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Exchange Rate Pass-through into Import and Consumer Prices in Turkey

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Abstract

By applying the autoregressive distributed lag (ARDL) model, this study examines the exchange rate pass-through into import and consumer prices as well as its asymmetric framework for Turkey, which has experienced a recent currency depreciation and then an increase in the inflation rate. The results demonstrate the exchange rate pass-through into import and consumer prices are complete, which suggests the effectiveness of monetary policy to tackle trade deficit. However, the decision to use exchange rate to tackle trade deficit should be taken with caution as it has a one-to-one effect on inflation. Furthermore, the evidence for the asymmetric effect of exchange rate on consumer price is statistically significant. The depreciation of Turkish lira has more effect on consumer price than appreciation does. The asymmetric analysis may then explain the increase in exchange rate pass-through, compared to previous studies, given the significant depreciation of Turkish lira over the concerned periods.

***Keywords**: Exchange rate pass through, Inflation, ARDL model*

***JEL Classification**: E31, F31*

Türkiye'de Döviz Kurunun İthalat ve Tüketici Fiyatlarına Geçişi

Özet

Bu çalışma, otoregresif dağıtılmış gecikme (ARDL) modelini uygulayarak son dönemlerde para birimi bir değer kaybı yaşayan ve ardından enflasyon oranındaki artışın buna eşlik ettiği Türkiye için döviz kurunun ithalat ve tüketici fiyatlarına geçişini ve bu geçişin asimetrik özelliklerini incelemektedir. Elde edilen sonuçlar, döviz kurunun ithalata ve tüketici fiyatlarına geçişini desteklemekte ve para politikasının ticaret açığıyla mücadeledeki etkinliğine işaret etmektedir. Ancak, enflasyon üzerinde birebir etkisi olduğu dikkate alındığında dış ticaret açığına yönelik döviz kuru kararlarında ihtiyatlı olmak gerekir. Bunun yanı sıra, döviz kurunun tüketici fiyatı üzerindeki etkisinin asimetrik olduğunu destekleyen kanıtlar elde edilmiştir. Liradaki değer kaybının tüketici fiyatları üzerindeki etkisinin değer kazanımlarının etkisinden daha fazla olduğu görülmüştür. Asimetrik analiz, ilgili dönemlerde Türk lirasının önemli değer kaybı göz önüne alındığında, önceki çalışmalara kıyasla döviz kur geçişkenliğindeki artışı açıklayabilir.

***Anahtar Kelimeler**: Döviz kuru geçişi, Enflasyon, ARDL modeli*

***JEL Sınıflandırması**: E31, F31*

1. Introduction

Since 2006, Central Bank of Republic of Turkey (CBRT) has adopted inflation-targeting monetary policy. It includes, among others, the one-week repo rate, interest rate corridor, Turkish lira and foreign-currency liquidity and required reserves, to control the spillover effect from global economy and to target a moderate inflation. In 2015, Turkish repo rate, which indicates the rate at which the

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central bank lends money to the commercial banks, was reduced to 7.75% (8.25% in 2014), resulted from the weak global economic perspective and the slowing growth rate of bank loans to the private sector (CBRT, 2019). Following a high inflation rate in 2018 (16.33%), CBTR delivered a strong monetary tightening and raised the policy rate by 625 basis points. By December 2019, long-term commercial loans oriented towards investment production and housing sector were encouraged by a monetary policy revision as CBRT tried to boost the sectors having a poor link to the imports following the severe depreciation of Turkish Lira.

A monetary policy aiming to reduce trade deficit can resort to exchange rate as it has a positive effect on import price which then discouraged the demand of consumers. Such a policy however depends upon the exchange rate pass-through (ERPT). It would be limited if the changes in exchange rate do not get completely transmitted into the prices. ERPT can be defined as the transmission of change in exchange rate into price, and it is said complete if 1% change in exchange rate results in 1% change in the price. Later, these last 5 years, a great depreciation along with a high domestic inflation rate has been observed in Turkish economy. In January 2014, 1 USD was exchanged with 2.22 TL, while 5.84 TL in December 2019. At these mentioned periods, the inflation rate was 8.86% and 15.18%, respectively. The previous empirical works on Turkish exchange rate found complete ERPT into a domestic price (Alper, 2003; Arbatlı, 2003; and Ayşegül, 2009).

In the literature, a complete pass-through into price is assumed to be governed by the hypothesis of producer currency pricing (PCP), while it is zero for the local currency pricing (LCP) hypothesis. Incomplete ERPT is mostly found in the empirical work involving developed countries (Hooper and Mann, 1989; Menon, 1996; Maria-Dolores, 2010; Lee, 1997). However, the work studies carried out in developing countries often concluded complete pass-through (Alper, 2003; Webber, 1999; Yanamandra, 2015). This difference can be explained by many factors, among others, the pricing strategy of firms (Krugman, 1987), market concentration (Lee, 1997) and the influence of the persistence of inflation on ERPT into prices (Taylor, 2000; Devreux and Yetman, 20002). Others have highlighted the trade composition to account for the difference of ERPT across countries. The change in the composition of imported goods explains the negative variation of ERPT (Campa et al., 2005). Furthermore, the difference in ERPT across countries can be explained by the share of domestic demand and the persistent change of exchange rates (Hooper and Mann, 1989; McCarthy, 2007).

Most earlier research literatures focused on developed countries such as EU and USA. Few recent studies have targeted the case of Turkey though it shows possible evidence of high exchange rate pass-through in recent years. Given the seemingly parallel movements of exchange rate and inflation and the lack of recent research on Turkish case, the present paper attempts to study exchange rate pass-through into prices in Turkey and its asymmetric effect. The previous empirical works on Turkish case, among others, Alper (2003), Arbatlı (2003), Doğan (2013), Akçelik and Öğünç (2016), and Kotil (2020), have focused on ERPT into domestic prices

and its asymmetric effect in terms of direction (appreciation and depreciation). Maria-Dolores (2010) studied the ERPT into unit import prices in Turkey but did not consider the asymmetric effect. The present paper investigates ERPT into consumer and import prices as well as the asymmetric analysis in the direction of change (appreciation or depreciation) and the size of change (small and high change). As for the methodology, the research works in the literature applied different estimators to investigate the long-run coefficient of ERPT. Each estimator has its own assumption, of which the violation entails spurious results. For instance, ordinary least square would yield inefficient results if the variable has unit-root since the error-term is not normally distributed. Other methodologies, such as Engle and Granger (1987), Johansen (1988), and Johansen and Juselius (1990), deals with first-differenced variables and require the same order of integration equal to one. Moreover, Johansen cointegration is based on maximum likelihood estimation and is asymptotically efficient, which needs a sufficiently large sample. However, the result of unit-root test (Table 1) rejects the null hypothesis of unit-root for industrial production index (IPI) at a level. Therefore, this paper employed autoregressive distributed lag (ARDL) to estimate a model involving dataset between January 2005 and December 2019. Therefore, the present paper employed ARDL to estimate a model involving dataset between January 2005 and December 2019. The results show that ERPT into import and consumer prices is complete. The asymmetric analysis reveals that the pass-through of depreciation into consumer price is higher than the appreciation. High depreciation has higher impact on price than high appreciation does. Other results will be further discussed in the analysis. The rest of this paper is organized as the following: section 2 presents the literature review. Section 3 indicates the theoretical framework, methodology, and dataset. Sections 4 and 5 discuss the empirical results and the conclusion, respectively.

2. Literature Review

The extent to which exchange rate influences the price is of the main preoccupation for monetary policy. Turkish national currency has shown an unprecedented depreciation coupled with relatively high inflation for the last 5 years. Some previous works studied the exchange rate pass-through into prices in Turkey and its asymmetric effect. Most of them find the evidence for the asymmetry and the complete pass-through, though others argue the opposite for some specific price index. Alper (2003) used vector autoregressive model to study exchange rate pass-through into consumer price and whole price index in Turkey and reached to the conclusion of complete ERPT in the long-run. He also emphasized ERPT changes according to the share of imported goods, which accounts for the reason that makes ERPT into the whole price larger than ERPT into consumer price. Kara et al. (2005) supported that the magnitude of pass-through is complete but has diminished after the adoption of floating exchange rate regime. However, Maria-Dolores (2010) has another conclusion about the coefficient of ERPT. She found no evidence for complete long-run ERPT into import price in Turkey.

Later, the asymmetric effect seems to prevail in many works of literature on ERPT into inflation in Turkey. Arbatlı (2003) and Aysegul (2009) asserted that there is an

asymmetry in the relationship between exchange rate and inflation (wholesale and consumer price). Aysegul (2009) investigated the exchange rate pass-through in Turkey by applying Johansen (1988) and Engle-Granger (1987) and concluded that depreciation has a higher impact on ERPT. However, Doğan (2013) concluded no evidence for asymmetric ERPT. Kotil (2020) investigated the effect of exchange rate on producer and consumer price index in Turkey by applying vector auto-regressive (VAR) model to the monthly dataset between 2005 and 2019. The results demonstrated that the response of consumer price to the change in nominal exchange rate is larger than that of producer price. His conclusion is in line with Alper (2003) affirming that the difference can be explained by the dependence of the consumption demand on import goods. However, a recent study, carried out by Emek et al. (2021), contrasted this result.

Most of research literatures appear to agree with an incomplete pass-through into import price in developed countries. Hooper and Mann (1989) studied the exchange rate pass-through into US import of manufactures such as capital goods, automotive products, consumer goods, and industrial supplies except for petroleum and products, over the periods 1980-1988. They employed two estimators such as ordinary least squares (OLS) with polynomial distributed lags (PDL) and correction for serial correlation (SCC) and error correction model. Their work supported that 50 to 60% change in the nominal exchange rate is incurred in manufactured import prices. It means that foreign firm faces profit margin change as exchange rate fluctuates. Also, they argued the degree of pass-through varies over periods. Menon (1996) looked into the exchange rate pass-through for manufactured goods imported to Australia. Besides the market structure and product characteristics, their work captures the role played by the government by considering tariff-barrier. Their result supports the exchange rate pass-through is incomplete and changes a bit considerably across products. Later, the works in developing countries have seemingly shown a complete ERPT to prices as they have less competitive market structure and less important market for foreign market. For instance, complete ERPT into prices has been concluded for ERPT into the price in Pakistan and Philippines (Webber, 1999). Yanamandra (2015) found the same results for India.

Other researchers attempted to explain the difference in ERPT across countries. Krugman (1987) mentioned the pricing to market dominated by oligopolistic firms and the mark-up adjustment in response to the exchange rate change as a factor accounting for the difference in pass-through. Another line of argument is about sticky prices (Devereux and Yetman, 2002). Lee (1997) provided another explanation from a study in South Korean industries. He examined the exchange rate pass-through behaviour with a domestic market concentration in Korea using industry-level data. In his model, the unit import price of industry is the dependent variable and industry characteristics as independent variables. The estimation results show that the coefficient on concentration significantly has negative value, which implies that the higher the concentration, the lower the ERPT. McCarthy (2007) examined the effect of exchange rate on the domestic producer and consumer prices in some industrialized countries by applying a VAR model. He

indicated that with post-Bretton Woods periods, the exchange rate has a moderate effect on domestic inflation based on the result of impulse response. Exchange rate pass-through is higher in the countries where import share in the market is larger. Maria-Dolores (2010) emphasized that exchange rate regime and openness account for the cross-countries difference in ERPT. She studied exchange rate pass-through into import price from the eurozone to the new member state of European Union and Turkey. Two methodologies were used, such as Campa and Gonzalez-Minguez (2006) and de Bandt et al. (2007). The former one estimated the short and long-run pass-through elasticities such that long-run elasticities are defined as the sum of coefficients associated with the actual and the first four lag of exchange rate. The latter methodology expressed a long-run Engle and Granger (1987) cointegrating relationship with the error correction model. The author concluded the flexible exchange rate regime has the smallest exchange rate pass-through, and the higher the openness the higher is the long-run ERPT. Later, Taylor (2000) discussed the decline of ERPT in many countries and suggested a hypothesis, known as Taylor's hypothesis, which describes that the exchange rate pass-through can be influenced by inflation rate. A country with a low inflation environment involves a small degree of exchange rate pass-through and vice-versa. The persistent effect of inflation on the cost explains the link between the inflation rate and the value of ERPT. Firms tend to incur the change in cost into their price if the cost is persistent. In relation to this, Campa and Goldberg (2005) showed that the lower the fluctuation of exchange rate and the average rate of inflation, the lower the degree of ERPT. The absorption of cost into mark-ups depends on the country's inflation figure. They also emphasized that ERPT can be affected by the macroeconomic parameters, which can explain the ERPT difference across countries. Furthermore, the hypothesis of Taylor has been demonstrated in several empirical works such as Gagnon and Ihrig (2004), Choudhri and Hakura (2006), and Mohammed et al. (2017).

The previous empirical works on Turkish case, among others, Alper (2003), Arbatlı (2003), Doğan (2013), Akçelik and Öğünç (2016), and Kotil (2020), have focused on ERPT into domestic prices and its asymmetric effect in terms of direction (appreciation and depreciation). Maria-Dolores (2010) studied the ERPT into unit import prices in Turkey but did not consider the asymmetric effect. The literature research applied different models such as vector error correction model (VECM), vector autoregression (VAR) and ARDL.

3. Analytical Framework, Methodology and Data Description

This section first provides a simple framework that shows the determinant of unit import price. Later, the part of methodology explains the estimator that is relevant to the model. The data description presents the variables used in the model estimation.

3.1. Analytical Framework

Let suppose a world with 2 countries. 1 and 2 denote a country's index and $P_{1,t}$ and $P_{2,t}$ are their respective price at time t. Following Campa and Goldberg (2005), the

unit import price of country 1 from country 2 in its national currency is expressed as the following:

$$P_{1,t} = P_{2,t}X_{2,1} \quad (1)$$

where $X_{2,1}$ represents the exchange rate of country 2's currency to the country 1's. The unit profit (μ) of country 2 from its export is the difference between the unit export price and unit cost, which is represented by equation below:

$$\mu = P_{2,t} - c_2 \quad (2)$$

And by subtracting the unit price, one obtains:

$$P_{2,t} = \mu + c_2 \quad (3)$$

In firm's behaviour, inflation expectation (π_2) can incite the firm's owner to increase his profit. Unit cost is assumed to depend on output (y_2) and inflation (π_2). Moreover, the output (y_2) can be shaped by the import demand condition depending on the import country (1)'s income (y_1). Then, profit and unit cost can be expressed as follows:

$$\mu_2 = f(\pi_2) \quad (4)$$

and

$$c_2 = h(\pi_2, y_1) \quad (5)$$

where π_2 and y_1 indicate inflation in the country (2) and output in country (1). Based on equations (4) and (5), (3) can be rewritten as:

$$P_{2,t} = f(\pi_2) + h(\pi_2, y_2, y_1) \quad (6)$$

Substituting equation (6) for $P_{2,t}$ in (1), (6) becomes:

$$P_{1,t} = X_{2,1}f(\pi_2) + X_{2,1}h(\pi_2, y_1) \quad (7)$$

Later, equation (7) can be changed into a Cobb-Douglass form. Let λ, α, and ρ denote the share of exchange rate, inflation (π_2) and country (1)'s income (y_1) in $P_{1,t}$. Then, equation (7) can be rewritten as the following:

$$P_1 = X_{2,1}^{\lambda}\pi_2^{\alpha}y_1^{\rho} \quad (8)$$

By taking derivative of (8) logarithmically, one obtains:

$$logP_1 = \lambda \log X_{2,1} + \alpha log\pi_2 + \rho log y_1 \quad (9)$$

Equation (9) will be estimated in the next section to examine the exchange rate pass-through to the unit import price.

3.2. Methodology

This study applies the ARDL model proposed by *Pesaran et al. (2001)* to estimate the long-run relationships between exchange rate and price. This methodology has a relative advantage in the sense that it does not require all variables to be integrated at the same order. The generalized ARDL (p, q) model is specified as:

$$Y_t = \alpha_0 + \sum_{i=1}^{p} \alpha_{1i} Y_{t-i} + \sum_{i=o}^{q} \alpha_{2i} X_{t-i} + \varepsilon_t \quad (10)$$

Where Y_t is dependent variable; X_t is independent variable which can be I(0) or I(1); α is coefficient; $i = 1, \dots, k$; p and q are optimal lag orders; ε_t is error term with white noise. By using the variables in the dataset and taking into account the conditional error correction form, the model can be written as:

$$P_t = \alpha_0 + \sum_{i=1}^{k} \alpha_{1i} P_{t-i} + \sum_{i=1}^{m} \alpha_{2i} OIL_{t-i} + \sum_{i=1}^{q} \alpha_{3i} IPI_{t-i} + \sum_{i=1}^{p} \theta_{1,i} EXCH_{t-i} + \varepsilon_t \quad (11)$$

where P denotes the price (consumer or import price) at time t; EXCH stands for the exchange rate; OIL represents the international price index of oil at national currency; IPI is the national industrial price index; α_1, α_2, α_3, and θ_1 represent the short-run dynamics of the model.

Before examining the long-run relationship between the variables, the model should first satisfy the bounds test criteria. In this test, the decision to accept or reject the null hypothesis depends on F-statistic and the critical values related to I(0) and I(1). The test bounds introduced by *Pesaran et al. (2001)* require that a time series be integrated of the order less than 2, which is 1 and 0. This means that all variables should be either stationary at level or first difference. It analyses the short and long-run relationships between variables. The model includes the lagged dependent and independent variables. The ARDL bounds cointegration test is expressed as follows:

$$\Delta P_t = \alpha_0 + \sum_{i=1}^{k} \alpha_{1i} \Delta P_{t-i} + \sum_{i=1}^{m} \alpha_{2i} \Delta OIL_{t-i} + \sum_{i=1}^{q} \alpha_{3i} \Delta IPI_{t-i} + \sum_{i=1}^{p} \theta_{1,i} \Delta EXCH_{t-i} + \alpha_5 P_{t-1} + \theta_2 EXCH_{t-i} + \alpha_6 OIL_{t-1} + \alpha_7 \Delta IPI_{t-1} + \varepsilon_t \quad (12)$$

where α_5, α_6, α_7, and θ_2 indicate the long-run relationship. Δ is the first difference operator; k, p, m, and q stand for the optimal lag length of P, EXCH, OIL, and IPI, respectively. In the bounds test,

- Null hypothesis: $\alpha_5 = \theta_2 = \alpha_6 = \alpha_7 = 0$

- Alternative hypothesis: one of these coefficients is different from zero

The result of this test provides the F value associated with the test along with the critical value. The decision to reject or accept the null hypothesis depends on the F value. If F-test is lower than the critical value for I(0) regressors, the null hypothesis would be accepted while it is rejected if F-test is higher than the critical value for I(1) regressors. However, it would be inconclusive if it falls between the critical values for I(0) and I(1).

In case the presence of long-run relationship is proved, the error correction model can be formulated as follows:

$$\Delta P_t = \alpha_0 + \sum_{i=1}^{k} \alpha_{1i} \Delta P_{t-i} + \sum_{i=1}^{m} \alpha_{2i} \Delta OIL_{t-i} + \sum_{i=1}^{q} \alpha_{3i} \Delta IPI_{t-i} + \sum_{i=1}^{p} \theta_i \Delta EXCH_{t-i} + \gamma EC_{t-1} + \varepsilon_t \quad (13)$$

where EC_{t-1} stands for the error correction model and γ represents the speed of adjustment. The long-run coefficient is given by normalizing the lagged coefficients

of the concerned variable on the coefficient of lagged dependent variable. For instance, the long-run coefficient associated with exchange rate (LR_{ERPT}) in equation (13) is expressed as follows:

$$LR_{ERPT} = \frac{\sum_1^p \theta_i}{1-\sum_1^k \alpha_{1i}} \tag{14}$$

Later, this paper deals with the asymmetric effect of exchange rate on unit import price. Following Yanamandra (2015), the analysis of ERPT asymmetry uses two subsamples which represent appreciation ($EXCH^-$) and depreciation ($EXCH^+$) and is written as the following:

$$\begin{pmatrix} EXCH^+ \\ EXCH^- \end{pmatrix} = \begin{pmatrix} I_i EXCH_i \; if \; I_i = 1 \\ (1 - I_i) EXCH_i \; otherwise \end{pmatrix} \tag{15}$$

where I_i is a binary variable defined as:

$$I_i = \begin{cases} 1 \; if \Delta EXCH_i > 0 \\ 0 \; otherwise \end{cases} \tag{16}$$

Then, the equation to be estimated is as follows:

$$\Delta P_t = \alpha_0 + \sum_{i=1}^k \alpha_{1i} \Delta P_{t-i} + \sum_{i=1}^x \alpha_{2i} \Delta OIL_{t-i} + \sum_{i=1}^q \alpha_{3i} \Delta IPI_{t-i} + \sum_{i=1}^p \theta_{1i} \Delta EXCH^+{}_{t-i} + \sum_{i=1}^p \theta_{2i} \Delta EXCH^-{}_{t-i} + \gamma EC_{t-1} + \varepsilon_t \tag{17}$$

The asymmetric effect of size is also studied. Large and small changes in depreciation and appreciation are defined such that it is small if it is less than the mean and large otherwise. They are given by equation (18):

$$\begin{pmatrix} EXCH_+^{>v} \\ EXCH_+^{<v} \\ EXCH_-^{>x} \\ EXCH_-^{<x} \end{pmatrix} = \begin{pmatrix} I_{1,i} EXCH^+{}_i \; if \; I_{1,i} = 1 \\ (1 - I_{1,i}) EXCH^+{}_i \; otherwise \\ I_{2,i} EXCH^-{}_i \; if I_{2,i} = 1 \\ (1 - I_{2,i}) EXCH^-{}_i \; otherwise \end{pmatrix} \tag{18}$$

where $I_{1,i}$ and $I_{2,i}$ are binary variables defined as:

$$I_{1,i} = \begin{cases} 1 \; if EXCH^+{}_i > v \\ 0 \; otherwise \end{cases} \; and \; I_{2,i} = \begin{cases} 1 \; if EXCH^-{}_i > x \\ 0 \; otherwise \end{cases} \tag{19}$$

And $v \; and \; x$ are the mean of $EXCH^+{}_i$ and $EXCH^-{}_i$, respectively. By considering these variables, the estimate equation is:

$$\Delta P_t = \alpha_0 + \sum_{i=1}^k \alpha_{1i} \Delta P_{t-i} + \sum_{i=1}^m \alpha_{2i} \Delta OIL_{t-i} + \sum_{i=1}^q \alpha_{3i} \Delta IPI_{t-i} + \sum_{i=1}^p \theta_{1i} \Delta EXCH_{+,t-i}^{>v} + \sum_{i=1}^p \theta_{2i} \Delta EXCH_{+,t-i}^{<v} + \sum_{i=1}^p \theta_{3i} \Delta EXCH_{-,t-i}^{>x} + \sum_{i=1}^p \theta_{4i} \Delta EXCH_{-,t-i}^{<x} + \gamma EC_{t-1} + \varepsilon_t \tag{20}$$

3.3. Data

At the first stage, the exchange rate affects the price of imported goods expressed in Turkish national currency. Later, some part of the imported goods is used as intermediate goods in the manufacturing and others are a component of consumption goods in the domestic market. This involves the second stage of effect

of exchange rate (Yanamandra, 2015). In this paper, the dependent variables are unit import price index (IMP) or consumer price index (CPI) depending on the model considered. Following Alper (2003) and Yanamandra (2015), the independent variables are exchange rate (EXCH), European Brent price (OIL), and Turkish industrial production index. The monthly dataset used for the empirical analysis ranges from Jan 2005 to Dec 2019 and is taken from Turkish Statistical Institute and Central Bank. Oil is used to capture inflation in the trading partner countries. Industrial production index shows the dynamics of output in Turkish industry sector. Then, it can represent the national income as there is no data for monthly GDP. For the exchange rate, nominal exchange rate from dollar USD (buying) to Turkish national currency TRY (EXCH) is used. Oil and exchange rate are expected to have a positive sign, whereas based on Yanamandra (2015), the coefficient associated with industrial production index can be positive or negative. The unit import price index (IMP) is taken from Turkish Statistical Institute while the remaining variables are extracted from Turkish Central Bank.

4. Empirical Results

As mentioned earlier, there is a need to ascertain that none of the variables is integrated of order (2). Then, Augmented-Dickey Fuller (ADF) and Philip-Peron tests are performed at a level and first-difference; the results are reported in table 1. These tests are set out such that the null hypothesis indicates the presence of unit-root. The industrial production index is stationary at level, which means that the null hypothesis is rejected. Then, it is integrated of order zero. The unit-root tests for the remaining variables have accepted the null hypothesis at the level and rejected at the first difference. Then, the condition for the integration of order less than 2 is satisfied.

Table 1. Unit Root Test Results

	Level		First Difference	
Variables	ADF	PP	ADF	PP
IMP	1.08	1.21	-8.81***	-94.23***
CPI	-1.45	-1.28	-12.55***	-128.63***
REER	-0.63	-2.26	-10.24***	-113.78***
EXCH	1.71	2.12	-9.05***	-96.93***
OIL	-2.06	-11.76	-9.55***	-119.18***
IPI	-2.84**	-6.75	-22.59***	-220.80***

***, ** and * significant at 1, 5 and 10%, respectively.

4.1. Long-run Relationship between Exchange Rate and Prices

Prior to estimating long-run relationship between exchange rate and price, the bounds test should be performed. In this empirical research, the main interest is to estimate the coefficient of exchange rate pass-through into prices. In Table 2, the model (1) includes import unit price (IMP) as dependent variable and, as independent variable, industrial production index (IPI), oil price (OIL), and nominal exchange rate from dollar USD (buying) to Turkish national currency TRY (EXCH). To recall what was mentioned earlier, a positive change in the value of

this exchange rate means depreciation of Turkish currency. The estimation results for this model are shown in the second column of Table 2. Its bounds test results rejected the null hypothesis of no long-run relationship between unit import price, exchange rate, oil price and industrial production index as the F-value is higher than the 1% critical value. The long-run coefficient of nominal exchange rate (EXCH) is equal to 0.91. This value will be later tested against the hypothesis of PCP and LCP. The next is to estimate the model (2) in which the dependent variable is CPI, while the independent variables are industrial production index (IPI), oil price (OIL), and nominal exchange rate from dollar USD (buying) to Turkish national currency TRY (EXCH). The estimation results are shown in column (3) of the table (2). The bounds test demonstrates a long-run relationship. All variables except for the industrial production index have a significant coefficient. The exchange rate pass-through is significant at 1% and is equal to 0.88, which is less than the one in which the dependent variable is unit import price. The effect of exchange rate on unit import price being direct may explain the difference between ERPT into unit import price and domestic price. The effect of exchange rate on consumer price is rather through the intermediate input and the share of non-domestic goods in the consumption goods market. At most, firms would reflect in the domestic market the complete change that occurs in the import price following the change in exchange rate. Then, ERPT into consumer price does not normally exceed ERPT into import price.

Table 2. Exchange Rate Pass-through into Prices

Variables	(1) IMP ARDL(1,2,2,1)	(2) CPI ARDL(3,0,0,1)
Adjustment speed	-0.14(0.02)***	-0.025(0.007)***
IPI	0.12(0.102)	0.078(0.21)
OIL	0.004(0.0004)***	0.003(0.001)***
EXCH	0.916(0.04)***	0.881(0.13)***
Short-run ERPT	0.75(0.04)***	0.06(0.016)***
C	0.46(0.04)***	4.4(0.03)***
Bounds test: F-statistic Critical value	 6.23 5.61***	 4.894 4.35**
Diagnostic tests: Durbin-Watson Breusch-Godfrey White's test	 2.11 0.73 59.73	 1.66 0.41 89.01***

***, ** and * significant at 1, 5 and 10%, respectively. The number in the bracket shows the standard deviation.

The coefficient of ERPT into consumer price obtained from this analysis is slightly higher than the one found in the previous works. For instance, ERPT into CPI equals 0.77 in Ayşegül (2009). A possible explanation is given in the section of asymmetric analysis. Later, the coefficients of EXCH in the models (1) and (2) are tested against the hypothesis of PCP and LCP. PCP stresses that ERPT is equal to

one, whereas, in LCP, it is zero. F-test is applied, in which the null hypothesis is the coefficients of EXCH for the models (1) and (2) equals 1 or 0.

The result of F-test accepts the hypothesis of PCP. Then, the pass-through into import and consumer prices is complete. Same results are concluded by the most of previous research works on Turkish case, e.g*: Alper (2003), Arbatlı (2003), Kara et. al (2005), and Aysegul (2009).*

4.2. Testing for Asymmetry

The asymmetry analyses the effect of depreciation and appreciation (and their respective size) on the price. The decrease in exchange rate (EXCH), which means appreciation ($EXCH^{-}$), theoretically leads to a fall in the import price unit, whereas the increase does the opposite.

Table 3. Long-run Coefficient for Asymmetric Effect of Exchange Rate

Variables	(3) IMP ARDL (1,0,2,1,1)	(4) IMP ARDL (1,0,2,1,1,1,1)	(5) CPI ARDL (3,0,0,0,0)	(6) CPI ARDL (3,0,0,0,0,0,0)
Adjustment speed	-0.14*** (0.08)	-0.14*** (0.029)	-0.027*** (0.007)	-0.27*** (0.08)
IPI	0.13(0.08)	0.13(0.06)	0.085(0.205)	0.101(0.2)
OIL	0.004*** (0.0004)	0.004*** (0.0004)	0.003*** (0.001)	0.003*** (0.001)
EXCH $^{+}$(depreci.)	0.90*** (0.05)		0.95*** (0.14)	
EXCH^{-}(appreci.)	0.92*** (0.05)		0.81*** (0.11)	
$EXCH_{+}^{\geq v}$		0.898*** ((0.05)		0.94*** (0.015)
$EXCH_{+}^{\leq v}$		0.96*** (0.15)		1.21*** (0.39)
$EXCH_{-}^{\geq x}$		0.918*** (0.05)		0.82*** (0.13)
$EXCH_{-}^{\leq x}$		0.79*** (0.15)		0.65* (0.37)
C	0.45*** (0.11)	0.49*** (0.11)	0.10*** (0.03)	0.11*** (0.03)
Bounds test: F-statistic Critical value	5.7 5.06***	4.22 3.61**	7.77 5.06***	5.86 4.43***
Diagnostic tests: Durbin-Watson Breusch-Godfrey White's test	2.15 1.33 56.46	2.13 1.08 156.24	1.98 0.06 83.8***	2.007 0.05 96.43***

***, ** and * significant at 1, 5 and 10%, respectively. The number in the bracket shows the standard deviation

The expectation on its respective sign is discussed as the following: the higher the EXCH depreciates, the greater the increase in the price, and the higher it appreciates, the greater the drop in the price. Then, appreciation and depreciation are expected to have the same sign but different coefficient if asymmetry holds.

The idea behind the asymmetric analysis is that the importer may think that although there is small depreciation of his national currency, there would be no need to change the price in the domestic market due to some reasons like a harsh competitive market, menu cost, etc. In that case, the importer absorbs the difference and prefers to lower his profit. However, this choc absorption might be impossible if there is a large depreciation like the one greater than the mean of the sample. Then, the present step is to explore the effect of the direction (appreciation or depreciation) and the size (small or high) of change in exchange rate such that whether the depreciation and appreciation as well as their size give the same extent effect on price. The exchange rate is first divided into two subsamples based on the direction such as appreciation or depreciation, respectively ($EXCH^-$ and $EXCH^+$), which are included in the models (3) and (5). More explanation is provided in equations (15), (16), and (17). Later, each of the two subsamples is divided into two other subsamples based on its mean (*see equations (18), (19), and (20)*). Then, apart from IPI and OIL, four variables are added into the models (4) and (6). $EXCH_+^{\geq v}$ and $EXCH_+^{\leq v}$ indicate the subsample of appreciation in which $> v$ and $< v$ represents the value being greater and less than the mean (v), respectively. $EXCH_-^{\geq x}$ and $EXCH_-^{\leq x}$ express the subsample of depreciation being higher and lower than the mean (x), respectively.

The results from models (4) and (5) in which import price is the dependent variable show that the coefficients of exchange rate for appreciation, depreciation and their respective sizes are all significant at 1% and have the expected sign. However, the F-test applied to these models has accepted the null hypothesis in which these coefficients are all equals. Their difference is not significant, which indicates that there is no asymmetric ERPT into import price. Later, the results from the models (5) and (6) where the dependent variable is consumer price indicate the coefficients of appreciation, depreciation, and their respective sizes being significant. F-test applied for the model (5) rejects at 1% level the null hypothesis in which the coefficient of the appreciation and the depreciation are equal. The depreciation of exchange rate has a higher impact on consumer price than the appreciation does. The model (6) analyses the effect of size in each direction. F-test accepts the equality of coefficients of small and large appreciation of exchange rate, and the coefficients of large appreciation and small depreciation of exchange rate, respectively. A similar result is found for the coefficients of large and small appreciation. However, F-test rejects the equality between the coefficients of large depreciation and appreciation as well as small depreciation and appreciation, both at 10% significance.

The asymmetric analysis indicates that the depreciation of Turkish lira generates higher effect on consumer price than the appreciation does. The evidence of asymmetric effect of appreciation and depreciation is consistent with some previous

works examining Turkish case (e.g.: Arbatlı, 2003; Aysegul, 2009). As for the size, large depreciation and appreciation have different effect on consumer price. The former is higher than the latter. The similar scenario occurs in small depreciation and appreciation. The asymmetric effect may explain the reason behind the increase in ERPT compared to the previous literatures because over the concerned periods in the present paper, Turkish lira has dropped by 487%. Furthermore, the asymmetric effect shows that the firm does not absorb any choc from depreciation while they tend not to incorporate the effect of small appreciation on the price. This situation can suggest either the lack of substitution between domestic and foreign products or the sticky price.

5. Conclusion

This paper applied the ARDL model to examine the ERPT into import and consumer prices in Turkey using monthly data for the period between January 2005 and December 2019. The value of ERPT carries out a significant meaning for monetary policy as low ERPT leads to poor effectiveness of exchange rate-based adjustment to correct the trade deficit. However, low ERPT also means that the country is less concerned with the inflationary effect of exchange rate.

The empirical result points out the validity of PCP. ERPT into import and consumer prices is complete. ERPT into import is higher than ERPT into consumer price, which is somewhat expected. The effect of exchange rate on the import price is the first stage of exchange rate transmission and the second stage occurs when it affects the domestic goods as these import goods are the intermediate input and the components of domestic market. The complete pass-through is concluded by the most of previous literature considering the developing countries as well as those selecting Turkish case. Moreover, the analysis in this paper finds a significant asymmetric response with respect to the direction of exchange rate such as appreciation and depreciation and the size of change (small or high). The depreciation has a higher impact on price than appreciation. A small appreciation has the same magnitude impact on consumer prices as a large appreciation. The lack of substitution between domestic and foreign products and the downward price rigidity can account for the asymmetric effect.

Previous research works on ERPT into Turkish consumer price have found complete ERPT into consumer price. It is also supported by the empirical results of this paper involving the recent dataset. However, its coefficient is somewhat higher than that of previous works. The change in ERPT into price has been discussed in the research literature in which authors put forward the change in import composition, market competition, pricing strategy, and other macroeconomic factors. Following the asymmetric results in this paper, the depreciation has a higher value of ERPT than appreciation. Then, the high depreciation of nominal exchange rate over the concerned periods can be thought to contribute to the rise in ERPT given the asymmetric effect.

Finally, the complete ERPT into import price implies the effectiveness of monetary policy targeting the adjustment in the trade deficit as any change in exchange rate

significantly increases or decreases the import price. However, the decision to use exchange rate to tackle trade deficit should be taken with caution as it has a one-to-one effect on inflation, which can then lead to deteriorating the trade competitiveness. The results of the present paper can give a hint on the fact that high inflation rate observed these recent years is partly caused by the unprecedented depreciation. As a suggestion for the next research, this present paper did not provide any information about the time needed for exchange rate to reach its highest impact on prices (policy effectiveness).

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