The Nexus between Monetary Variables and Economic Growth under Inflation Targeting Regime: Empirical Evidence from Turkey

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Abstract

The aim of this paper is to analyze the nexus between monetary variables and economic growth in Turkey under inflation targeting regime. The cointegration analysis and error correction model are used to test the long-run relationship and short-run effects respectively. Then, Granger causality test is done to determine the direction of causality between the monetary variables and economic growth. The cointegration analysis shows that there is a long-run relationship between all the variables. However, none of the monetary variables has significant effects on the economic growth in the long run. This result could be interpreted as inflation targeting regime is neutral in the long run. The error correction model supports the long-run relationship between the variables and the variables return to their long-run values in a high speed of adjustment. There is unidirectional causality from economic growth to money supply. As real economy grows, increasing demand for money leads to increase of money supply in the economy.

Keywords*:* Monetary policy, inflation targeting, economic growth, cointegration, error correction model
JEL classification numbers: E52, O11, C32

I. Introduction

The major determinants of long-run economic growth are capital stock, labor supply, and technology. Besides, many other factors affect long-run economic growth, but most of these factors lie outside the sphere of monetary policy (Barro and Sala-i-Martin, 2004 and Smith, 2004). Chirwa and Adhiambo (2016) states that the determinants of economic growth show differences depending on whether the country is developed or developing country. Chirwa and Odhiambo (2016) reveals that for developing countries the key macroeconomic determinants of economic growth based on the order of their importance include exogenous factors (foreign aid, foreign direct investment), fiscal policy, trade, physical capital, human capital, demographics, monetary policy, natural resources and geographic, regional, political and financial factors. For developed countries, the key macroeconomic determinants are associated significantly with economic growth are physical capital, fiscal policy, human capital, trade, demographics, monetary policy as well as financial and technological factors. So, it is possible to say that monetary policy may have only limited capacity to economic growth over the longer term for both developed and developing countries. However, keeping inflation low and stable may make a positive contribution to long-run economic growth, and that this may be the most effective contribution that monetary policy can make to the economy's performance over time (Smith, 2004).

The inflation-targeting regime is widely used monetary policy regime in both developed and developing economies. In the inflation-targeting regime, the central bank targets an inflation rate for a certain period with the aim of price stability and makes its target open to public. Inflation targeting regime may target explicit numerical inflation target or an implicit inflation target. The inflation-targeting regime firstly used by New Zealand in 1991. The main factors that differentiate the inflation-targeting regime from other monetary policy regimes are that the central banks implementing an inflation-targeting regime announce their inflation targets numerically and commit themselves to achieving these targets and are

accountable to the public in case targets are not attained. Secondly, as monetary policy decisions effect on the economy with a time lag, central banks control future inflation rather than current inflation. Therefore, they develop inflation forecasts periodically and make them public. For that reason, the inflation-targeting regime is frequently called "inflation forecast targeting" (CBRT, 2005). As Fontana and Palacio-Vera (2007) states that inflation targeting, namely aggregate demand fine-tuning through interest rate management with a view to hitting inflation targets, do not affect unemployment, output or any other real variable in the long-run. The inflation-targeting regime can achieve modest short-run output stabilization and long-run price stability.

The Central Bank of Republic of Turkey (CBRT) started to implement "implicit inflation targeting regime" in 2002 taking into consideration expected inflation rates in the future (Pınar and Erdal, 2016). The expected inflation rate was determined together with the Government. The CBRT started to implement "explicit inflation targeting regime" in 2006. The primary objective of the CBRT is to achieve and maintain price stability (CBRT, 2005). The Article 4 of the CBRT Law states that "The Bank shall, provided that it shall not conflict with the objective of maintaining price stability, support the growth and employment policies of the Government". Low inflation rate is among the prerequisites of achieving long-term economic objectives. Therefore, the major contribution of the CBRT to policies aiming at economic growth and employment would be to maintain price stability. The price stability helps economic agents make well-informed decisions, thereby enhancing the efficient allocation of resources. In addition, low inflation rates due to reduction in inflation risk premium reduce real interest rates that would support real investment decisions positively.

However, the nexus between monetary variables and economic growth remains inconclusive in the economic literature. There are extensive empirical works about the effect of monetary policy on economic growth. However, these empirical studies do not have a common consensus about this issue. Twinoburyo and Odhiambo (2018) give both theoretical and empirical literature survey about the relationship between monetary policy and economic growth. Besides, Chirwa and Odhiambo (2016) give a review of international literature on macroeconomic determinants of economic growth. Chirwa and Odhiambo (2016) states that monetary policy supports economic growth mainly in financially developed economies with fairly independent central banks. The relationship tends to be weaker in developing economies with structural weaknesses and underdeveloped financial markets. Chirwa and Odhiambo (2016) conclude that monetary policy matters for growth both in the short-run and in long run despite the prevailing ambiguous relationship.

The recent empirical studies about the monetary policy and economic growth relationship give different results. Some of these studies are summarized as follows: Ufoeze, Odimgbe, Ezeabalisi and Alajekwu (2018) shows that around 98 percent of the changes in economic growth can be explained by the monetary policy and monetary policy can be used effectively to control the Nigerian economy during the period 1986 to 2016. Njimanted, Akume and Mukete (2016) shows that the monetary variables inflation rate and lending rate have substantial destabilizing effects on the economic growth that imply monetary authorities should play a critical role in creating and enabling environment for growth in Central African Economic and Monetary Community (CEMAC) zone for the period 1981 to 2015. Ahmad, Afzal and Ghani (2016) shows that monetary policy measures that control inflation and favorable interest rates stimulate economic growth in Pakistan in between 1973 and 2014. Alavinasab (2016) finds that economic growth is influenced from money supply, exchange rate and inflation rate in the long run in İran over the period 1971 to 2011. Sulaiman and

Migiro (2014) shows that while monetary policy has significant influence on economic growth, economic growth is not linked to monetary policy in Nigeria from 1981 to 2012. Hussain and Hoang (2014) finds that fiscal policy has more powerful effects on output that the monetary policy in 12 Asian economies for the period 1974 to 2007. Soufan (2013) states that there is a causal relationship from money supply to GDP, but not vice versa in Jordan during the period 1978 to 2010. Lashkary and Kashani (2011) shows that there is no significant relationship between the money volume and real economic variables, production and employment as well as monetary policies are neutral in İran between 1959 and 2008. Regarding Turkey, Fry (1980) examines the effects of monetary policy instruments on inflation rate and economic growth over the period 1950 to 1970 in Turkey. Fry (1980) finds that both money supply and deposit interest rate affect the inflation rate and economic growth, but monetary policy that uses the deposit interest rate actively superior to monetary policy that only controls the nominal money supply.

The aim of this study is to analyze the relationship between monetary variables and economic growth under inflation targeting regime in Turkey. The question is "Does the inflation targeting regime support the economic growth in the long-run?" If so, "Which of the monetary variables have significant effects on economic growth in the long-run and in the short-run and?" and "What is the direction of causality between monetary variables and economic growth?" To the best of my knowledge, there is no empirical study that examines the nexus between monetary variables and economic growth under inflation targeting regime in Turkey. The monetary variables are the ratio of money supply to Gross Domestic Product (GDP), inflation rate, central bank policy rate and real exchange rate. In this framework, the structure of the study is organized as follows: The second part gives theoretical framework of the study. In the third part, methodology of study and data description and data sources are explained. In the fourth part, empirical results of the study are presented and discussed. The last part concludes the study.

II. Theoretical Framework

In the theoretical part of the study, a modified Solow model is used to see the effects of additional growth enhancing shift variables (Bhaskara, 2006). The production function can be written as follows:

$$Y_t = A_o\, e^{(g_1 + g_2 Z)t}\, K_t^{\beta}\, L_t^{1-\beta} \qquad (1)$$

where "Yt" is output, "A_o" is the initial stock of knowledge, "K_t" is physical capital, "L_t" is labor, "g" is assumed a function of growth promoting shift variable "Z" and is also some unknown trended variables proxied with time. Therefore, the "Z" variable could be openness, foreign aid etc., or a vector of some growth improving variables. Let's take logarithm of both sides of equation. Therefore, the suggestions of this modification are as follows:

$$\ln Y_t = \ln A_o + (g_1 + g_2 Z_t)t + \beta \ln K_t + (1-\beta)\ln L_t \qquad (2)$$

$$\Delta \ln Y_t = [g_1 + g_2 (\Delta Z_t\ t + Z_t)] + \beta \Delta \ln K_t + (1-\beta)\Delta \ln L_t \qquad (3)$$

$$\Delta \ln y_t = [g_1 + g_2 (\Delta Z_t\ t + Z)] + \beta \Delta \ln k_t \qquad (4)$$

$$\Delta \ln y^* = g_1 + g_2 Z \quad \text{as } \Delta \ln k_t \text{ and } \Delta Z \gg 0 \qquad (5)$$

If Z is trade openness, economic growth rate will be higher in economies that are more open in the long-run equilibrium. Let's now consider non-linear form of this equation:

$$Y_t = A_o\, e^{(\beta_1 \frac{\beta 2}{Z})t}\, K_t^{\beta}\, L_t^{1-\beta} \qquad (6)$$

In equation (6), if Z is research and development expenditures, the economic growth rate will not perpetually increase with ever-increasing research and development expenditures. Therefore, it would be useful to use non-linear specification to see the effects of monetary variables on economic growth. Then, to examine the effects of monetary variables on economic growth the following equation is constructed:

$$GROWTHRATEOFREALGDP_t = B_o + B_1 M2/GDP_t + B_2\, INFLATION_t + B_3 CBPOLICYRATE_t + B_4\, REALEXCHANGERATE_t + u_t$$

The dependent variable is the growth rate of real GDP. The independent variables and expected signs of the coefficients can be described as follows:

$M2/GDP_t$ is the ratio of money supply (M2) to GDP at time t. This variable shows the monetization ratio in the economy. The degree of an economy's monetization may have important implications on economic growth and can be affected by the conduct of monetary policy, financial sector reforms and financial crises. The sign of the coefficient is expected to be positive.

$INFLATION_t$ is the inflation rate at time t. Inflation rate is the rate of change in general price level. High inflation rates increase uncertainty about future price levels. This uncertainty may deter investment decisions of the firms. So, the sign of the coefficient is expected to be negative. On the other hand, it is also argued that moderate inflation may increase investment, and thereby economic growth. A small increase in output prices stimulates producers to increase their production or production capacity. This increase in inflation rate may lead to higher economic growth. So, the sign of the coefficient is an empirical issue.

$CBPOLICYRATE_t$ is the central bank policy interest rate at time t. Under inflation targeting regime, the central bank policy rate is used as a monetary policy tool. The level of central bank policy rate has direct effects on the level of both deposit and credit interest rates. As the central bank policy rate increases, both demand and deposit interest rates increase. Since, an increase of interest rates leads to decrease of investment, economic growth decreases. So, the sign of the coefficient is expected to be negative.

$REALEXCHRATE_t$ is nominal exchange rate deflated by inflation at time t. The sign of the coefficient is expected to be positive. An increase in exchange rate shows depreciation of domestic currency and export volume should increase, import volume should decrease and net exports should increase. An increase in net exports leads do increase of growth rate of real GDP. However, in this study, real effective exchange rates based on manufacturing unit labor cost for Turkey are used. So, an increase in real exchange rate shows appreciation of Turkish lira, then exports should decrease, imports should increase and net exports should decrease. This outcome may lead to decrease of growth rate of real GDP. So, the sign of the coefficient is expected to be negative.

III. Research Method, Data Description and Data Sources

In the empirical part of the study, the relationship between the monetary variables and growth rate of real GDP is analyzed in Turkey under inflation targeting regime. The Johansen cointegration test is done if there is a long-term relationship between the variables and Error Correction Model (ECM) is estimated to see if there is short-term adjustment to return to

long-run values. Then, Granger causality test is done to determine the direction of causality between the growth rate of real GDP and monetary variables. The data used in the empirical part is quarterly and covers the period from first quarter 2001 to fourth quarter 2013. The estimation equation is as follows:

$$GROWTHRATEOFREALGDP_t = B_o + B_1 M2/GDP_t + B_2\, INFLATION_t + B_3 CBPOLICYRATE_t + B_4\, REALEXCHANGERATE_t + u_t$$

In this equation, growth rate of real GDP and M2/GDP are in levels, because they are in the ratio form. The variables inflation rate, central bank policy rate and real exchange rate are in logarithmic forms.

The dependent variable is the growth rate of real GDP. Real GDP is calculated as nominal GDP divided by Consumer Price Index (CPI). Source: International Financial Statistics (IFS) of the International Monetary Fund (IMF). The construction of independent variables and their data sources can be described as follows:

M2/GDP: The ratio of M2 to GDP. Source: M2 data is taken from the Federal Reserve Bank of St. Louis Economic Data (FREDII). The GDP data is taken from the IFS of the IMF.

INFLATION: Inflation rate is the annual percentage change of Consumer Price Index (CPI) (2003 = 100). Source: Turkish Statistical Institute.

CBPOLICYRATE: The overnight borrowing rate was used as monetary policy rate by the central bank. However, since 20 May 2010, the one week lending repo rate has been using as the central bank policy rate. Source: IFS of the IMF.

REALEXCHANGERATE: Real effective exchange rate based on manufacturing unit labor cost for Turkey (Index 2010=1), not seasonally adjusted. Source: Federal Reserve Bank of St. Louis Economic Data (FREDII).

IV. Empirical Results

The cointegration analysis is done using the variables that are integrated in the same order and causality test is done using stationary variables. Therefore, firstly, all the variables are tested whether they have a unit root. The E-views econometric program is used in the empirical analysis.

IV.1 Unit Root Test

Each of the variable is tested using Augmented Dickey Fuller (ADF) test whether the variable has a unit root. The ADF test consists of regressing each series on its lagged value and lagged difference terms (Dickey and Fuller, 1981). The ADF test results are shown in Table 1. The ADF test results show that the growth rate of real GDP, M2/GDP, inflation rate, central bank policy rate and real exchange rate have a unit root at their levels. Then, first differences of these variables are taken and ADF test is done again. Now, the test results show that the first differences of the variables have no unit root. This means that these variables are not integrated of order (0) and integrated of order (1).

Table 1. ADF Unit Root Test Results

Variable Name	Level	First Difference	Second Difference
GROWTHRATEOFREALGDP	-2.81***	-2.94**	-8.96*
M2/GDP	-0.39	-2.67***	- 6.23*

INFLATION	-1.50	-2.93**	-7.28*
CBPOLICYRATE	-1.43	-5.95*	-
REALEXCHANGERATE	-2.10	-2.10*	-

Note:"*" shows that the variable is stationary at 1 %, "**" shows that the variable is stationary at 5 % and "***" shows that the variable is stationary at 10%. McKinnon critical values: for total: -3.56 for 1%, -2.91 for 5%, -2.59 for 10%.

IV.2 Cointegration Analysis

The cointegration analysis is done using the Johansen test statistics Trace and maximum Eigenvalue (Engel and Granger, 1987). The cointegration test results for growth rate of real GDP and monetary variables; M2/GDP, inflation, central bank policy rate and real exchange rate are presented in Table 2. The test results show that cointegration exists between the variables. The existence of cointegration between variables means that there is a long-run relationship between growth rate of real GDP, M2/GDP, inflation rate, central bank policy rate and real exchange rate.

Table 2. Cointegration Test Results

	Trace	**Statistic**		
All the variables	Eigenvalue	Trace Statistic	0.05 Critical Value	Probability***
None*	0.53	82.10	69.81	0.00
At most 1**	0.36	42.72	47.85	0.13
At most 2	0.17	19.83	29.79	0.43
At most 3	0.14	9.77	15.49	0.29
At most 4	0.03	1.60	3.84	0.20
	Max-Eigen	**Statistic**		
All the variables	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Probability***
None*	0.53	39.37	33.87	0.01
At most 1*	0.36	22.89	27.58	0.17
At most 2**	0.17	10.05	21.13	0.73
At most 3	0.14	8.17	14.26	0.36
At most 4	0.03	1.60	3.84	0.20

* denotes rejection of the hypothesis at the 0.05 level
** Max-eigenvalue test indicates 1 cointegrating equation at the 0.05 level
*** MacKinnon-Haug-Michelis (1999) p-values

The estimation of long-run (cointegrating) relationship for growth rate of real GDP, M2/GDP, inflation rate, central bank policy rate and real exchange rate are presented in Table 3. As can be seen in Table 3, the monetary variables do not have statistically significant effects on growth rate of real GDP in the end. This result could be interpreted as monetary policy is neutral in the end in Turkey. In other words, the inflation-targeting regime has no effects on economic growth in the end. Fontana and Palacio-Vera (2007) states that inflation

targeting approach rests on the principle of neutrality of monetary policy in the long run. Monetary policy does not have any long-run effects on output and employment. The estimation results of cointegration relationship or long-run relationship of this study supports the results of Fontana and Palacio-Vera (2007).

Table 3: Estimation of Long-Run Relationship

Dependent variable: GROWTHRATEOFREALGDP	
Independent Variables	**Coefficient**
M2/GDP	-0.01 (0.74)
INFLATION	0.021 (0.99)
CBPOLICYRATE	0.004 (0.25)
REALEXCHANGERATE	0.136 (1.23)

Note: "**" shows that the variable is significant at 5 % level. The values in the parenthesis is t-statistics. T- statistics table value (51, 0.05) = 1.6775.

IV.3 Error Correction Model

As a third step, the Error Correction Model (ECM) is estimated. The long-run relationship will be supported if the coefficient of the lag of the error correction model (ECM_{t-1}) carries a negative and statistically significant coefficient. Besides, the coefficient of ECM_{t-1} represents the proportion of disequilibrium in the variables in one period corrected in the next period. To do the ECM estimation, three period lags of the independent variables are included in the regression and it is estimated. The statistically insignificant variables are dropped from the regression, the statistically significant ones are kept in the regression, and it is re-estimated. The residual of estimated equation is saved as ECM. Then, the regression using first difference of both dependent and independent variables and the lag of the ECM (i.e., ECM_{t-1}) are estimated.

The estimation results of this regression in other words, the estimation of the ECM are given in Table 4. As can be seen in Table 4, the coefficient of ECM_{t-1} is negative and statistically significant in the regression that shows the long-run relationship between monetary variables and economic growth are supported. The value of the ECM_{t-1} coefficient shows that the short-run dynamic converges to its long-run cointegrating relationship with a high speed of adjustment. Besides, the coefficient of money supply ratio has a positive sign and statistically significant and the coefficient of central bank policy rate has a negative sign and statistically significant in the short-run. This result could be interpreted as money supply increases have positive and central bank policy rate has negative effects on economic growth in the short-run as expected.

Table 4: Error Correction Model Estimation Results

Dependent variable: Δ GROWTH RATEOFREAL GDP	
Independent Variables	**Coefficient**
Δ $M2/GDP_{t-1}$	0.19** (5.74)
Δ $INFLATION_{t-1}$	0.01 (0.28)

Δ CBPOLICYRATE	-0.09** (-1.97)
Δ REALEXCHANGERATE	-0.11 (-0.63)
ECM $_{t-1}$	-1.36** (-11.42)
R^2	0.77
DW statistic	2.35

Note: "Δ " shows the first difference of the variable. "**" shows that the variable is significant at 5 % level. The values in the parenthesis are t-statistics.

IV.4 Granger Causality Test

Granger causality test is done to see the direction of causality between the variables (Granger, 1969). Since Granger causality test is done using stationary variables, first differences of the variables are used in the causality test. In the Granger causality test, the lag length criteria is determined using Likelihood Ratio (LR) test statistic, Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz Information Criterion (SC) and Hannan-Quinn Information Criterion (HQ). Since the most accepted lag lengths by these tests is three, the lag length is taken as three in the test. Granger causality test results (i.e., F-statistic values) are presented in Table 5. As can be seen in Table 5, there is unidirectional causality from the growth rate of real GDP to the ratio of money supply to GDP.

Table 5: Granger Causality Test Results

Pairwise Granger Causality Tests	F-Statistic
ΔM2/GDP does not Granger cause ΔGROWTHRATEOFREALGDP	2.84
ΔGROWTHRATEOFREALGDP does not Granger cause ΔM2/GDP	9.17*
ΔINFLATION does not Granger cause ΔGROWTHRATEOFREALGDP	1.85
ΔGROWTHRATEOFREALGDP does not Granger cause ΔINFLATION	0.62
ΔCBPOLICYRATE does not Granger cause ΔGROWTHRATEOFREALGDP	1.15
ΔGROWTHRATEOFREALGDP does not Granger cause ΔCBPOLICYRATE	1.85
ΔREALEXCHANGERATE does not Granger cause ΔGROWTHRATEOFREALGDP	2.01
ΔGROWTHRATEOFREALGDP does not Granger cause ΔREALEXCHANGERATE	0.96

Not: "Δ " shows the first difference of the variable. F statistic table value (1, 51): 4.04. "*" shows that the value is greater than the F statistic table value.

In other words, this test result shows that there is a unidirectional causality from the growth rate of real GDP to monetization ratio of the economy. As the real economy grows, increasing demand for money leads to increase of money supply in the economy. On the other hand, any causality does not found between the growth rate of real GDP and inflation rate, central bank policy rate and real exchange rate.

V. Conclusion

This paper analyzed empirically the nexus between monetary variables and economic growth in the end and short-run as well as causality between monetary variables and economic growth under inflation targeting regime. The monetary variables are the ratio of money supply to GDP, inflation rate, central bank policy rate and real exchange rate. The empirical results indicate the existence of cointegration between monetary variables and economic growth. This means that there is a long-run relationship between the growth rate of real GDP and monetary variables. However, none of the monetary variables has significant effects on the economic growth in the long run. This result could be interpreted as inflation targeting regime is neutral in the long run in Turkey. Fontana and Vera (2007) also mentions that inflation targets do not affect unemployment, output or any other real variable in the long run. Besides, Bollard (2005) states that inflation-targeting regime contributed to better economic

performance in New Zealand, but it remains only a small part of determinants of economic growth. The long-run per capita growth mostly depends on physical and human capital together with the efficiently use of physical and human capital.

The ECM estimation results show that the short-run dynamics converge to their long-run values with a high speed of adjustment. Granger causality test shows that there a unidirectional causality from economic growth to money supply ratio. As the real economy grows, an increasing demand for money may lead to expansion of money supply in the economy. On the other hand, no causality is found between economic growth and other monetary variables.

Consequently, it could be said that inflation targeting regime has no effect on economic growth in the long run. In other words, inflation targeting regime is neutral in the long run. Nevertheless, this does not mean that inflation targeting regime has no contribution to economic growth in the long-run. The inflation targeting regime may make a positive contribution to long-run economic growth by maintaining price stability. This may be the most effective contribution that monetary policy can make to the economy's performance over time. On the other hand, the policy makers should develop fiscal policies and supply policies to increase and maintain physical and human capital as well as to develop technological progress in order to efficiently use physical and human capital. Ffurther research could be to examine how other economic policies such as fiscal policy could affect economic growth.

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