Inflation Dynamics and Monetary Transmission in Turkey in the Inflation Targeting Regime

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Abstract: This study aims to analyse the determinants of inflation and the effectiveness of the monetary transmission in Turkey. The study is covering the period 2003:Q2-2015:Q3 which consists of just an inflation targeting time before 2008, and inflation and financial stability targeting time after 2008 global financial crises. The autoregressive distributed lag model (ARDL) bound test is used for the long-run relationship and a VAR analysis for the short-run dynamics. The cointegration results reveal that the credit growth, US/TL exchange rate, real effective exchange rate, interest rate, and imported inflation are the determinants of inflation in Turkey in the long run. Also, our empirical findings indicate that exchange rate is the most effective factor in inflation. According to the VAR model's impulse responses, the key drivers of inflation are the movements in the US/TL nominal effective exchange rate, real effective exchange rate, interest rate, GDP growth in the short-term, and credit growth is in the medium-term. ARDL cointegration and impulse responses also show that interest rate and credit growth are efficient instruments as a monetary policy for the inflation targeting and financial stability.

Keywords: Inflation, Monetary Transmission, Cointegration, VAR Model.

INTRODUCTION

After the deep crisis of February 2001, Turkey has involved the transition to inflation targeting (IT), and the floating exchange rate regime coupled with the structural reforms aimed at overcoming the crisis and having economic stability. In this regard, implicit inflation targeting regime (IIT) was implemented between 2002 and 2005 in Turkey, and full-fledged (IT) after 2006. At the beginning of the inflation targeting process, Turkey exhibited a high exchange rate pass-through, asset and liability dollarization, fiscal dominance, imperfect financial markets, import dependency. Additionally, Turkey suffered a political instability and insufficient institutional development like all small open emerging market economies (Kara 2006; Arı *et al*. 2013; Başçı Özel and Sarıkaya 2007; Us 2004; Frankel 2010).

The main policy instrument of inflation targeters is short-term interest rates and also long-term interest rate in conjunction with the short-term interest rate. Short-term interest rate effects on aggregate demand and manages expectation related to the linkage of long-term interest rate. As Woodford (1999), Rotemberg and Woodford (1998) imply that aggregate demand has a stronger relationship with long term rates than short-term rates. To interrelate between short term and long term interest rates, monetary transmission mechanism needs to be effective. However, the small open economy context complicates the interest rate channel beyond that observed in some conventional mechanisms. It means that the credit and aggregate demand channels may not react accurately to a change in interest rates because of exchange rate pass-through effect on economic growth, and inflation is driven by the direction and magnitude of capital flows (Başçı, Özel and Sarıkaya 2007).

During 2003-2008, weakened fiscal dominance, dollarization[1], and diminished exchange rate pass-through to prices, enhanced the impact of policy interest rate changes on economic activity. So, inflation became more predictable and improved the transmission capacity of monetary policy (Mohanty and Turner 2008, Akyürek, Kutan and Yılmazkuday 2011; Başçı Özel and Sarıkaya 2007; Dedeoglu and Kaya 2014; Kara and Öğünç 2005; Kara 2006; Kara *et al.*2007; Özcan and Us 2009). Following the global crisis in 2008, the central bank of Turkey has begun to target financial stability as well as inflation targeting. In this process, the exchange rate and the credit channel have started to be used effectively as well as the interest rate tool, to control the short-term capital inflows and current account.

Although inflation targeting showed favorable results as in Figure **1**, inflation is still a concern for both

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[1]Özcan and Us (2009) suggest that both the asset dollarization and the liability dollarization ratios fell significantly; however the economic stabilization led to more external funding opportunities for banks, as indicated by higher offshore dollarization.

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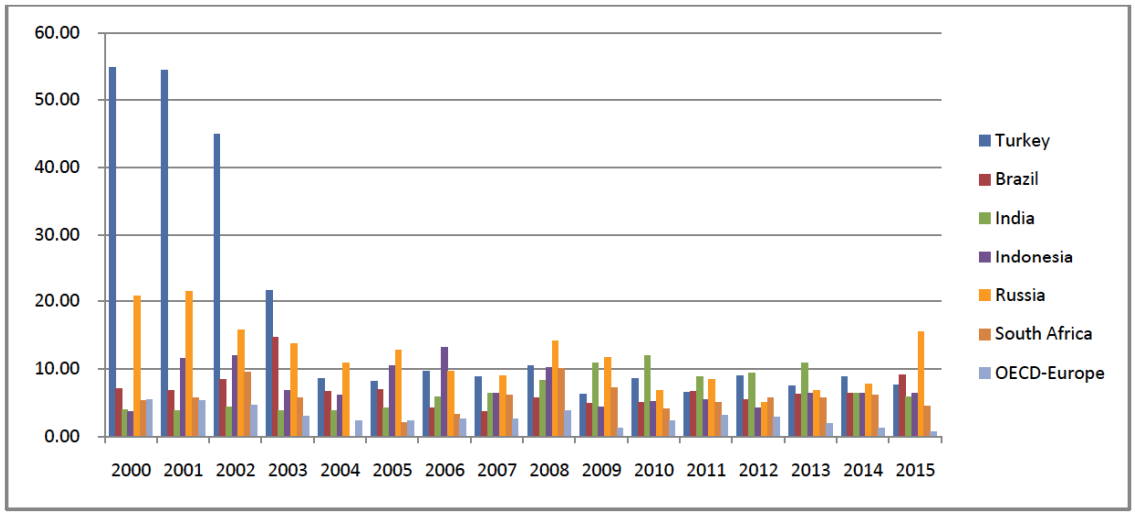


Figure 1: The Growth Rate of Consumer Price Index, Emerging Economies (2000-2015).

Source: http://stats.oecd.org/

economic agents and monetary authorities in Turkey. As Turkey has a higher inflation rate compared to many emerging market economies as in below Figure **1**.

Some factors complicated monetary policy in the regime of inflation targeting and floating exchange rates in Turkey. These factors are listed as follows, the liability of public sector debt, market expectations, a problematic demand channel with the an unstable and unpredictable link between the output gap and inflation, a relatively low level of financial intermediation, strong capital inflows and partial de-dolarization (Akyürek, Kutan and Yılmazkuday 2011).

Dollarization has implications for the impact of exchange rate policy and inflation targeting through the three potential channels as emphasised by Goujon (2006) Cavoli and Wilson (2012), and Bhattachary (2013). At first, as the economy is highly dollarized, fluctuations in the exchange rate affect both the prices of tradable goods and those of non-tradable goods. For example, in a dollarized economy, some non-tradable goods - particularly durable goods and real estate - are priced in dollars. Also, some services, including some long-term contracts and rents, are also quoted in dollars. As a result, exchange rate variations pass-through to domestic inflation for a larger set of goods than in a non-dollarized economy (Goujon 2006).

Second, in a dollarized economy, exchange rate fluctuations have a direct impact on money supply. Exchange rate depreciation causes an increase in the money supply because of the relation between the domestic-currency-equivalent of foreign-currency assets and the exchange rate. So, exchange rate fluctuations affect excess money and an inflation. In previous studies of dollarized economies, broad monetary aggregates including foreign currency deposits provide the tightest link to inflation, as Balino, Bennett and Borensztein (1999), Berg and Borensztein (2000), and Reinhart, Rogoff and Savastano (2003) show.

Third, a rise not only in the prices of tradable goods but also non-tradable goods indexed to the exchange rate ensures the exchange rate depreciation.When the relative price of tradable goods to non-tradable goods increases, the supply of non-tradable goods is decreased while the demand for them is increased. Besides, if we assume that the substitution of the request for tradable and nontradable goods is weak and that the distribution of production factors between the two sectors is fixed in the short run, the increase in production of tradable goods does not naturally imply a reduction in non-tradable goods.

The main objective of this study is to examine empirically the dynamics of the inflation and efficiency of the monetary transmission process in Turkey under the IT framework. Understanding the transmission channels of monetary policy is necessary for achieving further gains in disinflation and the maintenance of price stability going forward with the economic growth. As pointed out by Akyürek, Kutan and Yılmazkuday (2011), although there are some studies investigate the developed (Dodge 2002; Johnson 2002; Carare and Stone 2006) and developing countries (Amato and Gerlach 2002; Gonçalves and Salles 2008; Siklos 2008) in the literature, there are few studies about Turkey. So, the case of Turkey may give the valuable

lessons for the developing and emerging economies. Also, the effectiveness of the inflation targeting in Turkey is an important issue to the Maastricht criteria for the EU Membership for Turkey and the new member states of the Union such as Czech Republic and Poland, practice the inflation targeting regime.

Dissimilar to previous studies, this study is investigating the long period that is before and after the 2008 global financial crises. So, we examine the monetary transmission in inflation targeting with financial stability targeting.

The rest of the paper is organised as follows. Section 2 reviews previous studies in the literature. Section 3 describes the model, section 4 reports data, econometric methodology, and estimation results of cointegration and VAR model. Section 5 provides conclusions.

2. LITERATURE

In the literature, Vector Autoregression (VAR) Models and cointegration models are used to determine the inflation dynamics by both structural econometric models and new theoretical models as New Classical, New Keynesian Philips Curves.

Us (2004) analysed the major determinants of inflation in the Turkish economy using VAR model in the period 1990:1-2002:4. The results showed that inflation was not a monetary issue, caused by fiscal dominance. Goujon (2006) investigated the determinants of inflation in Vietnam over the period of 1991:1-1999:12. The cointegration results indicated that the export price of rice, exchange rate changes and excess money were the main causes of inflation. Nguyen, Cavoli and Wilson (2012) explored the role of the exchange rate in explaining inflation, and the prices of crude oil and rice from the supply side in the period of 2001-2009 in Vietnam. The OLS, Granger causality and VAR results showed that money supply, oil prices and rice prices were the effect on CPI inflation. Bhattacharya (2013) examined the role of monetary policy and the drivers of inflation in Vietnam over the period of 2000Q1-2012Q2 by using VAR approach. The impulse responses demonstrated that nominal effective exchange was the main driver of inflation in the short term, whereas GDP growth and growth in credit to the economy were in the medium-term.

Caceres, Ribeiro and Tartari (2012) explored the inflation dynamics in Cameroon, Republic of Central Asia, Central Republic of Congo and Gabon using a panel cointegration and panel VAR models. They showed that imported commodity price shocks were significant in explaining inflation in the region. Zhang (2013) examined the relationship between monetary growth and inflation in China using quarterly data between 1980 and 2010. The study investigated both short-run dynamics and long-run equilibrium relationships by using multivariate dynamic models based on Friedman's and Meltzer's monetarist framework. The empirical results suggested that inflation in China was Granger-caused by monetary growth in both the short and the long run. Also, it found that there was an indirect causal relationship between monetary growth and inflation through the asset inflation channel.

Mosayed and Mohammad (2009) examined the dynamics of inflation in Iran between 1971-2006 by applying the autoregressive distributed lag model (ARDL) approach. They concluded that in the long-run, the liquidity, exchange rate, expected inflation and import price explained the dynamics of inflation in the short run as well as long run. Manamperi (2014) investigated the short-run and long-run relationships between inflation and economic growth in BRICS (Brazil, Russia, China and South Africa) countries for the period of 1980 to 2012. The Johansen cointegration and the ARDL bound tests were used for the long-run relationship and a VAR analysis for the short-run dynamics. When cointegration analysis showed a long-run positive relationship between inflation and economic growth in India, and VAR analysis showed a short-run relationship between the two variables for all five countries. Kamal (2014) estimated an open economy version of Philips curve in the period 1990 to 2013 for India. GMM estimation results said that imported intermediate goods played a major role in inflation dynamics by way of real marginal cost and exchange rate pass-through.

Çiçek (2005) developed an Expectations-Augmented Philips Curve Model to explore the effects of unit labor costs, output gap, real exchange rate, and price expectations on the inflation in Turkey over the period of 2000:01-2004:12 by using Johansen Cointegration Test. The empirical results showed that the exchange rate and supply shocks were the most important variables in the short term. In the long term, mark-up behavior of output prices and the real exchange rate were the main cause of inflation. Özdemir and Saygılı (2009) explored determinants of inflation in Turkey in the New Classical Phillips curve

relationship framework. The results showed that the price gap, which represents the pressure on price, was related to the money in the economy. They concluded that the emerge of excess money when output was greater than the potential, the interest rate was less than the natural rate, was a major factor in explaining inflation dynamics**.**

Arı *et al*. (2013) explored inflation dynamics in the Turkish economy during the period of 1990-2011 by using the Johansen Cointegration methodology. The results showed that money supply, economic growth, nominal exchange rates, dollarization and real wages were the main determinants of the inflation in Turkey. Andıç, Küçük and Öğünç (2014) applied the Bayesian model of consumer price inflation in Turkey based on the hybrid New Keynesian Phillips Curve. The results showed that when an output gap as a measure of domestic real marginal cost was important for explaining CPI, then real unit labor costs have importance for services inflation.

3. THE MODEL

We analyse the determinants of the inflation using a model based on Goujon (2006), and modified by Nguyen, Cavoli and Wilson (2012), for a standard price-taking open economy such as Turkey. The model also used in Bhattachary (2013) as follows:

$$\Delta p_t = \theta \Delta p_t^T + (1-\theta)\Delta p_t^{NT} \quad (1)$$

Where *p, p*^{T} and *p*^{NT} are the logs of the consumer price index (CPI), tradable goods and non-tradable goods price, namely. θ is the weight of the prices of tradable and non-tradable goods in the CPI ($0 < \theta < 1$) which is constant, and Δ is the first difference operator. On the other hand, the rate of change in the price of tradable goods is defined for a small, price-taking economy as in below:

$$\Delta p_t^T = \lambda \Delta e_t + \mu \Delta p_t^W + \delta_T \quad (2)$$

Where *e* represents the nominal exchange rate about U.S dollar, *p*^{w} is the international price for tradable goods (in US dollars). δ_T is a constant capturing the evolution of other factors, e.g., transportation and transactions costs or trade policy, and λ and μ are coefficients to be estimated.

Regarding the determination of the prices of non-tradable goods, dollarization introduces additional channels between exchange rate policy and inflation. The change in the price of non-tradable goods is thus defined by Goujon (2006) as (Bhattachary 2013).

$$\Delta p_t^{NT} = \alpha EC_{t-1} + \eta \Delta e_t + \delta_{NT} \quad (3)$$

Where *EC* represents excess money and η the impact of the exchange rate on non-tradable goods. *EC* is in lagged form, as it is presumed that those holding excess money at the beginning of the current period will adjust their holdings and fuel inflationary pressures at the end of the period.

The inflation equation is derived by substituting (2) and (3) into (1):

$$\Delta p_t = \left[\lambda\theta + (1-\theta)\eta\right]\Delta e_t + \theta\mu\Delta p_t^w + (1-\theta)\alpha EC_{t-1} + \delta \quad (4)$$

moreover, can be written in reduced form as

$$\Delta p_t = \kappa_1 \Delta e_t + \kappa_2 \Delta p_t^w + \kappa_3 EC_{t-1} \quad (5)$$

We follow the more conventional approach adopted by Nguyen, Cavoli and Wilson (2012) rather than following the two-step estimation approach advocated by Goujon (2006). The difference is the specification of the money demand as a function of aggregate demand /output and the nominal interest rate. So, the inflation model is a function of foreign price inflation, nominal exchange rate and movements in the key economic variables- the credit growth, aggregate demand /real output, and the nominal interest rate:

$$\Delta p_t = \kappa_1 \Delta e_t + \kappa_2 \Delta p_t^W + \kappa_3 \Delta CG_t + \kappa_4 \Delta Y_t + \kappa_5 \Delta R_t + \xi_t \quad (6)$$

Where *e* represents US/TL nominal exchange rate, *p*^{w} represents import price index, *CG* represents the credit growth, *R* the nominal interest rate, *Y* the level of real output (GDP), and ξ*t* denotes the error term. The expansion of the money supply does not induce inflation necessarily because it may be absorbed by an equivalent increase in money demand. Therefore, we exclude money supply and prefer credit growth.

Coefficients on the credit growth and the interest rate should capture the effects of monetary policy on inflation. Economic theory would suggest that credit growth, foreign price inflation and nominal exchange rate depreciation would have a positive effect on domestic inflation, while increases in the interest rate and higher output growth (to the extent that it reflects higher productive capacity and not excess demand) would have a negative effect on domestic inflation (Bhattachary 2013).

4. DATA, METHOD AND EMPIRICAL RESULTS

4.1. Data

In this model, our dependent variable is CPI (consumer price index) headline inflation. Independent variables are CG the real credit growth, ER US/TL exchange rate, RER real effective exchange rate, GDP Real Gross Domestic Product; IR nominal interest rate and IP is import price index. The data are quarterly and the period is between 2003:Q2-2015:Q3. The variables' definitions and sources are presented in Table **1**, and summary of the descriptive statistics is presented in Table **2**. Time series plots of the variables are presented in Figure **2**.

We go on to estimate Equation (6), measured regarding percentage changes of the variables from the previous year, except for the interest rate, where the end-of-period nominal rate is used. All variables are seasonally adjusted according to the Census X-13.

4.2. Unit Root Tests

In this section, we examine the time-series properties of the data. We have conducted the Augmented Dickey-Fuller (ADF,1979) and Phillips-Perron (PP, 1988). These unit-root tests are performed on both levels and first differences of all the variables. According to the Table **2** some variables (CG, RER, ER, IP) are I(0), some variables(CPI, GDP, IR) are integrated that is, I(1).

4.3. ARDL Cointegration

The autoregressive distributed lag (ARDL) approach is a cointegration methodology for determining long-run relationships among variables small samples, while the Johansen co-integration techniques require larger samples for the results to be valid (Ghatak and Siddiki 2001). A significant advantage of the ARDL approach is that, while other cointegration techniques need all of

Table 1: Definition and Source of Variables

Variable	Definition	Source
CPI	Consumer Price Index, Headline Inflation (2003=100)	TUIK (Turkish Statistical Institute)
CG	Banking Sector Real Credit Growth	CBRT (Central Bank of Republic of Turkey)
RER	Real Effective Exchange Rate (2003=100)	CBRT
ER	National Currency per US Dollar	OECD
GDP	Real Gross Domestic Product (1998=100)	CBRT
IR	Interbank Rate	OECD
IP	Import Price Index (2010=100)	TUIK

Table 2: Summary of the Descriptive Statistics

Statistics	RER	IR	IP	GDP	ER	CPI	CG
Mean	0.284143	11.75422	0.802070	1.598450	1.203767	2.043938	5.351505
Median	0.717872	8.523310	0.740602	1.595878	0.598982	2.016166	5.149888
Maximum	13.24806	38.15270	8.265040	6.736699	28.35686	4.041626	17.34565
Minimum	-12.01576	1.573608	-15.70679	-4.913236	-14.17979	0.676583	-4.247489
Std. Dev.	4.737597	7.813370	4.616767	2.218746	6.288244	0.808302	4.313205
Skewness	-0.043135	1.046469	-1.090344	-0.472917	1.389998	0.546149	0.339413
Kurtosis	3.680066	4.191391	5.335541	4.514327	8.547991	2.863247	3.738290
Jarque-Bera	0.979025	12.08292	21.27115	6.641222	80.22623	2.524613	2.095580
Probability	0.612925	0.002378	0.000024	0.036131	0.000000	0.283001	0.350712
Sum	14.20715	587.7112	40.10350	79.92250	60.18833	102.1969	267.5753
Sum Sq. Dev.	1099.796	2991.389	1044.412	241.2188	1937.558	32.01426	911.5832
Observations	50	50	50	50	50	50	50

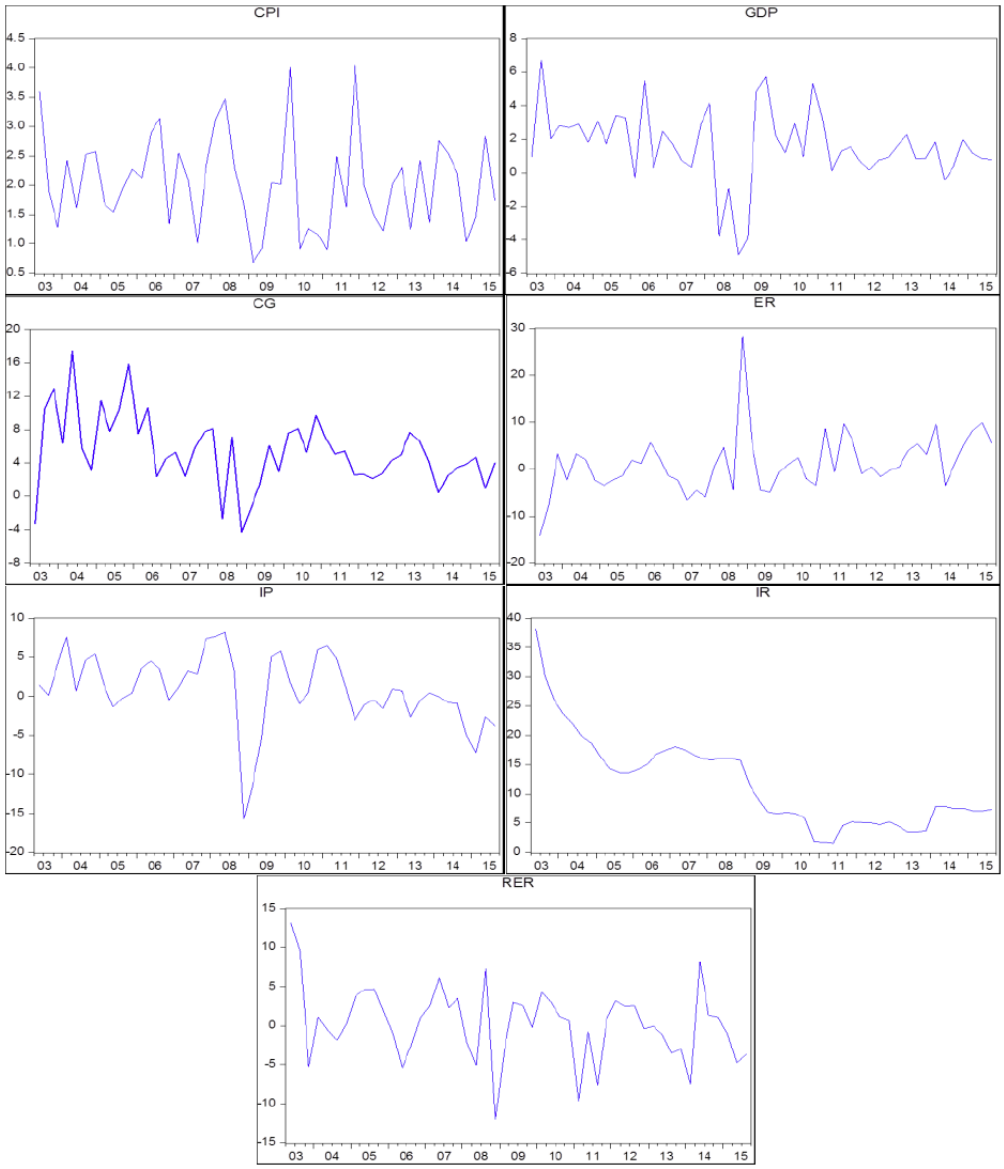


Figure 2: Time series plots of variables.

Table 3: The Result of Unit Root Tests

Variable	ADF Intercept	PP Intercept
CPI	0.1947 (-2.2431) I(0) 0.0001* (-5.2022) I(1)	0.0000* (-7.8869)
CG	0.0318** (-3.1188) I(0)	0.0000* (-5.9151)
RER	0.0005* (-4.6108) I(0)	0.0000* (-6.5966)
ER	0.0000* (-6.0323) I(0)	0.0000* (-6.0226)
GDP	0.0752** (-2.7470) I(0) 0.0063* (-3.7775) I(1)	0.0000* (-5.5914)
IR	0.2412 (-2.3577) I(0) 0.0066* (-5.3247) I(1)	0.0014* (-4.3042)
IP	0.0004* (-4.6413) I(0)	0.0423** (-2.9957)

Note: "*", and ** is implied that provided stationary in 1% and 5% critical value. Akaike Information Criterion (AIC) was used for the determining the lag order. ADF critical values for 1% and 5% are -2.9237, -3.5744 respectively. PP critical values for 1% and 5% are -3.5713, -2.9224.

the variables to be integrated of the same order, ARDL can be applied irrespective of their order of integration. It thus avoids the pretesting problems associated with standard cointegration tests (Pesaran, Shin and Smith 2001). Furthermore, with the ARDL, it is possible that different variables have differing optimal numbers of lags, while in previous models this is not possible.

Following Pesaran, Shin and Smith (2001), the error correction representation of the ARDL model is as follows:

$$\Delta CPI_t = a_0 + \sum_{j=1}^{n} b_j \Delta CPI_{t-j} + \sum_{j=1}^{n} c_j ER_{t-j} + \sum_{j=1}^{n} d_j \Delta IP_{t-j} + \sum_{j=1}^{n} e_j \Delta CG_{t-j} + \sum_{j=1}^{n} f_j \Delta GDP_{t-j} + \sum_{J=1}^{n} g_j \Delta IR_{t-j} + \sum_{j=1}^{n} h_j \Delta RER_{t-j} + \delta_1 \Delta ER_{t-1} + \delta_2 \Delta IP_{t-1} + \delta_3 \Delta CG_{t-1} + \delta_4 \Delta GDP_{t-1} + \delta_5 IR_{t-1} + \delta_6 \Delta RER_{t-1} + \xi_{1t} \quad (7)$$

The parameter *δi*, where *i*=1, 2, 3, 4, 5, 6, is the corresponding long run multipliers, while the parameters *bj, cj, dj, ej, fj, gj and* h_j are the short-run dynamic coefficients of the underlying ARDL model. The null hypothesis (i.e. H_0: *δ1=δ2=δ3=δ4=δ5=δ6=0*, implying no cointegration) in the first step is tested by computing a general *F* statistic. First, one has to estimate Eq. (7) excluding the ECM term. This term is subsequently incorporated into the ARDL model.

One of the more important issues in applying ARDL involves selecting the order of the distributed lag functions. Since we use 47 quarterly observations, we choose four as the maximum lag length in the ARDL model and select appropriate lag in Schwartz Bayesian Criteria (SBC). Pesaran and Smith (1998) argue that the SBC should be used in preference to other model specification criteria because it often has more parsimonious specifications: the small data sample in the current study further reinforces this point. The optimal number of lags for each of the variables is shown as ARDL (3, 0, 1, 0, 0, 2, 0) with no autocorrelation as seen in Appendix 2. The ARDL model is shown Table **4**, and the models' calculated F-statistic is equal to 8.18, above that the upper bound critical value reported by Pesaran, Shin and Smith (2001) at the 1 percent level (3.15 - 4.43). So the presence of the long-run relationship is confirmed.

After selected ARDL model we estimated long-run coefficients, and they are shown in Table **5**. The empirical results in Table **5** reveal that in the long run the increases in US/TL exchange rate, real effective exchange rate, interest rate, imported inflation, and the decreases in credit growth give rise to inflation in Turkey. More specifically, in the long-run a one percent increase in nominal US/TL exchange rate leads to 0.128 percent increase in inflation and a one percent increase in real effective exchange rate leads to 0.122 percent increase in inflation. It can be seen that the exchange rate is the most efficient factor in inflation in Turkey as indicated in existing literature.

Table **6** reports the results of applying the ECM version of the ARDL model. These results show that

Table 4: ARDL (3,0,1,0,0,2,0) Estimates

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
CPI(-1)	-0.358676	0.114612	-3.129467	0.0036
CPI(-2)	-0.154341	0.116560	-1.324135	0.1943
CPI(-3)	-0.266276	0.110600	-2.407569	0.0216
CG	-0.058696	0.026758	-2.193558	0.0352
ER	0.194261	0.041861	4.640617	0.0000
ER(-1)	0.034430	0.016534	2.082397	0.0449
GDP	0.049410	0.055734	0.886528	0.3816
IP	0.169510	0.032340	5.241579	0.0000
IR	0.114173	0.076311	1.496160	0.1438
IR(-1)	0.107143	0.128128	0.836224	0.4089
IR(-2)	-0.170227	0.072935	-2.333943	0.0256
REK	0.218181	0.050056	4.358763	0.0001
C	2.926841	0.472347	6.196376	0.0000

Table 5: Estimated Long-Run Coefficients Using the ARDL Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CG	-0.032988	0.015346	-2.149701	0.0388**
ER	0.128529	0.033027	3.891673	0.0004*
GDP	0.027769	0.032227	0.861674	0.3949
IP	0.095268	0.023932	3.980770	0.0003*
IR	0.028713	0.007565	3.795710	0.0006*
RER	0.122622	0.030606	4.006453	0.0003*
C	1.644946	0.119774	13.733776	0.0000*

Note: "*", "**"are implied that provided significant in 1% and 5% critical values.

Table 6: Error Correction Model (ECM)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(ER)	0.208401	0.037711	5.526303	0.0000*
D(GDP)	-0.010592	0.044225	-0.239497	0.8120
D(IP)	0.192652	0.031998	6.020775	0.0000*
D(IR)	0.037451	0.070570	0.530695	0.5987
D(CG)	-0.055441	0.025726	-2.155046	0.0376**
D(RER)	0.245775	0.044667	5.502374	0.0000*
C	0.027395	0.095070	0.288162	0.7748
ECT(-1)	-1.561547	0.212651	-7.343243	0.0000*

Note: "*", "**"are implied that provided significance in 1% and 5% critical values.

the expected negative sign of the ECM_{t-1} is highly significant. The estimated coefficient of the ECM_{t-1} is -1.5615, suggesting that deviation from the long-term inflation path is corrected by around 1.5 percent over the following quarter. It means that the adjustment takes place relatively quickly.

Moreover, CUSUM stability tests of the model presented in Appendix 1, also indicate that the model is stable as evidenced by the graph of the cumulative sum of squares of recursive residuals.

4.4. VAR Model

Vector Autoregressive (VAR) approach is suitable for looking at the main drivers of inflation, primarily because this method allows us to fully capture the interaction among macroeconomic variables and their feedback effects. The purpose of using VAR method is to investigate the endogenous variables response to shocks in interest rate and money growth in the short run. The endogenous variables in our VAR model include CPI inflation, GDP growth, growth in credit, US/TL nominal exchange rate, real effective exchange rate, and the nominal interest rate. The VAR is estimated over the period 2003Q2 to 2015Q3. Exogenous variables include the percentage change in the import price as well as dummy for a structural break in 2009Q2 caused by global financial crises. In light of the short period involved a lag length of one was chosen, consistent with the results of the Schwarz Information Criterion (SIC) for optimal lag length. The stability of the model is checked based on roots of the AR characteristic polynomial, and all roots are found to be inside the unit circle, indicating that the model fulfils the stability condition (Appendix 3).

The impulse responses are based on a Cholesky decomposition of the variance-covariance matrix of the error terms from the estimation of the VAR. Foreign price inflation is assumed to be exogenous and influences the other variables in the model, both in the short run and in the long-term. The ordering of variables that is used for the Cholesky decomposition is the following: the nominal interest rate, real GDP growth, growth of total credit to the economy, percentage changes in the nominal effective exchange rate, real effective exchange rate and headline inflation.

It implies that the nominal interest rate affects all the other endogenous variables in the model in the short run; real GDP growth does not impact the nominal interest rate contemporaneously but does impact the other three endogenous variables. The growth of total credit to the economy affects only the nominal effective exchange rate, real effective exchange rate and headline inflation in the short run. Nominal effective exchange rate movements have a contemporaneous impact only on real effective exchange rate and inflation, and inflation is affected in the short-run by all the other variables in the model but does not have a short-run contemporaneous impact on the other endogenous variables in the model.

The impulse responses of headline inflation to shocks in the other endogenous variables are presented in Figure **3** below. The impulse responses suggest that the key drivers of inflation in the short-term are movements in the real effective exchange rate, US/TL nominal effective exchange rate, interest rate, and GDP growth whereas over the medium-term (a two- to ten-quarter horizon) credit growth is the principal factor driving inflation. The response of inflation to a rise in the nominal interest rate, US/TL exchange rate, and GDP growth appear to be significant only in the first two-quarters, positively, while fall in real effective exchange rate appears to be significant only in the first quarter.

Figure **4** below shows the impulse responses of the endogenous variables to a one standard deviation shock to the nominal interest rate to show the impacts of monetary policy. The impulse responses suggest

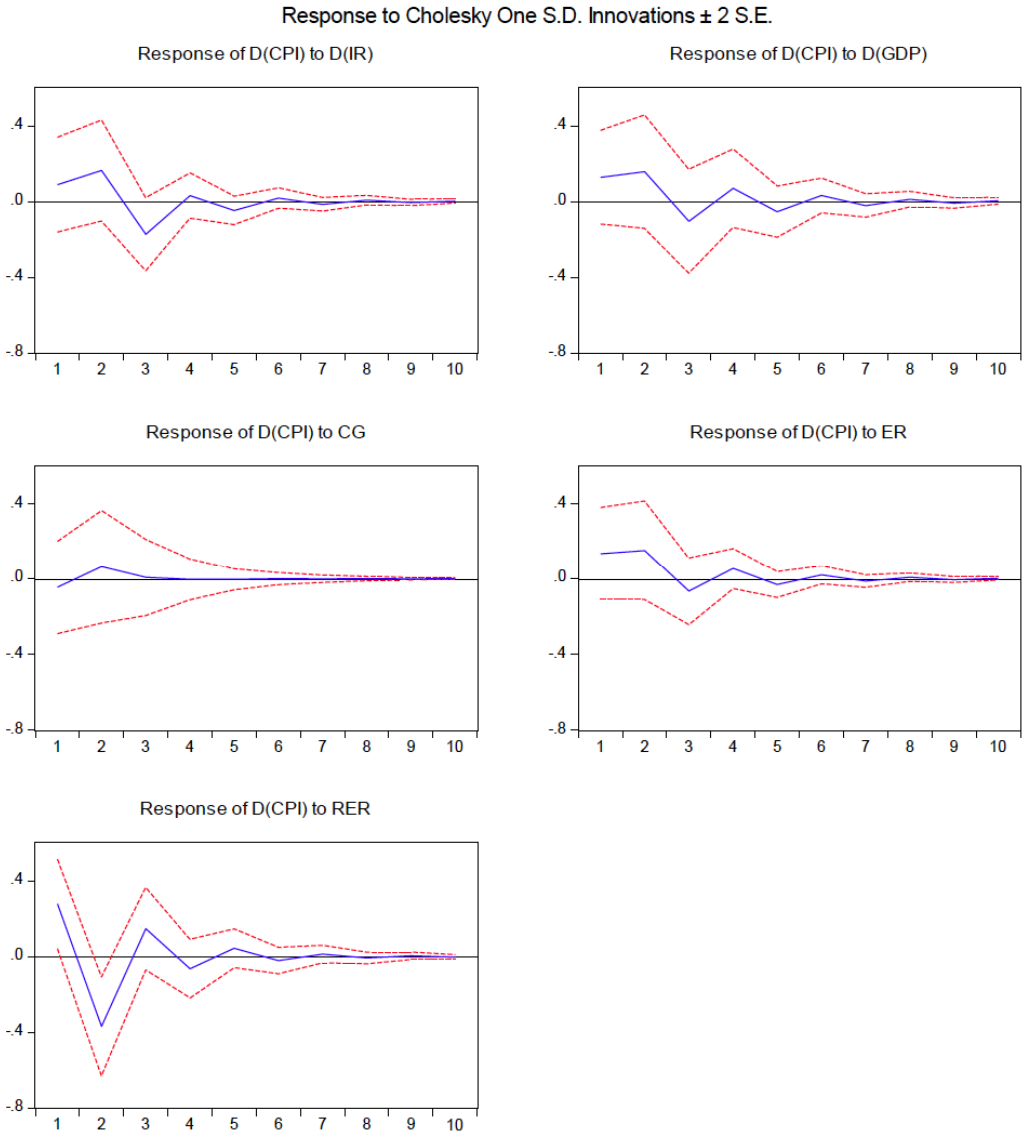


Figure 3: Impulse response of Inflation from VAR Estimation.

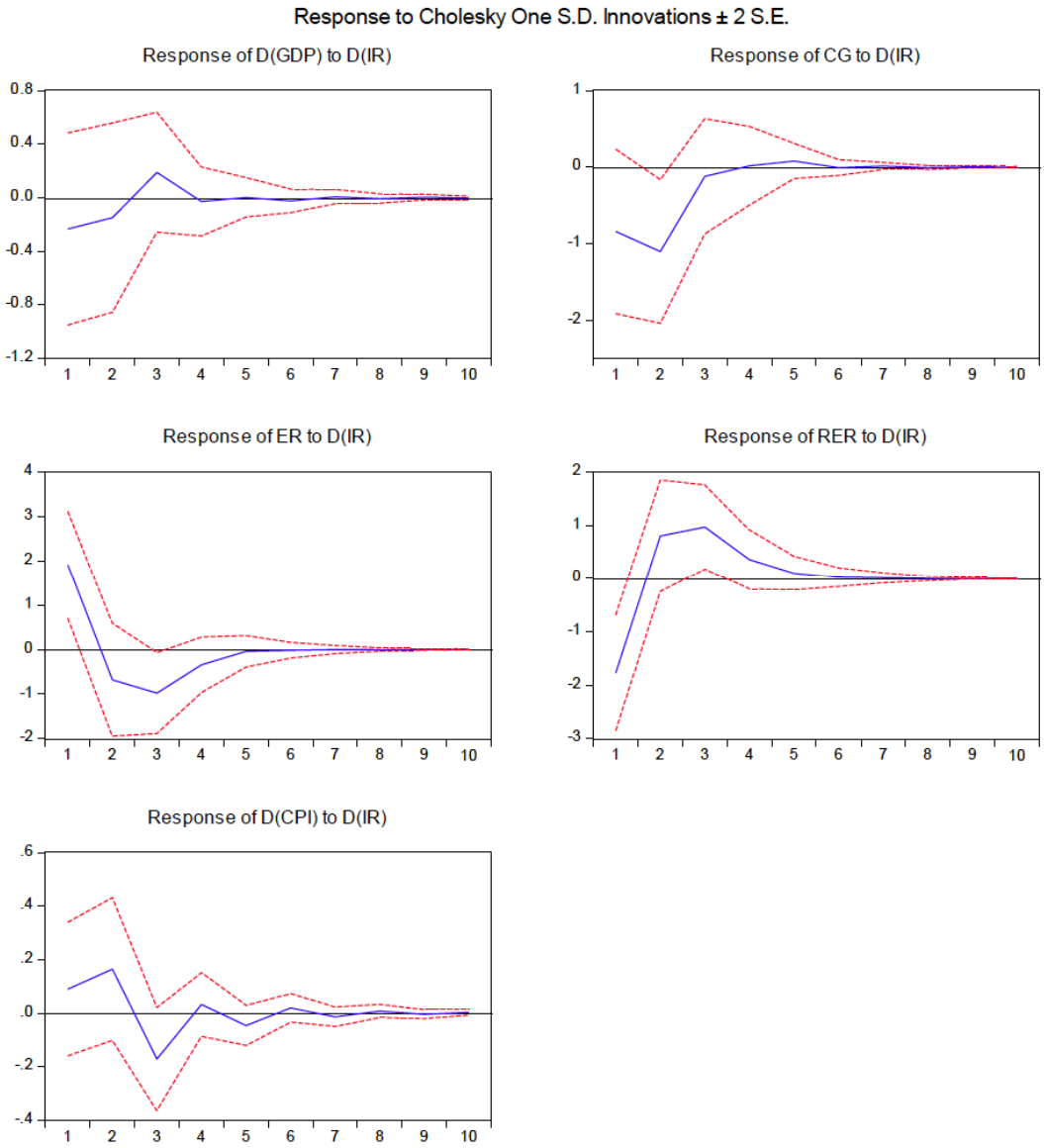


Figure 4: Endogenous Variable Response to one standard Deviation Interest Rate Shock.

that shocks to the nominal interest rate have a significant positive impact on GDP growth, and headline inflation over the two-quarter horizon and on real effective exchange rate over one-quarter horizon. The nominal interest rate has a significant negative impact on credit growth on the first two-quarters and then a positive impact over the third quarter. The nominal interest rate has a significant negative impact on US/TL exchange rate over one and half quarter horizon.

To summarize, our empirical results suggest that the key drivers of inflation in the short-run are movements in the US/TL nominal effective exchange rate, real effective exchange rate, interest rate, and GDP growth. Credit growth has a significant positive impact on inflation over a medium-term horizon of 2-10 quarters. Interest rate shocks tend to have a significant impact on GDP growth, exchange rates, consumer price inflation over the short term, and credit growth over the short and medium term.

5. CONCLUDING REMARKS

This paper explores the major determinants of inflation and the role of monetary policy for the purpose of reducing inflation in Turkey. The sample period is the inflation targeting regime during 2003-2015. We used the ARDL cointegration model for the long run dynamics and the VAR methodology for the short run dynamics.

The empirical results confirm the existence of a co-integrating relationship between inflation, US/TL

exchange rate, real effective exchange rate, import prices, credit growth and interest rate in the long run. Based on the ARDL cointegration results, US/TL exchange rate and real effective exchange rate have the most significant impact on the inflation. After exchange rates other variables such as the rate of imported inflation, credit growth and interest rate are the effective factors having in inflation, respectively. The results shows that monetary policy is effective to target inflation and financial stability in Turkey since interest rate and credit growth variables are statistically significant.

The results of the VAR model impulse responses show that the key drivers of inflation in the short-run are movements in the US/TL nominal effective exchange rate, real effective exchange rate, interest rate, and GDP growth. Credit growth has a significant positive impact on inflation over a medium-term. Also, interest rate shocks tend to have a significant impact on GDP growth, exchange rates, consumer price inflation over the short term, and credit growth over the medium term. We conclude that exchange rate is still the main determinant of the inflation, and interest rate is an effective monetary instrument for the inflation targeting in Turkey.

APPENDIX 1

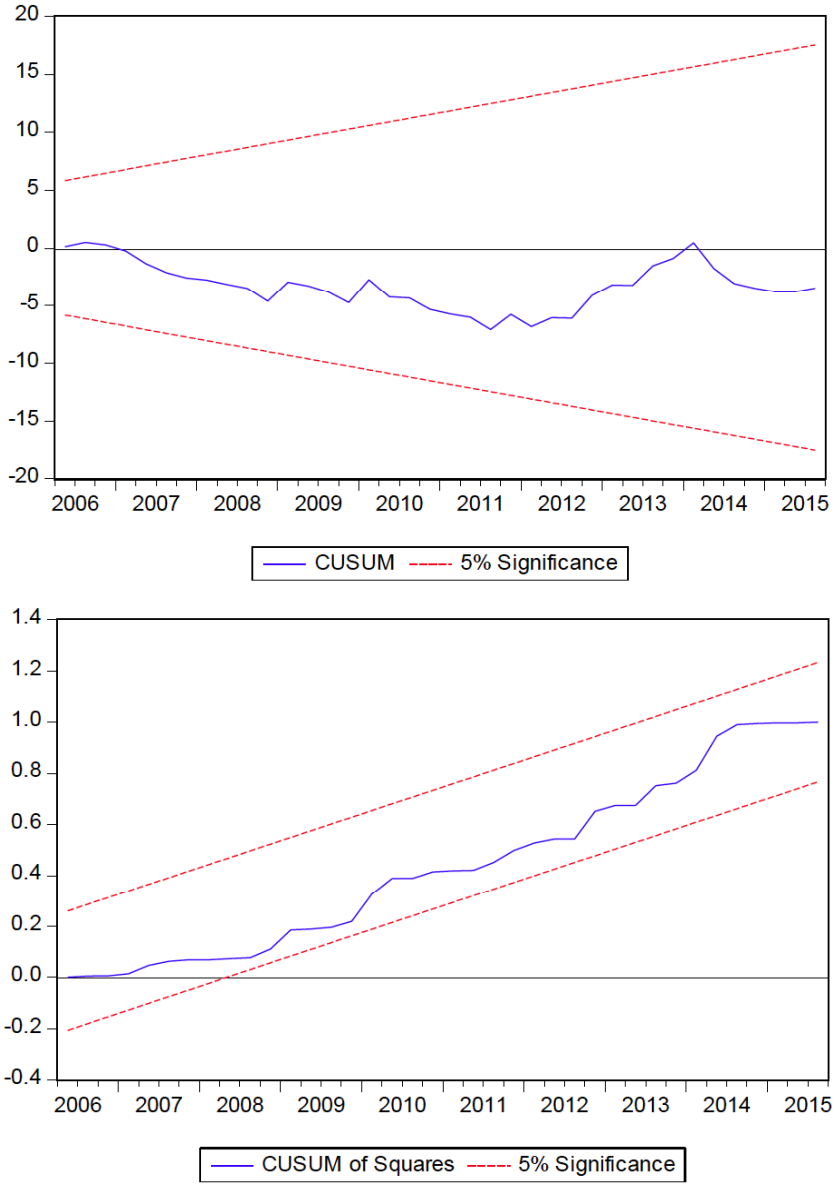
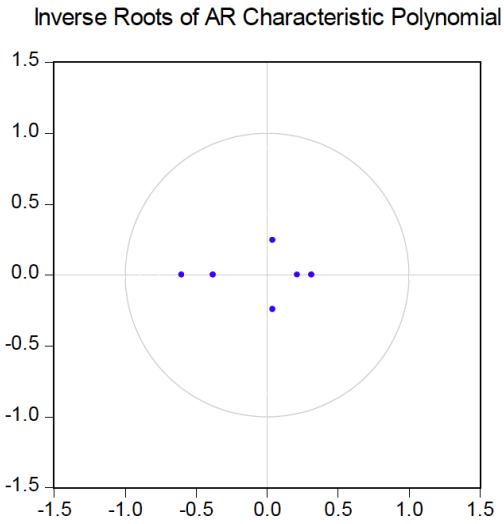


Figure 5: Plots of CUSUM and CUSUMQ Statistics for Coefficients Stability Tests.

APPENDIX 2: Breusch-Godfrey Serial Correlation LM Test

F-statistic	0.678727	Prob. F(4,30)		0.6121
Obs*R-squared	3.900381	Prob. Chi-Square(4)		0.4197
Test Equation:				
Dependent Variable: RESID				
Method: ARDL				
Date: 05/17/16 Time: 14:28				
Sample: 2004Q1 2015Q3				
Included observations: 47				
Presample missing value lagged residuals set to zero.				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
CPI(-1)	0.151312	0.167075	0.905649	0.3723
CPI(-2)	0.064442	0.148516	0.433903	0.6675
CPI(-3)	-0.051983	0.137831	-0.377151	0.7087
CG	-0.003947	0.028821	-0.136933	0.8920
ER	-0.010600	0.045954	-0.230677	0.8191
ER(-1)	0.002424	0.017322	0.139935	0.8896
GDP	0.016301	0.060531	0.269307	0.7895
IP	-0.007515	0.035898	-0.209333	0.8356
IRR	-0.007081	0.082272	-0.086075	0.9320
IRR(-1)	-0.040425	0.140191	-0.288358	0.7751
IRR(-2)	0.043072	0.082484	0.522181	0.6054
REKK	-0.011430	0.055573	-0.205673	0.8384
C	-0.289392	0.551350	-0.524879	0.6035
RESID(-1)	-0.326112	0.237061	-1.375647	0.1791
RESID(-2)	-0.035732	0.249251	-0.143356	0.8870
RESID(-3)	0.176695	0.248601	0.710758	0.4827
RESID(-4)	-0.086452	0.219676	-0.393545	0.6967
R-squared	0.082987	Mean dependent var		2.13E-16
Adjusted R-squared	-0.406087	S.D. dependent var		0.432123
S.E. of regression	0.512405	Akaike info criterion		1.775052
Sum squared resid	7.876776	Schwarz criterion		2.444255
Log likelihood	-24.71373	Hannan-Quinn criter.		2.026878
F-statistic	0.169682	Durbin-Watson stat		2.034893
Prob(F-statistic)	0.999752			

APPENDIX 3



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