A MODIFIED TAYLOR RULE FOR THE CENTRAL BANK OF TURKEY* (CBRT): 2003-2012

Ç. Levent USLU** Ahmet ÖZÇAM***

ABSTRACT

In this paper we investigated whether the Central bank of Turkey (CBRT) followed a strict Taylor Rule during 2003-2012. We found that it has not, due to different reasons in different periods: inflation targeting policy before the global crisis and trying to achieve the joint targets of price and financial stabilities after the crisis. Furthermore we tried to formulate a modified Taylor Rule which fitted the actual courseof nominal interest rate during 2010-2012 as closely as possible. In contrast with our estimated modified Taylor Rule which indicated that the nominal interest rates were increased only by 0.49% in practice during 2010-2012, the estimated standard Taylor Rule suggested an increase of the nominal interest rates by 1.23% during 2008-2010 for each percentage change in the inflationary gap. Hence, this displayed a loose monetary policy with respect to the strict Taylor Rule. As a matter of fact, in January 2014, CBRT had to increase its policy interest rate down from 4 % up to 10 %.

Key Words: Taylor Rule, Reaction Function Of Central Bank, Modified Taylor Rule, Turkey

ÖZ

Bu makalede Türkiye Cumhuriyet Merkez Bankasının (TCMB) 2003-2012 seneleri arasında katı bir Taylor Kuralı uygulayıp uygulamadığını araştırdık. Değişik dönemlerde değişik sebeplerden uygulamadığına karar verdik: küresel krizden önce enflasyon hedeflemesi politikası ve küresel krizden sonra fiyat ve finansal istikrar hedeflerini beraber gözetmeye çalışan politikalar. İlaveten, 2010-2012 yılları arasında nominal faizlerin gelişimini oldukça iyi açıklayan uyarlanmış bir Taylor Kuralı formüle etmeğe çalıştık. Enflasyon açığındaki her % 1 için, bizim uyarlamış Taylor kuralı 2010-2012 yılları arasında nominal faizlerin % 0,49 yükseltildiğini işaret ederken, 2008-2010 yılları arasında standart Taylor kuralı nominal faizlerin % 1,23 yükseltilmesini tavsiye etmiştir. Dolayısıyla, bu standart Taylor kaidesine göre oldukça gevşek bir para politikasının uygulandığını göstermektedir. Nitekim, 2014 yılı Ocak ayında

TCMB'sı politika faizini % 4'ten % 10'a kadar yükseltmek mecburiyetinde kalmıştır.

Anahtar Kelimeler: Taylor Kuralı, Merkez Bankası Tepki Fonksiyonu, Uyarlanmış Taylor Kuralı, Türkiye

INTRODUCTION

Did ever the Central Bank of Republic of Turkey (CBRT) follow a strict (standard) Taylor Rule prescription during 2003-2012? The answer seems to be NO! However, the reasons are different when different periods of time are considered separately. CBRT delayed announcing a full-fledged' inflation targeting policy up until the beginning of 2006, since the excess variability in exchange rates, high Public Debt/GDP and a dollarized economy could all lead to a credibility loss for the conduct of monetary policy had the inflation targeting system not been successful. Therefore, during 2003-2008, the joint coordinated task of the government and CBRT was to try to reduce the remarkably high nominal interest rates which hovered around 15-30%.

On the other hand, during and after the global crisis (2008-2012), the heavy money capital inflows/outflows posed a challenge to the way the monetary policy should have been implemented. In early 2010, CBRT announced the beginning of a likely and necessary new monetary policy toward achieving both the price and financial stability by using the policy interest rate, require reserve ratio (RRR) and the width of the interest rate corridor together as complementary policy instruments. As long as the CBRT continued providing short-term liquidity to the borrowing banks and therefore kept the interbank interest rate close to its policy rate, the latter had to lie between the lower and upper limits of its interest rate corridor. CBRT has been one of the first CB's trying to monitor the financial stability while preserving the inflation targeting system. While this unorthodox system demonstrated a kind of courage in implementing the monetary policy, it certainly paved the way for intense deliberations.

Even though the new policy kept the objective of price stability, it added a new objective: the financial stability where macroeconomic equilibria could be disturbed quickly in the event of fast capital outflows. The president of CBRT, Başçı (2011) gave more details about the framework of the new policy in April 2011 in presentations to IMF and the World Bank. Başçı described the underlying states of Turkish economy as made up of 4 Zones in each of which both the price and financial stabilities should have been watched. These 4 zones constituted the basis of the way how the joint use of complementary tools of the policy interest rate and RRR were to be implemented. We will show that out of these 4 Zones, the Turkish economy mostly switched back and forth between Zones III and I, which represent heavy capital inflows when the economy grows due to easily accessible credits financed by foreign currency and a sudden stop in the growth rate of the Turkish economy because of money capital outflows.

It seems that in both of these 2 periods (before and after 2008) CBRT followed monetary policies not in line with the standard Taylor Rule. In the traditional monetary policy, the policy interest rate and RRR were substitutes, whereas CBRT used them as complements and aiming at different targets. In general, the policy rate was used to block the excessive capital

inflows/outflows and RRR policy was thought to effective toward the credits of banks, the growth rate of economy, the Current Account deficit.

Therefore, the new policy was clearly different from the standard Taylor Rule, since in the case of heavy capital inflows and growing economy, Taylor suggested the increasing of the nominal and even the real interest rates. However, CBRT decided to *decrease* the rates counting on the complementary RRR policy to cool the economy in such a case.

What was the reason that the CBRT chose such an experimental approach? The easy monetary policies (Quantitative expansions) implemented in developed countries after the global crisis lowered the interest rates to unprecedented levels in those countries. This situation forced the capital owners in these developed countries to search for better alternatives. The destination address for such money capitals were the developing countries like Turkey. From the developing countries' point of view, even though some of these capital flows were desirable, its continual movement created an overvalued domestic currency and a deterioration in Current Account balance.

Section-2 reviews the monetary policy in Turkey since 2001 in 4 distinct periods and tries to explore whether CBRT used the standard Taylor Rule, and if so when? Section-3 discusses additionally the financial stability issues. In Sections 4 and 5, we investigate the data and estimation. Section-6 is the conclusion which summarizes the findings.

1. THE MONETARY POLICY IN TURKEY SINCE 2001

In this paper, by the standard Taylor rule for Turkey it is meant an **increase** (decrease) in the short-term nominal interest rate by the Central Bank of Republic of Turkey (CBRT) when the *inflationary gap* (difference between the actual rate of inflation and the officially targeted inflation rate) and the *output gap* (difference between the actual output and the natural level of output in % terms) **increase** (decrease). We calculated the natural level of output using Hodrick - Prescott (HP) filtering.

Following the collapse of crawling exchange rate peg in February 2001, Turkish Lira was allowed to depreciate substantially and the rate of inflation reached about 70% at the end of 2001. Bringing down the inflationary expectations posed a big challenge. From 2002 till end of 2005, CBRT implemented only an 'implicit' inflation targeting in Turkey before it started adopting a 'full-fledged' inflation targeting policy at the beginning of 2006, since the excess variability in exchange rates, high Public Debt/GDP and a dollarized economy could all lead to a credibility loss for the conduct of monetary policy had the inflation targeting system not been successful.

1-a) Period: 2003:Q4-2008:Q3

Kara (2006) argues that institutional independence of CBRT (April 2001) and political support laid the foundations for initiating the inflation targeting framework. CBRT never raised the interest rate during 2003:Q4-2006:Q2 (the first part of this period) even though both the inflation gap and the output gap increased from -2.5% up to 4.6% and from 0% up to 3.2% respectively (Table-1and Figure 1-A). Raising the interest rate when the fiscal sustainability was

not fully present was thought to be risky by CBRT in the case of a possible sudden capital outflow which could result in a depreciating TL and render the public foreign debt worse.

Nevertheless, CBRT tightened the interest rates in the quarter of 2006:Q3 up to 17.7% down from 14% in the previous quarter, and kept it at around 16.5% till the end of this period (2008:Q3). The real interest rates decreased due to the decrease in nominal rates and an increase in the rate of inflation throughout this period (2003-2008). The only exception was 2006:Q3-2007:Q3 when the nominal rates were increased up to 17.7%. The real rates increased from 4.4% in 2006:Q2 up to 10.3% in 2007:Q3.

While the inflationary gap ended up at 7.6%, the output gap reached 7% at the end of this period (2008:Q3). During this whole period (2003-2008) while Public Domestic Debt/GDP ratio (PDD/GDP) decreased from 42% down to 28%, Current Account Deficit/GDP ratio (CAD/GDP) steadily rose from 1% up to 9% (Table-1 and Figure 1-B).

As a result, during 2003-2008, CBRT seems to have followed a standard Taylor Rule prescription only to a certain extent: at the first part of this period (2003-2006), CBRT lowered the interest rates when both the inflation and output gaps were increasing but mostly negative, and raised them in 2006:Q3 up to 17.7% from about 14% when both gaps had started turning positive and became quite substantial afterwards. However, the interest rates were kept constant (at about 16.5% on the average) during the second part of this period (2006-2008) when the inflationary and output gaps kept rising and reached 7.6% and 7% respectively at the end of this whole period.

Table 1: Monetary Policy and Economic Indicators, 2003-2010

	ZONE	Nominal Interest Rate	Required Reserve Ratio	Inflationay Gap	Output Gap	CA Deficit/ GDP	Public Domestic Debt/GDP
200 3Q4- 200 8Q3	III and I	26.5% 16.7% Decrease	6% Stable	- 2.5% 7.6% Increase	0 % 7% Increase	1% 9% Increase	42% 28% Decrease
200 8Q3- 2010Q4	III and I	16.7% 6.6% Decrease	5.25% Stable	7.6% 1% Decrease	7 % - 2.3% Decrease	9% 6% Decrease	28% 32% Increase

Figure 1-A: Nominal Interest Rate, Inflationary Gap and Output Gap
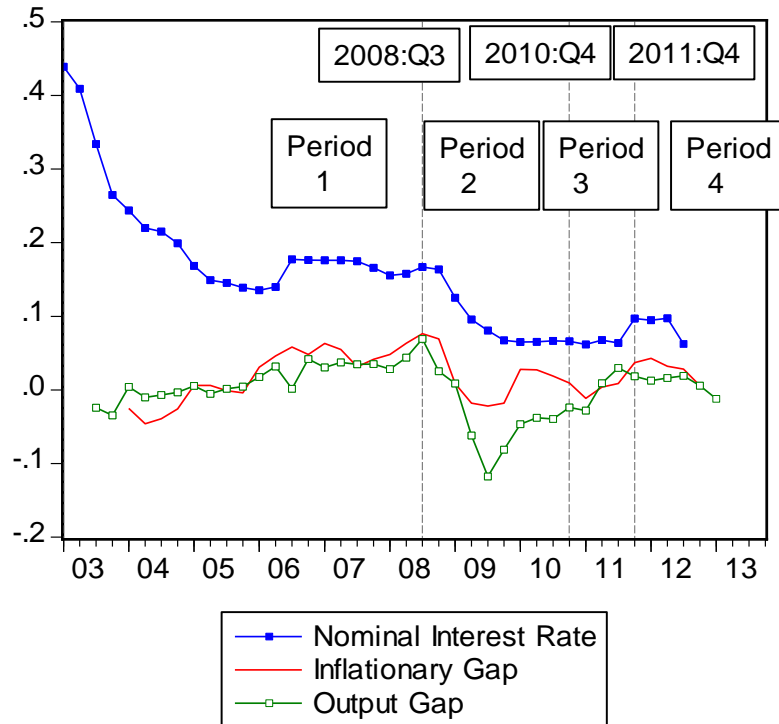
1-b) Period: 2008:Q3-2010:Q4

In the last quarter of 2008, the countries in the world started to conduct economic policies to alleviate the consequences of the *global crisis*. During 2003-May 2010, we can say that the CBRT's *policy interest rate* was determined mostly by the excess liquidity conditions, since CBRT withdrew banks' funds from the lower limit of its *interest rate corridor* (borrowing rate) on overnight basis. These excess liquidity conditions lasted till May 2010. On May 20th 2010, CBRT started 1-week *quantity* repo auctions to supply funds to banks and withdrew the excess funds on overnight basis from its borrowing rate again. Therefore, CBRT's policy interest rate up till May 2010 can be considered as its borrowing rate due to excess liquidity in the money markets and non-willingness of banks to extend credits to private sector during the global crisis and heavy capital inflows from developed countries afterwards (Interview with the Money Markets General Directorate of CBRT).

CBRT had already started loosening the monetary policy in 2008:Q3 by starting paying interests on overnight loans it accepted from the banking market in order to boost bank credits. The interest rates came down by 1,010 basis point, from about 16.7% down to 6.6% in about one year's time from 2008:Q3 to 2009:Q4. Moreover, CBRT lowered RRR (required reserve ratio) from 6% down to 5% in 2009 and up to 5.5% in 2010 on TL deposits.

The inflationary gap decreased from 7.6% in the beginning of this period down to 1% at the end reaching a trough of -2% in 2009:Q3 and an in-between

peak of 2.8% in the first half of 2010. The output gap decreased similarly from 7% down to -2.3% at the end of this period. However, a substantial trough of -11.7% occurred in 2009:Q3. CBRT followed an easy monetary policy in such an environment and was able to lower the interest rates since the banks chose to keep their excess liquidity with the CBRT rather than extending credits to the private sector. However, the rates were kept at about 6.6% after 2009:Q4.

Unlike the previous period (2003-2008), both The Public Domestic Debt/GDP (PDD/GDP) and Current Account Deficit/GDP (CAD/GDP) reversed their trends (Table-1 and Figure 1-B). PDD/GDP ratio which had steadily decreased since 2002 started rising during the global crisis period. It deteriorated from 28% up to 34.5% during the global crisis (2008:Q4-2009:Q4) due to weak government tax collections. On the other hand, CAD/GDP improved and shrank down to 2% in 2009:Q4 due to weak GDP and widening again in the later part of the period reaching 6% at the end of this period in 2010:Q4.

During 2008:Q3-2010:Q4 we can say that CBRT <u>seems to have followed</u> somehow a standard Taylor Rule prescription: it lowered the short term interest rates substantially when both the inflationary and output gaps became negative and kept the interest rate constant at around 6.6% from 2009:Q4 to 2010:Q4 when they both started rising again. In Section-5 below where we will estimate the standard Taylor Rule we will examine whether the monetary policy has been loose enough during the global crisis and tight enough in the 2010.

1-c) Period: 2010:Q4-2011:Q3

Due to the fact that the household balance sheet was not damaged during the crisis, Turkish economy recovered in the lead of domestic demand with the help of appreciation TL. However imports increased also. The fact that Turkish exports had been sent to developed countries which were heavily affected from the global crisis put a restraint on these earnings. Therefore, the Turkish economy faced a divergence between the domestic and external demands (IMF, 2012, Country Report: Turkey).

The divergence between the domestic and external demands became more pronounced in the later part of 2010 when strong short-term capital inflows (portfolio investments) increased. CBRT realized that the appreciating TL (Turkish Lira) in real terms fueled a credit boom deteriorating the CA deficit, undermining competitiveness and adding to inflation from the demand side. Of course, this inflow of foreign capital was a natural consequence of the 2008-2009 global crisis when the world interest rates had plummeted and the capital owners started looking for better alternatives in developing countries. CA deficit started increasing from 6% upward while the inflationary gap and the output gap were 1% and about -2.3% respectively at the beginning of this period (Table-2 and Figure 1-B).

Figure 1-B: Nominal Interest Rate, the Public Domestic Debt/GDP PDD/GDP) and Current Account Deficit/GDP (CAD/GDP)
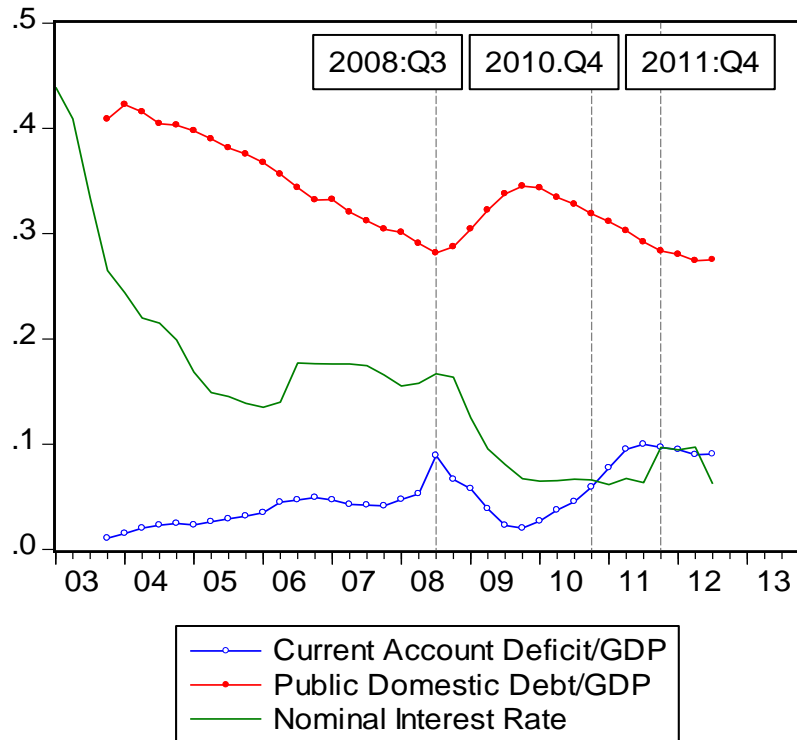
In view of these new developments, CBRT started implementing the monetary policy in a manner that can be considered as unorthodox or experimental, taking the financial stability into account in addition to the price stability. To fight against the strong capital inflows which could dry up either in response to increasing CA deficits or a sudden reversal in global risk appetite which could suddenly depreciate TL and adversely affecting banks' and firms' balance sheets that had been borrowing in FX, CBRT designed and introduced a new policy by using a variety of instruments it considered to be complementary, instead of using the short term interest rate as the sole policy tool in order to achieve two objectives: price and financial stability. In fact Turkey always suffered from such sudden capital outflows resulting in deep recessions such as those in 1994 and 2001. Hence, the CBRT operating as an inflation-targeting central bank became more outspoken about the financial stability which may most likely be undermined by deepening CA deficit since mid-2010. Even though some countries like Brazil and South Korea used capital flow measures to restrict inflows along with a tightening via interest rates, Turkey used macro-prudential measures to restrict domestic demand and credit expansion while keeping the short term interest rates as low as possible to discourage excessive capital inflows (Başçı, 2011). The officials of the CBRT thought that high nominal interest rates attracted capital inflows feeding into credit boom. CBRT lowered the overnight borrowing rate by opened down the

interest rate corridor (down to about 2%) and allowed more volatility in overnight rates in trying to reduce excessive capital inflows.

Thinking that the elasticity of demand for credit to interest rates was low, Required Reserve Ratio (RRR) policy was deemed to be more effective in fighting the excessive credit expansions. RRR was increased from 6% up to 16% during this period. Moreover, tightening of RRR was conducted according to maturity and therefore tried to penalize short-term deposit liabilities. Also, CBRT purchased FX by regular daily auctions injecting more TL's to the market coupled with quantity auctions which tried to restrain liquidity. TL depreciated from 1.49TL/$ up to 1.76TL/$. Nevertheless, the likely effects of instruments (policy interest rate, RRR, width of corridor, liquidity management...) on final targets (inflation and financial stability) were said not to be clearly anticipated. In other words, since this type of policy was being used the first time in Turkey and its theoretical basis was not well established, CBRT introduced the real exchange rate and the credit expansion as intermediate target/transmission mechanisms as they were quicker measurable variables. In any case, the new policy aimed a soft landing by allowing the output rate to follow a more stable path without being disturbed by the sudden short term capital inflows.

Table 2: Monetary Policy and Economic Indicators, 2010-2012

	ZONE	Nominal Interest Rate	Required Reserve Ratio	Inflationary Gap	Output Gap	CA Deficit/ GDP	Public Domestic Debt/GDP
2010Q4-2011Q3	IV	6.6% Stable	6% - 16% Increase	1% Stable	- 2.3% 3% Increase	6% 10% Increase	32% 29% Decrease
2011Q4-2012Q4	I and III	9.7% 6.2% Decrease	16% - 11% Decrease	3.7% 2.8% Decrease	1.8% 0.5% Decrease	9.7% 7% Decrease	28% 27.5% Decrease

In the classical framework an increase in interest rates was sufficient to cause TL to appreciate and credit expansion to be restrained when the economy warmed up due to internal reasons as an increase in aggregate demand. Both channels would help to restrain the price instability. However, the story was different if the expansion was helped by continued capital inflows in a case where TL would appreciate out of line with a fundamental level that was considered to be in accordance with other macro variables. Therefore, the new framework clearly abandoned the use of high interest rates as the main policy tool to fight against the inflation in trying to restrain the credit expansion, domestic demand and imports, especially when the capital inflows were strong. A monetary policy authority which included the macro financial stability into its reaction function had to monitor other macro variables besides the rate of inflation. RRR was then considered to be more effective in restraining excess credit and output expansions fueled by easily accessible money capital. The low interest rate policy was thought to help to block the

incoming capital flows which could end up appreciating TL and stop excessive imports and high CA deficits. We can conclude that the interest rate policy was therefore used to prevent CA deficits and exchange rate imbalances whereas RRR policy was tried to be employed to prevent excess domestic demand and output expansions. Hence, the monetary policy of CBRT started to be quite different from the monetary policies that had been in use in the world before the global crisis for about 20 years explained quite accurately by the Taylor Rule and from also CBRT's own announcement of inflation targeting strategies in 2006 where solely the short term rates were to be increased (decreased) when the rate of inflation speeded up (down).

Overall, the macroeconomic results of the newly introduced framework during this period were not promising since the credit growth reached 33% at the end of 2011 which was deemed to be dangerously high by the Turkish government and the CA deficit/GDP was up to 10% in 2011:Q3 and the annual rate of inflation rose to 10.45% in December 2011 raising the inflationary gap up to 3.7% (the first quarter of next period, 2011:Q4). Also whether the policies against the 3 evils: CA deficit, rise in the rate of inflation and output fall, were implemented *timely*, is another important question? The purchase of FX was expansionary and keeping the short term interest rates at about 6.6% did not prevent neither the credit expansion nor the CA deficit deterioration. Therefore, we can say that the exercise of the new unorthodox policy has been *expansionary.*

During 2010:Q4-2011:Q3 <u>we cannot quite say that CBRT seems to have followed</u> a standard version of the Taylor Rule prescription <u>to a certain extent:</u> it kept the short term interest rate at about 6.6% up until 2011:Q3 (end of this period) when the inflationary gap was stable at 1% on the average. However, on the output front, CBRT does not seem to have reacted to the output gap which increased from -2.3% up to 3% during this period. Finally, CBRT officials increased the interest rate up to 9.7% at the very beginning of the next period (2011:Q4): perhaps a decision which was a little late.

1-d) Period: 2011:Q4-2012:Q4

Since the middle of 2011, the global risk appetite reversed in the sense that capital inflows into Turkey worsened especially due to deepening fiscal debts in the Euro region. The uncertainties related to the world economy resulted in a substantial decrease in capital flows to developing countries.

At the end of 2011, a need to increase the interest rates arose due to the rise in the exchange rate and to the surging rate of inflation because of price hikes in energy and tobacco items. The tight monetary policy of CBRT was manifested by increasing the lower limit of the interest rate corridor up to 6% in August 2011. Up till October 2011 CBRT funded the market by only 1 week repo auctions. Therefore, up to this date, CBRT's effective (average) funding rate and the policy rate had been the same. At the point CBRT pulled the upper limit of the interest rate corridor up to 12% and started giving half of the funding by at its lending rate (upper limit of the corridor) rather than increasing its policy rate which was 5.75%. In other words, the lower cost funding by 1 week repo auctions were decreased and the remaining part of the funding was provided at

the higher cost of lending rate. Therefore, the effective interest rates rose from 6.6% up to 9.7%.

Moreover the CBRT stopped purchasing FX and started *selling* it starting from end of 2011 in an attempt to defend the depreciating TL and due to the increasing rate of inflation to prevent both the rate of inflation from going up further and stop the CA deficit/GDP ratio which reached 9.7% at the end of 2011. RRR was lowered down to 11% from 16% in October 2011 to stop any possible credit and output contraction. Nevertheless, the rate of inflation reached 10.45% at the end of 2011 and the inflation gap increased substantially from about 0.5% up to 3.7% at the last quarter of 2011. This may indicate that the monetary policy may not have been tight enough in terms of the policy interest rate during the previous period. Moreover, we can conclude that even though capital inflows may not have caused the rate of inflation to increase noticeably in the short run, they may have done so more in the longer run when capital inflows continued and the rate of inflation gained momentum. The interest rate policy alone not accompanied with an appropriate RRR policy do not seem to have stopped neither the accelerating rate of inflation nor the credit expansion in the longer run since the economy grew by 8.8% in 2011 which was considered to be dangerously high.

The 28 day repo auctions were started in 2012 as another liquidity tool. The interest rates stood at around 10-11.50% at these auctions which automatically increased the banks' borrowing cost by about 2%. At the beginning of 2012, in to boost the FX selling interventions CBRT closed the 1 week repo auctions completely funding the market only by 28 day auctions. At those days the effective rate hit the lending rate which was 12%. In February 2012, CBRT decreased the upper limit of the interest rate corridor a little when some steps were taken to try to solve the problem of fiscal debts in Europe.

In the later part of 2012 when both inflationary and output gaps decreased CBRT relaxed the short term rates in order to boost the growth rate of the economy. Nevertheless, the economic growth stood at 2.2% at the end of 2012 despite a planned 4% growth. In the later part of 2012 the CBRT officials became more spoken about putting an about 15% restraint on credit growth without declaring their policy instrument. In a conference in April 2013, the President of CBRT, Başçı announced that the right policy combination for Turkey required a low equilibrium rate of interest for a sustainable output.

At the beginning of 2012, the banks realized that the market interest rates could rise all the way up to the lending rate of CBRT in a situation of liquidity crunch when the funding of CBRT in 1 week repo auctions could be restrained and they started to raise the expected costs of their credits extended to the private sector. The expected costs of banks, of course depended on their individual anticipations of the market and future interest rates. In the second half of 2012, the banks aligned again their costs of borrowing from repos with the policy rate due to a downward adjustment in the lending rate of CBRT, announcements by CBRT that the rates would be allowed to decrease further and the fact that all of banks' money demands were supplied. However, the portion of CBRT funding represents a small portion of banks' total TL resources and there had always been a certain degree of downward rigidity in banks' deposit rates due to the competition among them and the desire not to lose their customers' deposits base. Moreover, the ongoing high rate of inflation and

a sudden possible increase in the exchange rate must always been incorporated in the calculations of the borrowing cost (Interview with the Economics Research Department of a private bank).

During 2011:Q4-2012:Q4 we can say that CBRT does not seem to have followed a standard Taylor Rule prescription. It increased the short term interest rates up to 9.7% in 2011:Q4 when the inflationary gap reached 3.7%, and the output gap decreased from 1.8% down to 0.5%. However, the timing of the policy of raising the interest rates may be questionable, because it may have been a little late. The reaction to the rising and gaining momentum of the rate of inflation may have required a proactive policy in terms of the interest rates.

PROPOSITION- 1: *The standard Taylor Rule framework does not seem to describe precisely the history of the reaction function of CBRT during 2003-2012. Out of the 4 distinct periods considered above, only in the period 2008:Q3-2010:Q4, which covers the global crisis, the policies of CBRT seems to match with the standard Taylor Rule.*

Our narrative analysis in this Section has been *qualitative* in terms of the directions of the movements in the nominal interest rate and those of the gaps in the rate of inflation and output. In Section-5 below we will estimate a standard Taylor Rule for Turkey and compare *quantitatively* the rule against the actual interest rate.

In the next section, we will discuss the price and financial stabilities policies of CBRT which were finalized and announced in 2011. These new policies , as explained in Section 2-c above, are somehow in contrast with both the previously announced pure Inflation Targeting regime of CBRT and the standard Taylor Rule.

2. THE PRICE AND FINANCIAL STABILITIES

Başçı (2011) explained in presentations given to the World Bank and to IMF that CBRT's reaction function in terms of the short term interest rates and RRR depended on which of the 4 Zones the Turkish economy was. These 4 Zones and the reaction stance of CBRT are shown in Table-3 below. Zones I and IV are dangerous in terms of financial stability and are related to the situations where there might be continual capital outflows for example. They require macroprudential policies to be used. On the other hand Zones I and II require policies to fight against the rising rate of inflation. Zone III is the region where the economy seems to be stable and calm. However in Zone III, the growth rate of output may be low. Başçı declared that this framework in spirit was not significantly different from the conventional inflation targeting framework.

We will now try to evaluate the reaction of CBRT with respect to financial and price stabilities during 2003-2012 as described by Table-3 below. This type of reaction function by a central bank is clearly quite different than the Taylor Rule which proposes to take the inflationary and output gaps into consideration.

Table 3: Two Targets and Two Instruments

PRICE INSTABILITY	(ZONE II) Increase R Decrease RRR	(ZONE I) Increase R Increase RRR
PRICE STABILITY	(ZONE III) Decrease R Decrease RRR	(ZONE IV) Decrease R Increase RRR
	FINANCIAL STABILITY	FINANCIAL INSTABILITY

Note: R=Nominal Interest Rate, RRR= Required Reserve Ratio.

i) **2003:Q4-2008:Q3:** During the first sub-period, 2003:Q4 to 2006:Q2, CA deficit/GDP ratio increased steadily from 1% up to 4.5% while the inflationary gap reached 4.6% down from - 2.5% putting the Turkish economy *roughly* in _Zone III_ on the average. While the use of RRR was not an active or frequently used policy tool then, CBRT kept lowering the short term interest rate in the first sub-period. In the second sub-period, from 2006:Q3 to 2008:Q3, the inflationary gap had high levels of 5.8-7.6% and CA deficit/GDP ratio widened up to 9% putting the Turkish economy in _Zone I._ CBRT raised the short term interest rate up to 17.7% in 2006:Q3 and kept it at around 16.5% level thereafter till 2008:Q3 (Figure-3 below).

Therefore, for this whole period we can conclude that CBRT *followed* the interest rate policy Başçı announced in 2011 given in Table-3 above. However, back then RRR policy was not an active policy instrument and was not taken into account as a complementary tool to the interest rate policy. RRR was kept constant at 6% during the whole period.

ii) **2008:Q3-2010:Q4:** During the global crisis (the first part of this period), CA deficit/GDP ratio improved and reached a level as low as 2% in 2009:Q4, and the inflationary gap decreased due to a slack demand from 7.6% down to - 1.8% in 2009:Q4, putting the Turkish economy in _Zone III_ again. CBRT decreased the short term rates sharply in this period and adjusted RRR downward from 6% down to 5% as explained in Section-2 above.

However, as the effects of the global crisis passed and/or was started being felt to a lesser degree, and Current Account Deficit/GDP started increasing again, CBRT kept the short term rates constant at about 6.6% and announced that it returned to its pre-crisis policies by raising RRR again up to 6% on Nov 12th 2010. The inflationary gap ended with 1% at the end of the period with an in-between peak of 3% in the first quarter of 2010 (Figure-3). This puts the Turkish economy in _Zone I_ again.

Figure 3: Two Targets and Two Instruments Policy
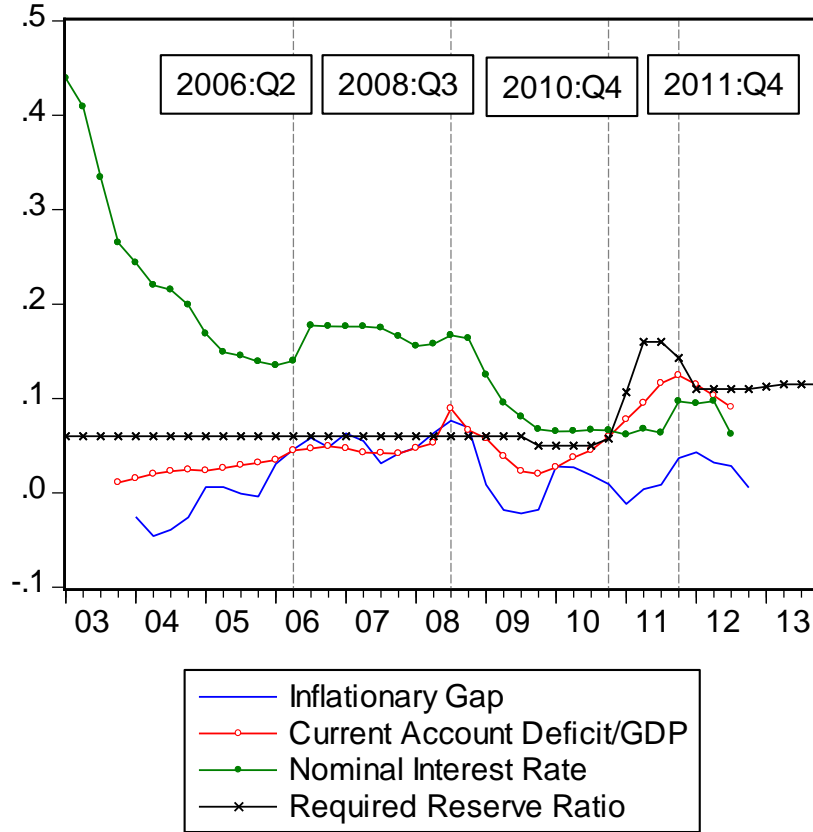
Therefore, for the whole of this period, we can conclude that CBRT *followed* the RRR rate policy Başçı announced in 2011 *only to a certain degree* since the % changes were perhaps not significant enough (CBRT first decreased RRR from 6% down to 5% and then raised it up to 5.5%). Moreover, the interest rate policy could be followed more strictly, and the nominal interest rate could perhaps be tried to be raised when the inflationary gap reached 2.8% in 2010:Q1 which was an important discrepancy between the actual inflation and the target inflation.

iii) **2010:Q4-2011:Q3:** CA deficit/GDP ratio kept widening steadily up to 10% and the inflationary gap was about 1%, putting the Turkish economy in *Zone IV.* Even though RRR were substantially raised agreeing with Table-3 above, the short term interest rates were kept constant at around 6.6%. In view of heavy capital inflows, CBRT lowered the lower limit of the interest rate corridor rather than trying to decrease its policy rate as explained in Section-2 above. Giving an indicative lower bound rather than decreasing the actual policy rate does not seem to have been contractionary enough in view of capital inflows.

iv) **2011:Q4-2012:Q4:** CA deficit/GDP decreased from 9.7% down to 7%. However this level was still high and the inflationary gap was around 3% on the average putting the Turkish economy in *Zone I* again. CBRT decreased RRR

from 16% down to 11% in October 2011. Furthermore, it first raised the short term interest rates and then relaxing them in the second half of 2012 when the official figure about the output growth rate of 2012 was announced and CBRT was criticized. The medium term plan required 4% for output growth for 2012, but the realization was 2.2%. The picture of the second part of 2012 puts Turkish economy roughly in _Zone III_. Did CBRT follow Başçı's prescription of 2011? Not quite, _relaxing the short term interest rates_ in the second half of 2012 indicated that CBRT could be sensitive to output contractions too, contrarily to Table-3 above, even though the inflationary gap was still high (2.8%). _However, the output is a target of Taylor Rule, but not a consideration of Table-3._

PROPOSITION- 2: _The 2-target and 2-instrument policy framework_ _does not_ _seem_ _to describe the reaction function of CBRT precisely. The main reason is that another important target is the real GDP growth which must also be closely watched as it became mostly apparent in 2012 in Turkey._

PROPOSITION- 3: _It seems that the Turkish economy switched back and forth between Zones I and III of Table-3 above for the most part of 2003-2012. Zone I is the dangerous region for both the price and financial stability whereas Zone III is the region where these stabilities are seemingly calm. The driving force which moves the Turkish economy between these 2 quite opposite regions seems to be the sudden changing capital inflows and outflows._

3. DATA AND VARIABLES

The <u>dependent variable</u> is:

I = _The short term nominal interest rate_ is the quarterly average of daily O/N repo interest rates in BIST (Istanbul Stock Exchange) among banks.

The <u>explanatory variables</u> are as follows:

$\Pi - \Pi^*$ = _The inflationary gap_ is the difference between the change in CPI and the inflation targets on yearly basis. Π^* is the annual year-end quarterly CPI inflation targets for 2003-2012.

$\dfrac{y - y^*}{y^*}$ = _The output gap_ is simply the difference between the actual output and trend output divided by the trend output. y is _the output_ which is the quarterly seasonally adjusted real GDP in TL (Turkish Liras).

CAD / y = _The Current Account Deficit/GDP_ (CAD/GDP) is the ratio of Current Account Deficit in $'s published by CBRT to GDP in $'s published by TurkStat (TUIK).

PDD / y = _The Public Domestic Debt/GDP_ (PDD/GDP) is the ratio of the internal debt of the Central Government to GDP in TL's.

RRR = _Required Reserve Ratio_ (on demand TL deposits)

REK = Real Exchange Rate based on Turkish CPI (TUFE).

We use quarterly Turkish data from 2003:Q1 to 2012:Q3. CPI inflation targets for 2003-2012 (Π^*) are 20%, 12%, 8%, 5%, 4%, 4%, 7.5%, 6.5%, 5.5% and 5%.[1] y^* is _the trend output_ which is obtained by Hodrick-Prescott (HP) filtering (Lambda = 1,600).

4. MODELS AND ESTIMATION

Taylor (1993) suggested the estimation of the following model,

$$I_t = LRR + \Pi_t + \alpha_1 * (\Pi_t - \Pi_t^*) + \alpha_2 * (\frac{y_t - y^*)}{y^*} + \varepsilon_t \qquad (1)$$

where *LRR* is the Long Run real equilibrium interest rate. If the estimated coefficient α_1 was positive then an increase of one percentage point in the inflationary gap was associated with an increase of $(1 + \alpha_1)$ percentage point in short term nominal interest rates by the Central Bank due to the presence of Π_t term. Therefore, α_1 being positive amounted to increasing the real interest rate by α_1% when the inflationary gap rose 1% ceteris paribus. In addition, the central bank was also expected to react to the output gap variable measured by the coefficient of α_2. Overall, the idea was to cool or activate the economy based on the parameters α_1 and α_2 which were suggested to be taken a numerical value of about 0.5 each in practice.

Since the structure changes quite frequently in Turkey, we cannot assume a constant *LRR* for long periods of time like a span of 10 years. However, for some short periods of time, we can *estimate* an average *LRR.* So, in equation (2) below we formulate the standard Taylor Rule equation for Turkish data for shorter periods of time like 4 to 5 years (at least for the 2000's), as follows,

$$I_t = \alpha_0 + \Pi_t + \alpha_1 * (\Pi_t - \Pi_t^*) + \alpha_2 * (\frac{y_{t-1} - y_{t-1}^*)}{y_{t-1}^*} + \varepsilon_t \qquad (2)$$

where α_0 is the constant term of the econometric model which tries to capture the *LRR* (Long Run real equilibrium interest rate) for short periods of time and the subscript *t-1* (a lag of 1 quarter) in both y_{t-1} and y_{t-1}^* refers to GDP figures in Turkey being announced with a lag of about 4-5 months. Considering the fact that some leading indicators of GDP like the Industrial Production Index (IPI) is available, we kept the lag at 1 quarter. ε_t is the error term.

4.1. Model-1: The Standard Taylor Rule For 2003-2008:

In Table-4 below, in Model-1 (the Standard Taylor Rule for 2003:Q1 – 2008:Q3 period), we see that the coefficient of the *Inflationary Gap* variable is negative (-0.722) while that of the *Output Gap* variable is positive (0.25).

Overall, Model-1 suggests that CBRT was quite <u>*insensitive*</u> to the rate of inflation and allowed the nominal interest rates to <u>*increase*</u> by only 0.28 % (1 - 0.722) when the inflationary gap increased by 1% over this period. In other words, CBRT did not increase the nominal interest rates as much as the inflationary gap on the average ceteris paribus, and therefore allowing the real interest rates to fall by 0.72% when the inflationary gap increased by 1%. This

result is quite normal since we know from Section-2, that CBRT never allowed the nominal interest rates to increase, except 2006:Q3, when the public debt was high and a sudden capital outflow was always closely watched. Even though the output gap coefficient has the expected sign according to the standard Taylor Rule, its p-value is 0.53, indicating insignificance.

Table 4: Estimation Results of Models: Short Term Nominal Interest Rate (Dependent Variable)

	MODEL-1 Standard Taylor Rule	MODEL-2 Standard Taylor Rule	MODEL-3 Modified Taylor Rule-A	MODEL-4 Modified Taylor Rule-B
ESTIMATION PERIOD	2003Q1 - 2008Q3	2008Q3 - 2012Q3	2010Q1 – 2012Q3	2010Q1 – 2012Q3
EXPLANATORY VARIABLES				
Constant	0.09** (0.0)	0.00006 (0.95)	0.007 (0.818)	- 0.024* (0.054)
INFLATIONARY GAP	- 0.722** (0.0)	0.23 (0.46)	- 0.44* (0.078)	- 0.509** (0.04)
OUTPUT GAP	0.25 (0.53)	-0.188 (0.37)	0.483 (0.31)	-
CAD / y	-	-	-0.069** (0.02)	0.365** (0.02)
SUMMARY STATISTICS				
ADJUSTED R-SQUARED	0.424	0.32	0.485	0.474
Durbin-Watson	0.383	0.565	1.978	2.16
SAMPLE SIZE	19	17	11	11

(**) and (*) indicate the statistical significance of coefficients at 5% and 10% levels respectively.

The estimated value of 0.09 of the constant term during this period which represents *LRR* is important since it is quite close to the value of the real interest rate (nominal interest rate – rate of inflation) of 0.082 for 2003:Q1 – 2008:Q3.

4.2. Model-2: The Standard Taylor Rule For 2008-2012:

In Table-4 above, in Model-2 (the Standard Taylor Rule for 2008:Q3 – 2012:Q3 period), we see that the coefficient of the *Inflationary Gap* variable is now positive (0.23) while that of the *Output Gap* variable is negative (-0.188).

Overall, Model-2 may suggest that CBRT became more sensitive to the rate of inflation and kept the change in the real interest rates at 0.23% (or the change in the nominal interest rate at 1.23%) for each 1% change in the inflationary gap over this more recent period. The output gap coefficient of -0.188 does not have the expected sign according to the standard Taylor Rule which is 0.5. However, CBRT seems to have considered also the output gap, but not as much, since the nominal interest was allowed to increase by 0.81% (1-0.188) for each percentage point gap in output. This result seems to be logical since this period includes the Global Crisis and we know from Section-2 that then CBRT allowed the interest rates to drop in advance. The value of 0.32 of R-Squared is again quite low as that of 0.42 before.

The estimated value of 0.0006 of the constant term during this period which represents *LRR* is *again* important since it is somehow close to the value of the real interest rate (nominal interest rate – rate of inflation) of 0.0081 for 2008:Q3 – 2012:Q3.

The outcomes of Models 1 and 2 are not surprising given our result summarized in Proposition-1 above at the end of Section-2. CBRT did not use the standard Taylor Rule. Before 2008, there was a need to decrease the unacceptable high nominal interest rates to make the Inflation Targeting policy operative and credible given the low targeted inflation rates and after 2008 (the Global Crisis) CBRT announced a new policy where financial stability was additionally to be watched closely in view of heavy inflows/outflows of money capitals.

Taylor Rule seems suggesting to monitor the rate inflation and the growth of output simultaneously. Usually, when economies heat up with a high growth rate of output, the rate of inflation increases as well and the interest rates must be increased (and vice versa). However, especially in the case of Turkey when such an event does not occur, for example in a macroeconomic situation where the rate of inflation may rise due to an exchange rate depreciation following a capital outflow and the growth of output can be endangered, then the rule seems to prescribe to keep a balanced stance in view of these two important targets. In such a case, even though the nominal interest rates are suggested to be increased due to the high rate of inflation, they are recommended to be decreased with respect to the output gap.

PROPOSITION- 4: The Taylor Rule recommends keeping a balanced stance with respect to the inflationary gap and the output gap. The suggested changes in nominal interest rates with respect to these two variables may sometimes be _in opposite directions_ depending on the specific macroeconomic circumstances.

4.3. Model-3 And 4: Some *Modified* Taylor Rules For 2010-2012:

As explained in Section-3 above, CBRT introduced a new policy by being more alert to capital flows in and out of Turkey. Therefore we can define a _Modified Taylor Rule_ for Turkey considering our narrative discussions in Sections 2 and 3 above, which then adds the *CAD/y* (Current Account Deficit/GDP) variable to the standard version of Taylor Rule in view of heavy capital flows into and out of Turkey from 2010:Q1 to 2012:Q3. [2]

$$I_t = \alpha_0 + \Pi_t + \alpha_1 * (\Pi_t - \Pi_t^*) + \alpha_2 * (\frac{y_{t-1} - y_{t-1}^*)}{y_{t-1}^*} + \alpha_3 * \frac{CAD}{y} + \varepsilon_t \qquad (3)$$

In Table-4 above in Model-3 (Modified Taylor Rule-A), we observe that even though the estimated coefficient of inflationary gap is significant, that of the output gap is insignificant. The coefficient of CAD/y variable is -0.069 and significant indicating that for each 1% increase in the Current Account/GDP variable, the real interest rates were decreased by about 0.07% (due to the presence of Π_t term in eq-3 above).[3] Our Model-3 included the output gap variable as before, since in practice in the second part of 2012, CBRT was criticized by some ministers of the government by not taking into account the slow growth rate of output judged to be due to high interest rates. In fact the growth rate of 2012 was realized to be 2.2%.

In Model-4 (Modified Taylor Rule-B), we drop the insignificant output gap variable. We observe that the coefficient of the inflationary gap changes very little. It decreases from -0.44 down to -0.509. This indicates that CBRT allowed the *real* interest rates to *fall* by 0.509 which corresponds to a quite loose monetary policy with respect the rate of inflation. This result agrees with our narrative story in Sections 2 and 3 above where during this period the monetary policy has not been tight enough according to the Taylor Rule and perhaps a little late in certain periods. However, from Turkish officials' perspective, the heavy capital inflows to Turkey must also been monitored to assure financial stability and they preferred to keep the nominal interest rates low in order to prevent excessive capital inflows counting on the complementary tool of RRR. Nevertheless CBRT increased the *lower bound* of the interest rate corridor from 2% up to 6% in October 2011, and the market interest rates were allowed to rise and fluctuate substantially.

The estimated coefficient of *CAD/y* is 0.365 and significant. This suggests that the *real* interest rates were raised by 0.365% when the *CAD/y* increased by 1% ceteris paribus. In Section-3, Table: 3, we observe that CBRT announced either a decrease or an increase in nominal interest rates depending the economy being on Zones IV and I respectively. From the end of 2010 to August 2011, in view of its new policy CBRT preferred to decrease the lower corridor rather than decreasing the market rates when the capital inflows were heavy and after October 2011 in view of capital outflows, CBRT had to increase the market interest rates. This shows that in the case of financial instability (capital inflows or outflows), the nominal interest rates could be decreased or increased depending on the state of the rate of inflation (Zone IV or I).

The Durbin Watson values for the Models 3 and 4 (1.98 and 2.16 respectively) are higher than the higher bound of DW of 1.604 for n=11 indicating no serial correlation of residuals and also some robustness toward the specifications of these last 2 models.

Again, the estimated value of -0.024 of the constant term during this period tries to represent *LRR* and it is somewhat close to the value of the real interest rate (nominal interest rate – rate of inflation) of -0.0075 for 2010:Q1 – 2012:Q3.

**Figure 4: Nominal Interest Rates and The CBRT'S Reaction Function
According to _Standard_ and _Modified_ Taylor Rule-B**
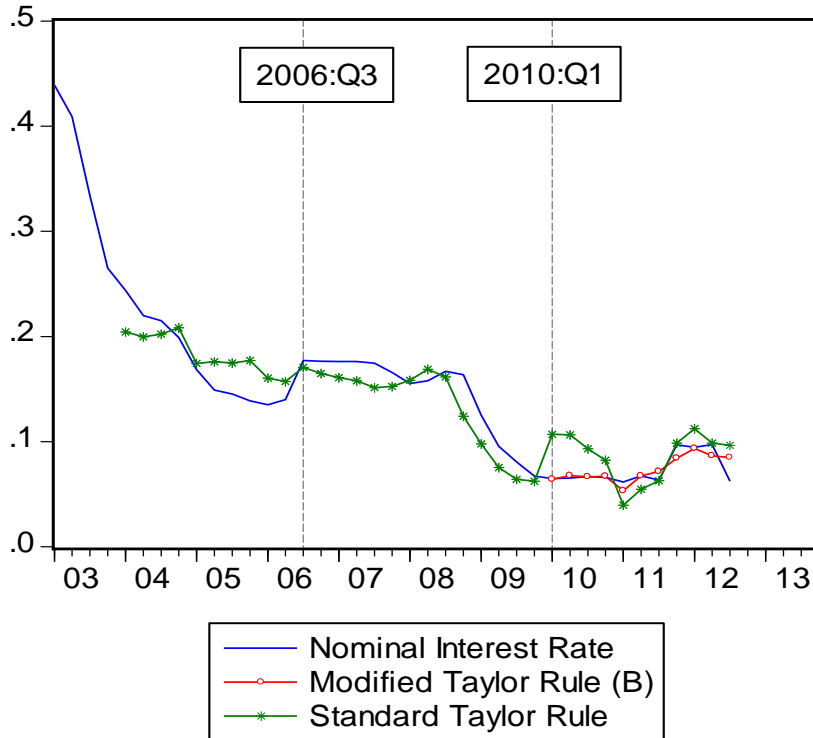
In Figure-4 above, the Standard Taylor Rule series is comprised of two fitted series: before and after 2008:Q3 according to Models 1 and 2 respectively. The standard Taylor Rule seems to suggest an increase in the interest rates _long time before_ the CBRT's actual increase in interest rates in 2006:Q3 from 14% up to 17.7%. On the other hand, the same rule suggests that the interest rates could have been lower from 2006:Q3 to 2010:Q1, including the global crisis of 2008-2009.

In Section-2 above, we discussed the tightness of the monetary policy in 2010. The Taylor Rule series indicates consistently higher than the actual interest rates in Figure-4 above. The Taylor Rule suggested also somehow a lower interest rate in 2011 and a higher interest rate in 2012 for Turkey. .

There is a check! Our calculations of the inflationary gap, the output and the Taylor-Rule implied Interest Rates are very similar to those of IMF's (2012, Country Report No. 12/339. Turkey: Selected Issues, page 14). In this Country report, the coefficients of the inflationary and the output gaps were said to be taken 0.5 each since 2006:Q1. Even though we did not use fixed 0.5 values for each gap, surprisingly our estimated equations after 2006:Q1 (our Models 1 and 2) closely match those findings.

Finally comes our most accurate estimation of the reaction function of CBRT since 2010:Q1. It is given by Model-4 (modified Taylor Rule-B) above. In Figure-4 above, the series of actual nominal interest rates and the modified Taylor Rule-B are surprisingly close!

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_PROPOSITION-5:__The most appropriate _modified_ reaction function of CBRT for Turkey in recent periods seems to include the Current Account Deficit/GDP variable in addition to the standard Taylor Rule in terms of the inflationary gap. The choice of keeping the output gap variable depends on user's preferences. In contrast with the estimated standard Taylor Rule of increasing the nominal interest rates by 1.23% during 2008-2012, our estimated _modified_ Taylor Rule for Turkey which fits the actual movements of the interest rates very closely indicates that the nominal interest rates were increased only by 0.49% in practice for each percentage point increase in the inflationary gap during 2010-2012. This indicates a loose monetary policy._

CONCLUSION

In this paper, we investigated whether the Central Bank of Republic of Turkey (CBRT) followed a strict (standard) Taylor Rule prescription, and if not what relationship can describe its reaction function since 2010. We can draw the following results:

i) The standard Taylor Rule framework does not seem to describe precisely the history of the reaction function of CBRT during 2003-2012. Out of the 4 distinct periods considered in Section-2 above, only in the period 2008:Q3-2010:Q4, which covers the global crisis, the policies of CBRT seems to have matched with the standard Taylor Rule in a qualitative respect to a certain degree. In the quantitative aspect, there were some discrepancies.

ii) Moreover, the 2-target and 2-instrument policy framework in terms of price and financial stability targets does not seem either to describe the reaction function of CBRT precisely. The main reason is that another important target is the real GDP growth which was taken into account in practice being apparent in the second half of 2012 in Turkey. However, Table:3 above does not show the output gap as an explicit state of the economy on which CBRT would react.

iii) It seems that the Turkish economy switched back and forth between Zones I and III of Table-3 above for the most part of 2003-2012. Zone I is the dangerous region for both the price and financial stabilities whereas Zone III is the region where these stabilities are seemingly calm. The driving force which moves the Turkish economy between these 2 quite opposite regions seems to have been the changing and sudden capital inflows and outflows.

iv) The most appropriate modified reaction function of CBRT for Turkey in recent periods seems to include the Current Account Deficit/GDP variable in addition to the standard Taylor Rule in terms of the inflationary gap. In contrast with the estimated standard Taylor Rule of increasing the nominal interest rates by 1.23% during 2008-2010, our estimated modified Taylor Rule for Turkey which fit the actual movements of the interest rates quite closely indicated that the nominal interest rates were increased only by 0.49% in practice during 2010-2012. Hence, this indicated a loose monetary policy with respect to the strict Taylor Rule.

Another important issue for further research is that, whereas the FED is trying to affect the long term interest rates by purchasing substantial amounts of _long term_ government bonds and mortgage guarantees, CBRT tries to affect the daily interbank rates by 1 week repo rates (at most 28 days). Can the new

tools of monetary policy of CBRT (policy interest rate, liquidity measures and the interest rate corridor) affect the longer term interest rates in Turkey? The officials of CBRT seem so far to have been concerned solely on providing banks for short term liquidity.

NOTES

[1] We used the actual rate of inflation in each quarter. However, in practice, CBRT watches also the results of its 'Survey of Public's Inflationary Expectations'. In times when the exchange rate and the rate of inflation have transitory nature, CBRT may not react to those short run changes. However, at the end of the year, the actual rate of inflation counts.

[2] We tried also the CBRT's real exchange rate based on Turkish CPI (TUFE) as an independent variable in addition to the *CAD/y* variable. However, the results were similar in terms of estimated coefficients while the fit was a little worse.

[3] The modified Taylor Rule Model-A gave also a very good fit comparable to Model-B shown in Figure-4 in Section-5 in the text (not shown). So, keeping the output gap variable when the goal is to obtain the best fit is a matter of user's choice, at least for this short period.

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