

Exchange Rate Pass-Through in Turkey under Inflation Targeting Regime

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Abstract: *Exchange rate pass through, the impact of exchange rate change on the domestic price level through changes in the import prices, has long been of interest in international economics literature. Along with the application of inflation targeting regime widely, the focus of this interest has also evolved to examine the changes in degree and speed of exchange rate pass through under inflation targeting regime. Turkey, adopted Inflation Targeting (IT) as a monetary regime between 2001 and 2006 implicitly and then explicitly, exhibits a genuine experience to be analyzed in this respect. From this point of view, the goal of the paper is to provide a time-series analysis of exchange rate pass-through for Turkish Economy based on single equation Error Correction Model estimation using the monthly data under pre-IT period 1995-2000 and post-IT period 2006-2014. Thus, we try to clarify the connection between the effectiveness of inflation targeting regime as monetary policy and the development of exchange rate pass-through.*

Keywords: exchange rate pass through, inflation targeting, error correction model, Turkey

JEL codes: E52, E58, C23

1 Introduction

Along with increasing globalization, international financial and business relationships grow dramatically, which leads exchange rate to be one of the most significant macroeconomic factors. In this context, large fluctuations in nominal exchange rates have also become very important from the perspectives of policy actions aiming at macroeconomic stability. Therefore, dynamics of exchange rate and its relationships with other macroeconomic variables need to be understood intensively. Accordingly, understanding the impacts of exchange rate changes on other macroeconomic variables has been the focus of international economics literature for last decades. In this literature it appears that studies examining the impact of changes in exchange rate on domestic price level, called as "Exchange Rate Pass Through" has a big share.

The changes in exchange rate effect the level of domestic prices through prices of imports. During the process of exchange rates pass through, exchange rate movements are firstly transmitted to import prices and then domestic prices. Accordingly, the literature on exchange rate pass-through previously focuses on the link between exchange rate and import prices (Swamy and Thurman 1994; Webber 1999; Campa and Goldberg 2002; Barhouni 2006). In detail, exchange rate affects domestic consumer prices through prices of imported consumer goods and the price of imported inputs used in domestic production. To put it another way, exchange rate movements affect domestic consumer prices via either directly prices of imported consumption goods or indirectly prices of imported intermediate goods. Subsequently, much of the research deals with the relationship between movements in exchange rate and producer and consumer prices (Takhtamanova 2010; Jimborean 2013; Ahn and Park 2014).

Recently, it seems that large body of literature devoted to examine the link between the effectiveness of monetary policies adopted in the framework of inflation targeting regime and the exchange rate pass-through process. The findings of empirical studies generally argued that the low inflation environment recently achieved in many countries after adopted inflation targeting regime causes a decline in the impact of exchange rate on domestic prices. Thus, after the adoption of the inflation target regime, the pass-through

effect seems to be diminished in the most of the countries. In this context, Reyes (2007) uses the simulations for the pass through effect analysis under two monetary regimes crawling peg and inflation targeting. Rolling Windows Correlation methodology based on stochastic stimulated data shows that declining pass through effects in Brazil, Chile and Mexico are results of changes in monetary policy regimes, a switch from a crawling peg regime to an inflation targeting regime. Thus, it is also indicated that the nominal exchange rate effects on the overall inflation rate may no longer be an issue for emerging economies implementing inflation targeting policy.

Odria et al (2012) tries to analyse whether the exchange rate pass-through into prices changed when the inflation targeting scheme was adopted in Peru between 1994 and 2007. In the framework of a vector smooth transition autoregressive model (VSTAR), analysis of the generalized impulse response functions reveals that the decision to adopt inflation targeting significantly decreased the exchange rate pass-through into producer and consumer prices. Thus, they indicate that adopting inflation targeting generates a pass-through contraction. Looking at the European area, Beirne and Bijsterbosch (2011) assess the degree of exchange rate pass through to consumer prices using both a multivariate cointegration approach and impulse responses derived from the VECM for nine central and eastern EU Member States based on monthly data from 1995 to 2008. They find notable differences across countries with fixed exchange rate regimes compared to those with more flexible regimes. Accordingly, while for the four fixed exchange rate countries such as Bulgaria, Estonia, Latvia and Lithuania, a hypothesis test for full pass-through cannot be rejected, for the countries with more flexible regimes like the Czech Republic, Hungary, Poland, Romania and Slovakia, full pass-through is rejected in all cases.

Concerning with the studies focusing on Turkey, Volkan et al (2007) also try to determine if there has been a change in the magnitude of exchange rate passes through for the 2003-2006 periods, when the exchange rates were allowed to float under inflation targeting regime. Their findings indicate that exchange rate pass through has declined for the post-2003 period by nearly one-half compared to the pre-2003 period. In addition, the decline in the exchange rate pass-through impact on domestic prices coincides with a 25 percent decline in the post-2003 consumer price inflation. However, they also argue that the pass-through of exchange rate changes is still important when establishing monetary policies for the Turkish economy. More recently, Dedeoğlu and Kaya (2014) employ a rolling VAR framework to examine exchange rate pass through over the period between 1995 and 2012 in Turkey. They find that the exchange rate pass-through has declined sharply after the adoption of inflation targeting regime. The larger impact of exchange rate pass through on the producer prices compared to consumer prices upwards in the inflation targeting regime. Overall, they indicate that the disinflation period and the implementation of the IT regime appear to play a significant role in the dynamics of ERPT in Turkey.

Contrary to findings presented by two studies relating Turkey above, Civcir and Akçağlayan (2010) prominently argue that the main channel in feeding the inflation in Turkey is the depreciation of the domestic currency even under inflation targeting although exchange rate pass through weakened and slowed compared to its degree in crawling peg system. They analyse the exchange rate pass through and monetary policy reaction function of the Central Bank of Republic of Turkey over the two different periods before inflation targeting (1987-2001) and after inflation targeting (2001-2009). Using VAR model, they shows that there has been strong pass-through during whole period while exchange rate has also been the main reaction variable for the Central Bank. Thus, they also argue that, Central Bank, taking into account of presence of higher level exchange rate pass through, still intervenes in the foreign exchange rate markets against to temporary fluctuations even during the inflation targeting period.

Based on short review indicated above it seems that analyzing the impact of the exchange rate on domestic prices becomes a significant research agenda for Turkey. After adopting Inflation Targeting as a monetary regime in 2001, accompanied by an

increase in the transparency of monetary policy and hence the credibility of the central bank, Turkish Economy has embarked into a process of diminishing inflation. Accordingly, the crucial research question here is whether the lower the inflation rate under inflation targeting regime cause the weaker the exchange rate pass through in Turkey.

From the starting point of consideration above, this paper aims to understand the relationship between changes in nominal exchange rates and domestic prices in Turkey by using of Error Correction Model over two different periods; the pre-Inflation Targeting period between 1995 and 2000 and post-Inflation Targeting period between 2006 and 2014. Thus, we try to investigate how changes in the exchange rate are transmitted to the consumer prices in Turkey after adopting Inflation Targeting Regime explicitly in 2006. Our paper is organised after this introduction as follows. Second section describes the methodology and data. The third section presents empirical results and makes some discussion on the relationship between exchange rate pass through process and implementation of inflation targeting regime. Final section concludes and makes some policy implications.

2 Methodology and Data

We use two basic data set including nominal exchange rate and consumer prices while we explore the exchange rate pass through in Turkey over the period pre-Inflation Targeting (IT) regime between 1995 and 2000 and post-IT regime between 2006 and 2014. Accordingly, the data set consist of monthly observation of TL/USD nominal exchange rate (ER) and consumer prices (CP) covering the periods, pre-inflation-targeting (1995-2000) and inflation-targeting (2006-2014) periods. We do not consider the term between 2001 and 2005 since this term is a transition period to inflation targeting and inflation targeting has only been applied implicitly in this process. All of the data have been obtained from the data base of Central Bank of Turkey (CBRT).

Looking at the econometric approach used in related literature, it seems that different version of single and multiple equation regressions based on Auto regression model introduced by Christopher Sims (1972) and Error Correction Model introduced model by Engle and Granger (1987) are most frequently performed. We preferred Error Correction Model (ECM) while examining the exchange rate pass through, since it presents the significant advantage to estimate the degree and speed of pass through together.

In order conduct an ECM, one can start with a bivariate autoregressive distributed lag (ADL) model such that the current value of the y is a function of its own past value and current and past value of x (Thomas, 1993, p. 153). In this equation, C symbolizes intercept while ε shows white noise error terms.

$$y_t = C + \beta_1 x_t + \beta_2 x_{t-1} + \alpha y_{t-1} + \varepsilon_t \quad (1)$$

subtracting y_{t-1} to both sides of the Equation (1) yields

$$\Delta y_t = C + \beta_1 x_t + \beta_2 x_{t-1} - (1 - \alpha) y_{t-1} + \varepsilon_t \quad (2)$$

adding and subtracting $\beta_1 x_{t-1}$ to right side of the Equation (2);

$$\Delta y_t = C + \beta_1 x_t + \beta_2 x_{t-1} - \beta_1 x_{t-1} + \beta_1 x_{t-1} - (1 - \alpha) y_{t-1} + \varepsilon_t$$

$$\Delta y_t = C + \beta_1 \Delta x_t + (\beta_1 + \beta_2) x_{t-1} - (1 - \alpha) y_{t-1} + \varepsilon_t$$

$$\Delta y_t = C + \beta_1 \Delta x_t - (1 - \alpha) \left(y_{t-1} - \frac{\beta_1 + \beta_2}{1 - \alpha} x_{t-1} \right) + \varepsilon_t \quad (3)$$

re-arranging Equation (3) in terms of $\lambda = (1 - \alpha)$ and $\delta = \frac{\beta_1 + \beta_2}{1 - \alpha}$;

$$\Delta y_t = C + \beta_1 \Delta x_t - \lambda (y_{t-1} - \delta x_{t-1}) + \varepsilon_t \quad (4)$$

$$\Delta y_t = \beta_1 \Delta x_t - \lambda (y_{t-1} - \frac{C}{1 - \alpha} - \delta x_{t-1}) + \varepsilon_t$$

finally re-arranging in terms $\mu = \frac{C}{1 - \alpha}$;

$$\Delta y_t = \beta_1 \Delta x_t - \lambda (y_{t-1} - \mu - \delta x_{t-1}) + \varepsilon_t \quad (5)$$

Where $(y_{t-1} - \mu - \delta x_{t-1})$ express long run relationship between x and y. Accordingly, δ means the coefficient of long run equilibrium relationship which shows the degree of exchange rate pass through. The coefficient of λ refers to the speed of adjustment of short run disequilibrium to long run equilibrium between y and x. To put it another way, the value of coefficient λ tells us what rate it corrects the previous period disequilibrium of the system. When λ is significant and contains negative sign, it validates that there exists a long run equilibrium relationship among variables y and x. The coefficient of β represents an immediate or short run effect of x on y. Thus, the coefficient β_1 indicates the effect of the change in x on the change in y, of which will be helpful to know short run dynamics of the system. Consequently, the change in y as a function of the change in x plus an error correction term, where β_1 describes the short-run relationship and λ the speed of adjustment to the long run equilibrium.

Error Correction Model (ECM) indicated above has been applied extensively in the literature to estimate exchange rate pass through. This approach has the advantage of yielding an estimate for the degree and speed of pass through. Accordingly, ECM given by Equation 5 will be estimated separately for both term's consumer prices, pre-inflation-targeting (1995-2000) and post-inflation targeting (2006-2014) periods. Thus, we will try to estimate the long term pass through (δ) as well as the speed (λ) at which the prices indices adjust to a change in the exchange rates for both terms.

3 Results and Discussion

First of all, we check whether our time series are stationary at same level or not since cointegrating necessitates that the variables be integrated of the same order. Cointegrated variables only have a built in error correction mechanism and subsequently cointegrating necessitates that the variables be integrated of the same order. Thus, before setting up the cointegration analysis and error correction model, we start with the determining the order of integration for both of the variables Consumer Prices (CP) and Exchange Rate (ER). The results of Augmented Dickey-Fuller (ADF) test in Table 1 suggest that non-stationary cannot be rejected for the levels of variables. In contrast, when the data are differenced, non-stationary can be rejected in all variables. Thus, both of the variables Consumer Prices (CP) and Exchange Rate (ER) appear to contain a single unit root which cancels out on first differencing. Thus, they clearly appear to be $I(1)$ in both pre-inflation targeting period and post-inflation targeting period.

Table 1 Augmented Dickey-Fuller Unit Root Test

Variables	Pre-IT period 1995-2000		Post-IT period 2006-2014	
	Levels	First Differ.	Levels	First Differ.
CP	- 3.231 (0.23)	- 11.231 (0.00)*	-2.089 (0.31)	-10.117 (0.00)*
ER	-1.346 (0.41)	-9.9837 (0.00)*	-0.346 (0.41)	-8.745 (0.00)*

Note: p-values in parenthesis; (*) indicates significance at the 1 percent level.

After determined that all of the variables are I (1) for both periods, a simple OLS regression indicated in Model 1 also runs on the levels of each variable for both periods again.

$$CP_t = \mu + \sigma ER_t + u_t \quad (\text{Model 1})$$

where CP and ER are non-stationary variables and u is the residual.

After estimation of the long run relationship in Model 1 by using OLS for both terms, cointegration can be tested using ADF-type unit root tests on the residuals (u_t) by testing the null hypothesis of non-stationary of the residuals (u_t). As can be shown in Table 2, results of unit root tests for residuals performed by ADF asserts that the null hypothesis of non-stationary of the residuals is rejected, which indicates that there is a cointegration between CP and ER for both terms.

Table 2 Augmented Dickey-Fuller Tests for the Residuals

Pre-IT period 1995-2000		Post-IT period 2006-2014	
Level	Order of integration	Level	Order of integration
-7,112 (0.00)*	I(0)	-8,834 (0.00)*	I(0)

Note: p-values in parenthesis; (*) indicates significance at the 1 percent level.

As the variables such as CP and ER are cointegrated for two terms, we then can run the error correction model (ECM). Accordingly, the ECM given by Equation 5 has been estimated in the form of Model 2 below for both term's consumer prices separately.

$$\Delta CP = \beta_1 \Delta ER_t - \lambda (CP_{t-1} - \mu - \delta ER_{t-1}) + \varepsilon_t \quad (\text{Model 2})$$

Where δ shows the long run relationship between consumer prices (CP) and exchange rate (ER) and hence degree of exchange rate pass through; λ refers to the speed of adjustment of short run disequilibrium to long run equilibrium between consumer prices (CP) and exchange rate (ER) and hence speed of exchange rate pass through.

Estimation results of ECM indicated Model 2 for both terms data is presented in Table 3. For two terms, explanatory power of the models (Adj R²) and the statistical significance of their regression coefficients (δ and λ) are appropriate. Results of the Breusch-Godfrey LM Test and White test also indicate that there is no serial correlation and no heteroscedasticity, respectively. The estimated results of the degree of exchange rate pass through (δ) as well as the speed at which the prices indices adjust to a change in the exchange rates (λ) are also presented in Table 3.

Speed of pass through or the coefficient of error correcting term (λ) in ECM estimation appears with the expected negative coefficient, which is significantly different from zero at the 5 percent level for both periods. Thus, empirical results support the acceptance of cointegration or the validity of long run equilibrium relationship between CP and ER or

exchange rate passes through for both terms. Consequently, after determination the cointegration between exchange rate and consumer prices by using ADF Test for residuals in Table 2, we also indicated again this fact with the results of error correction model. Besides, the coefficient of speed of adjustment are -0.347 and -0,091 percent meaning that system corrects its previous period disequilibrium at a speed of 34.70 and 9,10 percent monthly for pre-IT and post-IT period, respectively.

Table 3 Error Correction Model Estimation

	<i>Pre-IT period 1995-2000</i>	<i>Post-IT period 2006-2014</i>
Degree of pass-through (δ)	0,665 (0,013) **	0,218 (0,031)**
Speed of pass-through (λ)	-0,347 (0,014) **	-0,091 (0,021)**
Co-integration Relation	Yes	Yes
Complete pass through	No	No
Adj R ²	0.58	0.69
Breusch-Godfrey LM Test	1,123 (0,201)	1,917 (0,241)
White Test	0,513 (0,178)	0,698 (0,271)

Note: p-value in parentheses, (**) indicates significance at the 5 percent level.

Looking at the degree of long term pass-through (δ), although they seems to be statistically significant for both terms, the value of coefficients are 0,665 in the first term and 0,218 in the second term. This means that, in the long run, a change in the exchange rate is poorly transmitted to the consumer prices in post-IT period compared to pre-IT period. Given the fact that δ symbolizes complete exchange rate pass through when it equals one ($\delta=1$), it can be further asserted that exchange rate pas through for both terms are incomplete.

The findings of the study indicate that the pass-through effect dramatically reduce in post-IT period (2006-2014) with the introduction of the inflation targeting practices. This fact can be arisen from several reasons in the implementation of inflation targeting regime. The increase in the transparency of monetary policy may raise the credibility of the central bank regarding the prospects of disinflation and hence lower exchange rate volatility. The effects of price stability may also be reflected by the decrease in the risk premium included in the exchanges rates charged by economic agents.

Besides positive impacts of inflation targeting regime on exchange rate pass through, it also be noted that lower pass-through can be more advantages for central bank adopted inflation targeting regime. A low level of pass-through is beneficial because the high level exchange rate pass through decrease the flexibility of central bank for setting inflation target. Thus, the lower the extent of pass-through the larger will be the effectiveness of central bank's policies. Thus, on the one hand, the degree of exchange rate pass-through into inflation is important for the effectiveness of inflation targeting regime. But on the other hand inflation targeting regime is also the major determinants of the weaker exchange rate pass through process. In conclusion, this positive mutual interaction between weak exchange rate pass through and effective inflation targeting regime may be at the root of developments in post-IT term.

4 Conclusions

Along with globalization, capital account movements and international trade raised dramatically, leading that exchange had a huge significance and played important role in economies. In this context, understanding the process of exchange rate pass-through gains big significance since the size and speed of pass-through is a good estimator for the transmission of the international macroeconomic developments to a domestic economy. After most of the countries adopted Inflation Targeting (IT) Regime, related literature mostly focused to research the impact of inflation targeting regime on exchange rate pass through

This study tries to examine exchange rate pass through in Turkey applying a single equation Error Correction Model for the monthly data over the pre-IT period from 2005 to 2010 and the post-IT period from 2006-2014. With this perspective, the study focused on how changes in the exchange rate are transmitted to the consumer prices in Turkey after adopting Inflation Targeting Regime explicitly in 2006. The findings of the study indicate that the exchange rate pass-through decreases in the post-IT period compared to pre- IT period. Thus, development of exchange rate passes through process in Turkey identifies the effectiveness of inflation targeting policy. This finding advocates the related literature arguing that inflation targeting practices reduces exchange rate pass through. Accordingly, it can also be argued that monetary and correspondingly exchange rate regimes are among the major determinants of the exchange rate pass through process.

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