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Implicit asymmetric exchange rate peg under inflation targeting regimes: the case of Turkey

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Especially after the 2000s, many developing countries let exchange rates float and began implementing inflation targeting (IT) regimes based on mainly manipulation of expectations and aggregate demand. However, most developing countries implementing IT regimes experienced considerable appreciation trends in their currencies. Might have exchange rates been utilised as implicit tools even under IT regimes in developing countries? To answer this question and investigate the determinants of inflation under an IT regime, as a case study, this article analyses the Turkish experience with IT between 2002 and 2008. There are two main findings. 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 TL was tolerated during the period under investigation, whereas depreciation was responded aggressively by the bank. We call this policy stance under IT regimes 'implicit asymmetric exchange rate peg'. The Turkish experience indicates that as opposed to the rhetoric of central banks in developing countries, IT developing countries may have an asymmetric stance towards 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 over-appreciation of currencies in developing countries.

Key words: Inflation targeting, Central banking, Developing countries, Exchange rates
JEL classifications: E52, E58, E31, F31

1. Introduction

The developing world witnessed very high inflation rates after the 1980s. Since exchange rates and commodity prices are considered important determinants of inflation in

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developing countries, many 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 later stages. The unsatisfactory experiences with disinflation programs based on exchange rate regimes, such as fixed exchange rate or crawling peg exchange rate, 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 can be formally defined as 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 in this framework is to curb inflation, which is seen as an impediment in the pursuit of economic growth.

The implicit assumption behind IT is that inflation is a consequence of excess demand, which may be contained through appropriate monetary policy. Manipulation of aggregate demand and affecting expectations through interest rates is believed to have a significant impact on containing inflation. Monetary authorities could just determine policy interest rates and/or signal their future path, thereby affecting the level of aggregate demand and expectations which are ultimately supposed to determine inflation rate. In this framework, IT countries were supposed to tackle only with demand-pull inflation, ignoring supply-push inflation which cannot be controlled through monetary policy as experience reveals. In this vein, monetary authorities could either accommodate supply shocks or remain unresponsive given that the impact of these shocks on both current and expected inflation will be negligible on average. Mainstream thinking does not presume a profound difference between developed and developing countries in this respect. The causes of inflation and policy tools to fight 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. However, if cost-push shocks are the main determinants of variations in inflation, which is mostly the case in developing countries, then it is very likely that inflation targets are regularly missed, eroding the credibility of the monetary authority, which is essential for the IT framework. Given that conventional policy tools remain insufficient to control inflation, monetary authorities may be obliged to resort to other policy tools to achieve their inflation targets.

Proponents of IT are welcomed by the low inflation levels recorded in developing countries in the past 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. As pointed out by Epstein and Yeldan (2009), the inflation performance of IT countries is not better than countries with different monetary policy regimes. 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. Hence favourable conditions in exchange rates (rather than the active control of aggregate demand through monetary policy) might have been the factors that rein in inflation in developing countries.[1]

[1] During the period under investigation, the integration of China into global markets also played a disinflationary role in developing countries.

With regards to the exchange rate, as can be seen from Fig. 1, real appreciation trend is observable in many IT developing countries. All but two of the countries' currencies exhibit an upwards trend. Whether such a trend is a characteristic feature of IT and its role in curtailing inflation is the starting point of this article. 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 favouring/tolerating appreciation in an IT context? The asymmetric nature with respect to the exchange rate may arise from the positive bias between inflation targets and realised inflation in developing countries. If the direction of the bias is upwards

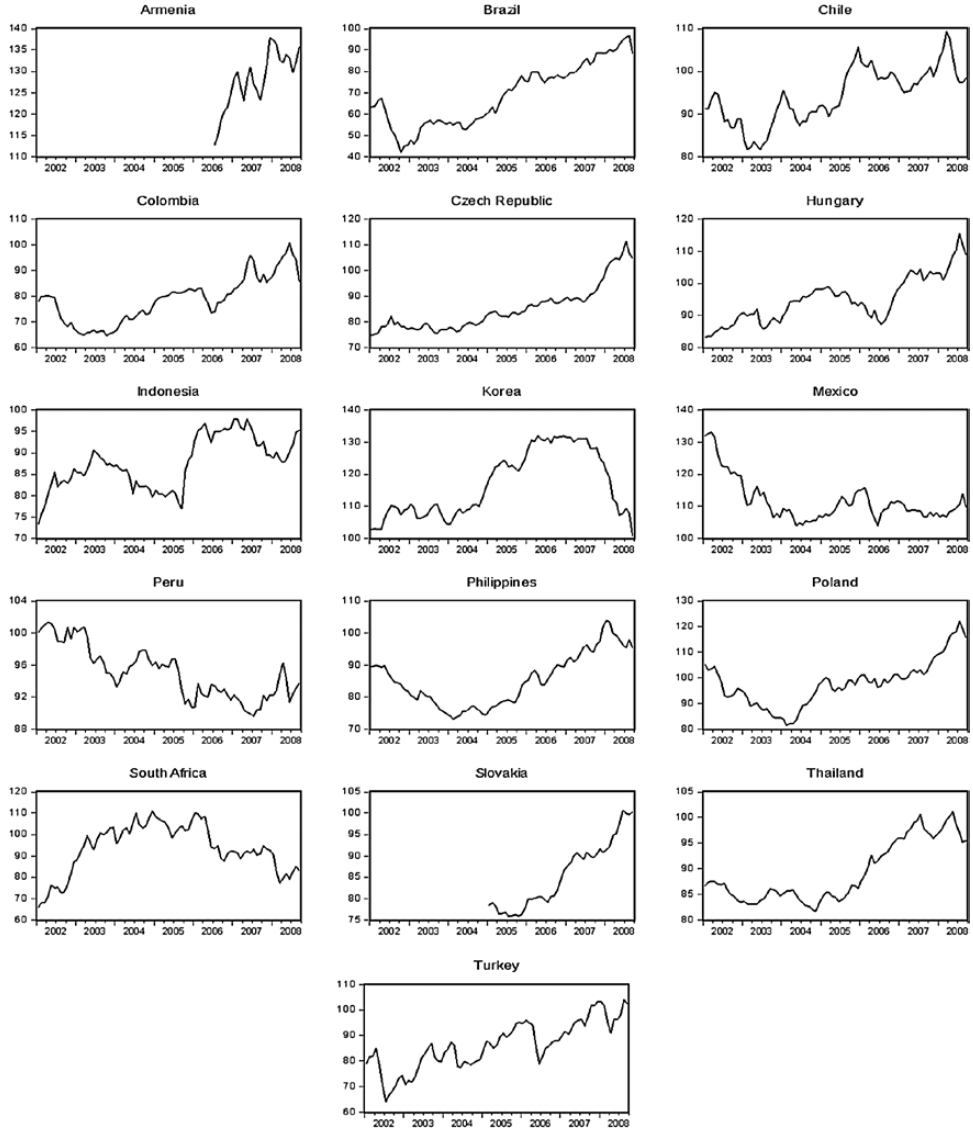

Fig. 1. Real effective exchange rates in inflation targeting developing countries
Source: BIS, 2010 = 100.

(ie misses from the target are usually above rather than below the target without the manipulation of exchange rate as a policy tool), 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, the exchange rate may emerge as a potential candidate for a policy tool.[2]

Might have exchange rate been utilised as an implicit tool even under IT regimes in developing countries? To answer this question and investigate the determinants of inflation under an IT regime, as a case study, this article analyses the Turkish experience with IT between 2002 and 2008.

The main findings 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 (TL) was considerably appreciated during this period, it is apparent that the Central Bank of the Republic of Turkey (CBRT) 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 CBRT with respect to the exchange rate. Both the econometric analysis from a VAR model and descriptive statistics indicate that appreciation of the TL was tolerated during the period under investigation, whereas depreciation was responded aggressively by the bank. We call this policy stance under the IT regimes 'implicit asymmetric exchange rate peg'.

The Turkish experience indicates that as opposed to the rhetoric of central banks in developing countries, IT developing countries may manipulate exchange rate movements to hit their inflation targets. This does not imply in any way that these countries are not inflation targeters. Given their official commitment to achieving their targets, we classify them as inflation targeters. However, the way they reach their targets are different from the formal framework of IT and from what central bankers claim they are doing. Our finding, then, suggests that there is no pure floating exchange rate or a pure IT regime. There is a substantial difference between theoretical implications and practical implementations of IT, which can be traced empirically in the differences between what central banks say and what they actually do. In this sense, we consider the manipulation of exchange rate as an essential part of IT regimes in developing countries.

In line with our empirical findings regarding Turkish experience, we claim that IT 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 rate regime.

[2] It is also important to note that this does not require central bank constantly intervening to ensure the appreciation of the currency. The period between 2002 and 2008 in general is characterised by increasing capital inflows to developing countries. Taking a confirmative stance to these inflows and responding heavily in case of depreciation also implies that exchange rate is implicitly used as a policy tool in fighting inflation. Hence, the difference in degrees of tolerance with respect to depreciation and appreciation pressures reveals as well the asymmetric nature in exchange rate policy.

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 behaviour of central banks in developing countries is not analysed 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 discuss later. In this sense, our study fills an important gap in the literature.[3]

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

2. Turkish experience with inflation targeting

Having noticed the impossibility of defending the exchange rate regime during the crisis of 2001, the CBRT allowed the TL 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 is 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. However, although the core of an IT framework existed, it can be defined as implicit as long as the regime is not formalised. 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, exchange rate pass-through (ERPT) has declined substantially as a result of the decline in indexation behaviour and reverse dollarisation in Turkey.[4] However, as the next section suggests, the decline in the ERPT was far from being sufficient to subordinate the exchange rate in determining inflation. Exchange rate remains one of the most important factors in explaining inflation in Turkey in this period.[5] In fact, whether the

[3] We should also note that there are some studies suggesting that some developing countries exhibit an asymmetric policy stance with respect to the exchange rate but in the reverse direction: they restrain appreciation pressures more than depreciation pressures (Rajan, 2011; Pontines and Siregar, 2012). However, they analyse countries from East and Southeast Asia (some IT and some non-IT) that are known for their concerns over competitiveness. Moreover, they analyse exchange rate interventions through policy tools other than interest rates. Levy-Yevati and Sturzenegger (2007), on the other hand, develop a 'fear of appreciation' argument suggesting an asymmetric policy response to exchange rate changes. However, they do not disaggregate their sample into IT and non-IT or developing countries and advanced countries. What distinguishes our work from the others is that we focus on policy rate decisions of central banks of IT developing countries in particular.

[4] See, amongst others, Kara and Öğünç (2008) and Kara *et al.* (2005). For an argument about the decline of dollarisation within the Turkish economy, see Akıncı et al. (2005A).

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

inflation targets are achieved or missed is closely related with what trend exchange rate and commodity prices exhibit, as Table 1 indicates.

Three success cases (indicated by a checkmark) 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 on average was observable during 2007 and 2008, inflation targets were missed. The reason is closely related with the acute upwards trend of international commodity prices in these years, as can be seen from Fig. 2. 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 import prices.

In line with this argument, between 2002 and 2008, the CBRT usually emphasised the role played by price rigidities in the services sector and increases in oil and food prices as the causes of hikes in inflation. 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 actual inflation (8.4%) exceeded target inflation (4%) in 2007 (CBRT, 2008). It is also reported that an upwards trend of lira eased such inflationary pressures. In a similar vein, the CBRT explained the reason behind missing the inflation target in 2008 (realised inflation: 10.1%, target inflation: 4%) 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 generally have sticky prices for non-tradeable goods.[6] Whilst commodity prices are beyond the control of monetary policy, price stickiness in the non-tradeables sector is also evidently beyond what monetary authority can affect due to credibility problems. In the Turkish case,

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

Year	Realized inflation (annual)	Target inflation	Average nominal exchange rate ($/TL)[a]	World Commodity Price inflation (annual)[b]
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

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

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

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

[6] See Kumhof (2000) for an analysis of price stickiness in non-tradeables sector in the context of IT.

Fig. 2. World Commodity Price Index
Source: IMF, 2005 = 100.

descriptive statistics suggest that IT does not seem to be effective in achieving inflation targets because realised inflation is largely determined by external shocks. However, one should go beyond descriptive statistics to have a more conclusive discussion. To shed more light on the question of 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.

3. 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 the output gap and monetisation of the fiscal, deficits whereas the other emphasises supply-side factors, such as exchange rates and international commodity prices, as the crux of inflation dynamics in developing countries. Whereas 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 outweigh demand-side factors.[7] There are also complementary approaches as to the relative importance of supply-side and demand-side factors in determining inflation. For instance, Mohanty and Klau (2001) analyse inflation dynamics in 14 developing countries in the 1980s and 1990s. They adopt an eclectic approach whereby the demand-side and supply-side factors are found to be important in determining inflation. Their empirical evidence shows that although conventional sources of inflation such as excess money supply, wages, and output gap play an important role, movement 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

[7] An elaborate presentation of literature review on the sources of inflation can be found in Mohanty and Klau (2001).

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' (Mohanty and Klau, 2001, p. 2).

In another pioneering study, focussing 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 triggering higher money growth or balance of payments crisis, thereby depreciation of the domestic currency), output gap, cost shocks and inflation inertia. They categorise the relative importance of these factors in explaining inflation according to different regions. In Latin America, for instance, exchange rates and monetisation 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 Mohanty and Klau (2001), they attribute significant differences in the relative importance of these factors in determining inflation across regions to differences in exchange rate regimes.

Thus, both demand and supply factors may play roles in explaining inflation in developing countries. Given this background, we construct a model including both factors to explain determinants of inflation in Turkey.

3.1 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 demand-side and supply-side factors in line with what is argued by Mohanty and Klau (2001). We use VAR econometrics because it has two conducive tools to interpret changes in inflation and interest rate: impulse response functions (IRF) and variance decomposition (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 analyse the VDC of inflation through a VAR framework to assess the relative importance of determinants of inflation.[8] The VAR model has the following form:

$$y_t = \propto_0 + \propto_1 y_{t-1} + \ldots + \propto_m y_{t-m} + u_t \quad (1)$$

where y_t is the vector of endogenous variables including 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), output gap (y_t^g), nominal exchange rate (e_t) and interest rate (i_t).

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 lagged inflation terms (ie $\pi_{t-1}, \pi_{t-2} \ldots \pi_{t-m}$) in the inflation equation is closely related with the nominal

[8] In analysing determinants of inflation, VAR is used heavily in the relevant literature. It seems to be the best way in assessing the importance of determinants of inflation in a comparative way. Comparing coefficients of variables, through generalised method of moments estimation, for instance, is problematic because we use monthly data. Using IRFs, however, we can see the impact of different factors on inflation over a certain time horizon, leading more meaningful results. Thus, we use VAR framework in this section.

wage inflation at time t.[9] In fact, the correlation coefficient between nominal wage inflation and inflation in consumer prices is found as 0.95.[10]

The selection of variables in the model is consistent with the relevant literature. Our model is similar to that developed by Loungani and Swagel (2001), who analyse sources of inflation in developing countries through a VDC in their model. 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.[11] Furthermore, 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 ERPT in India.

On the other hand, other studies include different variables in their VAR models to explain the determinants of inflation in Turkey. For instance, in their influential paper, Leigh and Rossi (2002) incorporate oil prices, real output, nominal exchange rate, wholesale prices and consumer prices as endogenous variables in their VAR framework to examine the impact of exchange rate shocks on both wholesale price index and CPI inflation through VDC. Following Leigh and Rossi (2002), Arbatlı (2003) uses a VAR framework to analyse ERPT in Turkey. Arbatlı (2003) also 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.

3.2 The data and periodisation

In this study, we use monthly data. The data cover the period between the second half of 2002 and the fourth quarter of 2008, hence we have 75 observations for each of the five variables in our model. 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 the impact of outliers.[12] Moreover, Turkey adopted IT in the beginning of 2002. It takes some time for institutions to adapt to the new regime. So excluding the first half of 2002 also helps avoid possible biases created by the transition period. The aftermath of the global crisis is excluded from the analysis because the post-crisis period witnessed a shift in the monetary policy stance into a more complex form of IT with an emphasis on financial stability along with price stability. In the post-crisis period, policy tools other than interest rates are used for this

[9] According to a recent study on wage negotiation between employer's unions and labor unions in Turkey "…employers' unions and labor unions agreed for the most part on using 'actual' inflation in Turkey" (cited in Ekinci, 2013, p. 43).

[10] Here we use quarterly nominal wage per hour index released by the Turkish Statistical Institute. Nominal wage inflation is calculated as the percentage change of nominal wage with respect to the corresponding quarter of the previous year. The same is done for quarterly inflation in consumer price data. The co-movement can be seen graphically in Figure A.1 in the Appendix.

[11] We also estimated another model having fuel and food price inflation as its explanatory variables. The results are similar with separate indices. We choose the model with general commodity price inflation so as not to consume degrees of freedom unnecessarily.

[12] Even if we include these observations in our sample, the estimation results do not change significantly.

aim. Therefore, the results presented here 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 International Monetary Fund (IMF) and we calculated monthly percentage change from this index. To eliminate seasonal fluctuations, we used the X-12 method for both variables. As a proxy of output gap, we calculated the percentage difference between the seasonally adjusted (through the X-12 method) monthly industrial production index (1997 = 100) released by the Turkish Statistical Institute and the trend of industrial production calculated through Hodrick-Prescott filter.[13] 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.

3.3 Estimation results

Our model consists of π_t, π_t^w, y_t^g, e_t and i_t. 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.1 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. 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 estimate the VAR model taking the first difference of the exchange rate.[14] The lag length two is chosen automatically according to the Akaike information criteria.[15] Moreover, diagnostic tests reveal that estimation results are free from heteroscedasticity and autocorrelation problems.[16] Estimation results and autocorrelation test results are given in the Appendix.

Having estimated the model with two lags of each variable we then analyse VDC of monthly inflation for this model using Cholesky decomposition. Since VDC will be used to unveil the separate contributions of the variables to the variations in inflation, the ordering of VAR is important. Pairwise Granger causality tests yields mostly ambiguous results. In most lags, variables are reported not to Granger cause each other. Yet 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. Given this assumption, we need to analyse 24 different

[13] $y_t^g = (y_t - y_t^t) / y_t^t$ here y_t is the seasonally adjusted monthly industrial production and y_t^t is the trend value of y_t at time t

[14] We also checked for the situation where exchange rate is stationary since the p-value is relatively low (0.09). This specification does not alter our main findings in a considerable way.

[15] In this selection process we restricted the model to use a maximum of six lags to have sufficient degrees of freedom for a meaningful econometric analysis. Given this restriction, the Akaike information criteria suggest using two lags; therefore we estimate the model with two lags. On the other hand, estimation results do not change significantly when we include more than two lags of each variable. As we include more lags, the contribution of WCPI inflation increases, whereas that of CPI inflation decreases.

[16] For most lags, the null hypothesis of no serial correlation is not rejected.

orderings. The estimation results indicate that specification of the ordering of variables does not significantly alter the results. Below we depict the VDC of domestic inflation for an arbitrary ordering: $\pi_t^w, \Delta e_t, i_t, y_t^g, \pi_t$.

Using VDC for inflation (see Fig. 3), we find the relative contribution of different variables to changes in inflation. According to the evidence, inflation in commodity prices explains 20% of the variations in domestic inflation, whilst innovations in exchange rate explain 13% of fluctuations in inflation. On the other hand, interest rate explains approximately 7% 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.[17]

According to estimation results, 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% in total), whereas the contribution of the changes in output gap and interest rates play only a subordinate role (nearly 11% 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 claims in its annual reports with regards to over-shooting the IT. Given that, however, the idea behind the implementation of IT is undermined considerably. If the supply-side factors determine changes in inflation that are typically beyond the scope of monetary policy, the reasons behind the implementation of IT that tries to control inflation through measures related with demand-side factors remain unclear.

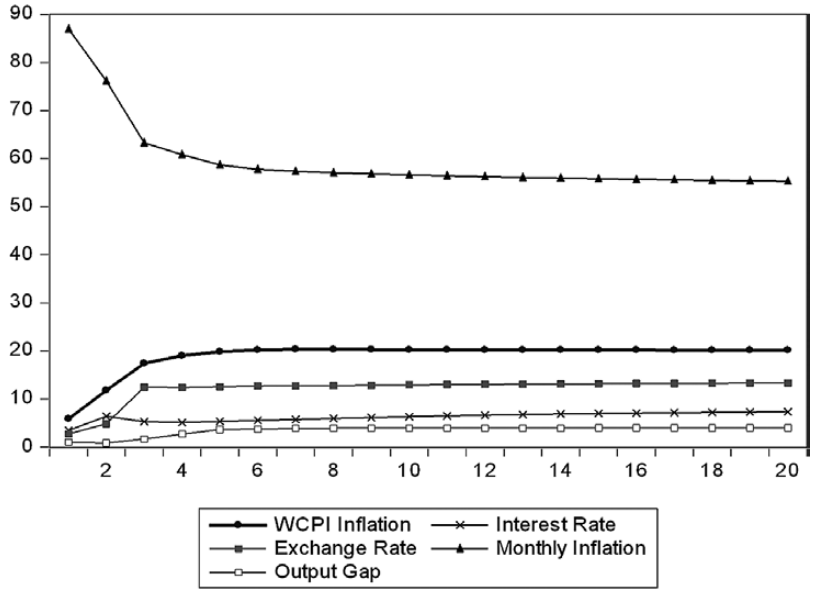

Fig. 3. Variance decomposition of CPI inflation

[17] 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 given the co-movement of inflation and nominal wages.

The role of exchange rates as an important source of changes in CPI inflation 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 helping the CBRT achieve its inflation target. Hence, along the lines with what is argued with regards to developing countries, monetary authorities in Turkey might have benefited from the appreciation of the TL to contain inflation. In this sense, a considerable part of the success for achieving the targets is very likely to be associated with favourable movements in exchange rates. Yet whether such trend is policy-induced (through toleration of appreciation) still needs further research. Did the CBRT favour the appreciation trend of the lira, or has it just treated depreciation and appreciation pressures equally? To shed more light on this issue, we turn our attentions to the interest rate–setting behaviour of the CBRT through constructing a classical monetary policy reaction function.

4. Asymmetric monetary policy stance with respect to the exchange rate

4.1 Asymmetric behaviour in interest rate setting

Many researches verify that exchange rate is an important concern in developing countries (both IT and non-IT) both for its effects on inflation and financial stability. In their highly influential paper, Calvo and Reinhart (2002) 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 39 countries, Calvo and Reinhart (2002) document that variability in nominal exchange rate is low and fluctuations in interest rates and level of reserves are 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 stabilise the exchange rate.

Similarly, other studies 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, using a mixed sample of both IT and non-IT countries, Mohanty and Klau (2004) report that in most developing countries interest rates are used strongly as a reaction to fluctuations in the exchange rate. In fact, the exchange rate is noted as the largest contributor in explaining variations in interest rate.

On the other hand, there are studies focussed exclusively on the role of exchange rate in IT developing countries. Ho and McCauley (2003) claim that developing countries are likely to respond to exchange rate movements in IT framework. Aizenman *et al.* (2011) document that policy rates in IT countries react significantly to exchange rate movements, although the response is higher in non-IT counterparts.

All of these studies reveal that monetary authorities in developing countries (whether IT or not) take into account the movements in the exchange rate when setting interest rates. However, the reasons underlying the intervention changes with the adoption of IT. Non-IT developing countries generally respond to exchange rate movements due

to concerns over international competitiveness and the devastating impact of large fluctuations of exchange rates on financial stability. Central banks in IT developing countries, on the other hand, commit themselves to hitting the inflation target, leaving aside all other goals; they may have to resort to appreciation of their currency, as argued in the introduction. The literature does not mention the asymmetric nature of this policy stance in the IT framework. In what follows we test this hypothesis on the basis of the Turkish experience.

4.2. 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 benefited from the monetary policy reaction function below:

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

where Δe_t (ie $e_t - e_{t-1}$) denotes the change in the nominal exchange rate, y_t^g refers to the output gap and $(\pi_t^e - \pi_t^\star)$ refers to the inflation gap (ie the difference between expected annual inflation at month t and the appropriate value of the target inflation at month t).[18] This model represents an extended classical monetary reaction function 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 decreases the policy rate if these variables decrease. On the other hand, it avoids excessive movements of the interest rate (interest rate smoothing), hence the presence of lagged interest rate in the model.

Before elaborating the empirical framework, we should evaluate the validity of existence of exchange rate in the model. The reason is that incorporation of exchange rate into the monetary policy reaction function remains an unsolved issue in the literature. One approach, pioneered by Taylor (2001) suggests that even in the explicit absence of exchange rate in the monetary policy rule, exchange rate considerations are already present in central banks' decisions if they take into account the impact of exchange rate variations on output gap and inflation. Thus, the exchange rate does not play a direct role in the policy rule. On the other hand, as Edwards (2006) contends, monetary authority may respond to changes in exchange rate at the time the change occurs, instead of waiting for its impact on output and inflation to materialise. Whether such policy is implemented depends on country specific issues and should be analysed empirically (Edwards, 2006). Below, following Edwards (2006), we argue that characteristics of developing countries pave the way for incorporating the exchange rate in the reaction function, and we present the empirical evidence accordingly.

First, exchange rate shocks are generally large in magnitude and persistent in developing countries, increasing the risk of overshooting and thereby threatening the credibility of IT regime (Mohanty and Klau, 2004). In this vein, Ho and McCauley (2003) indicate that emerging economies that miss their inflation targets are generally those witnessing acute exchange rate volatility. Similarly, Roger and Stone (2005) report that the largest deviations from the IT reflect the impact of exchange rate shocks resulting

[18] Construction of the targeted inflation at a given time is given in the Appendix.

from the shifts in capital inflows. Given the magnitude and persistence of exchange rate shocks in developing countries, we argue that the exchange rate should enter into monetary policy rule to preserve the credibility of the regime.

Second and related with the first, the central bank can actually manipulate the exchange rate to respond to inflationary shocks and hit its target. This follows from the idea that the lag between the exchange rate and inflation is much shorter compared with the lag between interest rate and inflation through aggregate demand relation. This channel is called the 'direct exchange rate channel for the transmission of monetary policy to CPI inflation' by Svensson (1999). In a similar vein, Ball (2000) also recognises that the direct channel operates more quickly and claims that if the focus is on hitting the IT, then monetary authority may respond to inflationary shocks by moving the exchange rate aggressively. Given the importance of exchange rate in determining inflation, then, central banks can manipulate the exchange rate through either direct intervention or setting policy interest rates accordingly to fight inflation.

Third, the implicit assumption behind the argument in Taylor (2001) is that monetary authority can effectively influence inflation through aggregate demand by setting the policy interest rate. Yet if the monetary transmission mechanism does not operate properly, which is the case in many developing countries due to weak financial and institutional structure, then effectiveness of monetary policy is undermined. Thus, in addition to being the fastest, the channel operating from exchange rates to inflation is also likely to be the most effective in developing countries.[19] In this regard, responding directly to exchange rate movements appears to be essential for an IT central bank once again.

Besides the summarised theoretical underpinnings, the existence of exchange rate in the monetary policy reaction function should also be analysed empirically as Edwards (2006) emphasises. The empirical results for the Turkish case confirm that exchange rate movements appear in the monetary policy rule. This empirically validates our assumption about the monetary policy reaction function.

Our perception about the monetary policy reaction function resembles to that of Aizenman *et al.* (2011). The difference lies in that instead of change in nominal exchange rate, they use change in real exchange rate and reserves as external variables. On the other hand, to reveal that central banks in developing countries respond strongly to changes in exchange rate, Filosa (2001) and Mohanty and Klau (2004) use a similar model. The difference is that they include the change in the real exchange rate and one lagged term of it (for the latter).[20]

For the Turkish case, a similar model is constructed by Civcir and Akçağlayan (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

[19] 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, p. 17).

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

neglecting the inflation targets. To find the causes of interest rate changes, on the other hand, Cömert et al. (2010) construct a very similar model to ours. The difference lies in that they include a US interest rate variable 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 analyse the role of exchange rates in the monetary policy reaction function of central banks in developing countries. However, the model given by eq. (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.[21] 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 behaviour 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. It is not easy to digest the idea that it holds in developing countries. Furthermore, eq. (3) used by Galindo and Ros (2008) can most likely suffer from omitted variable case, which can lead to unreliable biased coefficients. For example even if we assume those variables that are included in a simple conventional central bank reaction function as described by Taylor (1993), it becomes clear that the regression in eq. (3) suffers from omitted variable.[22]

To overcome these problems existing in this method, we modify the monetary policy reaction function defined by eq. (2) in the following sense: 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 is estimated.[23] IRF analysis is used to make inferences about the asymmetric policy stance of the CBRT.

[21] 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^- stand for depreciation and appreciation of the exchange rate, respectively.

[22] In recent years, there also emerged a literature analysing asymmetric monetary policy reaction functions. In it, whether monetary policy is asymmetric for some threshold values of output gap and inflation is investigated. However, splitting the sample according to the threshold value is unviable in our case due to limited number of observations.

[23] Actually, since we use IRF analysis, the VAR is estimated with $abs\_x_t^- = \left|x_t^-\right| \forall t$ to investigate the impulse response of interest rate to a positive 1 standard deviation shock in appreciation variable. On the other hand, y_t^g is defined as the same in note 13, whereas $\pi_t^g = (\pi_t^e - \pi_t^\star)$.

4.3 Estimation results

As in the inflation model we have 75 observations for each of the five variables. Now we analyse the IRF of the interest rate to make inferences about the relative contributions of depreciation variable (x_t^+) and appreciation variable (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 analyse the relative contribution of depreciation and appreciation on interest rate decisions. The results of the unit root tests given in the Appendix imply that all variables are stationary. We estimate the VAR model for two lags which is determined by the Akaike information criteria. Estimation results and autocorrelation test results are given in the Appendix. Having estimated the model, we then analyse IRF of interest rate for this model using Cholesky decomposition.

The ordering of VAR is important for IRF analysis; hence we apply pairwise Granger causality tests to each variable. Granger causality tests (presented in Table A.4 in the Appendix) yields that up to 16 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 10 lags, x_t^+ Granger causes x_t^- with the reverse again being not true. Hence, the depreciation variable is more exogenous than interest rate, and interest rate is more exogenous than the appreciation variable. With this restriction we are left with 20 specifications for the ordering of VAR. Using $x_t^+, i_t, x_t^-, y_t^g, \pi_t^g$ as the benchmark ordering, we depict the IRF of interest rate below.

Following the shocks, the interest rate increases within the first three months as a result of a one standard deviation shock in depreciation variable. However, the response of the interest rate to a shock in depreciation variable is much greater than that to a shock in the appreciation variable. Indeed, a 1 standard deviation increase in the appreciation variable does not seem to have a considerable impact on interest rate decisions of the CBRT as Fig. 4 indicates. Thus, the results indicate that monetary authority adjusts interest rates in response to changes in the nominal exchange rate in an asymmetric way.

This finding is not without 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. According to the authors, interest rate smoothing

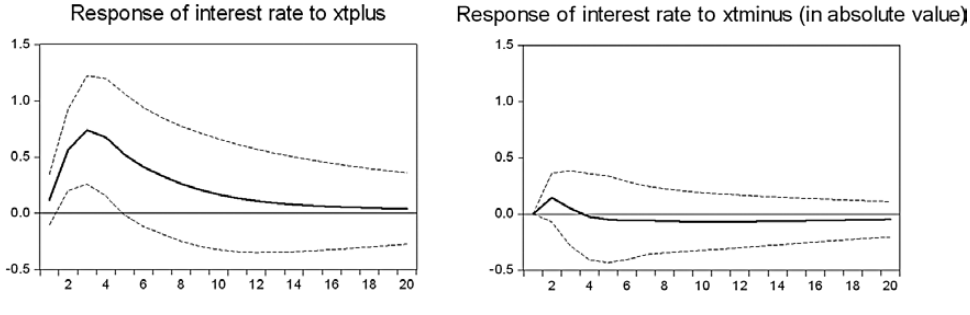

Fig. 4. Impulse response of the interest rate to one standard deviation shocks in x_t^+ and x_t^-

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 to ensure 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 Fig. 4 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 six lags) do not distort the asymmetric response of interest rate to exchange rates. To further increase the robustness of our analysis, we replicate the same procedure with new variables w_t^+ and w_t^- defined as:

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

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

Hence, now we assume that monetary authority takes into account only the changes bigger than 2% of the existing exchange rate. This assumption seems to be more realistic since monetary authority may remain unresponsive to small deviations of the exchange rate. The Granger causality tests and the VAR analysis give quite similar results with the new variables as Fig. 5 indicates.

Asymmetric exchange rate policy stance of the CBRT does not consist of only 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.

4.4 Asymmetric behaviour in foreign exchange market

During the period under investigation, foreign exchange purchases are perceived by the CBRT as not influencing 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 most of the purchases are made as auctions the terms of which were pre-announced. The CBRT claims that the aim of purchases is not affecting the level of exchange rate but rather increases foreign exchange reserves, the abundance of which is important

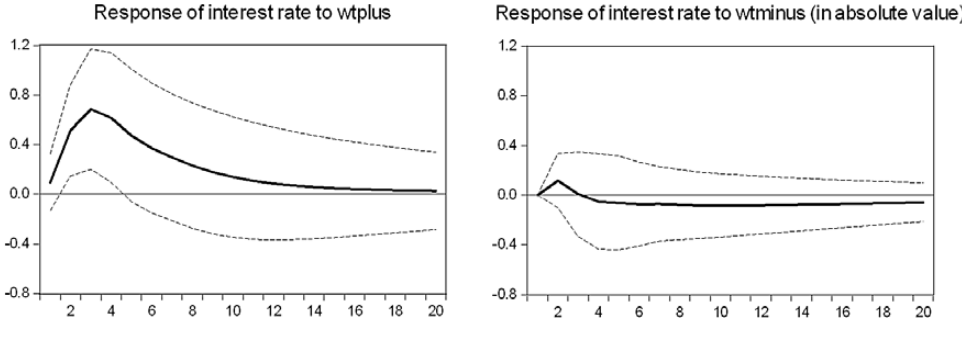

Fig. 5. Impulse response of the interest rate to shocks in w_t^+ and w_t^-

for the sake of the Turkish economy because of 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[24] indicate that sale operations are important in affecting the level and volatility of the exchange rate whilst purchase operations are not found to have a considerable role in explaining changes in the exchange rate. It is clear from the Table A.7 that purchase interventions do not change the level of exchange rate in a notable way. 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.7.

The changes in the level of daily foreign exchange purchases of the CBRT through auctions can also be considered a way to intervene in the foreign exchange market. As can be seen from Table A.8, 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[25] and that whenever a depreciation trend is observed, the CBRT subordinates this goal to refrain from depreciation.

Thus 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 not hindered the appreciation trend of the lira, whereas whenever the signals of permanent depreciation are observed, the CBRT responded immediately.

5. Policy implications and concluding remarks

Thus far, using descriptive and econometric methods, we have shown two inter-related 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 TL. Is the asymmetric policy stance peculiar to Turkey or does IT incorporate such a tendency in developing

[24] Due to a very small sample (13 purchase and 3 sale operations above US$100 million), using econometric analysis is not possible.

[25] In fact, increases and decreases in foreign exchange purchases is closely related with increases and decreases in capital inflows. As Table A.8 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? As we have seen, exchange rate appreciation has happened in most of the IT developing countries in the recent period. Although more research is needed to reach more conclusive results, the asymmetric nature of exchange rate policy under IT regimes in developing countries are most likely not peculiar to the Turkish case due to the importance of supply-side factors, which have been documented by many studies mentioned in the previous sections.

If central banks in developing countries have had a tendency of tolerating appreciation of their currencies, as 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 to curb inflation, which is mostly related with external factors such as commodity prices. These central banks may have a tendency for appreciation to compensate for the negative effects of other external shocks on domestic inflation. Second, stickiness in non-tradeable goods' prices in developing countries also hinders the effectiveness of monetary policy in combatting inflation. A conventional approach to IT extensively focusses on the experience of advanced countries, where credibility problems are less repressive compared with developing countries. In this respect, Kumhof (2000) shows that under imperfect credibility of the inflation target in a small open economy where non-tradeable goods' prices are sticky, the monetary authority is forced to reduce the level of depreciation through a tight monetary policy to meet the target. This is because non-tradeable goods' prices remain higher than the targeted inflation due to the public perception that sustaining a low CPI is not viable (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-tradeable 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 that are mostly peculiar to developing countries also restrict the capability of monetary policy to affect the real economy.[26] 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 in a way may be forced to resort to exchange rate movements to hit their inflation target. In other words, what the central bank could not do is left to an upwards trend (appreciation) of the real exchange rate. We consider this policy stance under IT 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.

Exchange rate appreciation, on the other hand, does not happen without costs. Since appreciation is directly related to massive capital flows, IT central banks have taken a positive stance towards capital inflows. In this respect, many economists and central banks seem to have forgotten the lessons of the currency crises of the 1990s from massive capital flows and, in relation to this, exchange rate movements.[27] The history

[26] See Mishra and Montiel (2012) and Mishra *et al.* (2010) for a detailed discussion on the causes of bottlenecks of monetary transmission mechanism in low-income countries.

[27] 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.

of Mexico (1994), Turkey (2001), Argentina (2001) and the 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 destabilising capital flows it brings 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 a low inflation target support this idea. For example, using a model of a small open economy with sticky non-tradeable goods prices, Kumhof (2000) suggests that reducing the level of depreciation as a response to sticky prices of non-tradeable goods brings about large current account deficits, which may cause the collapse of the currency. Similarly, Kumhof *et al.* (2007) document that an IT regime is also vulnerable to speculative attacks, as opposed to claims of the proponents of this regime.[28]

In addition to the systemic threads it poses in developing countries, empirical studies suggest that real exchange rate appreciation is harmful for economic growth. In fact, there is a vast literature still growing on the long-term growth-related impacts of exchange rate under-valuations in developing countries. For instance, Razmi *et al.* (2009) indicate that under-valuation of real exchange rates is a driving factor for investment growth. On the other hand, Rodrik (2008) reports that under-valuation stimulates economic growth in developing countries. This effect is due to the favourable impact of sustained under-valuation on the profitability of the tradeables sector, which typically suffers disproportionately from institutional weaknesses and market failures (Rodrik, 2008, p. 404). A real depreciation increases profitability of investing in the tradeables sector, and the ensuing reallocation of sources between sectors boosts 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 tradeables sector and thereby contributed to the economic growth.

Therefore, real exchange rate appreciation may jeopardise long-term economic development in developing countries not just through triggering a currency crisis but also through negative impact on economic growth.

The recent financial crisis has rendered classical IT regimes unfashionable 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 the developing world have not addressed important problems such as the detrimental impacts of financial flows, they have begun following a more balanced path by putting more emphasis on 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 IT developing countries may favour 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.

[28] Accordingly, 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% of the Turkish GDP in 2008.

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Appendix

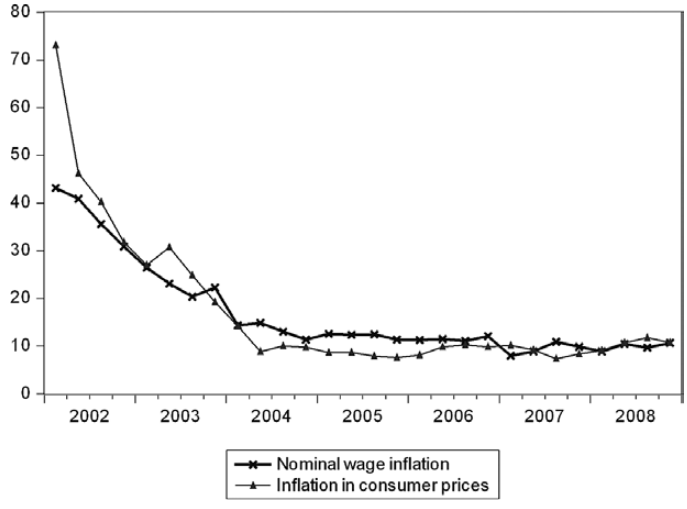

Fig. A.1. Co-movement of nominal wage inflation and inflation in consumer prices

Table A.1. *Unit root tests of the variables in the first and second model*

Variables	ADF(1)		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

⋆ 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. The results are quite similar for the Phillips-Perron unit root test.

Table A.2. *Estimation results of the VAR model*

	π_t^w	Δe_t	i_t	y_t^g	π_t
π_{t-1}^w	0.086629	0.000912	0.028426	0.089734	0.024956
	(0.13188)	(0.00213)	(0.03218)	(0.10363)	(0.01381)
π_{t-2}^w	-0.134121	-0.000531	-0.009640	0.101232	0.016986
	(0.13258)	(0.00214)	(0.03235)	(0.10418)	(0.01389)
Δe_{t-1}	-10.87137	-0.140354	3.824583	6.160330	0.740065
	(7.48232)	(0.12083)	(1.82568)	(5.87921)	(0.78369)
Δe_{t-2}	5.875476	-0.212452	3.867880	-2.490557	1.966160
	(7.68798)	(0.12415)	(1.87586)	(6.04080)	(0.80523)
i_{t-1}	-0.775749	-0.010296	0.994655	0.460363	0.071857
	(0.51254)	(0.00828)	(0.12506)	(0.40273)	(0.05368)
i_{t-2}	0.706868	0.009161	-0.076630	-0.342536	-0.047908
	(0.46682)	(0.00754)	(0.11390)	(0.36680)	(0.04889)
y_{t-1}^g	0.356704	0.001783	-0.015484	-0.071846	-0.001261
	(0.17569)	(0.00284)	(0.04287)	(0.13804)	(0.01840)
y_{t-2}^g	0.012104	0.005970	0.004805	0.057184	0.004442
	(0.17434)	(0.00282)	(0.04254)	(0.13699)	(0.01826)
π_{t-1}	0.230091	0.030175	0.574379	-1.278830	0.205739
	(1.16249)	(0.01877)	(0.28365)	(0.91342)	(0.12176)
π_{t-2}	0.025134	-0.021753	0.392525	-1.132989	0.231181
	(1.19240)	(0.01926)	(0.29094)	(0.93693)	(0.12489)
C	2.716717	0.006610	0.690466	-0.636764	-0.119729
	(1.35116)	(0.02182)	(0.32968)	(1.06167)	(0.14152)
R-squared	0.186098	0.199841	0.992021	0.129819	0.635756
Adj. *R*- squared	0.054823	0.070783	0.990734	-0.010533	0.577007
F-statistic	1.417623	1.548462	770.8230	0.924951	10.82154

Table A.3. *Test results for autocorrelation for the inflation model*

Lags	LM stat	*p*-value
1	20.31995	0.7298
2	25.56608	0.4310
3	27.10395	0.3507
4	18.61485	0.8152
5	38.68179	0.0396
6	27.36996	0.3377
7	26.11399	0.4015
8	26.58456	0.3770
9	23.57838	0.5438
10	43.91330	0.0111
11	28.77286	0.2735
12	15.86717	0.9187

Table A.4. *Pairwise Granger causality tests between* x_t^+, x_t^-, i_t

F-statistic/*p*-value

Hypothesis	1 lag	2 lags	3 lags	4 lags	5 lags	6 lags
i_t DNGC⋆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

⋆ DNGC: do not Granger cause.

Table A.5. *Estimation results of the VAR model*

	x_t^+	i_t	$\lvert x_t^- \rvert$	y_t^g	π_t^g
x_{t-1}^+	-0.121584	9.669327	0.238186	4.743136	8.263163
	(0.12889)	(2.73343)	(0.09635)	(8.74593)	(3.84984)
x_{t-2}^+	-0.187764	1.196543	0.234718	12.18397	3.744480
	(0.14437)	(3.06178)	(0.10793)	(9.79651)	(4.31229)
i_{t-1}	1.27E-05	1.162473	0.003526	-0.117408	0.238191
	(0.00549)	(0.11643)	(0.00410)	(0.37253)	(0.16398)
i_{t-2}	3.30E-05	-0.209538	-0.002658	0.056976	-0.241331
	(0.00524)	(0.11123)	(0.00392)	(0.35591)	(0.15667)
$\lvert x_{t-1}^- \rvert$	0.065417	4.394626	0.038533	-9.384748	1.198348
	(0.16039)	(3.40164)	0.038533	(10.8839)	(4.79095)
$\lvert x_{t-2}^- \rvert$	-0.111092	-4.622521	-0.128077	24.67590	3.676356
	(0.16126)	(3.42006)	(0.12056)	(10.9429)	(4.81691)
y_{t-1}^g	0.001340	-0.003111	-0.000796	-0.044979	0.052159
	(0.00189)	(0.04012)	(0.00141)	(0.12835)	(0.05650)
y_{t-2}^g	0.003060	3.25E-05	-0.002900	0.150142	-0.097783
	(0.00193)	(0.04103)	(0.00145)	(0.13130)	(0.05779)
π_{t-1}^g	8.31E-05	0.085412	0.005455	-0.502649	0.918188
	(0.00409)	(0.08670)	(0.00306)	(0.27740)	(0.12211)
π_{t-2}^g	-0.001621	-0.126076	-0.002845	0.253628	-0.076756
	(0.00399)	(0.08454)	(0.00298)	(0.27049)	(0.11907)
C	0.024271	0.557203	-1.89E-05	0.621350	-0.073358
	(0.01573)	(0.33359)	(0.01176)	(1.06737)	(0.46984)
R-squared	0.099704	0.992200	0.325088	0.160275	0.833463
Adj. *R*- squared	-0.045505	0.990942	0.216231	0.024835	0.806602
F-statistic	0.686625	788.6973	2.986383	1.183368	31.02896

Table A.6. *Test results for autocorrelation for policy interest rate model*

Lags	LM stat	*p*-value
1	19.17175	0.7888
2	15.67911	0.9241
3	20.35134	0.7282
4	13.69400	0.9668
5	43.15600	0.0135
6	32.73004	0.1380
7	13.21503	0.9738
8	19.26551	0.7842
9	15.73940	0.9224
10	22.67367	0.5966
11	19.74085	0.7603
12	40.77058	0.0243

Table A.7. *The time and amount of exchange rate interventions of the CBRT, and the exchange rate before and after the interventions*

Intervention	Amount (US$million)	Exchange rate 1 month before intervention ($/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	1,442	1.39	1.37	1.48
16.02.2004	1,283	1.34	1.33	1.32
27.01.2005	1,347	1.35	1.35	1.29
09.03.2005	2,361	1.33	1.28	1.35
03.06.2005	2,056	1.37	1.36	1.34
22.07.2005	2,366	1.36	1.34	1.36
04.10.2005	3,271	1.33	1.35	1.36
18.11.2005	3,164	1.36	1.37	1.35
15.02.2006	5,441	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

Source: Central Bank of the Republic of Turkey.

Table A.8. *Changes in the level of foreign exchange purchase of the CBRT through auctions and the exchange rates*

Date	Foreign Exchange Purchase (US$million)		Exchange rate 1 month before ($/TL)	Exchange rate ($/TL) at the time of intervention	Changes in capital inflows (US$million)
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 = 1,719
21.10.2003	80→40	-	1.36	1.45	October–September = -3,879
23.10.2003	40→0	-	1.35	1.48	October–September = -3,879
01.03.2004	30→40	+	1.33	1.32	February–January = 115
01.04.2004	40→50	+	1.32	1.31	March–February = -2,068
07.04.2004	50→70	+	1.32	1.32	March–February = -2,068
15.04.2004	70→40	-	1.31	1.37	March–February = -2,068 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 = 2,915
15.06.2006	20→0	-	1.35	1.45	June–May = -3,416 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 = -2,797
05.10.2007	15→30	+	1.31	1.19	September–August = 156
07.03.2008	30→15	-	1.20	1.25	February–January = -3,189
15.10.2008	15→0	-	1.27	1.39	October–September = -4,885 September–August = -2,660

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 $i = 2,3,\ldots 12$ 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.