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ASYMMETRIC IMPACT OF EXCHANGE RATE TO ISTANBUL STOCK MARKET: A NONLINEAR ARDL APPROACH

ABSTRACT

The stock market plays an important role for financial organizations and portfolio managers in modern economics. Volatility in stock market return is one of the essential tools between lenders and borrowers that help them to assess the risk of portfolios and predicting the return of future investment's income. This paper investigates the relationship between the stock market and the exchange rates of Turkey. BIST100 index is employed as a proxy for stock returns and TL/US\$ and TL/EURO (currency rate of Turkish Lira against US Dollar and EURO) are considered for exchange rate exposure. The series is on monthly data over the period 2008m10- 2021m03. We use the NARDL and ARDL mythology of the time series model to determine the short-run and long-run impacts of the exchange rates on the İstanbul Stock Market. Our findings indicate that there is a relationship between both exchange rates (US Dollar and EURO) and stock returns. This relationship is positive, asymmetric, and statistically significant for both the long and short run.

Keywords: NARDL, ARDL, US Dollar, EURO.

1. INTRODUCTION

Predictability of volatility of stock returns helps portfolio managers to minimized risks of investment. One of the important factors which help financial organizations and portfolio managers to the predictability of the stock market is changes in the exchange rate. Although there is not especial consensus on the relationship of fluctuation in the exchange rate and stock market there is wide research about the effect of exchange rate and interest rate on stock markets. Those researches are mainly based on "good market approaches", "portfolio balance approaches" and "Asset Market approach". The first one was developed by (Dornbusch & Fischer, 1980) that emphasize on moving in exchange rates effect on the international competitiveness of firm by the effect on income and cost of borrow in foreign currencies. According to "portfolio balance approaches" which were developed by Frankel, J. A. (1993) focused on the role and effect of capital account transactions on determining the relationship between the exchange rate and stock market returns. The asset market approach is a method that emphasizes the value of an asset based on the selling price of similar assets.

2. LİTERATURE SURVEY

Theoretically, there are three models to explain the relationship between exchange rate and stock returns which are basically different and conflicting models (Moeljadi & Fauziah, 2015).

I. "Flow-Oriented" that presented by Dornbusch and Fischer (1980): According to (Dornbusch & Fischer, 1980) -also is called the monetary approach model-, the exchange rate affects companies

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through *international operation* (by effecting on net export, consolidated report. Asset assessment/liability assessment...) and *domestic operation* (by the effect on the price of input and output...) that both of them have an effect on cash flow, profitability, and decision making within the company which ultimately effects to stock supply and demand and stock price (Ball & Brown, 1968), (Evelyn, 2010). Therefore, there is a positive relationship between the stock market and the exchange market. This relationship and causality run from exchange rate to stock market.

II. The theory of "Stock-Oriented" presented by (Frankel, 1983 and 1984): Frankel believes that changes in stock prices cause to change in the exchange rate. Stock price changes affect an investor's reaction in the stock market (capital flow) that which will cause changes in supply and demand of local currency and exchanger rate. In other words, if the domestic stock price decrease (rises), will persuade investors to (sell) buy more domestic assets by (buying) selling foreign assets in order to obtain local currency. Increased demand for domestic currency will lead to an appreciation of the domestic currency (Moeljadi & Fauziah, 2015). The exchange rate of the local currency will appreciate foreign currency and there is a negative relationship which it runs from stock market to exchanger rate.

III. Asset Market approach: according to this model due to different variable which has an effecton both exchange rate and the stock market, there is no interaction or very weak association between the exchange rate and stock market (Suriani, Jamil and Muneer, 2015).

When we look at the literature, there are studies in three fields. For example (Abdalla & Murinde, 1997) found a long-run relationship between the two variables in four Asian countries for the period 1985-1994 but there is no causality exists in Pakistan and Korea. While they found causality in India and the Philippines.

The study of (Bahmani-Oskooee & Sohrabian, 1992) is one of the first studies which employs causality methodology to examine the relationship between stock prices and exchange rates in the US. The study provided evidence that there is causality between the S&P 500 index and the effective exchange rate of the Dollar, at least in the short run. While (Ajayi, Friedman, and Mehdiian, 1998) employ daily stock indexes and exchange rates for a set of emerging economies to investigate causal relations between stock returns and exchange rates. The findings provide Granger causality between the stock and exchange rates in all the advanced economies such as Canada, Germany, France, Italy, Japan, US, UK. While no consistent causal relations are observed in the emerging economies such as Taiwan, Korea, Philippines, Malaysia, Singapore, Hong Kong, Indonesia, Thailand.

(Pan, Fok and Liu, 2007) found a high correlation between exchange rates and stock markets in seven Asian countries. The same results were get by (Kiymaz, 2003). Kiymaz, (2003) considered the efficiency of Turkish firms against the exchange rate. According to this study Turkish firms especially textile, machinery, chemical, and financial industries are highly exposed to foreign exchange risks. (Ojaghlou, 2020) focused on fundamental economic factors to the İstanbul stock market. According to this study, variables are cointegrated and there is a positive and statistically significant asymmetric long-run relationship from the nominal exchange rate and other factors to Istanbul stock market return. (Ojaghlou, 2020) suggests that the Istanbul stock market return (BIST-100) has consistent with the Efficient Market Hypothesis (EMH).

3. DATA and METHODOLOGY

The data on stock prices are collected from Investing.com (BİST100 index) data on the exchange rate of Turkish Lira against US Dollar and EURO are obtained from the Central Bank of Turkey on monthly basis over the period 2008m10- 2021m03;

US = Return of exchange rate TL/US Dollar

EURO = Return of exchange rate TL/EURO

BIST100 = Return of the stock price of the BIST100 index

Following (Bahmani-Oskooee & Sohrabian, 1992), (Ajayi, Friedman, and Mehdiian, 1998), (Suriani, Jamil and Muneer, 2015) and (Moeljadi & Fauziah, 2015) we set two models as follows:

We carried out hypostasis by both USD (eq1) and Euro (eq2)

$$BIST100 = f(USD) \quad (\text{eq1})$$

$$BIST100 = f(USD^+, USD^-) \quad (\text{eq2})$$

$$BIST100 = f(EURO) \quad (\text{eq3})$$

$$BIST100 = f(EURO^+, EURO^-) \quad (\text{eq4})$$

One of the is ARDL Bound Model developed by (Pesaran, Shin and Smith, 2001) which in our case for the effect of USD to BIST100 (eq1) can be written as follows:

$$\Delta BIST100 = \alpha_0 + \sum_{q=1}^{p1} \alpha_{1q} \Delta BIST100_{,t-q} + \sum_{q=0}^{p2} \alpha_{2q} \Delta USD_{,t-q} + \beta_0 BIST100_{t-1} + \beta_1 USD_{,t-1} + \varepsilon_t$$

For the effect of EURO to BIST100 (eq3):

$$\Delta BIST100 = \alpha_0 + \sum_{q=1}^{p1} \alpha_{1q} \Delta BIST100_{,t-q} + \sum_{q=0}^{p2} \alpha_{2q} \Delta EURO_{,t-q} + \beta_0 BIST100_{t-1} + \beta_1 EURO_{,t-1} + \varepsilon_t$$

Δ Where are the difference operator and q the number of lags of each variable? The null hypothesis is: $H_0 : \beta_0 = \beta_1 = 0$ and the alternative hypothesis is $H_1 : \beta_0 \neq 0, \beta_1 \neq 0$

The second and third is NARDL and multiplier Model developed by (Shin, Yu and Greenwood-Nimmo, M, 2013) which in our case can be written as follows:

Considering the asymmetric long-run relationship for the Nonlinear ARDL model: $y_t = \beta^+ x_t^+ + \beta^- x_t^- + u_t$ where x_t : $k \times 1$ vector of regressors decomposed as $x_t = x_0 + x_t^+ + x_t^-$ Where x_t^+ ve x_t^- are partial sum processes of positive and negative changes in x_t defined by

$$x_t^+ = \sum_{j=1}^t \Delta x_j^+ = \sum_{j=1}^t \max(\Delta x_j, 0), x_t^- = \sum_{j=1}^t \Delta x_j^- = \sum_{j=1}^t \min(\Delta x_j, 0)$$

and β^{pos} , β^{neg} are the associated asymmetric long-run parameters. The model can be written in an error-correction form as follows:

$$\Delta y_t = \rho y_{t-1} + \theta^+ x_{t-1}^+ + \theta^- x_{t-1}^- + \sum_{j=1}^{p-1} \gamma_j \Delta y_{t-j} + \sum_{j=0}^q (\pi_j^+ \Delta x_{t-j}^+ + \pi_j^- \Delta x_{t-j}^-) + \varepsilon_t$$

The null hypothesis: $\rho = \theta^{\text{pos}} = \theta^{\text{neg}} = 0$

The steady-state of the model is:

$$m_h^+ = \sum_{j=0}^h \frac{\partial y_{t+j}}{\partial x_t^+}$$

$$m_h^- = \sum_{j=0}^h \frac{\partial y_{t+j}}{\partial x_t^-} \quad h=0, 1, 2, \dots$$

Where m_h^+ and m_h^- tend toward the respective asymmetric long-run coefficients $\beta^+ = \theta^+ / -\rho$ and $\beta^- = \theta^- / -\rho$, respectively, as $h \rightarrow \infty$. In our case NARDL for the effect of USD to BIST100 (eq2) is:

$$\Delta BIST100 = \alpha_0 + \sum_{q=1}^{p1} \alpha_{1q} \Delta BIST100_{,t-q} + \sum_{q=0}^{p2} \alpha_{2q} \Delta USD^{\text{pos}}_{,t-q} + \sum_{q=0}^{p3} \alpha_{2q} \Delta USD^{\text{neg}}_{,t-q} + \beta_0 BIST100_{t-1} + \beta_1 USD^{\text{pos}}_{,t-1} + \beta_2 USD^{\text{neg}}_{,t-1} + \varepsilon_t$$

For the effect of EURO to BIST100 (eq4) is:

$$\Delta BIST100 = \alpha_0 + \sum_{q=1}^{p1} \alpha_{1q} \Delta BIST100_{t-q} + \sum_{q=0}^{p2} \alpha_{2q} \Delta EURO^{pos}_{t-q} + \sum_{q=0}^{p3} \alpha_{2q} \Delta EURO^{neg}_{t-q} + \beta_0 BIST100_{t-1} + \beta_1 EURO^{pos}_{t-1} + \beta_2 EURO^{neg}_{t-1} + \varepsilon_t$$

Δ Where are the difference operator and q the number of lags of each variable? The null hypothesis is: $H_0 : \beta_0 = \beta_1 = \beta_2 = 0$ and the alternative hypothesis is: $H_1 : \beta_0 \neq 0, \beta_1 \neq 0, \beta_2 \neq 0$

3.1. Unit Root Test

To determine the order of integration of the series Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests have been applied. The results are presented in Table 1.

Table 1: Unit Root Test¹

Variables	ADF ²		PP ³	
	Intercept	Intercept and trend	Intercept	Intercept and trend
BIST100	-1.46(0)	-3.43(0)**	-1.26(19)	-3.62(9)**
Δ BIST100	-11.78(0)***	-11.74(0)***	-13.12(28)***	-13.04(28)***
$\frac{USD}{TL}$	2.42(2)	-0.68(2)	5.37(21)	0.49(20)
$\Delta \frac{USD}{TL}$	-9.62(1)***	-10.31(1)***	-6.34(21)***	-6.95(38)***
$\frac{EURO}{TL}$	2.98(2)	0.09(2)	3.55(11)	0.41(10)
$\Delta \frac{EURO}{TL}$	-9.18(1)***	-10.06(1)***	-6.91(8)***	-7.04(15)***

Note: The signs *, ** and *** represent 10%, 5%, and less than 1% significance level, respectively and parenthesis show the optimum number of lags.

Table 1 indicates that in the case of BIST100 null hypothesis is rejected at the level and the data is stationary in level with trend and intercept but it is non-stationary level with intercept. In first difference all indicator of BIST100 is stationary. USD to TL and EURO to TL are stationary at the first difference (I(1)). Therefore, none of the series are stationary in second differences (I(2)).

Table 2: Long Run Coefficient of USD and EURO to BIST100

Variables	ARDL(1,2) Eq1	NLARDL (1,1,0) Eq2	ARDL(1,2) Eq3	NLARDL (1,4,4) Eq4
	Long Run Coefficients	Long Run Coefficients	Long Run Coefficients	Long Run Coefficients
C	489.92*** (6.55)	87.14*** (4.12)	464.51*** (5.71)	742.83*** (6.80)
EURO	-	-	107.38*** (5.46)	-
$\frac{USD}{TL}$	124.63*** (5.84)	-	-	-
$\frac{USD}{TL}^+$	-	317.49** (2.06)	-	-
$\frac{EURO}{TL}^+$	-	-	-	167.75** (1.92)
$\frac{USD}{TL}^-$	-	594.68* (1.62)	-	-
$\frac{EURO}{TL}^-$	-	-	-	205.87 (1.01)
EC ₋₁	-0.114*** (-3.45)	-0.105*** (-3.002)	-0.1146*** (-3.45)	-0.1247*** (-3.44)
F-Bounds	5.53** (upper bound of 95%=4.16)	7.40*** (upper bound of 99%=5)	4.96** (Lower bound of 99%=4.94)	5.009*** (upper bound of 99%=5)
χ^2_{Serial}	0.059	0.16	0.06	0.008

¹ All series are seasonally adjusted by moving average method

² Based on Schwartz Info Criterion

³ Based on Bartlett Kernel

⁴ EC = BIST100 - (124.6364*USD + 489.9297)

⁵ EC = BIST100 - (317.4979* $\frac{USD}{TL}^+$ + 594.6876* $\frac{USD}{TL}^-$ + 825.6449)

⁶ EC = BIST100 - (107.3864*EURO + 464.5177)

⁷ EC = BIST100 - (167.7257* $\frac{EURO}{TL}^+$ + 205.8704* $\frac{EURO}{TL}^-$ + 742.8362)

$\chi^2_{RESET_ARCH}$	2.04	1.17	2.54	2.1
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Note: The signs *, ** and *** represent 10%, 5%, and less than 1% significance level, respectively

According to Table 2, in eq1, the coefficient of the USD on GDP is positive and statistically significant. F-Bound (5.53) is greater than the upper bound of 95% critical value (4.16) and the Coefficient error term is (-0.10) which is negative and in accepted range (between -1 and 0) and it is statistically significant that all indicate that there is a long-run relationship between variables. In eq2; the Coefficient error term (ECT) is (-0.11) which is negative and in the accepted range (between -1 and 0) and it is statistically significant. F-Bound (7.40) is greater than the upper bound of 99% critical value (5) and all coefficients are statistically significant and positive.

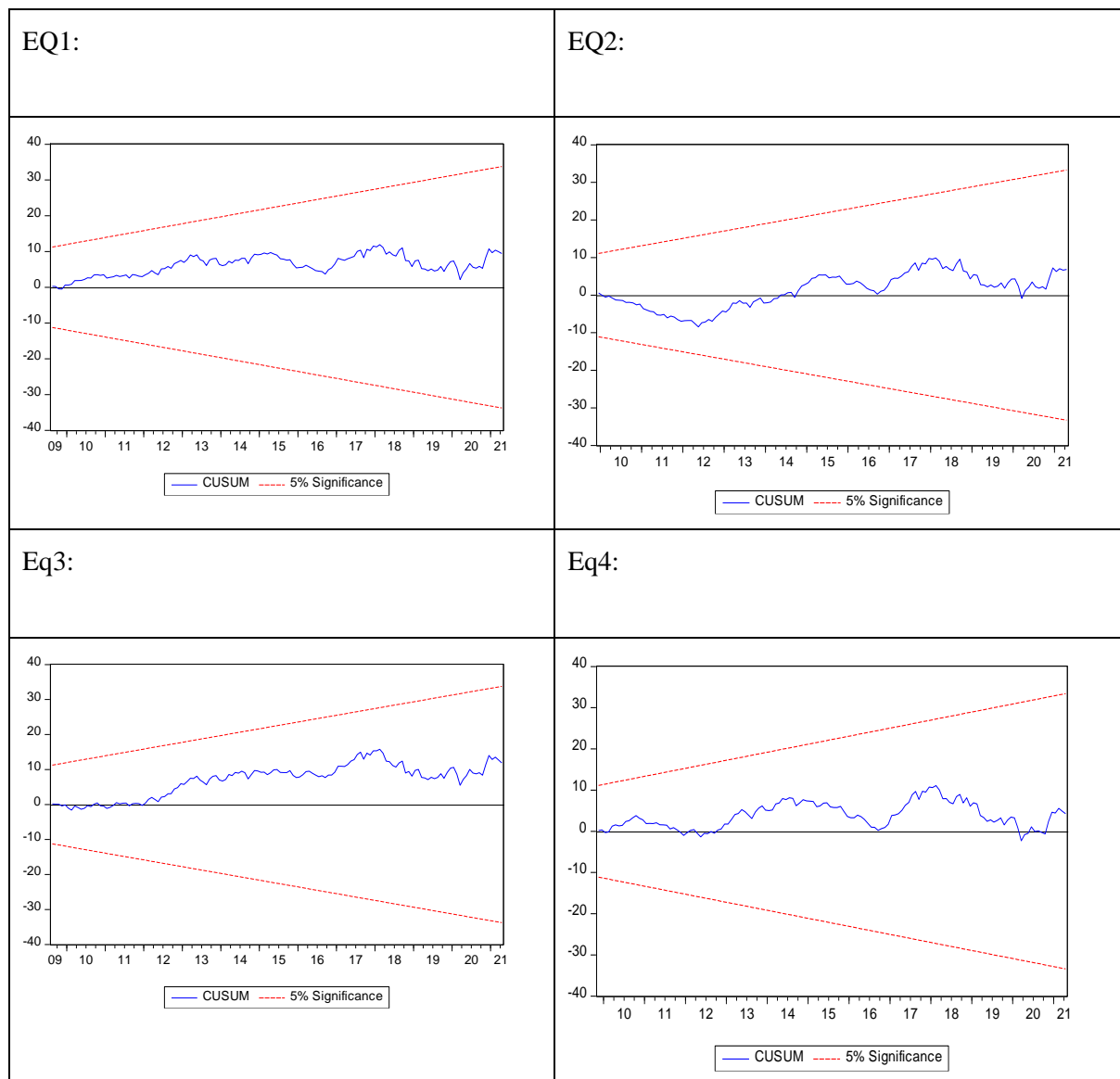
In the case of the effect of EURO to BIST100, in eq3, F-Bound (4.96) is greater than the upper bound of 99% critical value (4.94) and ECT is -0.11 negative and between -1 and 0. The coefficient of EURO is positive and statistically significant. Also in eq4 (NARDL model) coefficient error term (ECT) is (-0.124) which is negative and between -1 and 0) and it is statistically significant. The coefficient of Euro⁺ is positive and statistically significant. Also, the coefficient of Euro⁻ is positive but it is not statistically significant.

To sum up, all coefficients of EURO and USD are positive and statistically significant (except Euro⁻). Therefore, there is a positive long-run relationship from exchange rates to BIST100.

Table 3: Short Run Coefficient of USD and EURO to BIST100

Variables	ARDL(1,2) <i>Eq1</i>	NLARDL (1,1,0) <i>Eq2</i>	ARDL(1,2) <i>Eq3</i>	NLARDL (1,4,4) <i>Eq4</i>
	short Run wald test	short Run wald test	short Run wald test	short Run wald test
C	489.92*** (6.55)	87.14*** (4.12)	464.51*** (5.71)	742.83*** (6.80)
EURO	-	-	F-Ist.=6.29 $\chi^2 = 18.88$ There is a short run effect (99%)	-
USD	F-Ist.=8.46 $\chi^2 = 25.39$ There is a short run effect (99%)	-	-	-
USD ⁺	-	F-Ist.=7.69 $\chi^2 = 15.39$ There is a short run effect (99%)	-	-
EURO ⁺	-	-	-	F-Ist.=7.15 $\chi^2 = 22.54$ There is a short run effect (99%)
USD ⁻	-	F-Ist.=4.46 t-ist.=2.11 $\chi^2 = 4.46$ There is a short run effect (95%)	-	-
EURO ⁻	-	-	-	F-Ist.=2.86 $\chi^2 = 5.72$ There is a short run effect (90%)

According to (Pesaran et al., 2001) the stability of ECT of the estimated models should also be empirically stable. Graphical representations of CUSUM are shown in figure1 and 2 for both models. According to figure1 the null hypothesis of specified ARDL and NARDL models cannot be rejected if the plot of these statistics remains within the critical bounds of the 5% significance level. The plots of all the CUSUM tests are within the red lines. Therefore, the stability of the estimated model and estimated coefficients are confirmed.

Figure1: Stability of Estimated Models

4. CONCLUSION

The main objective of this study is to analyse whether the exchange rate has a long and short-run effect on the Istanbul stock market returns or not. The series is on monthly data over the period 2008m10-2021m03. We use the NARDL and ARDL methodology of the time series model to determine the short-run and long-run impacts of the exchange rates on the stock market.

The findings of the NARDL and ARDL Bound tests indicate that there is a relationship between both exchange rates (US Dollar and EURO) and stock returns. This relationship is positive positively asymmetric (NARDL), also linear (ARDL), and statistically significant for both the long and short run.

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