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ASYMMETRIC EXCHANGE RATE PASS-THROUGH TO IMPORT AND EXPORT PRICES FOR TURKEY: A NONLINEAR AUTOREGRESSIVE DISTRIBUTED LAG (NARDL) APPROACH

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ABSTRACT

This paper re-examines the exchange rate pass-through into trade prices in Turkey to observe possible asymmetries. This exercise is done using a Nonlinear Autoregressive Distributed Lag (NARDL) model. We provide empirical evidence that the impact of exchange rate into import and export prices are asymmetric, meaning that the export and import prices respond differently to a change in exchange rate depending on the direction. Moreover, we observe that the pass-through coefficients decline after Turkey adopts floating exchange rate regime. This result has important implications in terms of monetary policy.

Keywords: Exchange rate pass-through, import price, export price, NARDL, asymmetry

INTRODUCTION

Large fluctuations of exchange rates have led researchers to focus their attention on the relationship of exchange rate with other macroeconomic variables, since exchange rate plays a vital role in maintaining macroeconomic stability. In this context, exchange rate pass-through to prices has been a productive area of

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research over the past years in macroeconomic debate. In the literature, it is suggested that exchange rate fluctuations have a significant impact on the level of inflation. As Turkey adopted floating exchange rate regime in 2001, the evaluation of the sensitivity of trade prices to a change in the exchange rate of domestic currency is important in terms of monetary policy.

The exchange rate pass-through can be described as the extent of the impact of exchange rate into prices. When the movements in the exchange rate are fully reflected into prices, the pass-through is said to be complete. On the contrary, if the transmission process is less than proportional, the pass-through is partial. A common finding of prominent studies reveals that partial exchange rate pass-through (ERPT from now on) is more frequent in many countries. Two possible explanations had been put forward to address for this finding. First, exporters are not willing to adjust their prices when an appreciation of home currency occurs, in order to maintain their market share. Second, there exists price rigidities, meaning that prices are unresponsive to the changes in the short-run (see Monacelli, 2005; El Bejaoui, 2013; Bahmani-Oskooee, Usman, & Ullah, 2019; Bahmani-Oskooee, Harvey, & Hosny, 2019).

The determinants of ERPT can be documented as follows. The size of the market, the competition that exporter faces, the duration of exchange rate variation and the direction of the change in the exchange rate. Taking size of the market into consideration, Campa and Mínguez (2006) argue that firms are disposed to absorb the changes in the exchange rate and accept lower profits if the market size is huge and local demand is also elastic. They also study the competition effect and indicate that, when exporter firm faces a strong competition in the market, this makes consumers more price sensitive. However, if the competition is low, then exporter firm will be less price sensitive. The duration of the exchange rate variaton is also connected to the firm behaviour. When the changes in the exchange rate are temporary, exporter firms are willing to respond to these changes rapidly, in order to maintain their market share.

A growing body of empirical research analyses the magnitude of ERPT. The main findings of prominent studies are as follows. The observation of incomplete pass-through is more common and the estimated ERPT coefficients differ significantly across countries and across different periods of time (Menon, 1995). Chou (2019) suggests that ERPT's into import prices are relatively higher before 1990s. Apart from being country and time specific, it is observed that the estimated coefficient for import prices are bigger than that of the export prices (Choudhri & Hakura, 2015). The estimated coefficient also differs through long-run and short-run. Campa and Goldberg (2005) discover that the extent of pass-through is higher in the short-run than in the long-run.

The asymmetric impact of exchange rate on prices has also been widely studied in the literature. El Bejaoui (2013) points out that an appreciation is more passed through into export prices and import prices for major developed countries. Robitaille (2019) analyses a large number of developed and emerging countries and discovers that the ERPT is higher for emerging countries when it is compared to developed countries. McCarthy (2007) also considers the case for developed countries and justifies that the ERPT for those countries are lower due to less volatile exchange rate and stability of Gross Domestic Product (GDP) growth. Bussiere (2013) studies the case for G7 economies and discovers that the direction and magnitude of asymmetry differs across countries. Rasoulinezhad (2018) finds that pass-through is found to be lower in the short- run than in the long-run for Russia. Brun-Aguerre, Fuertes and Greenwood-Nimmo (2017) indicate that long-run ERPT estimates for depreciations have greater coefficients than that of the appreciations. As mentioned previously for symmetric impact, the asymmetric impact of exchange rate into prices are also country specific.

This paper aims to fill the gap in the literature by answering two questions:

1. Has exchange rate pass-through to export and import prices changed after Turkey adopted floating exchange rate regime?
2. Does nominal exchange rate in Turkey impact export and import prices asymetrically?

A previous study for Turkey based on a symmetric model was carried out by Tekin and Yazgan (2009) for the period 1988–2004. Their findings indicate that the exchange rate pass-through is complete for export prices, whereas it is incomplete for import prices. On this subject, the contribution of this paper to the existing literature is that, we provide evidence for an asymmetric impact of exchange rate on export and import prices both in the long-run and in the short-run. Meaning that, the prices do not react with the same coefficient to a decrease and an increase. Apart from that, unlike Tekin and Yazgan (2009), we observe that ERPT is not complete for both export and import prices.

DATA AND METHODOLOGY

Data

We use monthly data ranging from January 2004 to December 2018. As it is also applied by Markowicz and Baran (2019) and Falkowski (2018), we employ unit value index for export and import prices as a proxy for real transaction prices due to unavailability of data. The import price index represents the changes in

the prices of goods that are produced outside of Turkey, while the export price shows, how the prices of goods change which are produced in Turkey. These data are obtained from Turkish Statistical Institute (TUIK). The exchange rate used is the nominal exchange rate (TL/USD), which is obtained from www.investing.com. Since we use nominal exchange rate, home currency appreciations appear as decreases in the exchange rate series. As proposed by El Bejaoui (2013), we use producer price index in the equation of export prices and consumer price index in the equation of import prices as explanatory variables. Producer price index shows how the selling prices of domestic producers change on average, whereas the consumer price index represents the change in the weighted average of goods which the consumers buy. Since monthly data for GDP is not available, we use total production index as a proxy for GDP in import price equation to capture the effect of the domestic demand. These data are obtained from Federal Reserve Bank of St. Louis (FRED).

METHODOLOGY

The NARDL framework is useful to study both short-run and long-run effects by using negative and positive partial sum decompositions. Previously, the NARDL model is used in literature to study the asymmetric relationship between a large set of financial and macroeonomic variables such as: Inequality on real output (Nasr, Balcilar, Gupta, & Saint Akadiri, 2019), uncertainty on money demand (Bahmani-Oskooee & Nayeri, 2018) and exchange rate on trade balance (Bahmani-Oskooee, Usman, & Ullah, 2019; Bahmani-Oskooee, Harvey, & Hosny, 2019). In our model, exchange rate series are decomposed to appreciations and depreciations as follows:

$$\begin{aligned} EXRATE_t^+ &= \Sigma_{t=1}^{T} \max(\Delta\, EXRATE_t, 0), \\ EXRATE_t^- &= \Sigma_{t=1}^{T} \min(\Delta\, EXRATE_t, 0), \end{aligned} \tag{1}$$

where *EXRATE* denotes exchange rate. The models for export and import prices are provided respectively.

$$\begin{aligned} \Delta XP_t = {} & \sigma_1 + \rho_1 t + \varphi_1 EXRATE_{t-1}^+ + \varphi_2 EXRATE_{t-1}^- + \varphi_3 PPI_{t-1} \\ & + \Sigma_{i=0}^{j} \gamma_1 \Delta PPI_{t-i} + \Sigma_{i=0}^{z} (\Pi_i^+ \; EXRATE_{t-i}^+ + \Pi_i^- \; \Delta EXRATE_{t-i}^-) + \vartheta_t \end{aligned} \tag{2}$$

$$\begin{aligned} \Delta IP_t = {} & \partial_1 + \rho_2 t + \alpha IP_{t-1} + \beta_1 EXRATE_{t-1}^+ + \beta_2 EXRATE_{t-1}^- + \beta_3 CPI_{t-1} \\ & + \beta_4 TP_{t-1} + \Sigma_{i=0}^{j} \mu_1 \Delta CPI_{t-i} + \Sigma_{i=0}^{r} \mu_2 \Delta IP_{t-i} + \Sigma_{i=0}^{k} \mu_3 \Delta TP_{t-i} \\ & + \Sigma_{i=0}^{z} (\theta_i^+ \; EXRATE_{t-i}^+ + \theta_i^- \; \Delta EXRATE_{t-i}^-) + \varepsilon_t \end{aligned} \tag{3}$$

where *XP* and *IP* stand for export and import prices, *PPI* for producer price index, *CPI* for consumer price index, *TP* for total production index. We also include a linear trend term "t" in both equations to capture the effect of increasing productivity as it is proposed by Tekin and Yazgan (2009). Inclusion of a trend variable changes the critical values of cointegration test, but doesn't harm the appropriateness of the model (Shin, Yu, & Greenwood-Nimmo, 2014).

The asymmetric impact in the short-run can be detected by checking whether $\Pi_i^+ = \Pi_i^-$ for all $i = 0...z$ for export prices and $\theta_i^+ = \theta_i^-$ for all $i = 0...z$ for import prices. If the equality is rejected, then there is an evidence of an asymmetric impact. For the long-run case, the symmetry conditions are $\varphi_1 = \varphi_2$ and $\beta_1 = \beta_2$ for export prices and import prices, respectively. To detect cointegration, we apply NARDL bounds test approach proposed by Shin et al. (2014). The only criteria that should be met in order to apply this approach is that, the variables used should be integrated at most of order one.

We use Augmented Dickey Fuller (ADF) test to check whether all the variables meet the integration specification. The results show that all of the variables present in the model are I(1).[1] We then check whether there is cointegration by applying BDM *t*-statisic (t_{BDM}) and PSS *F*-statistic (F_{PSS}) tests. Pesaran, Shin and Smith (2001) specify two critical values for these tests: upper and lower bounds. Here, there exists a cointegration, if the test result is above the upper bound.

We use Akaike Information Criteria (AIC) to choose optimal lag length. For import price equation the selected model is NARDL(4,3,3,3,0), whereas it is NARDL(1,1,1,1) for export price equation.

FINDINGS

We start our discussion with the results of t_{BDM} and F_{PSS} cointegration tests which are presented in Table 1. Both tests confirm that there is a long-run relationship between export and import prices and the explanatory variables used. Then, we proceed with the findings of asymmetric exchange rate pass-through presented in Table 2.

Table 1
Bound cointegration test

	Error Corr. Term		F_{PSS}
	Coefficient	t_{BDM}	Coefficient
Import price	−0.174	−4.47**	4.19*
Export price	−0.228	−5.03***	7.81***

Notes: * indicate significance at 10% level, ** at 5% level, * at 1% level. For t_{BDM} test, the critical values are −3.13 and −4.04, −3.41 and −4.36, −3.96 and −4.96 for 10%, 5% and 1%, respectively. For F_{PSS} test, the critical values are 3.30 and 4.06, 3.47 and 4.57, 4.40 and 5.72, respectively.

Table 2
NARDL model estimates

Variables	Export price		Import price	
	Coefficient	S. E.	Coefficient	S. E.
Δe_t^+	−0.21***	(0.06)	0.95***	(0.06)
Δe_t^-	−0.21***	(0.05)	0.85***	(0.08)
Δe_{t-1}^+	N.S.		N.S.	
Δe_{t-1}^-	−0.14***	(0.04)	N.S.	
Δe_{t-3}^+	N.S.		N.S.	
Δe_{t-3}^-	N.S.		−0.26***	(0.08)
e_{t-1}^+	−0.21***	(0.04)	N.S.	
Δe_{t-1}^-	−0.11**	(0.04)	0.14*	(0.07)
χ^2_{HET}	46.88	[0.000]	43.32	[0.002]
χ^2_{SER}	1.66	[0.434]	7.65	[0.105]
R^2	0.595		0.818	

Notes: The superscript "+" and "-" denote positive and negative cumulative sums, respectively. N.S. indicates the insignificancy of the variable. Heteroskedasticity consistent standard errors are used. Value in [] are *p*-values. S.E. stands for standard errors. * indicate significance at 10% level, ** at 5% level, *** at 1% level.

Table 3
Wald Test results

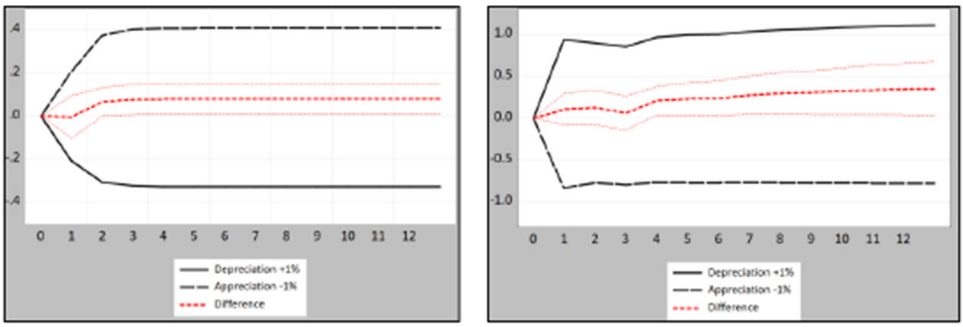
	Short-run Wald Test	Long-run Wald test
Import price	2.41 [0.02]	−0.93 [0.35]
Export price	−2.03 [0.04]	1.99 [0.04]

Note: numbers in brackets denote *p*-values.

Looking at the short-run results, it can be observed that the coefficient for a depreciation is 0.95, whereas the sum of the coefficients for an appreciation is 0.59 for import prices. We reject the symmetry condition based on Wald-test and conclude that the depreciations are more passed-through into import prices. When we consider export prices, the sum of two appreciation coefficients indicate that 35% of an appreciation pass-through to export prices. Yet, the pass-through of a depreciation is only 21%. The long-run results also show an asymmetric behaviour. The depreciations are not statistically significant for import prices, while the coefficient of an appreciation is found to be 14%. This finding is in line with market share and production switching theories. For export prices, we also reject the symmetry condition and conclude that the pass-through of an appreciation and a depreciation is not the same.

The pass-through coefficients contradict with the findings of Tekin and Yazgan (2009), who study the symmetric impact of exchange rate on trade prices for Turkey. They indicate that the pass-through is complete for export prices while it is incomplete for import prices with a coefficient of 0.45. In this study, the pass-through is found to be incomplete for export prices, whereas the estimated coefficient for import prices is lower. This finding is in line with the existing literature, since Dedeoglu and Kaya (2014) also observe a decline in ERPT, after Turkey adopts floating exchange rate regime. The decline in ERPT in post-2001 period can be explained by the findings of Coricelli, Jazbec and Masten (2006). They observe that if the floating exchange rate regime is in place, there may be a disconnection between exchange rate and prices, which is less likely if the country adopts a fixed exchange rate regime instead. In flexible exchange rate regimes, any change in exchange rate is considered as temporary and firms do not change their prices rapidly.

The asymmetric dynamic multipliers are shown in Figure 1. These multipliers show the adjustments of export and import prices to a positive and negative shock in exchange rate. According to the multiplier graphs, the effect of a depreciation shock is greater than an appreciation shock for import prices. However, the impact of an appreciation shock dominates in export prices case.



Export Price Case Import Price Case

Note: The depreciation of the exchange rate is shown by black line, whereas the appreciation is shown by dashed black line. The dashed red line shows the overall asymmetric impact with dotted red lines being 5% confidence interval.

Figure 1. Asymmetric dynamic multipliers

CONCLUSION

In this study, we provide evidence for the asymmetric impact of exchange rate on export and import prices for the case of Turkey using NARDL model. The obtained results indicate that there exists an asymmetric effect of exchange rate on export and import prices both in the long- and the short-run. Moreover, we observe that the degree of pass-through declines after Turkey switches to floating exchange rate regime. Taylor (2000) argues that the decline in ERPT is seen when a country experiences a relatively low inflation, which we also observe in Turkey after it adopts floating exchange rate regime. Indeed, from 1988 to 2004, the average inflation in Turkey is 59.5%, whereas it declines to an average of 9.0% for the period 2004–2018,which this study covers. These findings have certain policy implications. An incomplete pass-through for export prices indicate that Turkish manufacturing sector does not have enough competitive power to reflect exchange rate changes into export prices. As discussed by Monacelli (2005) and Aydoğan, Tunç and Yelkenci (2017), incomplete ERPT to import prices causes a trade-off between stabilisation of inflation and stabilisation of output gap. Since Turkey imports its raw material heavily by spending US Dollar, we use TL/USD nominal exchange rate. On the other side, it is well known that European Union has the biggest share in Turkey's exports. Taking this information into account, it would also be fruitful to study the asymmetry in ERPT by using TL/EUR exchange rate. Moreover, as the observed direction of asymmetry differs between short-run and long-run, it is productive to study the source of difference for further research.

NOTE

1. The results are not shown for brevity, available upon request.

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