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Implicit Asymmetric Exchange Rate Peg under Inflation Targeting Regimes: The Case of Turkey

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Abstract

Especially, after the 2000s, many developing countries let exchange rates float and began implementing inflation targeting regimes based on mainly manipulation of expectations and aggregate demand. However, most developing countries implementing inflation targeting regimes experienced considerable appreciation trends in their currencies. Might have exchange rates been utilized as implicit tools even under inflation targeting regimes in developing countries? To answer this question and investigate the determinants of inflation under an inflation targeting regime, as a case study, this paper analyzes the Turkish experience with the inflation targeting regime between 2002 and 2008. There are two main findings of this paper. First, the evidence from a Vector Autoregressive (VAR) model suggests that the main determinants of inflation in Turkey during this period are supply side factors such as international commodity prices and the variation in exchange rate rather than demand side factors. Since the Turkish lira (TL) was considerably over-appreciated during this period, it is apparent that the Turkish Central Bank benefited from the appreciation of the TL in its fight against inflation during this period. Second, our findings suggest that the appreciation of the TL is related to the deliberate asymmetric policy stance of the Bank with respect to the exchange rate. Both the econometric analysis from a VAR model and descriptive statistics indicate that appreciation of the Turkish lira was tolerated during the period under investigation whereas depreciation was responded aggressively by the Bank. We call this policy stance under the inflation targeting regimes as "implicit asymmetric exchange rate peg". The Turkish experience indicates that, as opposed to rhetoric of central banks in developing countries, inflation targeting developing countries may have an asymeyric stance toward exchange rates and favour appreciation of their currencies to hit their inflation targets. In this sense, IT seems to contribute to the ignorance of dangers regarding to over-appreciation of currencies in developing countries.

Key words: Inflation Targeting, Central Banking, Developing Countries, Exchange Rates

JEL Code: E52, E58, E31, F31

Introduction

Developing world witnessed very high inflation rates after the 1980s. Since exchange rates and commodity prices are considered as important determinants of inflation in developing countries, many developing countries followed disinflation programs based on mainly exchange rates after the 1980s. These programs were accused of having a tendency of over-appreciation at their earlier stages and then being vulnerable to speculative attacks at their later stages. The unsatisfactory experiences with disinflation programs based on exchange rate

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regimes such as fixed exchange rate or crawling peg exchange rate regimes paved the way for the implementation of a new policy regime called "Inflation Targeting" (IT).

Many developing countries have adopted IT as their monetary policy regime especially since the beginning of the 2000s. IT is a framework by which monetary policy is conducted through the announcement of quantitative point/range targets for inflation with the explicit declaration of the monetary authority that it will pursue price stability as its primary goal, subordinating all other possible goals. The ultimate aim was to curb inflation which was seen as an impediment in the pursuit of economic growth.

The implicit assumption behind IT was that inflation is a consequence of excess demand which may be avoided through appropriate monetary policy. Manipulation of aggregate spending and affecting expectations through interest rates is likely to have a significant impact on containing inflation. Monetary authorities could just determine and/or signal the future path of their policy interest rates and affect the level of aggregate demand and expectations which are supposed to ultimately determine inflation rate. Mainstream thinking does not presume a profound difference between developed countries and developing ones in this respect. The causes of inflation and policy tools to fight against it are assumed to be quite similar in these two groups, hence the insistence on developing countries to adopt IT as their monetary policy framework.

Proponents of IT are also welcomed by the low inflation levels recorded in developing countries in the last two decades. The evidence suggests that IT is associated with the reduction in inflation as admitted by the critics of IT. However, the extent to which this reduction is the result of implementation of IT is open to question. Gerald Epstein and Erinc Yeldan state that "IT has not yielded inflation below the levels attained by the non-industrial targeters that have adopted other monetary regimes" (Epstein and Yeldan, 2009: 8). In this respect, the alleged success of IT in curbing inflation is disputable. Moreover, disregarding supply side factors as sources of inflation in a conventional framework seems to be highly problematic particularly in the case of developing countries in which exchange rates and commodity prices are crucial determinants of inflation, undermining the main tenets of conventional wisdom[3]. Hence favorable conditions in exchange rates and commodity prices

[3] Stiglitz (2008) claims that oil and food prices constitute a larger share of the average household budget in developing countries compared to that in advanced countries. Hence, inflation in these economies is mostly "imported". In a similar vein, Anwar and Islam (2011) assert that the main sources of inflationary pressure in developing countries are not poor macroeconomic management of the economy but rather unexpected sudden supply shocks. They document the co-movement of inflation with food price index in least developed countries. The correlation coefficient between these two is found as 0.8. Considering the relationship between exchange rates and inflation in an IT context, on the other hand, a preliminary glance at misses of inflation targets and real exchange rate trends may be intuitive. Ho and McCauley (2003) find a stronger association between missed inflation targets and exchange rate movements in developing countries compared to developed countries. They report that: "of the 22 target misses by emerging market economies, 10 (45%) were associated with exchange rate moves of over 10% in the aggravating direction" (Ho and McCauley, 2003: 22). Similar results were found by Roger and Stone (2005). It is reported that largest deviations from the inflation target reflect impact of exchange rate shocks mostly in the form of shifts in capital inflows. They conclude that "all of the large misses reflected wide exchange rate fluctuations" (Roger and Stone, 2005: 29). Hence, besides international commodity prices, exchange rates also seem to be an important determinant of inflation in developing countries.

rather than the active control of aggregate demand through monetary policy might have been the factors which rein in inflation in developing countries.

With regards to the exchange rate, as can be seen from Figure 1, real appreciation trend is observable in many IT developing countries. All but two of the countries' currencies exhibit an upward trend[4]. Whether or not such a trend is a characteristic feature of IT and its role in curtailing inflation is the starting point of this paper. What is the role of exchange rates in determining inflation in developing countries, and if substantial, is the appreciation trend related to a deliberate policy stance with respect to exchange rate favoring appreciation in an IT context[5]? The asymmetric nature with respect to the exchange rate may arise from the positive bias between inflation targets and realized inflation in developing countries. If the direction of the bias is upward (i.e. misses from the target are usually above rather than below the target) which is evidently the case in many IT developing countries, then monetary policy may have a tendency for appreciation. After all, nominal appreciation reduces the domestic prices of imported goods thereby eases inflationary pressures coming from elsewhere within the domestic economy or from international commodity prices. Hence, where monetary policy remains insufficient to curb inflation with its control over short-term interest rates, exchange rate may emerge as a potential candidate for a policy tool[6].

[4] Among IT developing countries Serbia is excluded from the figure since it started IT as of late 2008. On the other hand, we have encountered with problems for obtaining real effective exchange rate data for Romania, Guatemala, Slovakia and Ghana.

[5] See Barbosa-Filho (2006) for such an argument for the Brazilian experience with IT. In a similar vein, Galindo and Ros (2008) present econometric evidence to support their argument, namely that the Bank of Mexico responds to depreciation through its short term interest rate decisions, whereas it remains irresponsive to appreciation pressures.

[6] Heintz and Ndikumana (2010) assert that monetary policymakers in South Africa had to resort to exchange rates in order not to miss the inflation target. They claim that given considerable exchange rate pass through (ERPT), monetary authorities will have to target exchange rates in order to achieve the target. One of the most important findings of their work is that between 2003 and beginning of 2007 during which IT proved successful in terms of achieving targets, real exchange rate of rand exhibited an appreciation trend. Similar to Heintz and Ndikumana (2010), Cömert and Epstein (2011) indicate that when commodity prices increased and exchange rate depreciated inflation targets were missed and inflation remained high in South Africa.

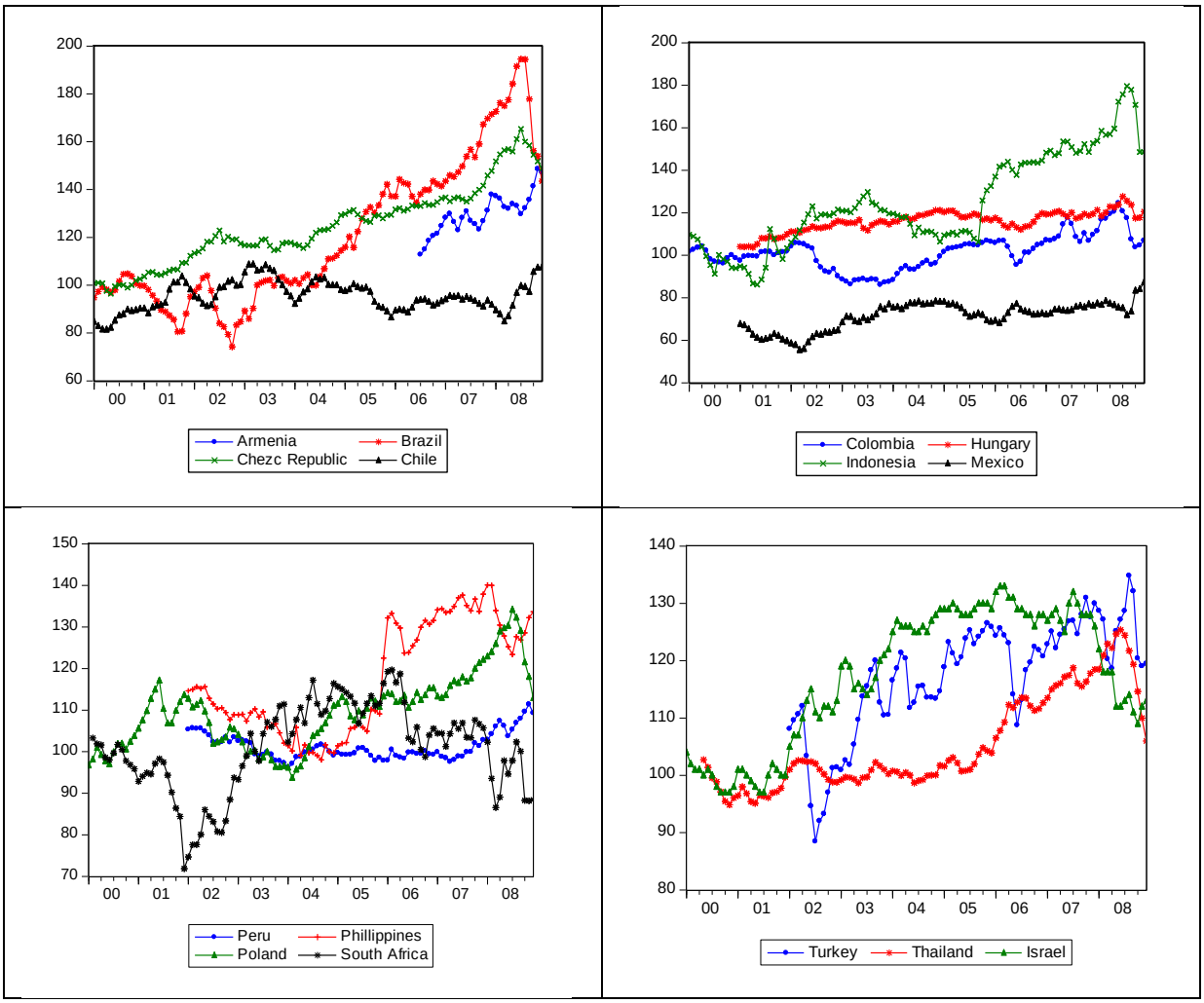

Figure 1. Real Effective Exchange Rates in Some of the Inflation Targeting Developing Countries

Source: National Data and JP Morgan, 2000=100[7]

Might have exchange rates been utilized as implicit tools even under inflation targeting regimes in developing countries? To answer this question and investigate the determinants of inflation under an inflation targeting regime, as a case study, this paper analyzes, the Turkish experience with the inflation targeting regime between 2002 and 2008.

The main findings of the paper are as follows. First, the evidence from a Vector Autoregressive (VAR) model suggests that the main determinants of inflation in Turkey during this period are supply side factors such as international commodity prices and the variation in exchange rate rather than demand side factors. Since the Turkish lira was considerably appreciated during this period, it is apparent that the Turkish Central Bank benefited from the appreciation of the TL in its fight against inflation during this period (see Figure 2). Second, our findings suggest that the appreciation of the Turkish currency is related to the deliberate asymmetric policy stance of the Bank with respect to the exchange rate. Both the econometric analysis from a VAR model and descriptive statistics indicate that appreciation of the Turkish lira was tolerated during the period under investigation whereas

[7] The data of JP Morgan is obtained from the Banco Central de Chile.

depreciation was responded aggressively by the Bank. We call this policy stance under the inflation targeting regimes as "implicit asymmetric exchange rate peg". The Turkish experience indicates that, as opposed to rhetoric of central banks in developing countries, inflation targeting developing countries may follow "implicit asymmetric exchange rate peg" regimes similar to the explicit exchange rate peg regimes of the previous periods. It is asymmetric because central banks have a tendency to tolerate appreciation of their currencies but not allow depreciation. It is implicit because most of them officially follow a flexible exchange regime

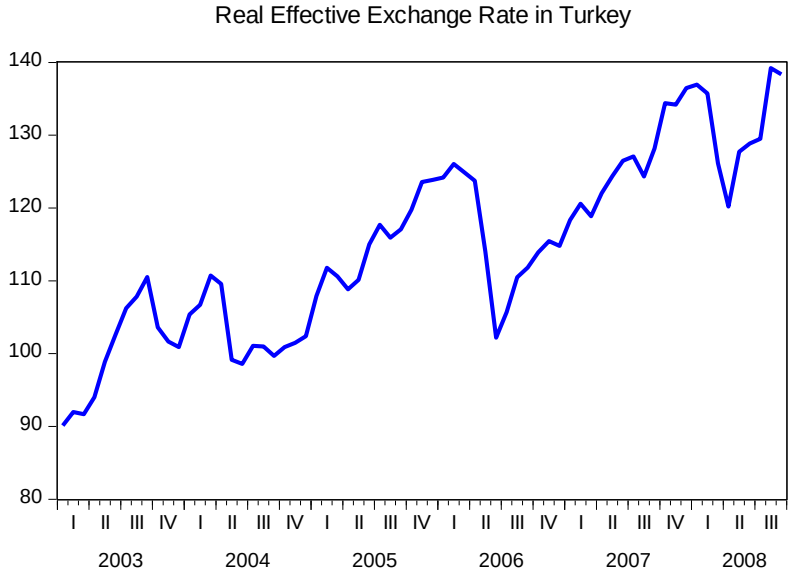

Figure 2. CPI Based Real Effective Exchange Rate in Turkey, 2003=100

Source: Central Bank of the Republic of Turkey.

There is a vast literature investigating the importance of exchange rates in monetary policy reaction functions of IT developing country central banks. Nevertheless, to the best of our knowledge, the asymmetric nature of the interest rate setting behavior of central banks in developing countries is not analyzed econometrically in the literature through a decomposition of exchange rate movements into depreciation and appreciation. One exception to that is the paper written by Galindo and Ros (2008). Yet, this paper suffers from some methodological deficiencies as we will discuss later in the next sections. In this sense, our study fills an important gap in the literature.

The plan of the paper is as follows. In the first section, a brief history of the Turkish experience with IT is discussed. In the second section, the determinants of inflation in Turkey between 2002 and 2008 are investigated by using a VAR model. Third section focuses on the policy stance of CBRT to the exchange rate. The fourth section discusses policy implications of asymmetric exchange rate peg with special reference to the debates over competitive exchange rates in developing countries and finalize the discussion with some concluding remarks.

1. Turkish Experience with Inflation Targeting

Having noticed the impossibility of defending the exchange rate regime during the crisis of 2001, the CBRT allowed the Turkish lira to float in February 2001. Accordingly, at the beginning of 2002 the CBRT declared that it would target inflation and monetary aggregates. Monetary aggregates were to be used as anchors to complement inflation targets. The CBRT also conducted liquidity management strategy besides the price stability goal. The framework incorporated the essence of formal IT in that, CBRT was already given formal independence by the Central Bank Law in 2001 which explicitly states that price stability was the main aim of the CBRT. Moreover, the CBRT announced its forecasts for inflation to affect expectations with regards to inflation and changed interest rates in line with its expectations on inflation. However, although the core of an IT framework existed, the framework can be defined as implicit as long as the regime is not formalized[89]. As of 2006, Turkey adopted IT as its formal monetary policy regime.

It is widely argued that, with the transformation into a flexible exchange rate regime and the success in reducing inflation from very high levels through implementation of IT, ERPT has declined substantially as a result of the decline in indexation behavior and reverse-dollarization in Turkey[10]. However, as the next section suggests, the decline in the ERPT was far away from being sufficient to subordinate the exchange rate in determining inflation. Exchange rate still remains as one of the most important factors in explaining inflation in Turkey in this period[11]. In fact, whether the inflation targets are achieved or missed is closely related with what trend exchange rate and commodity prices exhibit as Table 1 indicates.

Year	Realized Inflation (annual)	Target Inflation	Average Nominal Exchange Rate[12] ($/TL)	World Commodity Price Inflation (annual)
2003	18.4	20✓	1.486 (appreciation: 1.7%)	10
2004	9.3	12✓	1.420 (appreciation: 4.4%)	18.2
2005	7.7	8✓	1.339 (appreciation: 5.7%)	29.7
2006	9.7	5 X	1.429 (depreciation: 6.7%)	14.3
2007	8.4	4 X	1.306 (appreciation: 8.6%)	29.5
2008	10.1	4 X	1.213 (appreciation: 7.1%)	12.4[13]

Table 1. Success and failure in hitting inflation targets and the average nominal exchange rate.

Source: Central Bank of the Republic of Turkey, IMF.

[8] "Implicit inflation targeting can be defined as a period under which inflation targets are announced to the public, but not the regime and its details as such. It involves country acting as if inflation targeting were in place without a formal adoption of the regime" (Kara, 2006: 3).

[9] It is widely argued that a formal inflation targeting regime was not adopted until 2006 due to several constraints such as fiscal dominance, strong presence of inertial inflation, high ERPT and concerns over robustness of the financial sector. See Ersel and Özatay (2008) for an elaboration of these constraints in the pre-2006 period.

[10] See among others Kara and Öğünç (2008), Kara et. al (2005). For an argument about the decline of dollarization within the Turkish economy, see Akıncı et al (2005a).

[11] Actually, this point was made by the CBRT itself in many of its reports. For instance, see CBRT (2003, 2004)

[12] Average nominal exchange rate at a given year is calculated as the mean of end-month indicative exchange rate released by the CBRT.

[13] The last three months of the 2008 is excluded for calculating average nominal exchange rate and world commodity price inflation.

Three success cases (given by ✓) in hitting the inflation target is associated with appreciation of the lira. The miss of the target in 2006 is associated with depreciation. The claim that the exchange rate movements due to international liquidity shocks are important for the rise of inflation in 2006 is also made by the CBRT in its annual report for 2006 (CBRT, 2007). On the other hand, although appreciation of the lira in average was observable during 2007 and 2008, inflation targets were missed. The reason is closely related with the acute upward trend of international commodity prices in these years as can be seen from Figure 3. During the second half of 2007 and the first half of 2008 international commodity prices increased excessively, putting a pressure on domestic inflation in Turkey through imports.

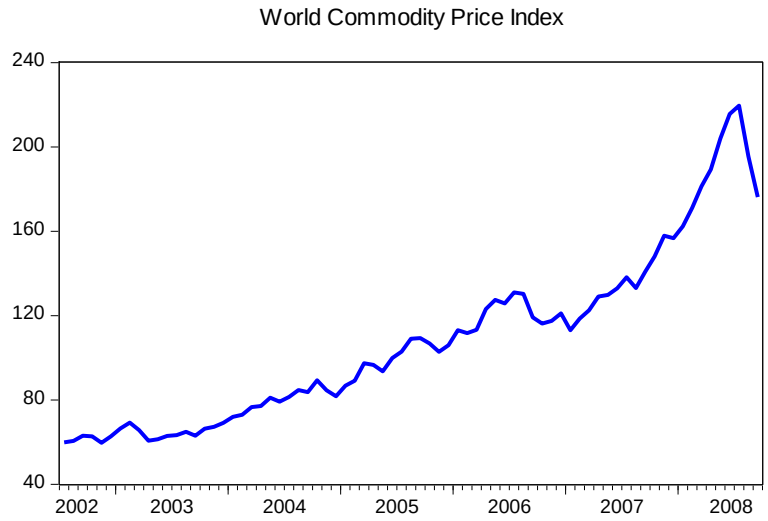

Figure 3. World Commodity Price Index, Source: IMF

In line with this argument, between 2002 and 2008, the CBRT usually emphasized the role played by price rigidities in services sector and increases in oil and food prices as the causes of hikes in the inflation in its annual reports. For instance, the CBRT explained that the hikes in administered prices and unprocessed food prices which are beyond the control of monetary policy are the main reasons why actual inflation (8.4 percent) exceeded target inflation (4 percent) in 2007 (CBRT, 2008). It is also reported that, upward trend of lira eased such inflationary pressures. In a similar vein, the CBRT explained the reason behind missing the inflation target in 2008 (realized inflation: 10.1 percent, target inflation: 4 percent) as the substantial increases in food and energy prices and their implications for prices in the service sector (CBRT, 2009).

That the CBRT had a tendency to present the reasons behind misses of targets as increases in the food and energy prices and nominal rigidities in services sector uncovers the contradictory nature of IT in developing countries which are highly exposed to external shocks such as changes in commodity prices and which have generally sticky prices for non-tradable goods[14]. While commodity prices are beyond the control of monetary policy, price stickiness in non-tradable sector is also evidently beyond what monetary authority can affect due to credibility

[14] See Kumhof (2000).

problems. In the Turkish case, descriptive statistics suggest that IT does not seem to be effective in achieving inflation targets as realized inflation is largely determined by external shocks. However, one should go beyond descriptive statistics to have a much more conclusive discussion. To shed more light on the question what lies behind the movements in inflation in Turkey, the next section develops an econometric analysis based on the existing literature to investigate the sources of inflation in Turkey between 2002 and 2008.

2. Econometric Evidence for the Sources of Inflation in Turkey

The literature on sources of inflation is generally divided into two views one of which attaches much more importance to demand side factors such as output gap and monetization of the fiscal deficits whereas the other emphasizes supply side factors such as exchange rates and international commodity prices as the crux of inflation dynamics in developing countries. While the first view propounds that even if supply shocks may induce inflationary pressures in the short run, demand side factors are the ultimate reasons of inflation in the long run, the second view asserts that given the high level of dependency in external resources in the production process in developing countries, supply side factors overweight demand side factors[15]. There are also integrative approaches as to the relative importance of supply side and demand side factors in determining inflation. For instance, Klau and Mohanty (2000) analyze inflation dynamics in 14 developing countries in 1980s and 1990s. They adopt an eclectic approach whereby both the demand side and supply side factors are found to be important in determining inflation. The empirical evidence shows that although conventional sources of inflation such as excess money supply, wages and output gap plays an important role, movements in food prices is the dominant determinant of inflation in most of the countries under investigation. It is also reported that, irrespective of the exchange rate regime, exchange rates emerge as a significant contributor to inflation in most of the countries (10 out of 14). Overall, they state that "shocks to food prices emerge as the most common inflation determinant in almost all emerging market economies, followed by the exchange rate" (Klau and Mohanty, 2000: 2).

In another pioneering study, focusing on the experience of 53 developing countries, Loungani and Swagel (2001) present evidence suggesting that money growth and exchange rate movements, the relative impact of which depend on the exchange rate regime, explain two-thirds of changes in inflation in these countries. They count four determinants of inflation, namely fiscal deficits (through either triggering higher money growth or trigger balance of payments crisis thereby depreciation of the domestic currency), output gap, cost shocks and inflation inertia. They categorize the relative importance of these four factors in explaining inflation according to different regions. In Latin America, for instance, exchange rates and monetization of fiscal deficits stand out as the predominant factors in explaining inflation. On the other hand, in African and Asian countries, inflation inertia is the most important factor subordinating all other three factors. In contrast with Klau and Mohanty (2000) they attribute

[15] An elaborated presentation of literature review on the sources of inflation can be found in Klau and Mohanty (2000).

significant differences in the relative importance of these factors in determining inflation across regions to differences in exchange rate regimes.

Hence seen, both demand and supply factors may play role in explaining inflation in developing countries. Given this background, now we will construct a model including both factors to explain determinants of inflation in Turkey.

A VAR model for the sources of inflation in Turkey

In this subsection, we first investigate the sources of inflation in Turkey, taking into account both the demand side and supply side factors in our model in line with what is argued by Klau and Mohanty (2000). We use Vector Autoregression (VAR) econometrics in this paper since it has two conducive tools to interpret changes in inflation and interest rate, namely Impulse Response Functions (IRF) and Variance Decemposition (VDC). IRF enables us to trace the response of one endogenous variable to a one unit shock in another endogenous variable in the model. On the other hand, VDC analysis is used to answer how much of the variance in one variable is explained by others. In this section, we will analyze the VDC of inflation through a VAR framework to assess the relative importance of determinants of inflation. In the VAR model, monthly inflation measured as the change in domestic Consumer Price Index (π_t), monthly inflation measured as the change in World Commodity Price Index (π_t^w)[16], output gap (y_t^g), nominal exchange rate (e_t), and interest rate (i_t) are treated as endogenous variables. Hence, the VAR model is of the form:

$$\pi_t = \propto_0 + E_{t-1}[\pi_t] + \propto_1 \pi_t^w + \propto_2 e_t + \propto_3 y_t^g + \propto_4 i_t \qquad (1)$$

where E_{t-1} stands for the expected inflation at time t depending on the information available at time $t-1$.[17]

At this juncture it is important to note that the model implicitly incorporates the impact of changes in nominal wages on inflation. This is because the appearance of the lagged inflation term in the model (i. e. $E_{t-1}[\pi_t]$) is closely related with the nominal wage inflation at time t. In fact, it can be assumed that wage inflation in Turkey is characterized by the following equation (Ekinci, 2013: 43)[18]:

$$\Delta lnw_t = \beta\pi_{t-1}, 0 < \beta < 1 \qquad (2)^{19}$$

[16] World Commodity Price Index is a price index released by the IMF incorporating all commodities (both fuel and non-fuel).

[17] Expectations are assumed to be linear projections of the lags of the variables.

[18] "More to the point a recent study based on a survey covering wage negotiations in selected unionized companies quoted in Istanbul Stock Exchange argues that ".... employers' unions and labor unions agreed for the most part on using "actual" inflation in Turkey. This is largely because the rate of increase in the past is known, while the future rates are a matter of personal judgment and prediction which may be affected subsequently by a wide range of factors… …there is therefore reason to suppose that the assumption reflected in (2) is a reasonable approximation to the wage determination process in Turkey" (Ekinci, 2013: 43).

[19] In order to test the relevance of this assumption, we present the relation between annual inflation in consumer prices and nominal wage inflation in Turkey during the period 2002-2008 in Table A.1 in the Appendix. Since the nominal wage data released by Turkish Statistical Institute is available only in quarterly

Our model is similar to that developed by Loungani and Swagel (2001) who analyze sources of inflation in developing countries through a VDC in their model. In this paper, Loungani and Swagel include oil price growth, non-oil price growth, output gap, exchange rate growth, domestic inflation and money growth as endogenous variables of the VAR model. Instead of separate indices for oil and non-oil commodity price inflation we choose to use a composite index of commodity prices[20]. Furthermore, in order to capture the effect of monetary policy on inflation we include interest rate in the model instead of money growth since the main policy tool of the CBRT is the short term interest rate. Similarly, Sohrabji (2011) constructs a VAR model including world oil prices, world food prices, output gap, exchange rate, domestic prices and short term interest rate to comprehend the impact of these variables on inflation and evaluate the exchange rate pass through in India. The order of VAR differs from that in our analysis; however, different specifications for the order do not change our results.

On the other hand, other studies include different variables in their VAR models in order to explain the determinants of inflation in Turkey. For instance, in their influential paper, Leigh and Rossi (1999) incorporates oil prices, real output, nominal exchange rate, wholesale prices and consumer prices as the endogenous variables in their VAR framework to examine the impact of exchange rate shocks on both WPI (wholesale price index) and CPI inflation through VDC. Following Leigh and Rossi (1999), Arbatlı (2003) uses a VAR framework to analyze ERPT in Turkey. In addition to the variables in Leigh and Rossi (1999), Arbatlı (2003) includes interest rate in the model so as to capture the impact of monetary policy on the economy. However, since our focus is on variations of the CPI inflation, we do not incorporate WPI inflation in our model.

The data and periodization

The data of our study covers the period between the second half of 2002 and the fourth quarter of 2008. Given the acute reduction in inflation and interest rates in the beginning of 2002, excluding the observations in the first half of 2002 from the data set was necessary to eliminate excessive movements of these variables. The aftermath of the global crisis is excluded from the analysis because post crisis period have witnessed a shift in the monetary policy stance into a more complex form of IT with an emphasis over financial stability. Hence, the results presented in this paper are valid only for the underlying period. The differences of monetary policy stances between these two periods, however, are subject to other researches.

The data for domestic inflation (monthly change) is obtained from the CBRT. World Commodity Price Index (WCPI) is obtained from the IMF and we calculate monthly WCPI inflation from this index. In order to eliminate seasonal fluctuations, we used X-12 method for

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form, we are not able to analyze correlation between the consumer price inflation and nominal wage inflation. This is also the main reason why we cannot have nominal wage inflation explicitly within the model.

[20] We have also estimated another model having fuel and food price inflation as its explanatory variables. The results are similar with separate indices. Yet, we choose the model with general commodity price inflation in order not to consume unnecessary degrees of freedom.

both variables. The output gap is calculated as a proxy to the difference between the seasonally adjusted (through X-12 method) monthly industrial production index (1997=100) released by the Turkish Statistical Institute and the trend industrial production calculated through Hodrick-Prescott filter. Nominal exchange rates are the CBRT's end month indicative exchange rates ($/TL) at 15.30. Finally, the mean of overnight borrowing and lending interest rate declared by the CBRT is used as the policy instrument influencing the inflation rate in the economy.

Estimation Results

Our model consists of π_t, π_t^w, y_t^g, e_t, and i_t. In order to estimate the model, stationarity properties of all the variables are tested. The results of Augmented Dickey Fuller (ADF) unit root tests are given in Table A.2 in the Appendix. The lags for ADF are chosen automatically according to Schwarz Criterion. Interest rate is reported to be stationary under the hypothesis that it is random walk with intercept only. On the other hand, CPI inflation, WCPI inflation and output gap are stationary no matter what the specification of the random walk is. Under the hypothesis that it follows random walk with intercept, exchange rate is found to be non-stationary. Hence, according to unit root tests all endogenous variables but exchange rates are stationary. Thus, we will use a reduced form VAR for the estimation taking the first difference of the exchange rate[21].

Since VDC will be used to unveil the separate contributions of the variables to the variations in inflation, the order of VAR is important. Using pairwise Granger Causality tests yield mostly ambiguous results[22]. Yet, following the literature and economic theory we make a few assumptions as to the degree of exogeneity of the variables. First, we assume that π_t^w is the most exogenous variable in the model which seems quite reasonable since the domestic factors in Turkey are unlikely to affect world commodity prices in a significant way. Second, following the literature we assume that output gap and exchange rate are more exogenous than monthly inflation. Given these assumptions, we need to estimate eight VAR models with different orders[23]. The estimation results indicate that specification of the order of variables does not significantly alter the results. Hence our results given below are robust to different specifications of the ordering. Besides we restricted the model to use a maximum of 6 lags of each variable in order not to consume degrees of freedom given the small size of our sample[24]. Below we give the estimation results and depict the VDC of domestic inflation for the following order: $\pi_t^w, e_t, i_t, y_t^g, \pi_t$. The lag length 2 is chosen automatically according to

[21] We also checked for the situation where interest rate follows random walk with trend and intercept and exchange rate is stationary since the p-value is relatively low (0.09). These specifications do not alter our main findings in a considerable way.

[22] In most lags, variables are reported not to Granger cause each other.

[23] Namely, 1-) $\pi_t^w e_t, y_t^g, i_t, \pi_t$; 2-) $\pi_t^w, e_t, i_t, y_t^g, \pi_t$; 3-) $\pi_t^w, e_t, y_t^g, \pi_t, i_t$; 4-) $\pi_t^w, i_t, e_t, y_t^g, \pi_t$; 5-) $\pi_t^w, i_t, y_t^g, e_t, \pi_t$; 6-) $\pi_t^w, y_t^g, e_t, i_t, \pi_t$; 7-) $\pi_t^w, y_t^g, e_t, \pi_t, i_t$; 8-) $\pi_t^w, y_t^g, i_t, e_t, \pi_t$

[24] For 8 lags, we are left with only 27 degrees of freedom which are not adequate for a meaningful econometric analysis.

the Akaike Information Criteria[25]. Moreover, diagnostic tests reveal that estimation results are free from heteroscedasticity and autocorrelation problems.

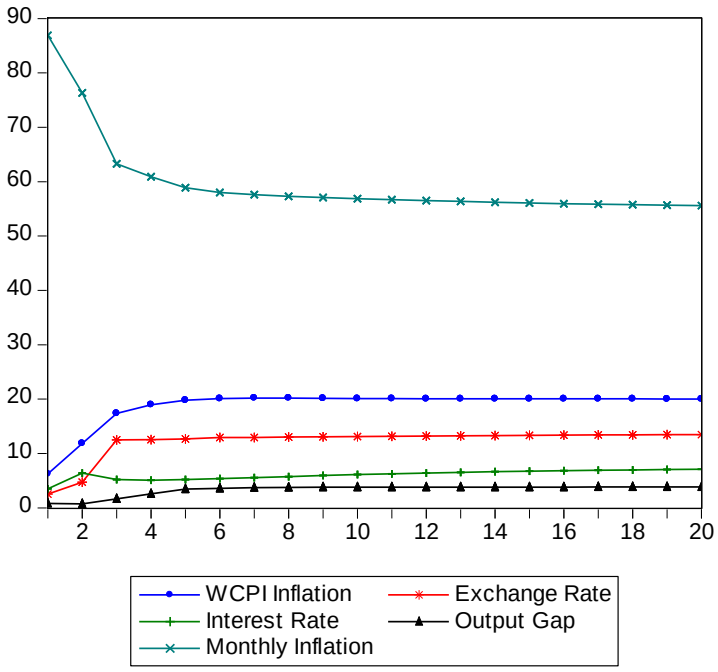

Figure 4. Variance Decomposition of CPI Inflation

Using VDC for inflation, we find the relative contribution of different variables to changes in inflation. According to the evidence, WCPI inflation explains 20% of the variations in domestic inflation, while innovations in exchange rate explain 13% of fluctuations in inflation On the other hand, interest rate explains approximately 6% of the variations in inflation. The contribution of output gap is quite low: approximately 4%. The rest of the variations is explained by the variations of CPI inflation itself[26].

Hence seen, VDC of CPI inflation yields that innovations in the exchange rate and commodity prices are the most important factors in explaining variations in CPI inflation (approximately 33 percent in total) whereas the contribution of the changes in output gap and interest rates play only a subordinate role (nearly 10 percent in total). Hence the conventional wisdom attaching a major role to demand side factors in determining inflation seems to be irrelevant in the Turkish case where supply side factors such as exchange rate and world commodity prices explain much of the variance in CPI inflation. This analysis is in line with what the CBRT

[25] The estimation results do not change in a considerable manner when we include more than two lags in the model. As we include more lags, the contribution of WCPI inflation increases whereas that of CPI inflation decreases.

[26] Most of the variation of CPI inflation is explained by itself as expected. This also reflects the fact that the changes in nominal wages is of great importance in determining inflation. However as we include more lags in the model, the contribution of CPI inflation in explaining variations in itself decreases approximately to 40 percent.

claims in its annual reports with regards to the reasons of overshooting the inflation target as mentioned in the previous section. Given that, however, the idea behind the implementation of IT is undermined considerably. If it is the supply side factors that determine changes in inflation which are typically behind the scope of monetary policy, the reasons behind the implementation of IT which tries to control inflation through measures related with demand side factors remain unclear.

The role of exchange rates as an important source of changes in CPI inflation (seemingly more important than the output gap and interest rates) has two crucial implications. First, it implies that inflation is considerably determined by the variations in the exchange rate which undermines the main tenets of IT. Second and arguably more important for the aim of this study, it may encourage central banks to tolerate appreciation of exchange rates to curb inflation pressures. A sustained appreciation of the domestic currency may decrease the import prices thereby helps the CBRT to achieve its inflation target. Hence, along the lines with what is argued above with regards to developing countries, monetary authorities in Turkey might have benefited from the appreciation of the Turkish lira to contain inflation. In this sense, a considerable part of the success for achieving the targets is very likely to be associated with favorable movements in exchange rates. Yet, whether such trend is policy-induced or not still needs further research. Did the CBRT favor appreciation trend of the lira or has it just treated depreciation and appreciation pressures equally? To shed more light on this issue we now turn our attentions to the interest rate setting behavior of the CBRT through constructing a classical monetary policy reaction function.

3. Asymmetric Monetary Policy Stance with Respect to the Exchange Rate

3.1. Asymmetric Behavior in Interest Rate Setting

Many researches verify that exchange rate is an important concern in monetary policy both for its effects on inflation and on financial stability[27]. In their highly influential paper, Calvo and Reinhart (2000) find that monetary authorities in floating exchange rate regimes exhibit "fear of floating" due to their credibility shortcomings and concerns over financial system. Using data for thirty nine countries, Calvo and Reinhart (2000) document that variability in nominal exchange rate is low and fluctuations in interest rates and level of reserves is high in developing countries relative to developed countries. They claim that, given their higher levels of exposure to external shocks, relative stability of exchange rates in developing countries must stem from deliberate interventions to stabilize the exchange rate. An indicator

[27] Besides its impact on inflation and financial system, the importance of exchange rates is also evident when one considers the much shorter lag between exchange rate and inflation than that between interest rates and inflation through the aggregate demand relation. After all, any change in the exchange rate may immediately alter the prices of imported goods denominated in domestic currency. This is called as the direct channel by Svensson (1999). Hence, using the direct exchange rate channel, an IT central bank may respond to inflationary shocks very quickly. In this vein, Ball (2000: 5) states that "In open economies, a danger with pure inflation targeting is that policymakers will move exchange rates too aggressively to control inflation. The effect of exchange rates on import prices is the fastest channel from monetary policy to inflation. It works more quickly than the channel through speedups or slowdowns in output. As a result, if policymakers are given a mandate to keep inflation as close as possible to its target, they may respond by moving exchange rates aggressively to offset inflation movements…"

of this is the co-movement of interest rates and nominal exchange rate. Another indicator is the negative relationship (in two thirds of the cases) between reserves and the nominal exchange rate revealing that "leaning against the wind" is the case (Calvo and Reinhart, 2000).

Similarly, other studies also reveal that monetary authorities respond to exchange rate fluctuations in developing countries. For instance, using a model estimated for Argentina, Brazil, Mexico, Indonesia, Korea and Thailand, Filosa (2001) concludes that monetary authorities strongly responded to exchange rate variations. Accordingly, Mohanty and Klau (2004) report that in most developing countries interest rates are used strongly as a reaction to fluctuations in the exchange rate. On the other hand, Ball (1999) derives the optimal policy rule for the open economy case. His findings indicate that if the monetary authority wishes to minimize the output gap and deviations of inflation from the target, optimal policy instrument is a weighted sum of the interest rate and the exchange rate. This finding is compatible with the implementation of Monetary Conditions Index (MCI) which is used in some IT countries most prominently in Canada and New Zealand[28].

All of these studies reveal that the monetary authority takes into account the movements in the exchange rate when conducting monetary policy. Nevertheless, they do not mention about the asymmetric nature of this policy stance. Yet, as argued in the introduction, IT developing countries may have to resort to appreciation of their currency due to the positive bias between actual inflation and inflation targets. In what follows we test this hypothesis on the basis of the Turkish experience.

A VAR model for the asymmetric policy stance of the CBRT

In this section, we test our hypothesis that the monetary policy stance in Turkey is asymmetric with respect to the exchange rate, tolerating appreciation and fighting against depreciation. For this aim, we hypothesize that the monetary policy reaction function is of the form:

$$i_t = \propto_0 + \propto_1 i_{t-1} + \propto_1 (\pi_t - \pi_t^*) + \propto_2 (y_t - y^*) + \propto_3 \Delta e_t \qquad (2)$$

where Δe_t (i.e. $e_t - e_{t-1}$) denotes the change in the nominal exchange rate, $(y_t - y^*)$ refers to the output gap (i.e. y_t^g) and $(\pi_t - \pi_t^*)$ refers to the inflation gap (i.e. the difference between expected annual inflation at month t and the appropriate value of the target inflation at month t[29]). This model represents an extended Taylor rule through which the impact of exchange rates on monetary policy decisions is captured. Monetary authority increases interest rate in case of an increase in exchange rate (depreciation), output gap and inflation gap and decrease the policy rate if these variables decrease. On the other hand, it avoids

[28] For the Turkish case, the evidence presented in Us (2004) suggests that MCI outperforms the simple Taylor rule in that economy stabilizes much more quickly and exhibits less fluctuations under the MCI rule. The advantage of the MCI, according to Us (2004), stems from the fact that implementing a simple Taylor rule in which changes in exchange rate is not taken into account leads to missed opportunities since monetary authority does not act to offset impacts of exchange rate on inflation.

[29] Construction of the targeted inflation at a given time is given in the appendix.

excessive movements of the interest rate (interest rate smoothing), hence the presence of lagged interest rate in the model.

Our perception about the monetary policy reaction function resembles to that of Aizenman, Hutchinson and Noy (2008). The difference lies in the fact that instead of an exchange rate difference variable, they include an index to incorporate the impact of all external factors in their setting of monetary policy reaction function. Using this model they conclude that both IT and non-IT central banks in developing countries respond to real exchange rate in their monetary policy decisions via their control over short term interest rates. On the other hand, in order to reveal that central banks in developing countries respond strongly to changes in exchange rate, Filosa (2001) and Klau and Mohanty (2004) use a very similar model. The difference is that they include the change in the real (not nominal[30]) exchange rate and the one lagged term of it (for the latter).

For the Turkish case, a similar model is constructed by Akçağlayan and Civcir (2010). Using IRF and VDC they demonstrate that the CBRT responds to changes in the exchange rate through interest rates. However, their model suffers from the specification of the endogenous variables. Following Hammermann (2005), they use a real exchange rate gap variable -the difference between the exchange rate and the trend exchange rate at time t- instead of a difference exchange rate variable. Moreover, they take the inflation gap as the difference between actual inflation and trend inflation neglecting the inflation targets. In order to find the causes of interest rate changes, on the other hand, Cömert et. al (2010) construct a very similar model to our model. The difference lies in that they include a US interest rate variable in order to incorporate external developments in the model. Yet, given the empirical result that the international interest rates might or might not have played a role in the policy interest rate decisions of the CBRT, this difference does not seem to be substantial.

All of these studies analyze the role of exchange rates in the monetary policy reaction function of central banks in developing countries. However, the model given by equation 2 does not give information as to the different response of interest rate to depreciation and appreciation. In this sense, Galindo and Ros (2008) develop a model to capture the asymmetric response of Banco de Mexico to changes in the exchange rate in their model[31]. In their model, the finding that the coefficient of the depreciation variable is statistically significant whereas that of the appreciation variable is not signifies the asymmetric nature of interest rate setting behavior of the central bank. However, the method of Galindo and Ros (2008) is likely to suffer from at least two major deficiencies. First, it is mainly based on the assumption that notorious PPP theorem holds in the long run. However there are a lot of disputes over this theorem. Especially it is not easy to digest the idea that it holds in developing countries. Furthermore, the equation (3) used by Galindo and Ros (2008) can most likely suffer from omitted variable case which can lead to unreliable biased coefficients. For

[30] We also run a regression with the real exchange rate yielding very similar results.

[31] They estimate an interest rate regression by using the regression equation:

$$R_t = \beta_0 + \beta_1 U_t^+ + \beta_2 U_t^- + \beta_3 R_{t-1} + e_t \quad (3)$$

where $U_t^+$and U_t^- stands for depreciation and appreciation of the exchange rate respectively.

example even if we assume those variables which are included in a very simple conventional central bank reaction function as described by Taylor (1993), it becomes clear that the regression in equation (3) most likely suffer from the omitted variable case.

In order to overcome these problems existing in this method, we modify the monetary policy reaction function defined by equation (2) in the following sense: in order to investigate whether the interest rate decisions of the CBRT is taken in an asymmetric manner with respect to exchange rate movements, two variables are defined representing depreciation and appreciation of the exchange rate respectively without resorting to the PPP hypothesis:

$$x_t^+ = \max(\Delta e_t, zero)$$

$$x_t^- = \min(\Delta e_t, zero)$$

Then a VAR model, including x_t^+, x_t^-, y_t^g, i_t and π_t^g[32], ordered according to their exogeneity (from most exogenous to most endogenous), is estimated[33]. IRF analysis then is used to make inferences about the asymmetric policy stance of the CBRT.

Estimation Results

Now, we will analyze the IRF of the interest rate to make inferences about the relative contributions of x_t^+ and x_t^-, on the interest rate decisions of the CBRT. IRF enables us to trace the response of the interest rate to one unit shocks in other variables so that we can analyze the relative contribution of x_t^+ and x_t^- on interest rate decisions. The results of the unit root tests given in the appendix imply that all variables are stationary.

The order of VAR is important for IRF analysis; hence we apply pairwise Granger Causality tests to each variable. Granger Causality tests presented in Table A.3 in the appendix yields that up to sixteen lags x_t^+ Granger causes i_t, whereas the reverse is not true. Up to four lags i_t Granger causes x_t^-, and the converse is not true. Accordingly, up to ten lags, x_t^+ Granger causes x_t^- with the reverse again being not true. Hence, x_t^+ is more exogenous than i_t and i_t is more exogenous than x_t^-. In order to make further restrictions about the specification of the order of variables in the model we make the following assumptions. First, in line with our presumption in the first model, we assume that x_t^+ and x_t^- and y_t^g are more exogenous than π_t^g. Second, according to the Granger Causality results, we assume that the order of exogeneity is such that x_t^+, i_t, y_t^g. Hence, we are left with four specifications for the order of VAR[34]. Using the first order, we estimate the VAR model and depict the IRF of the interest rate below for 2 lags which is determined by the Akaike Information Criteria:

[32] $y_t^g = (y_t - y^*)/y_t$; $\pi_t^g = (\pi_t - \pi_t^*)$.

[33] Actually, since we will use IRF analysis the VAR is estimated with $abs_x_t^- = |x_t^-| \; \forall t$ in order to investigate the impulse response of interest rate to a positive one standard innovation in appreciation variable.

[34] Namely: 1-) $x_t^+, y_t^g, i_t, x_t^-, \pi_t^g$; 2-) $x_t^+, i_t, y_t^g, x_t^-, \pi_t^g$; 3-) $x_t^+, i_t, x_t^-, y_t^g, \pi_t^g$; 4-) $y_t^g \; x_t^+, i_t, x_t^-, \pi_t^g$.

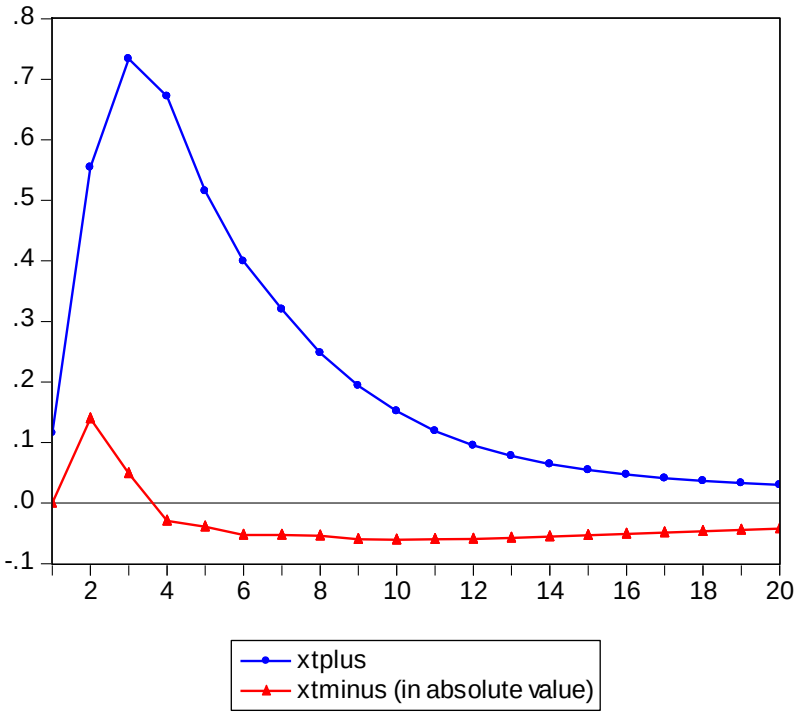

Figure 5. Impulse response of the interest rate to shocks in x_t^+ and x_t^-

Following the shocks, the interest rate increases within the first three months as a result of a one unit shock in x_t^+, and decreases (or increases in absolute value) within the first two months as a result of a one unit shock in x_t^- as anticipated. However, the response of the interest rate to a shock in depreciation variable is much greater (approximately five times in their peaks) than that to a shock in the appreciation variable. Indeed, one unit increase in the appreciation variable does not seem to have a considerable impact on interest rate decisions of the CBRT as Figure 5 indicates. Thus, the impact of a unit increase in depreciation on i_t is evidently much more significant indicating that monetary authority adjusts interest rates in response to changes in the nominal exchange rate in an asymmetric way.

This finding is not without any reservation and a caveat seems to be necessary at this juncture. Exchange rate depreciation is not the most dominant factor of interest rate decisions. One striking fact is the dominance of interest rate smoothing tendency of the CBRT during the period. VDC of interest rate yields that interest rate is the dominant factor in explaining variation in itself, possibly an inevitable consequence of interest rate smoothing tendency. In their paper, Cömert et. al (2010) present econometric evidence to verify their argument that interest rate smoothing was the main tendency of the CBRT between 2002 and 2008 and that the CBRT did not respond to changes in output, however it slightly responds to the movements in the exchange rate. According to the authors, interest rate smoothing was a consequence of the quest for a predictable policy environment through which the confidence of international investors is retained. Hence a gradual movement of interest rates in response to developments in the economy was perceived as necessary for the CBRT in order to assure financial stability and maintenance of capital inflows. Yet, besides the interest rate smoothing

tendency, the asymmetric nature of interest rate decisions is apparent from the econometric evidence as Figure 5 depicts.

The test results are robust to other specifications: with all other orderings the impulse response functions of the interest rate are very similar. Moreover, different lag specifications (up to 6 lags) do not distort the asymmetric response of interest rate to exchange rates[35]. To further increase the robustness of our analysis, we replicate the same procedure with new variables w_t^+ and w_t^- defined as:

$$w_t^+ = \begin{cases} \Delta e_t \; if \; \Delta e_t > 0.02 * e_{t-1} \\ 0 \; otherwise \end{cases}$$

$$w_t^- = \begin{cases} \Delta e_t \; if \; \Delta e_t < -0.02 * e_{t-1} \\ 0 \; otherwise \end{cases}$$

Hence, now we assume that monetary authority takes into account only the changes bigger than two percent of the existing exchange rate. This assumption seems to be more realistic since monetary authority may remain irresponsive to small deviations of the exchange rate. The Granger Causality tests and the VAR analysis give quite similar results with the new variables as Figure 6 indicates. However, the findings of the model with the new variables suffer from degrees of freedom problem[36]. Hence, we take the model with x_t^+ and x_t^- instead of that with w_t^+ and w_t^- as the benchmark case.

[35] A VAR model with the first difference of interest rate is also estimated in case the interest rate follows a random walk with trend. Actually, this may happen due to acute reductions in interest rate until the first half of 2004 although there is not an observable trend after 2004. The results with the new variable, again, clearly reveal the asymmetric nature of the policy stance; however the R-squared in the new regression remains low as expected. Hence, we stick into the model with the interest rate and not its first difference.

[36] w_t^+ takes a positive value only 16 times whereas w_t^- takes a negative value only 23 times with other observations remaining zero.

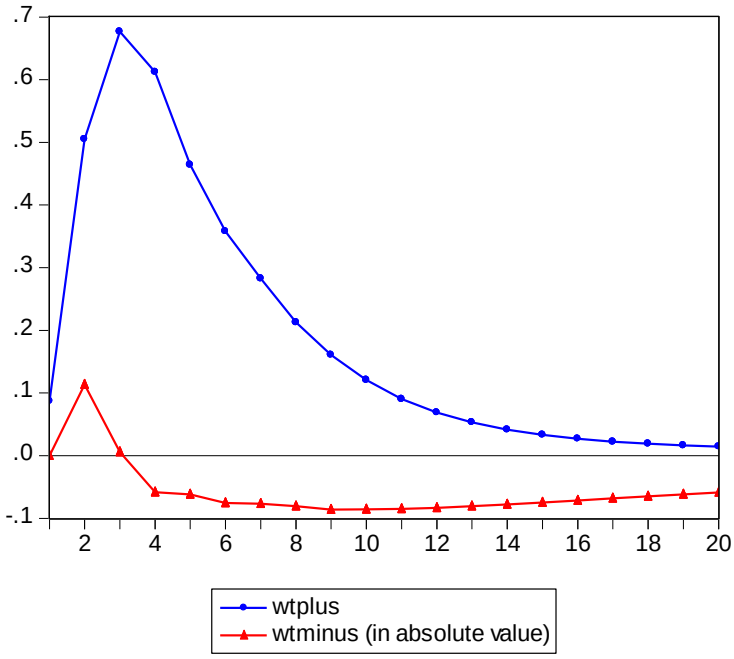

Figure 6. Impulse response of the interest rate to shocks in w_t^+ and w_t^-

Asymmetric exchange rate policy stance of the CBRT does not only consist of its decision on interest rate. The Bank also exhibits an affirmative approach towards appreciation in its operations in foreign exchange market as the next subsection discusses.

3.2 Asymmetric Behavior in Foreign Exchange Market

During the period under investigation, foreign exchange purchases are perceived by the CBRT as not to influence the value of exchange rate which is said to be determined by market forces (CBRT, 2004; Akıncı et. al 2005b). This is presented as the main reason why most of the purchases are made as auctions the terms of which are pre-announced. The CBRT claims that the aim of purchases is not affecting the level of exchange rate but rather to increase foreign exchange reserves, the abundance of which is important for the sake of the Turkish economy due to the need for a safety measure in case of an external shocks, for an increase in confidence to the economy, for resources to make the payments of the treasury and for clearing the high cost worker remittances from the CBRT's balance sheet (CBRT, 2006).

With regards to the impact of foreign exchange sales and purchases on the level of exchange rate, however, using descriptive statistics[37] indicate that sale operations are important in affecting the level and volatility of the exchange rate while purchase operations are not found to have a considerable role in explaining changes in the exchange rate. It is clear, from the Table A.4 that purchase interventions do not change the level of exchange rate in a notable

[37] Due to a very small sample (13 purchase and 3 sale operations above 100 million U.S. dollars), using econometric analysis is not possible.

way[38]. Hence, it can be argued that the impulse behind purchase interventions is to accumulate foreign exchange reserves rather than reverse the appreciation trend of the lira. On the other hand, aggressive purchase operations of the CBRT in the midst of the increased financial fragilities in May and June 2006 reversed the depreciation trend with an immediate and acute appreciation of the lira as can be seen from Table A.4.

The changes in the level of daily foreign exchange purchases of the CBRT through auctions can also be considered as a way to intervene in the foreign exchange market. As can be seen from Table A.5, the asymmetric nature of the CBRT with respect to exchange rate is valid in this case as well in the sense that decreases in the level of foreign exchange purchased in the auctions are always preceded by a substantial depreciation of the exchange rate whereas increases are loosely related with appreciation. This finding again suggests that the foreign exchange purchases of the CBRT are to a great extent associated with the purpose of accumulating reserves[39] and that whenever a depreciation trend is observed the CBRT subordinates this goal in order to refrain from depreciation.

Hence seen, it is apparent that the nature of foreign exchange interventions in this period is compatible with the asymmetric nature of the exchange rate policy of the CBRT. Capital inflows into Turkey during these years have been so intense that foreign exchange purchases of the CBRT have never hindered the appreciation trend of the lira whereas whenever the signals of permanent depreciation are observed, the CBRT responded immediately.

4. Policy Implications and Concluding Remarks

Thus far, using descriptive and econometric methods, we have shown two interrelated findings. First, the main determinants of inflation in Turkey are supply side factors such as commodity prices and exchange rates. Second, the monetary policy of the CBRT between 2002 and 2008 was asymmetric with respect to the exchange rate in that all of the interventions in the form of both sales and purchases into the foreign exchange market, foreign exchange purchase auctions of the CBRT and its interest rate decisions exhibited a tendency for appreciation of the Turkish lira. Is the asymmetric policy stance peculiar to Turkey or does IT itself incorporate such a tendency in developing countries? As we have seen, exchange rate appreciation has happened in most of the IT developing countries in the recent period. Although to have much more conclusive results, more researches are needed in this area, due to the importance of supply side factors in determining inflation in developing

[38] Two situations, namely interventions carried out at 25.09.2003 and 09.03.2005, seem to be exception as the exchange rate exhibited a considerable depreciation after the first month of the intervention. However, for the first case, comparing the level of exchange rate after intervention (1.35) and before intervention (1.33) yields that exchange rate simply returned approximately to its previous level, presumably not as a consequence of the intervention. In the second case, depreciation trend of the exchange rate commenced much after the intervention carried out. At October 9 exchange rate was 1.38 and it gradually increased to 1.48 until October 25. This reveals that depreciation may not be the result of the intervention but rather other factors are responsible for this trend.

[39] In fact, increases and decreases in foreign exchange purchases is closely related with increases and decreases in capital inflows. As Table A.5 indicates, most of the increases in purchases happened when capital inflows increase relative to the previous month whereas the CBRT decreased its purchase level through auctions when capital inflows decrease.

countries which have been documented by many studies mentioned in the previous sections, most likely, the asymmetric nature of exchange rate policy under inflation targeting regimes in developing countries are not peculiar to the Turkish case.

If central banks in developing countries have had a tendency of tolerating appreciation of their currencies, as that in Turkey, what might be the cause behind such a policy stance? The first reason behind the inclination towards an asymmetric policy may be the ineffectiveness of the monetary authorities in developing countries to curb inflation which is mostly related with external factors such as commodity prices. These central banks may have a tendency for appreciation in order to compensate the negative effects of other external shocks on domestic inflation. Second, stickiness in non-tradable goods' prices in developing countries also hinders the effectiveness of monetary policy in its combat with inflation. Conventional approach to IT extensively focuses on the experience of advanced countries where credibility problems are less repressive compared to developing countries. In this respect, Kumhof (2000) show that under imperfect credibility of the inflation target in a small open economy where non-tradable goods' prices are sticky, the monetary authority is forced to reduce the level of depreciation through a tight monetary policy so as to meet the target. This is because non-tradable goods prices remain higher than the targeted inflation due to the public perception that sustaining a low CPI is not sustainable (Kumhof, 2001). As a consequence, Kumhof (2001) claims that monetary tightening to reduce exchange rate depreciation is the endogenous policy response in the presence of non-tradable goods' price stickiness. Hence, lack of credibility is, in a way, offset by the exchange rate increasing (depreciation) more slowly than CPI (Kumhof, 2000). Third, the bottlenecks in the usual monetary transmission mechanism which are mostly peculiar to developing countries also restrict the capability of monetary policy to affect the real economy[40]. In such an environment where most of the inflationary developments are beyond what monetary authority can affect, appreciation of domestic currencies emerges as an indispensable outcome of the main aim of reaching the inflation targets.

Taking into account these constraints in restraining inflation and given that the supply side factors are the most prominent determinants of inflation in developing countries, IT central banks may be, in a way, forced to resort to exchange rate movements so as to hit their inflation target. In other words, what the central bank could not do is left to an upward trend (appreciation) of the real exchange rate[41]. We consider this policy stance under inflation targeting regimes in developing countries as "an asymmetric exchange rate peg". In this sense, it is very likely that IT is almost the equivalent of a crawling peg regime in developing countries.

[40] See Mishra and Montiel (2012) and Mishra, Montiel and Spiliembergo (2010) for a detailed discussion on the causes of bottlenecks of monetary transmission mechanism in developing countries.

[41] In this context, arguably the most explicit statement from a central bank (though non-IT) about the role of exchange rate to curb inflation is made by Monetary Authority of Singapore (MAS) in its exchange rate policy report. In this report MAS states that "…MAS has found the exchange rate to be the most effective instrument to keep inflation low. Other possible intermediate targets, in particular interest rates, are less effective in influencing real economic activity and domestic inflation outcomes" (MAS, 2001: 17).

Exchange rate appreciation, on the other hand, does not happen without its costs. Since exchange rate appreciation is directly related to massive capital flows IT central banks have taken a positive stance toward capital inflows. An increase in capital flows leads to the appreciation of their currencies. Many economists and central banks seem to have forgotten very quickly the lessons of the currency crises of the 1990s related to massive capital flows and, in relation to this, exchange rate movements[42]. The recent history of Mexico 1994, Turkey 2001, Argentina 2001 and Asian crisis 1997 has shown their devastating impacts on developing economies. In this vein, Frenkel and Taylor (2006) render a persistently strong exchange rate as an invitation to disaster due to destabilizing capital flows it brings with and its malign side effects on resource allocation and prospects for development.

Under free capital mobility a significant reversal of capital flows can be very costly. IT seems to contribute to the ignorance of dangers faced by developing countries. In fact, some formal models with imperfect credibility of low inflation target support this idea. For example, using a model of a small open economy with sticky non-tradable goods prices, Kumhof (2000) shows that central banks are forced to reduce the rate of currency depreciation through a tight monetary policy in order to reach their inflation targets. The model suggests that, at the end of the period, this brings about large current account deficits which may cause the collapse of the currency. Similarly, Kumhof et. al (2007) document that inflation targeting regime is also vulnerable to speculative attacks as opposed to claims of the proponents of this regime. [43]

In addition to the systemic threads it poses in developing countries, empirical studies suggest that real exchange rate appreciation is harmful for the economic growth in developing countries. In fact, there is a vast literature still growing on the long term growth-related impacts of exchange rate undervaluations in developing countries. For instance, Razmi et. al (2009) indicate that undervaluation of real exchange rates is a driving factor for investment growth. On the other hand, Rodrik (2008) report that undervaluation stimulates economic growth in developing countries. This effect is due to the favorable impact of sustained undervaluation on the profitability of tradable sector which typically suffers disproportionately from institutional weaknesses and market failures (Rodrik, 2008: 404). A real depreciation increases profitability in investing tradable sector and the ensuing reallocation of sources between sectors boost productivity growth through a structural change. Frenkel and Rapetti (2008) illustrate the nexus between competitive exchange rate and economic growth on the basis of Argentinian experience between 2002 and 2007. They assert that competitive exchange rate policy promoted expansion of the tradable sector and thereby contributed to the economic growth.

Thus seen, real exchange rate appreciation may jeopardize long term economic development in developing countries not only through triggering a currency crisis but also through its negative impact on economic growth.

[42] See Kaminsky et. al (1998) for a detailed literature review of the indicators of currency crises. The level of real exchange rates emerges as a significant indicator in many studies.

[43] Accordingly, with regards to the Turkish case, the ensuing real appreciation of the lira, has posed major challenges for the Turkish economy. Along with appreciation of the TL, one of the vulnerability indicators, current account deficit, soared to about 6 percent of the Turkish GDP in 2008.

Nowadays, the recent financial crisis has made classical IT regimes unfashioned due to the immediate need for addressing financial stability issues, low GDP growth and high unemployment. In this vein, although the CBRT and many other central banks in developing have not addressed many important problems such as the detrimental impacts of financial flows, they have begun following a more balanced path by putting more emphasis on especially financial stability issues and developing new unorthodox policy tools. However, many still argue that central banks should go back to IT regimes. Our study implies that inflation targeting central banks in developing countries would favor appreciation of their currencies which may have adverse impacts on developing countries. Thus, a broader perspective paying enough attention to the impacts of financial flows and exchange rate movements in implementation of monetary policy rather than returning to previous IT regimes should be developed.

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Appendix

Annual Inflation		Annual Nominal Wage Inflation[44]	
2002	29,75	2003	23
2003	18,36	2004	13,3
2004	9,32	2005	12,3
2005	7,72	2006	11,5
2006	9,65	2007	9,4
2007	8,39	2008	9,9

Table A.1 Annual inflation in consumer prices and nominal wage inflation

Source: Central Bank of the Republic of Turkey, Turkish Statistical Institute.

[44] Quarterly data for hourly wage index in manufacturing industry is used.

Variables	ADF(1)[45]		ADF(2)		ADF(3)		Result
	Lag	p-value	Lag	p-value	Lag	p-value	
CPI inflation	0	0.00	0	0.01	1	0.02	Stationary under all specifications
WCPI inflation	0	0.00	0	0.00	0	0.00	Stationary under all specifications
Output gap	0	0.00	0	0.00	0	0.00	Stationary under all specifications
Interest rate	0	0.00	0	0.86	1	0.00	Stationary under ADF(1)
Exchange Rate	0	0.09	0	0.05	0	0.27	Non-stationary under ADF(1)
x_t^+	0	0.00	0	0.00	0	0.00	Stationary under all specifications
x_t^-	0	0.00	0	0.00	0	0.00	Stationary under all specifications
Inflation gap	0	0.02	0	0.02	0	0.00	Stationary under all specifications

Table A.2. Unit Root Tests of the Variables in the First and Second Model[46].

F-statistic/p-value						
Hypothesis	1 lag	2 lags	3 lags	4 lags	5 lags	6 lags
i_t DNGC[47] x_t^+	0.00/0.98	0.04/0.96	0.02/1	0.19/0.94	0.40/0.85	0.37/0.90
x_t^+ DNGC i_t	10.17/0.00	7.07/0.00	5.96/0.00	6.12/0.00	4.70/0.00	4.04/0.00
i_t DNGC x_t^-	3.01/0.09	3.33/0.04	2.72/0.05	2.35/0.06	1.25/0.30	1.21/0.31
x_t^- DNGC i_t	0.04/0.85	1.74/0.18	1.35/0.27	1.38/0.25	1.74/0.14	1.30/0.27
x_t^+ DNGC x_t^-	6.06/0.02	7.83/0.00	5.93/0.00	3.90/0.00	3.43/0.01	3.15/0.01
x_t^- DNGC x_t^+	0.03/0.87	0.76/0.47	0.73/0.54	0.63/0.64	0.54/0.75	0.38/0.89

Table A.3. Pairwise Granger Causality Tests between x_t^+, x_t^-, i_t.

[45] ADF(1) represents random walk with intercept; ADF(2) represents random walk with trend and intercept; ADF(3) represents random walk without trend and intercept.
[46] The results are quite similar for the Phillips-Perron unit root test.
[47] DNGC: Do Not Granger Cause

Intervention	Amount (million U.S. dollar)	Exchange rate 1 month before intervention ($/TL)	Exchange rate at the time of intervention ($/TL)	Exchange rate 1 month after intervention
Purchase				
21.05.2003	517	1.59	1.49	1.41
09.06.2003	566	1.50	1.41	1.42
18.07.2003	938	1.42	1.40	1.40
10.09.2003	704	1.40	1.39	1.39
25.09.2003	1442	1.39	1.37	1.48*
16.02.2004	1283	1.34	1.33	1.32
27.01.2005	1347	1.35	1.35	1.29
09.03.2005	2361	1.33	1.28	1.35*
03.06.2005	2056	1.37	1.36	1.34
22.07.2005	2366	1.36	1.34	1.36
04.10.2005	3271	1.33	1.35	1.36
18.11.2005	3164	1.36	1.37	1.35
15.02.2006	5441	1.33	1.34	1.33
Sale				
13.06.2006	494	1.36	1.61	1.59
23.06.2006	763	1.51	1.71	1.55*
26.06.2006	848	1.54	1.66	1.52*

Table A.4. The time and amount of exchange rate interventions of the CBRT, and the exchange rate before and after the interventions.

Source: Central Bank of the Republic of Turkey.

Date	Foreign Exchange Purchase (million dollar)		Exchange rate 1 month before ($/TL)	Exchange rate ($/TL) at the time of intervention	Changes in capital inflows (million dollars)
01.07.2003	30→40	+	1.42	1.41	June-May=200
17.07.2003	40→50	+	1.42	1.39	July-June=537
02.09.2003	50→40	-	1.42	1.39	August-July=303
11.09.2003	40→50	+	1.40	1.39	August-July=303
07.10.2003	50→80	+	1.38	1.38	September-August=1719
21.10.2003	80→40	-	1.36	1.45	October-September=-3879
23.10.2003	40→0	-	1.35	1.48	October-September=-3879
01.03.2004	30→40	+	1.33	1.32	February-January=115
01.04.2004	40→50	+	1.32	1.31	March-February=-2068
07.04.2004	50→70	+	1.32	1.32	March-February=-2068
15.04.2004	70→40	-	1.31	1.37	March-February=-2068 April-March=698
27.04.2004	40→0	-	1.32	1.42	April-March=698
22.12.2004	0→15	+	1.44	1.39	December-November=2915
15.06.2006	20→0	-	1.35	1.45	June-May=-3416 May-April=512
25.07.2007	15→40	+	1.32	1.25	July-June=56
15.08.2007	40→15	-	1.27	1.34	July-June=56 August-July=-2797
05.10.2007	15→30	+	1.31	1.19	September-August=156
07.03.2008	30→15	-	1.20	1.25	February-January=-3189
15.10.2008	15→0	-	1.27	1.39	October-September=-4885 September-August=-2660

Table A5. Changes in the level of foreign exchange purchase of the CBRT through auctions and the exchange rates.

Source: Central Bank of the Republic of Turkey.

Calculation of Monthly Inflation Targets

The method to calculate inflation target of the CBRT at a given month is as follows: Consider we are at the beginning of year t. First, the difference between the inflation target for the year t (π_t^*) and the actual end year inflation of the year $t-1$ (π_{t-1}) is divided by 12. Then, monthly inflation targets are defined as:

$$\pi_{t,i}^* = \pi_{t,i-1}^* - (\pi_{t-1} - \pi_t^*)/12$$

with

$$\pi_{t,1}^* = \pi_{t-1} - (\pi_{t-1} - \pi_t^*)/12$$

where $i = 2,3, \dots 12$ represents the months at year t and $\pi_{t,i}^*$ represents the inflation target of the central bank at month i of the year t.