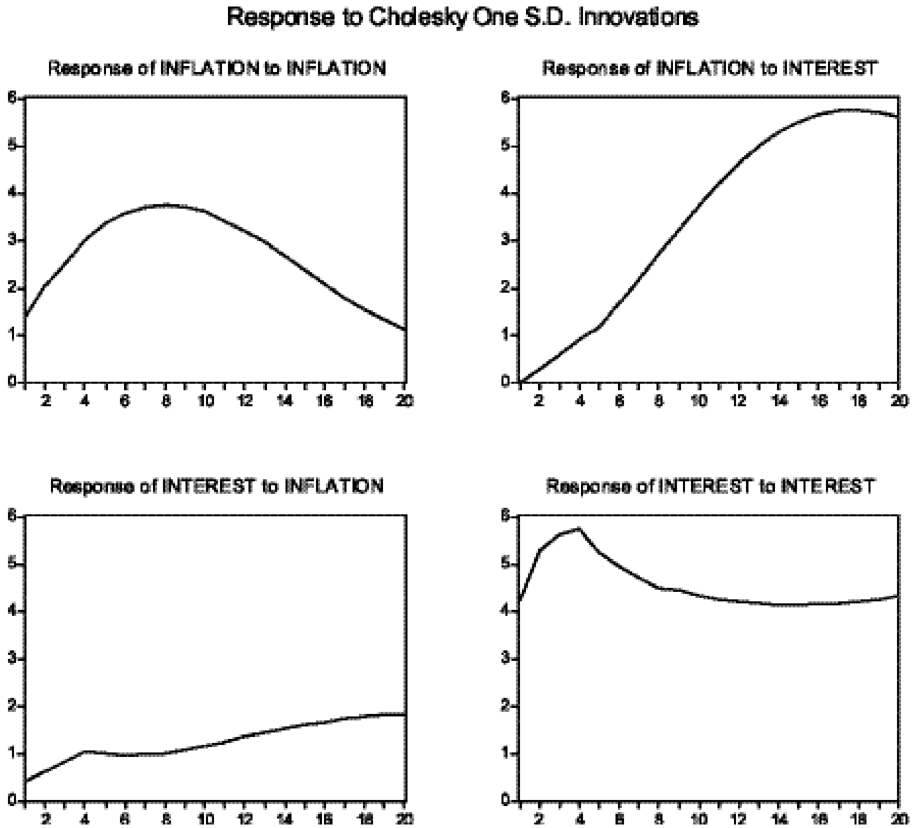
This paper analyzed empirically the relationship between nominal interest rates and inflation in the Turkish economy. Since, the variables in this paper are nonstationary and present a unit root, the Johansen's cointegration technique has been applied. This methodology has allowed to obtain a cointegrating relationship among these variables. The cointegration results provide evidence of a unique cointegrating vector. In other words, a long-run stable relationship between nominal interest rates and inflation exist. That means nominal interest rates and inflation move together in the long-run.

We next performed Granger causality test. We also find that causality relation exist from the nominal interest rates to inflation in a unique direction. This implies that there is information contained in the nominal rate concerning the future path of the inflation rate. This implications is consistent with Fama's (1975) position. In his seminal paper, Fama found that changes in nominal interest rates reflect fluctuations in expected inflation rather than the changes in real interest rates, and that consequently nominal interest rates can be used as an predictor of future inflation.

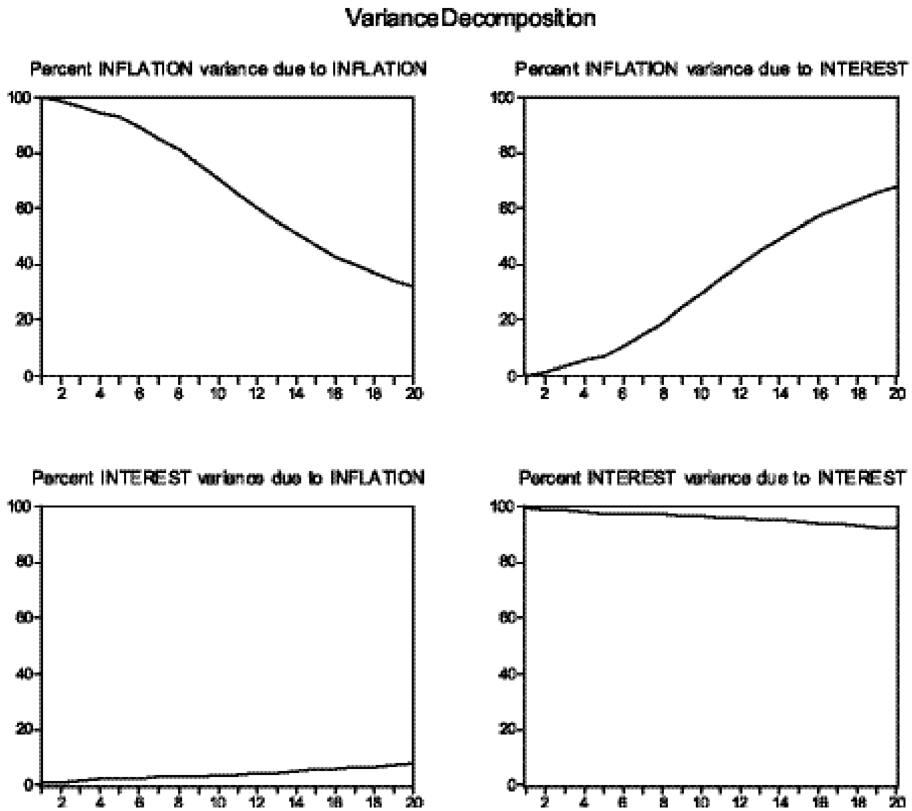
Many investors and economists in Turkey believe that any change in nominal interest rates will cause a change in inflation. The reason for this that public sector borrowing requirement has had major influence on the determination of inflation. Telatar (2002) found that short-term borrowing at high interest rates caused a need for re-borrowing in order to make debt service payments, and created a vicious circle of high budget deficits and high interest rates. In this study, we tried to examine whether statistical evidence supports this belief. Our findings suggest that nominal interest rates have played a role in determining the inflation rate in Turkey. It is likely that economic stability and low inflation can be achieved by reducing nominal interest rate. This requires implementation of credible structural reform of tax and expenditure systems to eliminate the public sector borrowing requirement for reducing pressure on nominal interest rates.

Appendix 1

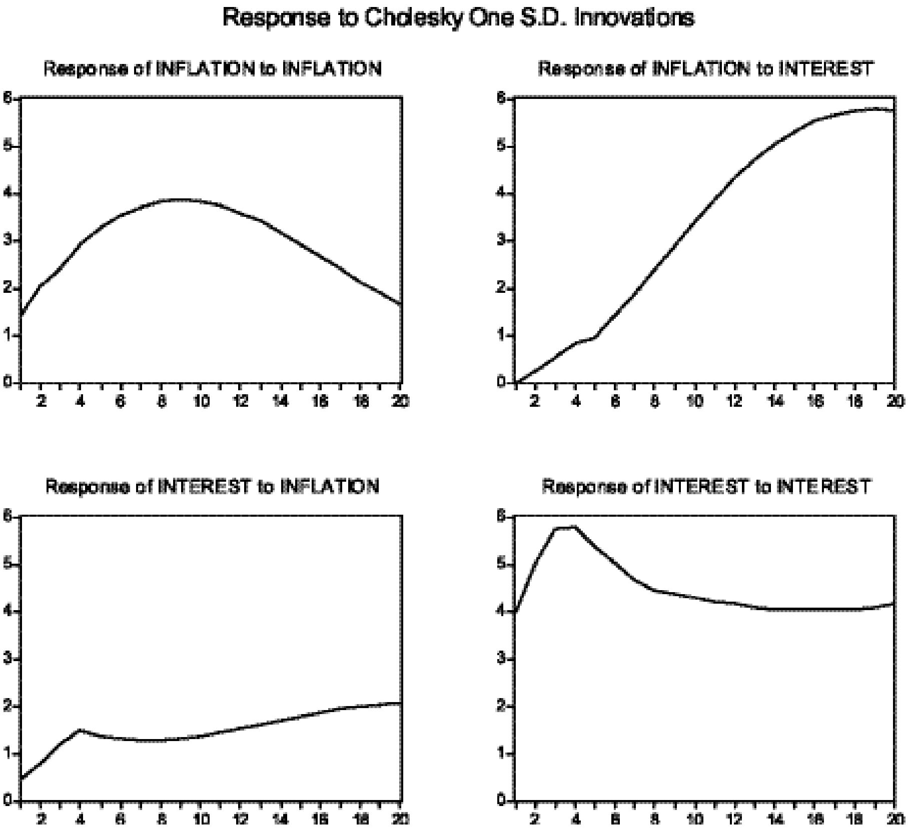
Graph 1: Impulse Response Function (sample:1984-2003)



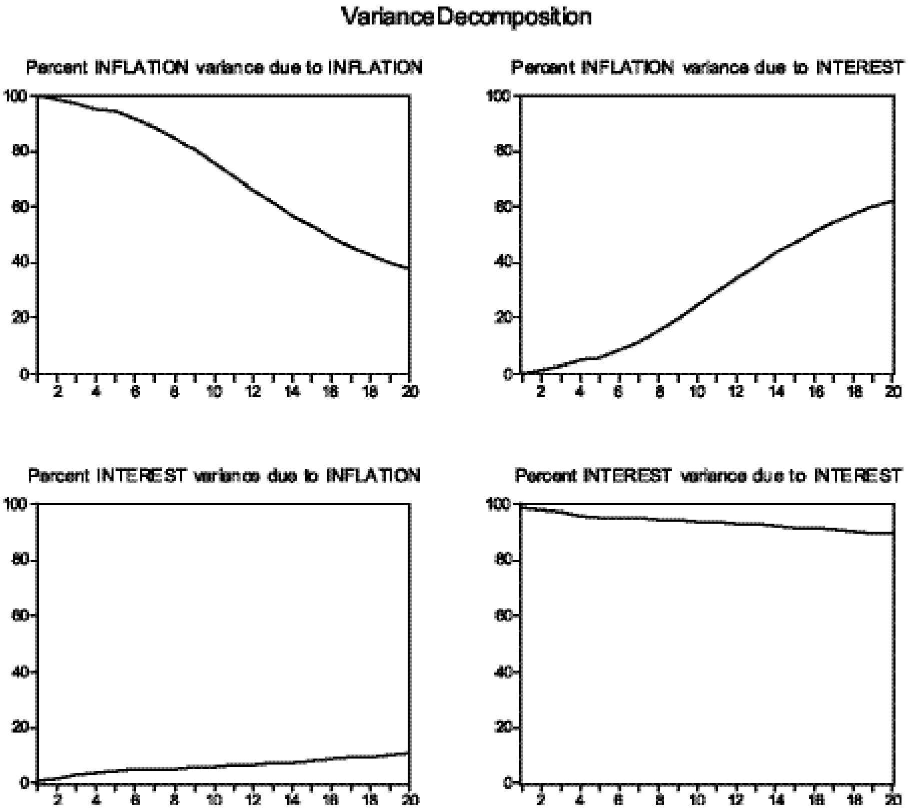
Graph 2: Variance Decomposition(sample:1984-2003)



Graph 3: Impulse Response Function (sample:1984-2000)



Graph 4: Variance Decomposition(sample:1984-2000)



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