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THE INTERACTION AMONG INTEREST RATE, INFLATION AND OUTPUT IN INFLATION TARGETING REGIMES: THE CASE OF TURKEY

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ABSTRACT

Inflation targeting (IT) as a framework for monetary policy was first adopted in the early 1990s by some developed countries. However, since the late 1990s, it has been adopted in a number of emerging market and developing countries, especially some new members of the European Union. This paper examines the interaction among interest rate, inflation and output in inflation targeting regimes in Turkey and the findings will help us to understand why and how the inflation targeting, as a new monetary policy regime, has become a succesful one among the alternative monetary regimes. There are many empirical studies on the effectiveness of inflation targeting regime for Turkey, and our study which is about Turkey's inflation targeting experience may provide some contribution to the other studies. Through the empirical analysis in this study, it is found out that there is a long term relationship among inflation, interest rate and production, by the way, in Turkey, inflation rate is significantly affected by the changes in interest rate and production together.

Keywords: *Inflation Targeting, Interest Rate Channel, VAR Analysis, Cointegration Analysis*

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INTRODUCTION

Inflation targeting (IT) as a framework for monetary policy was first adopted in the early 1990s by industrial countries like New Zealand, Canada, the United Kingdom and Sweden. In most cases, the adoption of this framework was in response to difficulties these countries faced in conducting monetary policy using an exchange rate peg or some monetary aggregates as an intermediate target[1]. For a time, it was exclusive to industrial countries.

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[1] See Masson, Savastano and Sharma (1997).

However, since the late 1990s, it has been adopted in a number of emerging market and developing countries. Currently, twenty-three countries[2] can be classified as IT countries of which 7 are industrial and 16 are non-industrial. According to Mishkin and Schmidt-Hebbel (2001), inflation targeting has been proven to be a successful new monetary framework, both in comparison to preceding experience of inflation targeter and relative to alternative monetary regimes during the 1990s.

Mishkin (2000a; 2000b), Svensson (2002), Eichengreen (2002), Mishkin and Posen (1997), Masson, Savastano and Sharma (1997), Oh (2000), Khan (2003), Carare, Schaechter, Stone and Zemler (2002), Tutar (2002), Ogretmen (2004), Golinelli and Rovelli (2005), Blejer and Hammond (2006) describe the necessary economic and political conditions for the implementation of a successful IT as follows: central bank independence, capacity of inflation forecasting, controllability of monetary policy instruments over operating targets, effective channel of interest rates on prices, transparency, consistency and credibility of monetary policy.

Turkish economy can be characterized by 4 distinct periods after the capital account liberalization in 1989. In the first period, between 1989 and 1994, the inflation dynamics were mostly driven by high support prices. The second period from 1995 to 1999 can be illustrated by an increased risk premium in the aftermath of 1994 financial crisis as well as strong inflation–devaluation spiral fed by implementation of implicit Real Exchange Rate Targeting Policy. The deterioration of the public financial balance, the increase in domestic debt stock because of the high real interest rates, and the rising trend of the inflation rate necessitated the adoption of a medium-term program. The third period covers the months beginning with the January 2000 till March 2001. On January 1, 2000, a three-year disinflation program was put into effect. In this program, the exchange rate was used as the nominal anchor. However, the three-year disinflation program collapsed as of the end of February 2001 due to two successive liquidity and interest rate crises, which took place in November 2000, and then, in February 2001. Finally, the last episode is after the adoption of the floating rate regime in February 2001 which then was followed by the launching of the Economic Program for Strengthening the Turkish Economy in May 2001 and by the introduction of the Medium-Term Economic Program in January 2002 that was the implementation of implicit IT regime in between 2002-2005. Then, as a framework for monetary policy was adopted the full-fledged IT in 2006.

As mentioned above, under the nominal anchor regime, the exchange rate was focused in order to control the general price levels thereby the inflation rate could be taken undercontrol. Here, we have to state that there are mainly two transmission mechanisms which affect the aggregate demand and price. One of them is the exchange rate and the other is the interest rate. Through the said nominal anchor regime, the exchange rate was used as an instrument of transmission mechanism related with the monetary policy. It is obvious that

[2] See Mark, Baumgartner and Raghuram (2006).

in open economies, the exchange rate affects the inflation rate and the interest rate has a high effect on inflation as well. During the years between 2002-2005, by the implicit IT regime, and later, in 2006, by full-fledged IT regime, the exchange rate mechanism was abandoned and the "interest rate mechanism" has been put into practice.

Inflation targeting, in the last decades, has become the main policy objective for most of the central banks, and the interest rate transmission has attracted much more attention than ever before. Being influenced by this attraction, the interest rate is used as the main instrument of monetary policy in inflation targeting regime in Turkey. Hence, in this paper, we only concentrate on the effects of interest rate which reflect the traditional interest rate mechanism. In this mechanism, the short-term nominal interest rate affects the real interest rate, thereby the inter-temporal consumption will be affected. Consequently, changes in consumption alter the output and then they affect the inflation via the general prices level.

By this paper, the interaction among interest rate, inflation and output are examined by using impulse response functions in vector autoregression (VAR) analysis and Johansen Cointegration Method in inflation targeting regimes in Turkey and it is hoped that the findings of this study can help us to understand why and how the inflation targeting has become a succesful one among the alternative monetary regimes as it is a new monetary policy regime. In this study, through the empirical analysis, it is aimed whether there is a short and a long term relationship among inflation, interest rate and production and whether the inflation rate is affected by the changes in interest rate and production under IT regime in Turkey. When the results show that there are short and long term relationships among inflation, interest rate and production, and also the inflation rate is significantly affected by the changes of interest rate and production together, this paper may contribute by giving some suggestions to the policy makers who wish to apply or who have already applied IT regime.

The paper is structured as follows. The first section surveys Turkey's implicit IT and IT experiences. The second presents a theoretical model. Empirical models and their results are presented in the third section, and the last section concludes.

INFLATION TARGETING EXPERIENCES OF TURKEY

Following the collapse of the crawling peg, Turkish Lira depreciated massively and the annual inflation rate soared to 68 percent at the end of 2001. Not only the contemporary inflation but also the past experiences of high and sticky inflation posed serious challenges for managing inflation expectations. Having been exposed to monetary and/or exchange rate targeting regimes for many decades, institutional infrastructure regarding IT needed to be adjusted accordingly. Inflation dynamics and the monetary transmission mechanism were highly uncertain due to the changing economic structure.

The CBT and the Government announced a multiyear "projection" of inflation consistent with the IMF stand-by program; official inflation and monetary targets were announced for only one year in advance during the

implicit IT period between 2002 and 2005. The program set out in 2002 envisaged a rather fast pace of disinflation. The plan was to reduce inflation to 35% in 2002, 20% in 2003, 12% in 2004 and 8% in 2005.

The fiscal conditions at the start of the implicit IT framework certainly provided a challenge for monetary policy. Prior to the 2001 crisis and, even more so in the aftermath, the level of public sector debt and concerns regarding its rollover had become the focus of markets. The restructuring of the banking system in 2001 increased the public debt burden to historically high levels, making the fiscal dominance a serious obstacle to IT (Akyürek and Kutan, 2006). According to Duman (2002), the main impediment to IT in Turkey is fiscal dominance. There is vast empirical evidence that emerging market economies have limited scope for fiscal adjustment and often have pro-cyclical fiscal policies, because of pro-cyclicality of capital flows, high levels of external debt, high burden of interest payments, and limited creditworthiness. These pro-cyclical policies are partly due to the fact that emerging market countries did not build surpluses and accumulate resources to be used during recessions in periods of economic expansion. By this program, bonds issued to recapitalize the banking system, the sharp fall in output, and rising real rates caused the public sector debt ratio to rise sharply. Additionally, the fiscal conditions gradually improved and became more supportive to monetary policy. The government responded to rising real interest rates by doubling the public sector primary surplus[3] (to over 6% in between 2002 and 2006), and IMF funding helped significantly to allay rollover concerns. Additionally, the risk exposure of public debt stock has decreased through a successful debt management policy: the share of foreign exchange denominated (or indexed) debt in the total public debt has also been reduced considerably (Ozatay, 2005).

What are the main objectives of IT in Turkey? (Akyürek & Kutan, 2006; Brook, 2006; Kara, 2006; Karasoy, Kunter & Us, 2005; Yılmaz, 2006). The answer of this question can be discussed in detail as follows:

a) There was one critical condition that Turkey ranked fairly high: central bank independence. The Central Bank Law (CBT Law)[4], which was amended in April 2001—right after the crisis and before the implementation of the implicit inflation-targeting regime—, strengthened instrument independence by allowing the Bank to be fully authorized to choose its monetary policy instrument. The CBT Law also opened the door for accountability by requiring bank officials to inform the public on the operations of the Bank and the monetary policy.

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[3] Despite a temporary deviation due to political chaos in the second half of 2002, the realizations were almost in line with the targets: 5.5% in 2001, 4.1% in 2002, 6.3% in 2003, and 6.5% in 2004 versus a 6.5% target. Simultaneously, the public sector reduced its deficit from 15.1% of the GDP in 2001 to 7.1% last year.

[4] "The primary objective of the Bank shall be to achieve and maintain price stability. The Bank shall determine on its own discretion the monetary policy that it shall implement and the monetary policy instruments that it is going to use in order to achieve and maintain price stability. The Bank shall, provided that it shall not be in confliction with the objective of achieving and maintaining price stability, support the growth and employment policies of the Government..." (Law No. 4651 of April 25, 2001).

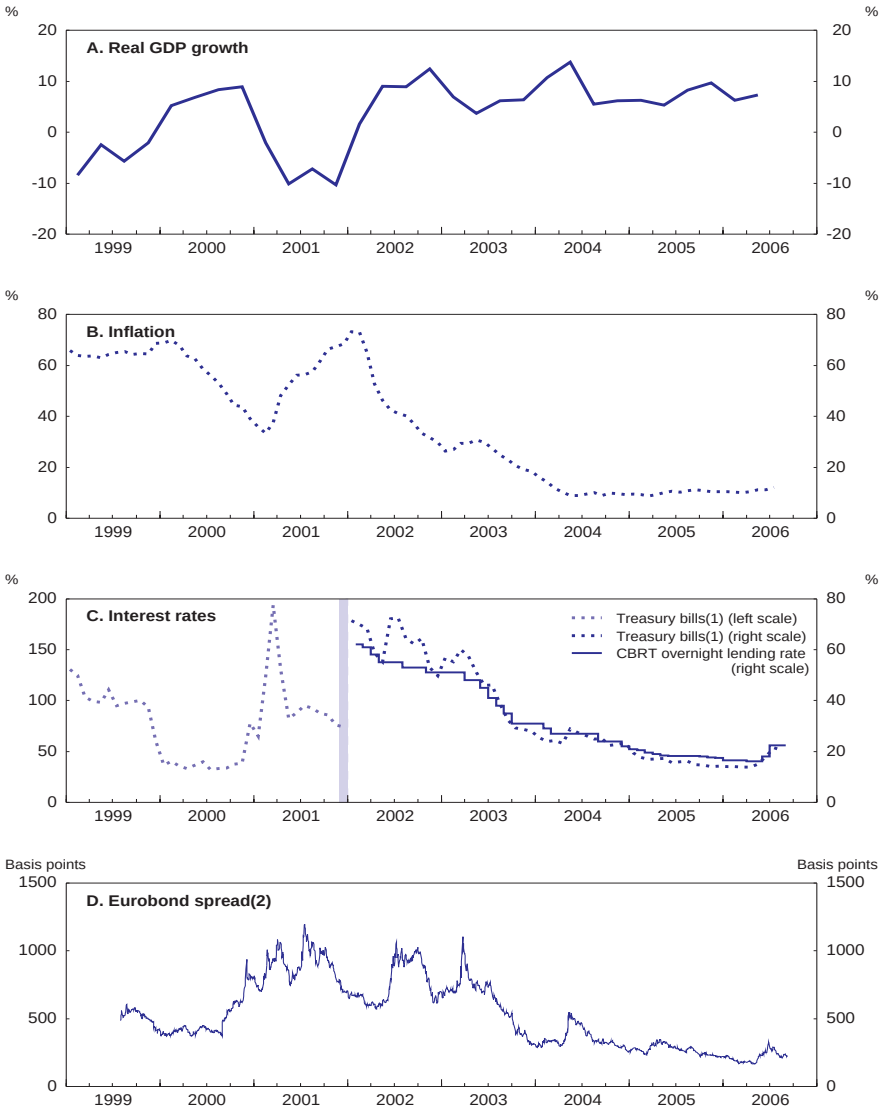


Figure 1: Positive Macroeconomic Fundamentals

Source: Brook, 2006

b) The primary objective of the CBT was defined as to achieve and maintain price stability. Inflation targets for year-end 2006, 2007 and 2008 were set at 5%, 4% and 4% (with an uncertainty band of ± 2%), respectively, with the year-end target for 2009 to be announced during 2006. Although the inflation targets are expressed in terms of CPI inflation, the central bank has emphasized the importance of monitoring several different measures of core inflation to ensure that policy is not unduly influenced by temporary CPI price movements which are beyond the influence of monetary policy. To date,

however, only exclusion-based measures of core inflation have been produced. To complement these, the CBT should also consider calculating alternative measures of central tendency - such as median inflation and trimmed means.

c) The CBT envisioned implicit IT as a transition period for IT, during which the communication, transparency and institutional setup would be enhanced gradually. The central bank has adopted a relatively transparent approach to communication, by publishing inflation and output gap projections, conditional on various alternative assumptions for the short-term interest rate, oil prices, etc.

d) In case the inflation figures fall outside the uncertainty band, the central bank must make public a separate report explaining the reasons for the incident, and the measures to be taken. Such an event would also be considered to be a breach of the economic programme with the IMF, prompting consultation with IMF staff.

At the start of implicit IT, CBT had no problem in controlling short-term interest rates through money market operations. However, monetary policy lacked control over the longer end of the yield curve, because under high public debt and short maturities, the risk premium (measured by the EMBI spread) in the post-crisis period exhibited excess sensitivity to economic and political "news". The volatile risk premium also manifested itself as excess variability in the exchange rates. Increased volatility in exchange rates coupled with fast and high exchange rate pass-through—inherited from the exchange rate targeting regimes—made forecasting inflation even more difficult, limiting the forecast horizon to a mere couple of months. By the end of the period of implicit IT, volatility in exchange rates and financial markets declined and risk premium came down. As a consequence, both the nominal and the real interest rates went down to historically low levels.

Turkey has made good progress in stabilizing the key macroeconomic indicators in recent years, not with standing the recent upward blip in inflation. In particular, Turkey has achieved significant primary fiscal surpluses every year, including outcomes close to the target of 6.5% of GDP in the past three years. Moreover, since 2001 the total fiscal deficit has fallen from 30% of GDP to around 1%, net public debt has fallen from around 90% of GNP to around 50%. By this result, Eurobond spreads have fallen. Inflation has fallen from over 50% to around 10%, and interest rates have fallen from triple digits to below 20%. These macroeconomic indicators are illustrated in Figure 1 above.

THEORETICAL MODEL OF MONETARY POLICY IN INFLATION TARGETING

Effective Channel of Interest Rates on Prices

The transmission mechanism of monetary policy refers to the series of processes through which monetary policy affects prices and quantities of various financial instruments and, ultimately, real economic activities such as inflation and growth. Keynesians have focused on the price function of interest rates on the basis of a stable investment function as shown in Figure 2. In an IT system, the interest rate channel is important since it is a system where

a short-term interest rate is used as an operating target, without an explicit intermediate target, to achieve the inflation target. A change in short term interest rates, which is used as a main tool of monetary policy during inflation targeting, can affect market rate. This change also affects the expenditures (consumption expenditure and investment demand, exports, imports). Thus, a change in short term interest rates affects the aggregate demand of economy. The changes in aggregate demand affect the price level. In other words, there is a relationship among inflation, interest rate and output, and inflation is affected by the changes in interest rate and production together in open economy.

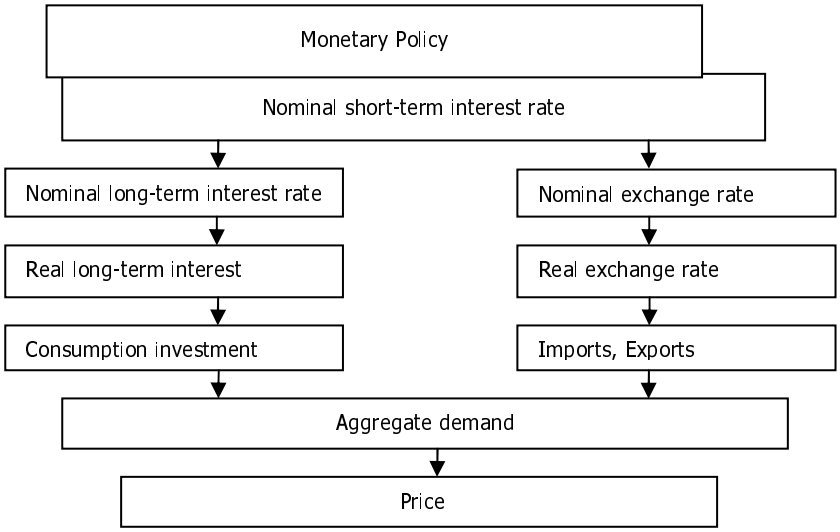


Figure 2: Transmission Channels of Interest Rates to Aggregate Demand and Prices

Source: Oh, 2000

Theoretical Model of Monetary Policy

In this section, we motivate the use of long-run restrictions in the structural vector error correction (VEC) model. For that purpose, a rational expectation to neo-Keynesian model of monetary policy is used. This model was used by Clarida, Gali and Gertler (2000), Duman (2002), Eichengreen (2002), Guender (2003), Kevin and Trehan (2003), Krusec (2005), Mishkin and Savastano (2000; 2001), Oh (2000), and Svensson (1996; 1997). Modifications of this basic framework are widely used in theoretical analysis of monetary policy. The model includes three variables: inflation, π_t, interest rate, i_t, and output, y_t, and contains three relationships. The first represents the demand relationship in the economy, also called the IS (Investment-Saving) curve, the second; the Phillips curve (the supply relation) and the third; the monetary policy rule (the Taylor rule) whose equations are as follows:

$$(\quad _{+}) = \quad + \frac{}{\gamma}[\quad - \quad (\pi_{+})] + \quad , \tag{1}$$

$$\pi \quad = \beta \quad (\pi_{+}) + \kappa \quad + \quad _{\pi} \, , \tag{2}$$

$$= \lambda \quad _{-} + \lambda_{\pi} \quad (\pi_{+}) + \lambda \quad + \tag{3}$$

respectively, where E_t denotes the expectation value based on information available at time t; γ, β, λ , λ_{π} and λ are parameters and $e_{y,t}$, $e_{\pi,t}$, $e_{i,t}$ are the error terms of the model.

The IS curve states that expected output is determined by output today and real interest rate changes. First equation represents the forward-looking IS relation, according to which the current output gap moves in concern with the current expectation of the output gap next period and responds negatively to an increase in the current real rate of interest.

The Phillips curve describes the inflation dynamics. According to this equation, the current inflation is determined by inflation expectations (also called the inflation objective) and the output gap. The current rate of inflation depends positively on the current expectation of the rate of inflation and the current output gap. In our Phillips curve output enters instead of the output gap.

The Taylor rule connects the interest rate movements to the changes in the inflation rate, past interest rate and output. The monetary policy rule (the Taylor rule) is the instrument rule that the policy maker follows in the conduct of monetary policy. The setting of the instrument responds to deviations of the variable that monetary policy targets.

In this paper we aim to investigate the long term relationship among interest rate, inflation and output in inflation targeting regimes in Turkey. The model hence implies that there is at least one cointegrating relationship among the three variables included, which is useful information for the empirical analysis.

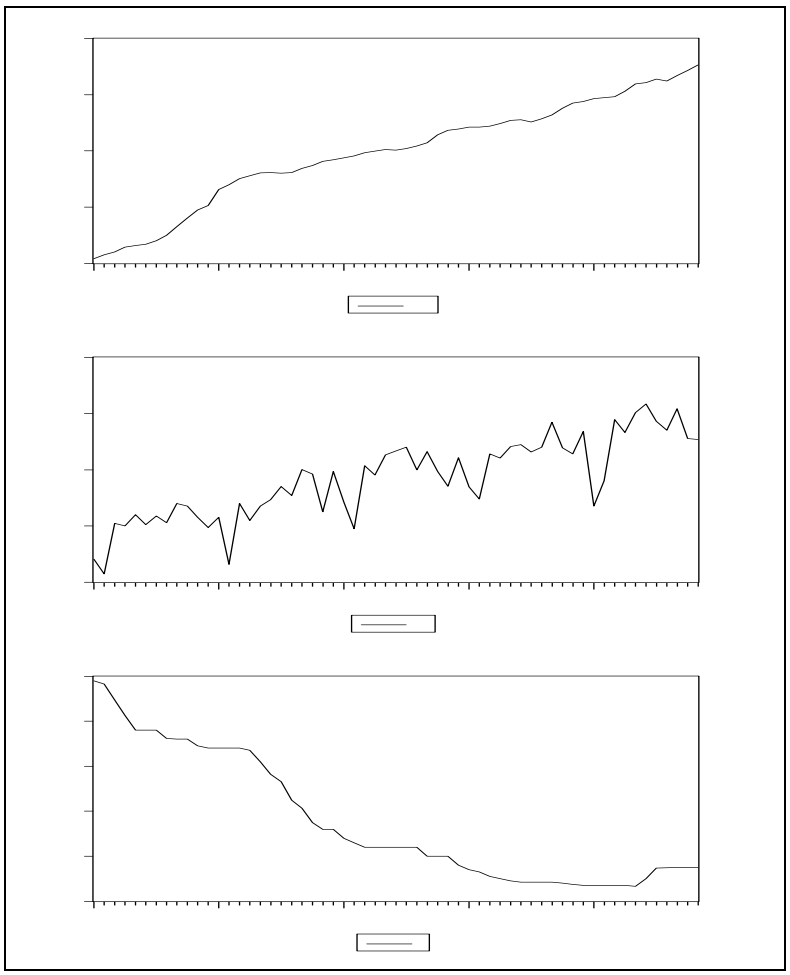
EMPIRICAL ANALYSIS

In this section, we have studied the short and long term relationships among the related series using impulse response functions in vector autoregression (VAR) analysis and Johansen Cointegration Method, respectively. For these statistical techniques, it should be known whether the series are stationary, or not. In order to see the order of integration of the series, we also use Augmented Dickey Fuller (ADF) Test, first[5] introduced by Dickey and Fuller (1979).

[5] Augmented Dickey Fuller Test is also examined by Said and Dickey (1984).

Data

In the empirical study, we include three variables: Inflation (π_t), industrial production (output) (y_t) and interest rate (i_t), as described in the former section, to analyze the monetary policy in Turkey. Interest rate is represented by money market rate (in percentages); inflation is represented by change in the consumer price index (in percentages, not seasonally adjusted), and industrial production is taken in the logarithmic form (not seasonally adjusted). The data was taken from the International Financial Statistics (IFS). All series have monthly data between 2002/01-2006/12. Graphs of all these series are shown in Figure 3. We would like to note that the reason why only three variables are included in this empirical study has been given in detail by a complete description of the economy with both supply and demand relations in the former section.



Note: Pi (π) represents the variable inflation.

Figure 3: Graphs of the Series

Unit Root Tests

The first step in econometric analysis is to analyze the time series properties of the data by testing whether the variables are stationary or not. For this aim, we apply ADF Test to the series and the results of this test are given in Table 1. If a series is stationary after differencing d times, this series is said to be integrated of order d, in short, it is shown as I(d). By this description, we observe from Table 1 that all series are first order integrated I(1) series. This means that first differences of these series are stationary. The lag number (k=1) used in the unit root test was determined by paying attention to errors (errors should be white noise) and according to the criteria of Akaike (1971) and Schwarz (1978).

Table 1: The Results of ADF Test

Variables	ADF Values (k = 1)		
	Level	First-difference	Result
π_t	-1.312067	-3.393973*	I(1)
i_t	-2.100075	-3.414375*	I(1)
y_t	-0.521711	-3.246814*	I(1)

Note: The first differences of series do not include unit root at 1% significance level (**) and at 5% significance level (*). MacKinnon critical values for 1%, 5%, 10% significance levels are -3.550, -2.914 and -2.594, respectively.

VAR Analysis

The VAR analysis[6] is originally introduced by Sims (1980). To perform VAR analysis, VAR model should be set up. By using the Schwarz Criterion, the order of VAR model is found as 6. Therefore, VAR (6) model can be written for the series we are interested in as follows:

$$\Delta\pi = + \sum = \Delta\pi_{-} + \sum = \Delta_{-} + \sum = \Delta_{-} + \quad (4)$$

$$\Delta = + \sum = \Delta\pi_{-} + \sum = \Delta_{-} + \sum = \Delta_{-} + \quad (5)$$

$$\Delta = + \sum = \Delta\pi_{-} + \sum = \Delta_{-} + \sum = \Delta_{-} + \quad (6)$$

where a_k are constants, b_{kj}, c_{kj}, and d_{kj} are coefficients, e_{kt} are the error terms of the model, k, j = 1,2,3, and Δ represents the first difference of the series.

[6] See Enders (2003) for details.

Lagrange Multiplier (LM) Test is used in order to examine the serial correlation in VAR model. The results of LM test indicate that there is no autocorrelation in the model[7].

White Test is used in order to examine homoskedasticity in VAR model. The results of this test, which are given in Table 2, show that there is no heteroskedasticity in the model.

Table 2: VAR Residual Heteroskedasticity Test

Joint test:			
	Chi-sq	df	Prob
	218.4505	216	0.4406

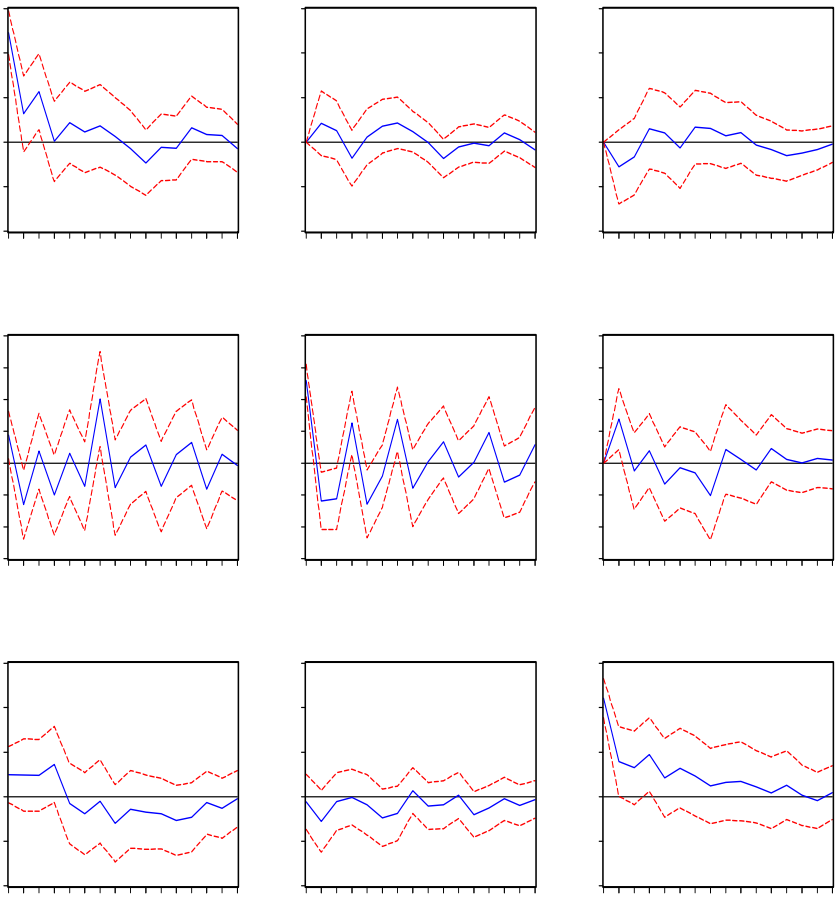
Consequently, VAR(6) model satisfies all statistical assumptions for this data set. For further analysis of VAR model, we will obtain the impulse response function and variance decomposition in the next subsections.

Impulse Response Function. The use of the impulse response function enables us to analyze the dynamic behavior of a variable due to random shocks given to other variables. In fact, the graphs of the impulse response functions provide a better device to examine the shocks. The inference of VAR model is made by the aid of the impulse response function graphs, given in Figure 4. In order to capture the dynamic effects, we consider responses of each variable over 16 months to a one standard deviation shock in these variables. The dash lines in Figure 4 show 95% confidence interval of the responses of the series.

According to Figure 4, interest rate series has a positive response to its lagged series for the first period and the responses of interest rate series gradually decline in the course of time. The interest rate also responds in the same way like inflation series to a shock in the industrial production, and similar behavior can be observed in the response of industrial production towards interest rate. In accordance with these findings, it can be confirmed that the interest rate movements are connected to the changes in the inflation rate, past interest rate and output under IT regime in Turkey as explained theoretically by the equation (3) in model.

According to Figure 4, inflation rate series has a positive response to its lagged series for the first period and the responses of inflation rate series gradually decline in the course of time. Inflation series has no response at the first period, whereas the responses of the inflation series have behavior for the later periods, in an oscillation way due to given shocks in industrial production and interest rate. These findings refer to the dynamics of inflation in Turkey under IT regime as represented in the equation (2). The rate of inflation depends positively on the current expectation of the rate of inflation and the current output.

[7] For each lag, all p values are greater than 0.05.



Note: Pi (π) represents the variable inflation and D represents the first difference of the series.

Figure 4: The Impulse Response Graphs

When a standard deviation shock is applied to the inflation series, the industrial production (output) gives positive response in the first period. Thereupon, while the inflation rate decreases the real interest rate increases. Thus, a change in short term interest rates affects the aggregate demand of economy. The changes in aggregate demand affect the price level. Therefore there is a relationship among inflation, interest rate and output, and inflation is affected by the changes in interest rate and production together in open economy as in Turkey.

Variance Decomposition. Variance decomposition method is used in order to analyze the impact of unanticipated policy shocks on macro variables in a more convenient and comprehensive way. This method can capture both

direct and indirect effects of the variables. We have investigated the sixteen periods, because after these sixteen periods the variance percentages have been found to be approximately steady in our application. The results of variance decompositions for all variables are reported in Table 3.

Table 3: The Values of Variance Decomposition

Variance Decomposition of DPI:			
Period	Dπ	DY	DI
1	100.00	0.00	0.00
4	89.72	4.38	5.90
8	84.07	7.90	8.03
12	82.43	8.95	8.62
16	80.67	9.36	9.97
Variance Decomposition of DY:			
Period	Dπ	DY	DI
1	10.26	89.74	0.00
4	21.61	65.73	12.66
8	31.83	54.90	13.27
12	32.85	53.26	13.89
16	33.46	53.77	12.77
Variance Decomposition of DI:			
Period	Dπ	DY	DI
1	4.72	0.27	95.01
4	14.65	3.98	81.37
8	17.31	7.35	75.34
12	21.09	8.70	70.21
16	22.76	9.27	67.97

Note: D represents the first difference of the series.

As expected, the explanation rates of the variables on themselves are quite high. According to Table 3, it is observed that price index is completely explained (100 percent) by its innovations in the first period, but in the last period the explanation percentages on itself are 80.67 percent, and we see that in this period innovations to industrial production and interest rate are 9.36 percent and 9.97 percent, respectively. On the other hand, innovations to industrial production and interest rate grow rapidly over time. This means that the variance in inflation is explained by innovations of itself and by the innovations of output and interest rate.

Furthermore, from Table 3 it is clear that the variance of output is explained by innovations on itself (89.74 percent) and by innovations of price index (10.26 percent) in the first period, but after first period, while the explanation shares of innovations to output are getting smaller, the shares of innovation to price index and interest rate are getting bigger. From the variance decomposition values

of interest rate, we see that the variance of interest rate is explained by innovations on itself (95.01 percent) in the first period, but while the period is getting longer. The interest rate is also explained by inflation and output (22.76 percent and 9.27 percent in the last period). Finally, the findings of variance decomposition show that there are short term relationships among inflation, interest rate and production, and also the inflation rate is significantly affected by the changes in interest rate and production together in Turkey under IT regime.

Cointegration Analysis

Engle and Granger (1987) were the first to formalize the idea of the integrated variables sharing an equilibrium relation which turned out to be either stationary or had a lower degree of integration than the original series. They denoted this property by cointegration, signifying co-movements among trending variables, which could be exploited to test for the existence of equilibrium relationships within fully dynamic specification framework. In this study, we use Johansen Cointegration Method, proposed by Johansen (1988) and Johansen and Juselius (1990), to see if there is a long term relationship among the series: inflation, interest rate and production. This method is based on the VAR model. The order of the VAR model used in Cointegration Analysis and the suitable model for cointegration equation are determined by using the Schwarz Criterion. The results of the cointegration test are given in Table 4.

Table 4: Johansen Cointegration Test

Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
53.22844	34.91	41.07	None **
18.40813	19.96	24.60	At most 1
2.832958	9.24	12.97	At most 2

Note: The hypothesis "there is no cointegration equation" is rejected at 1% significance level (**)

From the values of Likelihood Ratio (LR) Test in Table 4, we infer that the series are cointegrated, so the series have a long term relationship among each other, and this long term equilibrium can be expressed by the cointegrating equation (7), obtained by

$$\pi_t = -338.8415 + \underset{(1.471)}{5.168647}\, y_t - \underset{(-1.756)}{2.804058}\, i_t + e_t, \qquad (7)$$

where there are values of *t*-test statistics in the parentheses. Note that critical value is 1.282 at a 10% significance level. Production and interest rate have a statistically significant effect on inflation in the long term. Production has a positive effect on inflation in the long term, whereas interest rate has a negative effect. When production increases 1%, this makes the inflation increase 5%; on the other hand, when interest rate increases 1%, the inflation decreases nearly 3% in the long term.

When we examine the long term relations for paired variables, such as inflation-production, inflation-interest rate, the results of Cointegration Tests are given in Tables 5 and 6, respectively. From these results, we conclude that there are long term relationships both between inflation and production and between inflation and interest rate.

Table 5: Johansen Cointegration Test (inflation-production)

Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
27.45919	18.17	23.46	None **
4.837615	3.74	6.40	At most 1 *

The cointegrating relation between inflation and production can be given by

$$\pi_t = 1218.419 - 10.45281\ y_t + 10.16546\ t + e_t, \quad (8)$$
$$(-0.801)$$

where t is the trend term. From equation (8), it is clear that there is no statistically significant effect of production on inflation in the long term.

The cointegrating relation between inflation and interest rate can be given by

$$\pi_t = 362.6816 - 21.59415\ i_t + e_t. \quad (9)$$
$$(-0.345)$$

Table 6: Johansen Cointegration Test (inflation-interest rate)

Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
30.61159	19.96	24.60	None **
3.011973	9.24	12.97	At most 1

From equation (9), there is no significant effect of interest rate on inflation in the long term. It is worth to point out that inflation is not affected by only production or only interest rate change in the long term in Turkey. However, when we make changes on both production and interest rate, these changes make significant effect on inflation, as shown in (7).

By the results of cointegration analysis, it is confirmed that there is a long-term relationship among inflation, interest rate and output. Furthermore, it is also confirmed that the inflation rate is affected by the changes in interest rate and production together.

CONCLUSION

Primarily, it is briefed that Turkish economy is characterized by 4 distinct periods following the capital account liberalization in 1989. The first period is

the years between 1989 and 1994. The second is from 1995 to 1999. The third period covers the months beginning with the January 2000 till March 2001. The three-year disinflation program which was put into effect on January 1, 2000, is one of the highlights of the period. In this program, the exchange rate was used as the nominal anchor. Under the nominal anchor regime, the exchange rate was focused in order to control the general price levels thereby the inflation rate could be taken under control. The last episode is after the adoption of the floating rate regime in February 2001, which then was followed by the launching of the Economic Program for Strengthening the Turkish Economy in May 2001. During 2002-2005, the implicit IT regime was implemented. By 2006, the full-fledged IT was adopted as a framework for monetary policy. By IT regime, the exchange rate mechanism was abandoned and the "interest rate mechanism" has been put into practice. In this mechanism, the short-term nominal interest rate affects the real interest rate thereby the inter-temporal consumption will be affected. The influence of the changes in consumption alters the output and then it affects the inflation via the general prices level. Hence, in this paper, we especially concentrated on interest rate effects.

By this paper, the interaction among interest rate, inflation and output is examined for the years between 2002-2006, by using impulse response functions in vector autoregression (VAR) analysis and Johansen Cointegration Method in inflation targeting regimes in Turkey. Through the empirical analysis, it is aimed whether there is a short and a long term relationship among inflation, interest rate and production, and whether the inflation rate is affected by the changes in interest rate and production under IT regime in Turkey. The impulse responses based on the model dynamics reveal that the increase in interest rates will lead to a decline in inflation rates by decreasing the aggregate demand in Turkish economy. Besides, by the cointegration analysis, it is found out that there is a long-term relationship among inflation, interest rate and output.

Finally, this paper shows that the interest rate is effective in the transmission mechanism under inflation targeting regimes and, in order to achieve the targeted inflation rate, the interest rate channel in which a short-term interest rate is used as a monetary policy instrument has a high importance. Thereby the findings of this study can help us to understand why and how inflation targeting has become a successful one among the alternative monetary regimes as it is a new monetary policy regime, and this paper may contribute by giving some suggestions to the policy makers who wish to apply or who have already applied IT regime.

REFERENCES

Akaike, H. (1971). Statistical Predictor Identification. Annals of the Institute of Statistical Mathematics, 22, 203-217.

Akyürek, C. & Kutan, A.M. (2006). Can Inflation Targeting Regimes be Effective in Emerging Economies?: The Turkish Experience. Working Paper, No. 06-0902. Retrieved August 11, 2008 from the World Wide Web: http://www.siue.edu/BUSI NESS/econfin/acpages/kutan.html.

Blejer, M.I. & Hammond, G. (2006). Independence and Accountability: Concepts and the UK Experience. Paper presented at Inflation Targeting Conference, The Central Bank of the Republic of Turkey, Istanbul, 19-20 January 2006.

Brook, A.M. (2006). Policies Do Improve Turkey's Resilience to Financial to Financial Market Shocks. OECD Economics Department Working Paper, No. 528 ECO/ WKP/ 56.

Carare, A., Schaechter, A., Stone, M. & Zemler, M. (2002). Establishing Initial Conditions in Support of Inflation Targeting. IMF Working Paper, No. WP/02/102, Washington D.C.

Clarida, R., Gali, J. & Gertler, M. (2000). The Science of Monetary Policy: A New Keynesian Perspective. Journal of Economic Literature, 37, 1667-1707.

Dickey, D.A. & Fuller, W.A. (1979). Distribution of the Estimators for Autoregressive Time Series with a Unit Root. Journal of the American Statistical Association, 74, 427-431.

Duman, A. (2002). Inflation Targeting as a Monetary Policy and its Applicability to Developing Countries. The Central Bank of the Republic of Turkey, Research Department, Working Paper, No. 7, Ankara.

Eichengreen, B. (2002). Can Emerging Markets Float? Should They Inflation Target? Banco Central Do Brasil, Working Paper, No. 36.

Enders, W. (2003). Applied Econometric Time Series (2nd Ed.) John Wiley & Sons.

Engle, R.F. & Granger, C.W.J. (1987). Co-integration and Error Correction: Representation, Estimation and Testing. Econometrica, 55, 251-276.

Golinelli, R. & Rovelli, R. (2005). Monetary Policy Transmission, Interest Rate Rules and Inflation Targeting in three Transition Countries. Journal of Banking and Finance, 29, 183-201.

Guender, A.V. (2003). Optimal Monetary Policy under Inflation Targeting based on an Instrument Rule. Economics Letters, 78, 55-58.

Johansen, S. (1988). Statistical Analysis of Cointegration Vectors. Journal of Economic Dynamics and Control, 12(1), 231-254.

Johansen, S. & Juselius, K. (1990). Maximum Likelihood Estimation and Inference on Cointegration with Application to the Demand for Money. Oxford Bulletin of Economics and Statistics, 52, 169-210.

Kara, A.H. (2006). Turkish Experience with Implicit Inflation Targeting. The Central Bank of the Republic of Turkey, Research and Monetary Policy Department, Working Paper, No. 06/3.

Karasoy, A., Kunter, K., & Us, V. (2005). Monetary Transmission Mechanism in Turkey under Free Float Using a Small-scale Macroeconomic Model. Economic Modelling, 22, 1064-1073.

Kevin, J.L. & Trehan, B. (2003). Forward-looking Behavior and Optimal Discretionary Monetary Policy. Economics Letters, 81, 249-256.

Khan, M.S. (2003). Current Issues in the Design and Conduct of Monetary Policy. IMF Working Paper, No. WP/03/56, Washington D.C.

Krusec, D. (2005). Is inflation targeting effective? Monetary transmission in Poland, the Czech Republic, Slovakia and Hungary. European University Institute, Firenze, Italy. Retrieved August 11, 2008 from the World Wide Web: http://halweb.uc3m.es/ esp/Seminarios/abstract/Dejan.pdf.

Mark, A., Baumgartner, U. & Raghuram, A. (2006). Too much, too soon: IMF Conditionality and Inflation Targeting. Retrieved August 21, 2008 from the World Wide Web: http://www.brettonwoods project.org.

Masson, P., Savastano, M. & Sharma, S. (1997). The Scope for Inflation Targeting in Developing Countries. IMF Working Paper, No. 97/130, Washington.

Mishkin, F.S. (2000a). Inflation Targeting in Emerging-market Countries. American Economic Review, 90, 105-109.

Mishkin, F.S. (2000b). Inflation Targeting in Emerging Market Countries. NBER, Working Paper, No. 7618.

Mishkin, F.S. & Posen, A.S. (1997). Inflation Targeting: Lessons from four Countries. NBER, Working Paper, No. 6126.

Mishkin, F.S. & Schmidt-Hebbel, K. (2001). One Decade of Inflation Targeting in the World: What Do We Know and What Do We Need To Know?. NBER, Working Paper, No. 8397.

Mishkin, F.S. & Savastano, M.A. (2000). Monetary Policy Strategies for Latin America. NBER, Working Paper, No. 7617.

Mishkin, F.S. & Savastano, M.A. (2001). Monetary Policy Strategies for Latin America. Journal of Development Economics, 66, 415-444.

Oh, J. (2000). Inflation Targeting: A New Monetary Policy Framework in Korea. Paper presented at the International Symposium on Practical Experiences on Inflation Targeting, Bangkok, Thailand, 20 October 2000.

Ogretmen, E. (2004). Inflation Targeting. The Central Bank of the Republic of Turkey, Department of Foreign Relations.

Ozatay, F. (2005). Monetary Policy Challenges for Turkey in European Union Accession Process. The Central Bank of the Republic of Turkey, Research Department, Working Paper, No. 05/11.

Said, E. & Dickey, D.A. (1984). Testing for Unit Roots in Autoregressive Moving Average Models of Unknown Order. Biometrika, 71, 599-607.

Schwarz, G. (1978). Estimating the Dimension of a Model. Annals of Statistics, 6, 461-464.

Sims, C. (1980). Macroeconomics and Reality. Econometrica, 48, 1-48.

Svensson, L.E.O. (1996). Inflation Forecast Targeting: Implementing and Monitoring Inflation Targets. NBER, Working Paper, No. 5797.

Svensson, L.E.O. (1997). Inflation Forecast Targeting: Implementing and Monitoring Inflation Targets. European Economic Review, 41, 1111-1146.

Svensson, L.E.O. (2002). Inflation Targeting: Should It be Modeled as an Instrument Rule or a Targeting Rule?. NBER, Working Paper, No. 8925.

Tutar, E. (2002). Inflation Targeting in Developing Countries and Its Applicability to the Turkish Economy. Unpublished Master Thesis, Virginia Polytechnic Institute and State University, Blacksburg, Virginia.

Yılmaz, D. (2006). Dollarization: Consequences and Policy Options. Paper presented at the Dollarization Conference, Central Bank of the Republic of Turkey, 14-15 December 2006, Istanbul.