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Causal Relationship between Money and Inflation during a High Inflation Period: The Case of Turkey

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Abstract

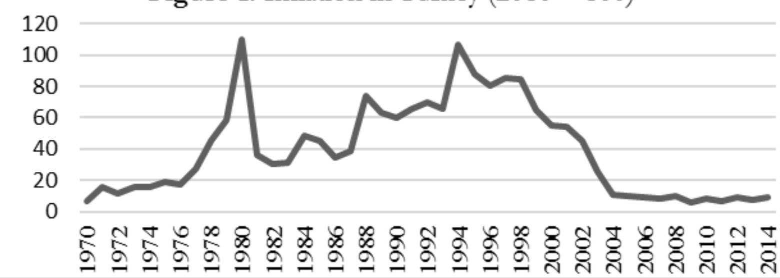
This paper re-examines the causal relationship between money supply and inflation in the context of Turkish economy. Co integration and Error Correction models are applied to monthly data covering the period 1970-1996. Most previous studies on the relationship between money and prices estimate a bivariate model raising the possibility of omitted variable bias. The present paper overcomes this problem by using both bivariate and multivariate models. In contrast to most previous studies on Turkey, the present study finds a feedback relationship between money supply and inflation. However, the causality from inflation to money supply is much stronger than the causality from money supply to inflation both in the bivariate and multivariate model. In order to provide more light on the money-price nexus and to see if the empirical results are sensitive to the series used, the causal relationship is also investigated by using the price level measured by the CPI. It is found that there is one-way causality from money supply to price level in the bivariate model and feedback relationship in the multivariate model.

Keywords: Money, Inflation, Unit Roots, Cointegration, Granger Causality.

1. Introduction

Since the Second World War, inflation has been a major economic problem in Turkey. Until 1971, Turkey has experienced two short periods of high inflation: 1940-43 and 1954-59. The inflation rate, based on the Consumer Price Index (CPI), averaged 35% in 1940-43 and 14% in 1954-59. In 1960s, inflation was kept within reasonable limits with an average annual rate of 5.34% during the period 1960-70. Since 1971, however, persistence of very high inflation has been a fundamental problem in Turkey. It reached its peak at 112% in 1980. It averaged 104% in 1994, 92% in 1995, 80% in 1996 and 77% in 1997. The era of accelerating inflation ended in the 1997-98 period.[2]

Figure 1: Inflation in Turkey (2010 = 100)



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[2] Source: Turkish Statistical Institute; World Development Indicators, The World Bank

One of many explanations for the continuing increase in the price level is the excessive growth of money supply. The monetarist theory, based on the quantity theory of money, believes that inflation is essentially a monetary phenomenon in the sense that a continuing increase in the price level is due to increases in aggregate demand. This increase in aggregate demand is caused, according to the monetarist view, by excessive expansion in money supply. Hence, according to monetarists, money supply is the cause, and inflation is the effect. The proposition of one-way causation from money to prices has been the central theme of monetarists' approach to the inflation. According to the endogeneity approach, however, the nominal stock of money is endogenously determined and the causal flow from money supply to inflation cannot be established (Biswas and Saunders, 1986). This approach views inflation because of structural bottlenecks in the development process (Masih and Masih, 1994). The resolution of the above theoretical dispute involves econometric testing of the causal relationship between the money supply and inflation. Therefore, the principal aim of this paper is to test for causality between money supply and inflation in Turkey.

The remainder of the paper is structured as follows: Section II reviews the literature, Section III presents data, methodology and test results, Section IV conclude the paper.

2. Literature Review

The empirical studies reviewed can be divided into two groups. Studies on macro aspects of Turkish inflation are reviewed in the first group. For some developing economies such as India, Egypt, Morocco, Tunisia, Algeria and Bangladesh, empirical studies of the causal relationship between money supply and inflation are reviewed in the second group.

Several studies have tried to examine the process of inflation in Turkey. Examples are Fry (1980), Togan (1987), Atesoglu and Dutkowsky (1995) and Metin (1995). Fry (1980) constructs an inflation model covering the period 1950-77. This study applies Ordinary Least Squares (OLS) method to the inflation model and finds consistent results with the monetarist explanation of inflation. Fry (1980) argues that large increases in agricultural exports caused the money supply to increase in early 1950s. After the Second World War, Turkey experienced relatively a high level of unemployment period. In order to reduce this high unemployment, Turkey began exporting labor to Western Europe in 1960s, mainly Germany in 1961. Fry (1980) argues that money transfers from these Turkish workers and large increases in foreign exchange receipts are among the reasons for having rapid monetary growth in the early 1970s. Fry also stresses that this rapid monetary growth stimulated inflation.

The influence of money and interest rates on inflation was addressed by Togan (1987), who has shown that money supply and the interest rate are the variables that have effects on the movements of inflation during the period 1960-83. Togan reports that incorporation of the rate of interest in the money demand equation improves the estimation results. Based on sample evidence, Togan finds negative relationship between nominal rate of interest and inflation. Togan applies Augmented Dickey-Fuller tests and finds first difference stationarity for all variables. First differenced and semi-log forms of the aggregate demand estimates indicate that money supply is a key variable in keeping inflation under control. Atesoglu and Dutkowsky (1995) examine the process of aggregate output and price level for the period 1960-88 with annual data. Their inflation model consists of log of nominal money stock, price level and nominal interest rate. They predict a unitary elasticity between the price level and the money stock. Metin (1995) covers the period 1950-88. He investigates the inflation process by utilizing the multivariate cointegration model. Excess demand in each sector (monetary, government, goods, international and labor) is measured by the deviation from the long-run equilibrium. Long-run equilibrium in each sector is determined by using the cointegration and error correction techniques. Excess demand in government sector, public sector deficit, is pointed out to be the main factor should be utilized to keep inflation under control.

The identification of the existence of a causal relationship between the money supply and the rate of inflation continues to stimulate economic research in an increasing number of developing countries. It is usually presumed that causality is unidirectional from money supply to inflation. Sims (1972) has shown that this is valid for the United States. Williams, Goodhart and Gowland (1976) argue that Sims' results cannot be applied to other economies where the institutional structure is different from that of the United States. The issue about the direction of causation between money supply and inflation, therefore, remains contradictory.

Differences in empirical results even within the same country and across countries come from institutional differences, methodology and optimal lag length determination methods. For example, for India, Sharma (1984) detects bi-directional causality between M1 and Wholesale Price Index (WPI) and between M3 and WPI, whereas Verma and Kumar (1994) find unidirectional causality from M1 to price but not from M3 to price. Ramachandran and Kamaiah (1992) and Masih and Masih (1994) find unidirectional causality from M1 to price in India. Deme and Fayissa (1995) estimate a monetarist model of inflation using annual data covering the period 1964-93 for Egypt, Morocco and Tunisia. Their empirical findings show that there is a positive and significant relationship between money growth and inflation for Egypt and Morocco. No significant relationship is observed between money and inflation in the case of Tunisia. On the other hand, Darrat (1986) reports unidirectional causality from money to inflation in the case of three North African developing countries, Egypt, Tunisia and Morocco.

For Algeria, Beltas and Jones (1993) apply Granger method and find unidirectional causality running from narrow definition of money supply to inflation for the period 1970-88. For Bangladesh, Chowdhury, Dao and Wahid (1995) investigate the causal relationship between money, prices, output, and exchange rate for the period 1974-92. Their results indicate that exclusively the monetarist or the structuralist explanation of inflation cannot explain the inflationary process in Bangladesh. They find strong bi-directional relationship between broad money supply and inflation while a unidirectional relationship runs from inflation to narrow money supply. However, Parikh and Starmer (1988) find a unidirectional causality running from prices to money supply during the period of 1973-86, using both levels and rates of change. Jones and Sattar (1988) examine the relationship between money, prices and output using a dynamic form of the Cambridge cash-balance equation relating real balances to income. They argue that, in the short run, a feedback relationship exists between money and prices. However, they do not support the claim that inflation is a monetary phenomenon in the long run.

Most previous studies on the relationship between money and prices estimate a bivariate model raising the possibility of an omitted variable bias. The present analysis will attempt to overcome this problem by using both a bivariate model and a multivariate model. In addition to money and prices, a four variate vector autoregressive (VAR) model including two important macro variables relevant in the price determination model, namely interest rates and exchange rates, are estimated and tested to derive a more robust finding about the money-price relationship in Turkey. A theoretical basis for including the exchange rate can be found in the monetarist model. For small countries, monetarist models assume that changes in the real exchange rate are instantly and proportionately transmitted into higher domestic prices. In the monetary approach to the balance of payments, a rise in foreign price, or a devaluation of domestic currency will increase the international reserve component of domestic money supply. This causes the excess demand for money to fall and inflation to rise. Studies by Lowinger (1978) and Bahmani-Oskooee and Malixi (1992) found that devaluations are inflationary.

It is widely believed that interest rates contain useful information about the evolution of future economic variables. For example, according to the Fisher hypothesis, an increase (decrease) in the spread between the long-term interest rate and the one-period inflation rate signals an increase (decrease) in future one-period inflation. Fama (1975) finds the short-term nominal interest rate to be a good predictor of future inflation. In a series of papers, Mishkin (1990a, 1990b, and 1991) and Jorion and Mishkin (1991) investigate whether the slope of the term structure has any predictive power in forecasting future inflation. Their general finding is that at long horizons it does, whereas at short horizons it does not. Another theoretical base for incorporating the interest rate can be found in the cost-push inflation view. According to this view, interest rate belongs to firms' production costs, and where conditions of monopolistic competition prevail in the industrial structure, firms will adopt the mark-up method and increase the prices.

3. Data and Methodology

The analysis uses monthly data covering the period January 1970-June 1996. Data were obtained from International Financial Statistics, State Institute of Statistics, Turkey, and the Central Bank of Turkey. The following four variables are used: Money, price level, nominal interest rate and exchange rate.

A narrow definition of money supply (M1) is used and expressed in millions of Turkish Liras, The Consumer Price Index (CPI) is used to measure general price level, percentage change in the CPI is the measure for inflation rate, the Central Bank discount rate of Turkey is used as the interest rate, and Turkish Lira per US dollar is the exchange rate.

Specification Test

In order to determine the most appropriate functional form for this analysis of money-price causality in the bivariate and multivariate models, a specification test is applied to decide whether to use linear or log-linear model. In this study, Box-Cox (1964) test is used to test for linearity. For the bivariate model, a Box-Cox likelihood ratio test statistic (χ^2 with one degree of freedom) is calculated to be 271.78. This is greater than the critical value, 6.63, at the 1% significance level. Therefore, the null hypothesis of linearity is rejected at the 1% level. For the multivariate model, this test statistic is equal to 245.1. The critical value at the 1% significance level is 6.63. Hence, in what follows, the null hypothesis of linearity is rejected and the log-linear model for both bivarite and multivariate frameworks is used. Since causality test requires stationary time series, a stationarity test is performed to determine the order of integration of each variable. If variables are not stationary, it can lead to spurious results when the levels of the variables are used for estimation purposes. However, a set of variables, all of which are stationary only after differencing, may have linear combinations that are stationary without differencing. If this is the case, then the variables are said to be cointegrated.

Dickey-Fuller and Augmented Dickey-Fuller Tests

Before performing a cointegration test, Dickey-Fuller (1979) and augmented Dickey-Fuller tests are applied to test for stationarity and determine the order of integration of each variable. If variables are not stationary, then the differences of each variable must be taken until it becomes stationary. The unit root test is represented by the following auto-regressive structural equation:

$$\Delta X_t = \delta + (\rho - 1)X_{t-1} + \sum_{i=1}^{k} \theta_i \Delta X_{t-i} + \varepsilon_t \qquad (1)$$

where X_t is a variable, ε_t is the error term, Δ is a difference operator, and k indicates the number of differenced terms used. Including the differenced terms distinguishes the augmented Dickey-Fuller (ADF) test from the ordinary Dickey-Fuller (DF) test. The test is whether H_0: $(\rho\text{-}1) = 0$. If the calculated test is negative and significantly different from zero using the critical values calculated by Dickey and Fuller (1979), then X_t is said to be stationary. A major concern in performing a causality test is the order of lags among the variables. An arbitrary number of lags may produce misleading results (Thornton and Batten, 1985). Therefore, Akaike's (1974) information criterion (AIC) is used to determine the lag order for the augmented terms in equation (1). The unit root test is conducted for both levels and for the first differences of each series. All the variables are in the form of natural logarithms. The test results are reported in Table 1. The null hypothesis of a unit root is accepted for the level series, but rejected for the first differenced series. These results indicate that each variable is non-stationary and integrated of order (1). Therefore, vicariate and multivariate co integration tests can be conducted.

Co integration Test

If a test fails to reject the hypothesis of unit root, one can difference the series in equation before using it in a regression analysis. However, differencing may result in a loss of information about the long-run relationship between variables. The co integration test allows us to describe the existence of a stationary relationship among time series, each of which is individually non-stationary. If a set of variables, all of which are stationary only after differencing, have a linear combination that is stationary without differencing, then the variables are said to be co integrated. Since the results in Table 1 show that each variable is no stationary and integrated of order (1), a multivariate co integration test can be applied.

Table 1: Dickey-Fuller Unit-Root Testing Results

Variables	Dickey-Fuller Test Statistic	Augmented Dickey-Fuller Test Statistic	Lag Order*
Levels:			
Money Supply	1.48	4.72	6
Exchange Rate	3.29	3.20	8
Interest Rate	-1.14	-1.15	1
Inflation	-2.14	-1.87	12
First -Differenced:			
Money Supply	-27.48**	-6.19**	12
Exchange Rate	-17.06**	-5.31**	6
Interest Rate	-17.89**	12.56**	1
Inflation	-16.51**	-6.65**	11

*The lag order for the augmented terms was determined using the minimum value of Akaike's information criterion (AIC).

** The null hypothesis of a unit root is rejected at the 1 percent level of significance. The critical values for n=318 are -2.88 at the 5 percent level and -3.46 at the 1 percent level.

Engle and Granger (1987) propose a cointegration testing technique using the Dickey-Fuller (1979) unit root test. However, this technique requires prior knowledge about the cointegration vectors, which are usually unknown, and does not consider simultaneity problems caused by the use of more than one endogenous variable at the same time. In contrast, Johansen (1988) and Johansen and Juselius (1990) consider multivariate cointegration tests, which can overcome simultaneity bias. Therefore, Johansen's multivariate testing procedure is used in this study. This approach allows us to test a long-run relationship among variables that are individually nonstationary. Two multivariate cointegration tests are used: trace test and maximal eigenvalue test (Johansen, 1988 and Johansen and Juselius, 1990). The results of the cointegration tests are shown in Table 2 and 3**.**

Table 2: Cointegration Test Results (Bivariate Model)

Test	Null Hypothesis	Cointegration Test Statistic	Critical Value 1%	5%
Trace Test:	H_0: r = 0	31.87**	24.988	20.16
	H_0: r ≤ 1	7.67	12.741	9.09
Maximal Eigen value Test:				
	H_0: r = 0	24.79**	19.834	15.75
	H_0: r = 1	7.07	12.740	9.09

** Reject the null hypothesis at the 1% significance levels.

Table 3: Cointegration Test Results (Multivariate Model)

Test	Null Hypothesis	Cointegration Test Statistic	Critical Value 1%	5%
Trace Test:	H_0: r = 0	84.75**	60.05	53.34
	H_0: r ≤ 1	31.28	40.19	35.06
	H_0: r ≤ 2	6.52	24.98	20.16
	H_0: r ≤ 3	1.67	12.74	9.09
Maximal Eigenvalue Test:				
	H_0: r = 0	53.47**	33.12	28.16
	H_0: r = 1	24.75*	26.40	21.89
	H_0: r = 2	4.86	19.83	5.75
	H_0: r = 3	1.67	12.74	9.09

** Reject the null hypothesis at the 1% significance level.
*Reject the null hypothesis at the 5% significance level.

The null and alternative hypotheses for the trace test are H_0: r ≤ k and H_A: r > k where, in the present study, k = 0 or 1 for the bivariate model and k = 0, 1, 2, 3 for the multivariate model, and r is the number of cointegrating vectors. The null and alternative hypotheses for the maximal eigenvalue test are H_0: r = k and H_A: r = k+1, where (again for the present study) k = 0 or 1 for the bivariate model and k =0, 1, 2, 3 for the multivariate model. In the bivariate model, both the trace and maximal eigenvalue tests show that the null hypothesis is rejected for k = 0 and accepted for k = 1, indicating that there is one cointegrating vector at the 1 % level. In the multivariate model, according to the trace tests, the null hypothesis is again rejected for k = 0 and accepted for k = 1 at the 1 percent level. However, at the 5 percent level, the maximal eigenvalue tests show that the null hypothesis is rejected for k = 0,1 and accepted for k = 2, indicating that there are two cointegrating vectors. These findings indicate that there exists long-run relationship among the variables used.

Error Correction Model and Granger Causality Test

If two variables are cointrgrated, then there exists an error correction model (ECM) for the variables in which an error-correction term represents deviations from a long-run equilibrium relationship, while short-run dynamics are represented by lagged difference terms (Engle and Granger, 1987). Consider the case of two variables, X_t and Y_t. In order to see that X_t and Y_t are both I (1), a unit root test is conducted. If X_t is I(1), Y_t is I(1), and $Z_t = Y_t - \beta X_t$ is I(0), then X_t and Y_t are said to be cointegrated. The Granger representation theorem says that X_t and Y_t can be generated by ECM, of the form:

$$\Delta X_t = \rho_1 Z_{t-1} + \text{lagged } (\Delta X_t, \Delta Y_t) + \varepsilon_{1t}$$
$$\Delta Y_t = \rho_2 Z_{t-1} + \text{lagged } (\Delta X_t, \Delta Y_t) + \varepsilon_{2t}$$

where at least one of ρ_1 and ρ_2 is nonzero, ε_{1t} and ε_{2t} are the white-noise error terms, and Δ is a difference operator. In this study, the ECM for the bivariate model is represented as follows:

$$\Delta(\ln M_t) = \beta_0 + \beta_1 e_{t-1} + \sum_{i=1}^{q} \beta_{2i} \Delta(\ln M_{t-i}) + \sum_{i=1}^{q} \beta_{3i} \Delta(\ln \dot{P}_{t-i}) + \eta_{2t} \quad (2)$$

$$\Delta(\ln \dot{P}_t) = \alpha_0 + \alpha_1 e_{t-1} + \sum_{i=1}^{p} \alpha_{2i} \Delta(\ln \dot{P}_{t-i}) + \sum_{i=1}^{p} \alpha_{3i} \Delta(\ln M_{t-i}) + \eta_{1t} \quad (3)$$

Since there is also at least one cointegrating vector in the multivariate model, ECM is represented by the following two equations:

$$\Delta(\ln \dot{P} t) = \alpha_0 + \alpha_1\omega_{t-1} + \sum_{i=1}^{p}\alpha_{2i}\Delta(\ln \dot{P}_{t-i}) + \sum_{i=1}^{p}\alpha_{3i}\Delta(\ln M_{t-i}) + \sum_{i=1}^{p}\alpha_{4i}\Delta(\ln E_{t-i}) + \sum_{i=1}^{p}\alpha_{5i}\Delta(\ln R_{t-i}) + \varepsilon_{1t} \quad (4)$$

$$\Delta(\ln M_t) = \beta_0 + \beta_1\omega_{t-1} + \sum_{i=1}^{q}\beta_{2i}\Delta(\ln M_{t-i}) + \sum_{i=1}^{q}\beta_{3i}\Delta(\ln \dot{P}_{t-i}) + \sum_{i=1}^{q}\beta_{4i}\Delta(\ln E_{t-i}) + \sum_{i=1}^{q}\beta_{5i}\Delta(\ln R_{t-i}) + \varepsilon_{2t} \quad (5)$$

where M = narrow money supply (M1); P = inflation; R = interest rate; E = exchange rate (TL/USD); $e_{t-1} = \ln P_{t-1} - \delta^e(\ln Mt_{-1})$, where δ^e is the least squares estimate of the parameter in the equation: $\ln P_t = \delta \ln M_t + \varepsilon_t$; $\omega_{t-1} = \ln P_{t-1} - \delta^e \ln M_{t-1} - \alpha^e \ln Et_{-1} - \beta^e \ln R_{t-1}$ where δ^e, α^e and β^e are the least squares estimates of the parameters in the equation: $\ln P_t = \delta \ln M_t + \alpha \ln E_t + \beta \ln R_t + \nu_t$. The AIC was used to determine the optimal lag length. Equation (2), (3), (4) and (5) are estimated with various lag lengths for p and $q \leq 12$, and found that p = 12 and q = 12 give the minimum of AIC for the bivariate model. In the multivariate framework, p = 7 and q = 9 minimize the AIC.

The definition of causality used in this study is that given by Granger (1969). In the Granger sense, money causes inflation if, and only if, inflation is better predicted when the history of money supply is employed. Consequently, if money causes inflation but inflation doesn't cause money, then unidirectional causality is established running from money to inflation. In cases where it is found that money doesn't cause inflation and inflation doesn't cause money, it is said that money and inflation are either statistically independent or related contemporaneously. Finally, if money causes inflation and inflation causes money, then feedback relationship exists between money and inflation.

There are two main reasons for selecting this procedure. First, this procedure is superior to other test procedures (Guilkey and Salemi, 1982). Second, by following the same test procedure, the updated results can be readily compared with the original results and economic inferences can be made. The test itself involves OLS estimation of the equation (2), (3), (4) and (5). The test of the null hypothesis that money doesn't cause inflation is the test that $\alpha_{3i} = 0$ for i = 1, 2, . . .p. The test of the null hypothesis that inflation doesn't cause money is the test that $\beta_{3i} = 0$ for i = 1, 2, 3, …q. Equation (2), (3), (4), and (5) are estimated in both restricted and unrestricted forms. The test of no causality is based on the following F-statistic:

$$F = [(ESS_R - ESS_U) / k] / [ESS_U / (n-(2k+2))]$$

where, ESS_U and ESS_R are the error sum of squares from the unrestricted and restricted regressions, n is the number of observations, and k indicates the number of lags (number of restrictions). To test the hypothesis that money doesn't cause inflation, the F-statistic is estimated while the roles of money and inflation are reversed. The equations are estimated in the log form as indicated by the Box-Cox specification test.

Causality Testing Results

Granger causality testing results are shown in Table 4 and 5. At the 10% significance level, there is a feedback relationship between the money supply (M1) and inflation rate for p = 12 and q = 12 in the bivariate framework. In the multivariate model consisting of price, money, nominal interest rates and exchange rates, the feedback relationship exists at the 5% level. However, empirical findings indicate that the causality from inflation to money supply is much stronger than the causality from money supply to inflation both in the bivariate and multivariate model.

Table 4: Granger Causality Test Results (Bivariate model)

Null Hypothesis	Number of lags	F-Statistic	Critical Value 5%	10%
H_0: Money doesn't cause inflation	12	1.68†	1.75	1.55
H_0: Inflation doesn't cause money	12	6.09**	1.75	1.55

** Reject the null at the 1% level. †Reject the null at the 10% level.

Table 5: Granger Causality Test Results (Multivariate Model)

Null hypothesis	Number of Lags	F-Statistic	Critical Value 5%	1%
H_0: Money doesn't cause inflation	7	2.18*	2.03	2.69
H_0: Inflation doesn't cause money	9	4.21**	1.90	2.46

* Reject the null at the 5% significance level. ** Reject the null at the 1% level.

Since the main purpose of this paper is to test for causality between the money supply and inflation, the percent change in the CPI is used to measure inflation. In order to provide more light on the money-price nexus and show how the empirical results are sensitive to the structure of series used, the present paper also investigates the causal relationship between the money supply and price level (CPI). For the purpose of comparison, the empirical results of the cointegration and Granger causality tests in which the inflation rate is replaced with CPI are shown in Tables 6, 7, 8 and 9.

Table 6: Cointegration Test Results (Bivariate Model)♣

Test	Null Hypothesis	Cointegration Test Statistic	Critical Value 1%	5%
Trace Test:	H_0: r = 0	46.89**	24.99	20.17
	H_0: r ≤ 1	7.08	12.74	9.09
Maximal Eigenvalue Test:				
	H_0: r = 0	39.68**	19.83	15.75
	H_0: r = 1	7.08	12.74	9.09

**Reject the null at the 1% significance level. ♣ The CPI replaced the inflation rate.

Table 7: Cointegration Test Results (Multivariate Model)♣

Test	Null Hypothesis	Cointegration Test Statistic	Critical Value 1%	5%
Trace Test:	H_0: r = 0	87.35**	60.05	53.35
	H_0: r ≤ 1	43.03**	40.19	35.07
	H_0: r ≤ 2	6.72	24.98	20.17
	H_0: r ≤ 3	0.70	12.74	9.09
Maximal Eigenvalue Test:				
	H_0: r = 0	44.32**	33.12	28.16
	H_0: r = 1	36.31**	26.40	21.89
	H_0: r = 2	6.02	19.83	15.75
	H_0: r = 3	0.70	12.74	9.09

** Reject the null hypothesis at the 1% significance level.♣ The CPI replaced the inflation rate.

In the bivariate model, both the trace and maximal eigenvalue tests show that the null hypothesis is rejected for k = 0 and accepted for k = 1, indicating that there is one cointegrating vector at the 1% level. In the multivariate model, both the trace test and the maximal eigenvalue test show that the null hypothesis is rejected for k = 0, 1 and accepted for k = 2, indicating that there are two cointegrating vectors at the 1% significance level. These findings indicate that there exists long-run relationship among the variables used. However, using the CPI improved the significance of cointegration among the variables.

Granger causality testing results are shown in Table 8 and 9. In the bivariate model, unlike the feedback relationship between the money supply and inflation, unidirectional causality from money supply to price is detected at the 1% level for p = 7 and q = 3. This finding supports the monetarist view of inflation. In the multivariate model consisting of price level, money supply, nominal interest rates and exchange rates, the feedback relationship exists at the 1 percent level. However, the significance level of causality from money supply to price level, 1%, is higher than the significance level of causality from money supply to inflation, 5%, in the multivariate model.

Table 8: Granger Causality Test Results (Bivariate model)♣

Null Hypothesis	Number of lags	F-Statistic	Critical Value 5%	1%
H_0: Money doesn't cause price level	l7	2.83**	2.03	2.69
H_0: Price level doesn't cause money	3	1.78	2.60	3.78

** Reject the null hypothesis at the 1% level. ♣ The CPI replaced the inflation rate.

Table 9: Granger Causality Test Results (Multivariate Model)♣

Null hypothesis	Number of Lags	F-Statistic	Critical Value 5%	1%
H_0: Money doesn't cause price level	8	4.03**	1.94	2.51
H_0: Price level doesn't cause money	11	4.16**	1.80	2.25

** Reject the null at the 1% significance level. ♣ The CPI replaced the inflation rate.

4. Conclusion

The main purpose of this study is to re-examine the causal relationship between the money supply and inflation in the context of Turkish economy. For this purpose, Cointegration and Error Correction models are applied to monthly data covering the period of 1970–1996. In order to obtain results that are more robust and avoid the omitted variable bias, nominal interest rates and exchange rates are added to the bivariate model. The empirical results provide mixed support for the monetarists' view of inflation in the case of Turkish economy. Unlike the previous studies on Turkey, the present study finds bidirectional causality between the money supply and inflation in the bivariate and multivariate models. The growth of money supply fuels inflation, which, in turn, leads to increases in the money supply. Because of sample evidence, it is also found that the causality from inflation to money supply is much stronger than the causality from money supply to inflation both in the bivariate and multivariate model. Because of this feedback relationship, the stock of money becomes less effective as a control variable. It is also found that including the exchange and interest rates improves the significance of causality from money supply to inflation. This indicates that exchange rates and interest rates together account for a significant portion of fluctuations in Turkish inflation.

In order to provide more light on the money-price nexus and show how the empirical results are sensitive to the structure of series used, the present study also investigates the causal link between the money supply and price level (CPI). For this, the inflation rate was replaced with the CPI. In the bivariate model, unidirectional causality from money supply to price level is found at the 1% level, supporting the monetarist view of inflation for the case of Turkey. Moreover, causality from money supply to price level is highly significant at the 1% level compared to causality running from money supply to inflation rate (10%). In the multivariate framework, on the other hand, there exists a feedback relationship at the 1% level. Finally, the results also show that exchange rates and interest rates played an important role during the period of high and persistent inflation in Turkey.

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