5. THE ASYMMETRIC IMPACT OF MACROECONOMIC SHOCKS ON STOCK RETURNS IN TURKEY: A NONLINEAR ARDL APPROACH

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Abstract

Several studies in the finance literature have investigated the impact of macroeconomic variables on stock returns by assuming symmetric adjustments between variables. Our study abandons this assumption by analyzing the potential asymmetric behavior of stock market to macroeconomic variables. Rare studies on Turkey's financial market account for asymmetry in the relationship between series. Most of the previous studies neglect asymmetry and use traditional linear time series approaches, which may lead the relevant output estimation to be biased. We fill in this empirical gap by exploring the effects of shocks in exchange rate, money supply and interest rate on stock returns through a multivariate nonlinear ARDL model. Using monthly data from January 2003 to May 2017, our empirical results provide evidence in favor of asymmetric cointegration relationships between stock returns-real effective exchange rate nexus, stock returns-interest rate nexus and stock returns-money supply nexus in Turkey. It is empirically shown that stock prices react asymmetrically to the real effective exchange rate changes in the short-run and long-run, while the effects of the changes in interest rate on stock returns are asymmetrical only in the short-run. We find that money supply changes are symmetrically related to stock returns in Turkey. These findings imply that policy makers should take into account asymmetry between selected macroeconomic variables and stock returns when developing policy to prevent financial risks.

Keywords: stock returns; exchange rates; nonlinear ARDL, financial market, money supply, interest rate
JEL Classification: F31, G15, C32, E4

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Introduction

Over the past three decades, the implementation of financial liberalization policies and the adoption of floating exchange rates by many emerging countries have sparked active discussions among scholars about how stock returns and macro-financial indicators interact. The adoption of a free-floating exchange rate coupled with financial liberalization has increased capital inflows, financial globalization, and cross-border investments (Dahir *et al.*, 2018). Accordingly, emerging markets' macroeconomic and financial variables are increasingly affected by global economic factors, causing greater fluctuations in their macro-financial variables.

It is well established that fluctuations in macro-financial variables are likely to affect stock market either in a positive or negative direction (Ulku, Demirci, 2012; Bahmani-Oskooee and Saha, 2016). Many events such as financial turmoil and international capital flow have shown how key macro-financial variables can affect stock markets. Most developed financial markets have been negatively affected during the recent financial crisis (Caporale *et al.*, 2014). The contagion effect between stock and foreign exchange markets has become more critical with the occurrence of the recent sub-prime crisis of 2008. During each crisis period, it has been noticed that high volatility in the financial system has adversely affected firms and households by modifying their current and future fund allocation decisions. Thus, investigating the interaction between stock returns, exchange rates, interest ratse and money supply is important for investors as most equity investors hold unhedged exchange rate exposure (Levich *et al.*, 1999). For instance, if foreign exchange markets and stock markets are related, then investors may minimize their portfolio risks by using information of one market to forecast the behavior of the other market.

Theoretically, two approaches have been advanced to explain the dynamic linkages amongst stock and foreign exchange markets. First, the flow-oriented approach proposed by Dornbush and Fisher (1980) posed that exchange rate changes have immediate effects on stock prices of domestic export-oriented firms. For instance, domestic currency appreciation (depreciation) will cause negative (positive) effect for the country export competitiveness and decrease (increase) the stock prices of export-oriented firms. For the traditional mainstream, international trade flow appears to be the main route through which exchange rate impulse response can be transmitted to the stock prices. Under this approach, we expect a positive relationship between stock prices and exchange rates depreciation. However, for an import-oriented country like Turkey, where intermediate input for domestic manufacturing firms' production are largely imported, we expect an opposite effect on stock prices given the higher cost of production caused by the depreciation of the Turkish Lira[3]. Accordingly, the adverse effect from the higher cost of production will depress domestic production and then lower stock prices. Moreover, the adoption of floating exchange rate-based policies to mitigate the effect of the twenties crises coupled with the highest volatility of the Turkish Lira, could evidence the possibility of flow-oriented hypothesis in Turkish stock and foreign exchange markets.

The second approach developed by Frankel (1983) documents the influence of stock prices on exchange rate determination; this approach is called the portfolio balance theory. This theory emphasizes the pivotal role of wealth in the determination of the exchange rate. For example, higher stock prices tend to enhance wealth (income), and this enhancement can

[3] *The empirical support of the contractionary effect of exchange rate on stock prices is provided in Cooper (1971). It is also shown that the effect of the currency depreciation depends on the slope of the supply and demand curves (Gylfason and Schmid, 1983).*

have a positive effect on domestic money demand and interest rates. By increasing interest rates, home country becomes more attractive for foreign investors, this phenomenon would lead to an increase in the demand of domestic currency and so, domestic currency will appreciate. Based on this approach, there will be a negative relationship between stock and foreign exchange markets. In this paper, we focus on revisiting the flow-oriented hypothesis for the case of Turkey as the dynamic of stock market performance has been shown to be strongly dependent on external and domestic factors directly affecting macroeconomic and financial indicators (Toraganli and Yalcin, 2016). As a result, a comprehensive study should consider the effect of other key macroeconomic variables (including interest rates and money supply) on stock market performance (Assefa *et al*., 2017). Bernanke and Reinhart (2004) report that current interest rates and the expectations of future interest rates are positively related to asset prices as central banks credibly commit to maintain low interest rates. In addition, stock market participants are very sensitive to money supply changes. Theoretically, several hypotheses have been advanced to capture the effects of money supply on returns. First, the liquidity hypothesis contends that an increase in money supply leads to higher demand for equity. As a result, investors switch to equity market because of its expected higher returns over bonds. Second, according to the Keynesian hypothesis the relation between money and asset prices is through the expected real rate. This hypothesis claims that stock prices will decline in response to an unexpected change in the money supply. Finally, the expected inflation hypothesis suggests that excess money increases the expected inflation, however, inflationary expectations in the economy positively influences nominal rate and the required rate of returns (Fama, 1970). Likewise, the existing literature on the effects of interest rates and money supply on stock returns is mixed and inconclusive (Cheng, 1996; Canova *et al*., 2000). Our study expands previous studies by analyzing the responses of stock prices to changes in real effective exchange rates, interest rates and money supply.

Accordingly, the purpose of this study is to investigate the asymmetric effects of changes in the real effective exchange rate, interest rate and money supply on stock returns in Turkey. We therefore analyse this relationship in the Turkish context for two reasons. First, as many emerging markets, the Turkish financial market has grown rapidly over the past few years due to several reforms including financial liberalization, abolition of the currency peg, structural change, trade liberalization and institutional improvements. These internal reforms combined with favorable global financial conditions have improved the sentiment of foreign investors toward the Turkish financial market. The higher share of foreign denominated resources (especially U.S dollar) made the Turkish foreign exchange market more volatile and sensitive to external conditions (Toraganli and Yalcin, 2016). This situation of higher real exchange rate volatility made investment riskier and raised concerns about the immediate effect of macroeconomic and financial indicators on stock market returns. Second, the focus on the Turkish financial market would provide potential readers sound information about the disaggregated effect of positive and negative changes in exchange rates, money supply and interest rates on stock market in the case of an emerging market like Turkey. By focusing on the Turkish market, this paper will add new evidence for the nonlinear relationship between stock prices and macroeconomic variables in countries subject to higher volatility and uncertainty in the evolution of their macroeconomic variables.

One of the major limitations of the existing studies are that they have been restricted to linear time series models. Many scholars believe that the magnitude of the effect of the exchange rate, interest rate and money supply on stock returns are the same regardless of the direction of changes (positive or negative shocks), which are hard to validate practically in an

emerging country subject to foreign capital inflows, financial globalization and cross-borders investors. In this study, we take a further step and argue that the relationship between exchange rate-stock returns, money supply-stock returns and interest rates-stock returns may be mis-specified since the traditional test assumes a linear relationship between these series (Bahmani-Oksooee and Suha, 2016). Our paper provides insightful evidence on the key drivers of stock market performance in an emerging country, Turkey. The knowledge of the linkage between macroeconomic variables and stock market has several practical implications for finance because it involves several dimensions of financial markets, asset allocation, and risk management. This is our first contribution to the existing literature.

Our second contribution is that we make use of the recently nonlinear ARDL model to study the nonlinear relation between stock returns-exchange rates; stock returns-interest rates and stock returns-money supply. Unlike earlier studies, which assume that variables display symmetry patterns, our study employs consistent nonlinear time series methodologies and assumes asymmetric adjustment paths between stock prices and macroeconomic variables[4]. To this aim, we employ the recently advanced nonlinear ARDL approach by Shin *et al.* (2014). Several empirical studies have shown the robustness of the nonlinear ARDL approach to model nonlinear and asymmetric relationships between macro-financial time series (Ajaz *et al*., 2017). Finally, this paper contributes to the literature on the asymmetric responses of stock returns for the case of an emerging market, Turkey. However, the findings of this study can be used to predict the behavior of stock returns in other emerging markets.

Based on monthly data from January 2003 to May 2017, we establish that stock prices react asymmetrically to Turkish Lira fluctuations in both the short-run and long run, while the effects of the changes in interest rate on stock returns are asymmetrical only in the short-run. Contrary to previous studies, we claim that asymmetry is very important when modelling stock returns determinants in an emerging market like Turkey. Effectively, investors and policy makers should understand the asymmetric behavior of the financial market in order to accurately forecast stock prices and mitigate the potential adverse effects of the exchange rate and interest rate fluctuations. Going by the role of asymmetry, the Central Bank of the Republic of Turkey (CBRT hereafter) should follow an asymmetric intervention pattern (with respect to positive or negative shocks in series) to reduce pressure on stock market. The rest of the study is organized as follows. Section 2 lays out a review of related literature. Section 3 describes the research methodology. Section 4 reports the empirical findings, Section 5 displays some discussions and finally Section 6 concludes the paper.

2. Literature Review

A broad stream of study has investigated the effect of exchange rate on stock prices for different economies. However, conclusions from this literature are mixed (Tsen, 2017). Bahmani-Oskooee and Sohrabian (1992) report a bidirectional causality between stock prices and exchange rates in the US between 1973 and 1988. In contrast, Abdalla and Murinde (1997) find a unidirectional causality from exchange rates to stock prices in India, Korea, and the Philippines. It is the reverse in the Philippines, whereas Ajayi *et al*. (1998) found no consistent causal relationship between stock prices and exchange rate in emerging markets. Some studies have investigated spillover effects between foreign and stock

[4] *The asymmetric adjustment paths indicate that stock prices react differently to a positive or negative shock to exchange rates and vice versa.*

markets. Kanas (2000) documents volatility spillover effects from stock returns to exchange rate changes in the UK, Japan, France, Canada and the US, while no spillover from exchange rate changes to stock returns was found for any country. Phylaktis and Ravazzolo (2005) found a close connection between stock and foreign exchange markets and indicate that a positive association between stock and foreign exchange markets depends particularly on the degree of exchange rate flexibility. Their study concentrates on a group of Basin Pacific countries and investigate whether the long-run and short-run relationship between stock and exchange rates were affected by the Asian financial crisis and the restrictions in capital mobility. In their paper, they employed the cointegration methodology and multivariate Granger causality tests over the period 1980-1998. Kasman *et al*. (2011) reached a similar conclusion that interest rate and exchange rate volatility are the major determinants of stock returns volatility in Turkey. Using the exponential GARCH model, Erdem *et al*. (2005) investigated the effects of several macroeconomic variables on stock prices over the period 1991 to 2004 in Turkey. Their results provide evidence of significant unidirectional spillover from selected macroeconomic variables to stock prices. In particular, they found positive spillover from exchange rate to all industrial indexes. Alcikalin *et al*. (2008) studied the relationship between returns in the Istanbul Stock Exchange and macroeconomic variables of the Turkish economy using cointegration tests and VECM methods. Their results report a cointegration relationships between the Istanbul Stock Exchange, GDP, exchange rate, interest rate and current account balance. They found causality from macroeconomic indicators to stock returns, which is consistent with the view that stock market rationally incorporates economic activity changes into pricing. Kandir (2008) used a multiple regression model to explore the relationship between Turkish stock returns and macroeconomic variables, including the exchange rate, interest rate, industrial production, crude oil price, world equity index, consumer price index and world equity index. He found that exchange rate, interest rate and world market return seem to affect all portfolio returns, while inflation rate is significant for only three. However, industrial production, money supply and oil prices do not appear to have any significant effect on stock returns. Using a similar approach, Buyuksalvarci and Abdioglu (2010) examined the effects of macroeconomic variables on stock returns in Turkey. They found that industrial production, interest rate money supply, oil price, and foreign exchange rate negatively affected the Istanbul stock Exchange 100-Index returns. Özlen and Ergun (2012) employed the Autoregressive Distributed Lag (ARDL) to identify the effects of macroeconomic indicators on stock returns of 45 companies from 11 different sectors. Their results indicated that exchange rate and interest rate are the most significant factors in the stock price fluctuations of the companies. Applying the Toda-Yamamoto procedure to investigate the causal relationship between stock prices and exchange rates, Aydemir and Demirhan, (2009) reported that negative causality exists from the exchange rate to several stock market indices. Their results revealed that the portfolio balance approach is supported in Turkey. Using the autoregressive distributed lag approach to cointegration, Savasa and Samiloglub's (2010) results show that money supply and the industrial production index are positively related to changes in stock prices. Also, they reported that changes in US monetary policy have spillover effects on the Turkish stock market. Tuncer and Turaboglu (2014) found that stock prices and real effective exchange rate affect GDP in the short run and there is causality from real effective exchange rates to stock prices. They employed the Johansen Test for cointegration to explore the short run and long run relationships between stock prices GDP, treasury bills and exchange rates. In recent research, Tursoy (2017) studied the relationship between stock prices and the exchange values of Turkish Lira. He used the autoregressive distribute lag model (ARDL), Error correction model (ECM) and Granger

causality tests. He claimed that (i) exchange rates and stock price are cointegrated; (ii) the method of Granger causality yields bidirectional causality in the long-run and unidirectional causality from exchange rates to stock prices in the long-run. The findings of Tursoy (2017) are subject to some criticisms because he assumed that economic agents react symmetrically to Turkish Lira appreciation and depreciation and failed to consider the heterogeneity of financial market investors, which may lead to potential nonlinearity between stock prices and exchange rates. In such an environment, stock prices may respond asymmetrically to exchange rates movements.[5] Additionally, Tursoy's (2017) bivariate model could be biased due to the omitted variable issues. From the literature review based on the financial market of Turkey, we can see econometric analysis of these studies are usually based on classical linear time series frameworks including standard OLS, ARDL, Vector Error Correction and Granger causality tests, which may yield spurious results if there is a nonlinear relationship between variables (Muller and Verschoor, 2006). Muller and Verschoor (2006) investigated the hypothesis that stock returns react differentially to large versus small currency shocks. They found an asymmetric behavior of US stock markets to currency movements for 935 U.S. multinational firms. Recently, Bahmani-Oksooee and Saha (2016) tested this hypothesis of asymmetric behaviors of stock markets using a nonlinear ARDL model. Their results showed that stock prices react asymmetrically to exchange rate changes, though the effects are mostly short-run. The present study explores the dynamic relationship among variables using the nonlinear ARDL approach technique. Moreover, published literature does not contain such analysis using data on Turkey's financial market. Hence, our study addresses this empirical gap and makes a significant contribution in terms of methodological framework as well as for investigating the dynamic relationships between stock returns, real effective exchange rate, money supply and interest rates using data from the Turkish economy. Likewise, empirical studies related to the effects of money supply and interest rates on stock returns seem to be inconclusive. For instance, Tursoy *et al.* (2008) investigated the effects of 13 macroeconomic variables on stock prices. They concluded that macroeconomic factors do not have a significant effect on stock returns in Turkey. Kandir's (2008) results showed a negative effect of interest rates on stock returns while money supply, industrial production and oil prices have no significant impact on stock returns. He employed a multiple regression analysis and macroeconomic factor model to study the dynamic relationship among variables. His data showed that interest rate and exchange rate changes have a negative and significant impact on bank stock return. Some authors report co-movement between exchange rate and stock prices. For instance, Tsen (2017) employed the multivariate generalized autoregressive conditional heteroskedasticity (MGARCH) model for emerging and developed markets including Malaysia, the Philippines, Singapore, Korea, Japan, the UK and Germany. He showed that exchange rate movements are important in influencing the stock markets in these countries. Ulku and Demirci (2012) found a significant comovement of exchange rate with stock markets in Poland, the Czech Republic, Turkey, Russia, Ukraine, Hungary, Romania and Croatia. Recently, Mitra (2017) applied the cointegration technique to examine dynamic links between the real effective exchange rate and the total value of stock transactions in South Africa using yearly data over the period 1979-2014. His findings revealed a positive association between foreign

[5] *During episodes of currency depreciation, the cost of imported intermediate input increases. Thus, to maintain their market share, some companies will not increase the price of their goods, and instead will reduce their markup in order to absorb the increased cost. In such environment, stock prices may remain invariant or reduce in response to the exchange rate depreciation, indicating the asymmetry impact of exchange rate changes on stock prices.*

exchange and stock markets with a positively significant impact of currency appreciation on stock transactions in South Africa. All of the above-mentioned studies assumed that the stock returns-macroeconomic variables relationship is linear and most of the previous studies yield mixed and inconclusive findings. In addition, they fail to provide instructive information about the effects of positive or negative shocks in real effective exchange rate, interest rates and money supply on stock returns. Following this argument our first hypothesis runs as follows.

Hypothesis 1

For an export-oriented country like Turkey, a real depreciation of Turkish Lira has a positive effect on stock returns, as this stimulates the exports of goods and hence causes the stock returns to increase, while a real appreciation of Turkish Lira has a reversal effect on stock returns. We expect an adverse effect of interest rate variations on stock returns because an increase in interest rate harms economic activity and decreases stock returns, and similarly, a decrease in interest rate is seen as a bad signal for investors. Similarly, money supply increase has a positive effect on stock returns through interest rate and investment channels while a decrease in money supply may have a reversal effect.

Recently, the higher uncertainties and turbulences in the financial markets following the great financial collapse of 2008 have renewed the interest in nonlinear time series to model the relationship between stock prices and exchange rates. Yau and Nieh (2009) used the threshold error correction model to investigate the relationship between foreign exchange markets and stock returns in Taiwan and Japan. Their results showed an asymmetric threshold cointegration relationship between series only in the financial market of Taiwan. Saman (2014) investigated the asymmetric interaction between stock market and exchange rates in Romania and reports that there is a nonlinear two-regime threshold autoregressive relationship between the Romanian stock-price and the exchange rate with asymmetric adjustment. Within this framework, Saman (2014) showed also a short-run non-linear relationship sensitive to short-term good or bad news in extreme regime. In another interesting paper, Chkili and Nguyen (2014) used a regime switching model to explore the dynamic relationship between stock returns and exchange rates for the BRICS countries. Their results indicated that stock returns significantly influenced exchange rate during both low and high volatility periods. Andries *et al*. (2014) adopted the wavelet analysis to examine the time-frequency relationship between interest rate, stock price and exchange rate in India. They suggested that stock market, interest rate and exchange rates are linked and that stock prices follow the interest rate signals. Recently, Bahmani-Oksooee and Saha (2016) tested this hypothesis of asymmetric behaviors of stock markets using a nonlinear ARDL model. Their results showed that stock prices react asymmetrically to exchange rate changes, though the effects are mostly short-run. The present study explores the dynamic relationship among variables using the nonlinear ARDL approach technique. Moreover, published literature does not contain such analysis using data on Turkey's financial market. Hence, our study addresses this empirical gap and makes a significant contribution in terms of methodological framework as well as for investigating the dynamic nonlinear relationships between stock returns, real effective exchange rate, money supply and interest rates using data of the Turkish economy. Thus, we develop the following hypothesis:

Hypothesis 2

Variations in a real effective exchange rate, interest rate and money supply have asymmetric significant effects on stock returns, and their effects on stock returns are dependent on either a positive or negative shock in the real effective exchange rate, interest rate and money supply.

3. Methodology

In this section of the paper, firstly the empirical model specification is established and then we describe the data set used in this study.

3.1 Empirical Model

We consider the following long-run model of stock return as in Bahmani-Oksooee and Saha (2016):

$$SR_t = c_0 + c_1 REX_t + c_1 MS_t + c_1 IR_t + e_t \quad (1)$$

where: (*SR*) represents real stock returns, (*REX*) real effective exchange rate, (*MS*) money supply and (*IR*) interest rates. Equation 1 can be expressed and extended to an asymmetric long-run equation

$$SR_t = a_0 + a_1 x_t^+ + a_2 x_t^- + a_3 y_t + \varepsilon_t \quad (2)$$

where: a_0 and a_1 are the long run parameters; x_t^+ and x_t^- denote positive and negative shocks; y_t refers to the control variable. Since the primal objective of this paper consists of investigating the effects of positive and negative variations in exchange rate, interest rate and money supply on stock returns, we can derive the following equations:

$$SR_t = b_0 + b_1 lnREX_t^+ + b_2 REX_t^- + b_3 y_t + v_t \quad (3)$$

$$SR_t = c_0 + c_1 IR_t^+ + c_2 IR_t^- + c_3 y_t + v_t \quad (4)$$

$$SR_t = d_0 + d_1 MS_t^+ + d_2 MS_t^- + d_3 y_t + v_t \quad (5)$$

b_1 and b_2 capture the long-run relation between stock prices and the real effective exchange rate variations (appreciation and depreciation); c_1 and c_2 refer to the long-run relation between stock prices and interest rate changes (increase and decrease); d_1 and d_2 are the long-run parameters between stock prices and money supply variations (increase and decrease).

In Equation 2, x_t^+ and x_t^- give the asymmetric positive and negative partial sum process, which can be expressed as follows:

$$x_t^+ = \sum_{j=1}^{t} \Delta x_j^+ = \sum_{j=1}^{t} \max(\Delta x_j, \quad 0) \quad (6)$$

$$x_t^- = \sum_{j=1}^{t} \Delta x_j^- = \sum_{j=1}^{t} \min(\Delta x_j, \quad 0) \quad (7)$$

Given equations (3-7), Shin *et al*. (2014) showed that Equation 2 can be modified into a nonlinear (asymmetric error correction) ARDL model form as:

$$\Delta SR_t = \rho_0 + \beta_0 SR_{t-1} + \beta_1 y_{t-1} + \beta_2 x_{t-1}^+ + \beta_3 x_{t-1}^- + \sum_{i=1}^{p} \varphi_i \Delta SR_{t-i} + \sum_{i=1}^{q} \gamma_i \Delta y_{t-i} + \sum_{i=0}^{s} (\pi_i^+ \Delta x_{t-i}^+ + \pi_i^+ \Delta x_{t-i}^+ + \pi_i^- \Delta x_{t-1}^-) + e_t \quad (8)$$

where: SR denotes stock returns; y refers to the set of control variables; x^+ and x^- denote positive and negative shocks to real effective exchange rate, interest rates and money supply; p, q and s are lag orders; $a_1 = -\beta_2/\beta_0$ and $a_2 = -\beta_3/\beta_0$ are the long-run parameters. $\sum_{i=0}^{s} \pi_i^+$ and $\sum_{i=0}^{s} \pi_i^-$ measure the short-run impact of positive and negative shocks of real exchange rate, interest rate or money supply. In the nonlinear ARDL model, the long-run ($\beta_1 = \beta_2 = \beta_3$) and short-run ($\pi_i^+ = \pi_i^-$) asymmetries are tested using the standard Wald test.

The empirical implementation of the nonlinear ARDL approach consists of the following steps. (i) Identify the time series properties of the series, since the ARDL model is applicable irrespective of whether the series are I (0) or I (1). (ii) Estimate equation (4) using the standard OLS estimation approach; as in Lin and Chen (2018), we adopt the general to specific procedure to choose the final specification of the nonlinear ARDL model by dropping insignificant lags. (iii) Launch the test of cointegration among variables using bounds testing approach of Pesaran et al. (2001). (iv) Estimate the long-run and short-run asymmetries between variables. In this final step, it is possible to derive the asymmetric cumulative dynamic multiplier effects.

$$m_h^+ = \sum_{j=0}^{h} \frac{\partial SR_{t+j}}{\partial x_{t-1}^+} \text{ and } m_h^- = \sum_{j=0}^{h} \frac{\partial SR_{t+j}}{\partial x_{t-1}^-},\ h = 0,1,2 \ldots\ldots$$

Note that as $h \to \infty$, $m_h^+ \to a_1$ and $m_h^- \to a_2$

3.2 Data

To determine the asymmetric effects of exchange rate on stock returns in Turkey we used monthly data from January 2003 to May 2017. Thus, this period helps to investigate the association between foreign exchange and stock markets during a tranquil period. The data for all variables is from the Central Bank of Turkey database, the International Financial Statistics (IFS), and the Organization for Economic Cooperation and Development (OECD) analytical database. In our study, we make use of four macroeconomic variables: real effective exchange rate (*REX*), the Borsa Istanbul (BIST100) index is used as a proxy of the stock market returns (*SR*), the interbank interest rate (I*R*) and M3 for money supply (*MS)*. All the variables are expressed in natural logarithm. Important missing values appear in our dataset after May 2017; for this reason, we could not extend our sample period. In order to prevent any misleading results due to poor quality of data we used data covering January 2003 to May 2017. Also, the time period from January 2003 to May 2017 includes the period of subprime global financial crisis, the European sovereign debt crisis and the emerging markets currency crisis (the Russia ruble crisis). Thus, this period helps to investigate the relationship between stock and foreign exchange markets in a globally agitated context. Statistically, Shin *et al*. (2014) reported the good statistical properties of the NARDL model under small samples. [6]

4. Empirical Results

4.1 Advanced Unit Root Tests with the ESTAR Approach

Recently, the growing consensus among scholars regarding the nonlinear process that may characterize the stock prices and the macro-financial series has led to the development of nonlinear stationarity tests. Our paper employs the ESTAR unit root tests advanced by Kapetanios *et al*. (2003) to investigate whether Turkish stock prices and exchange rate and other macro finance variables are nonlinear stationary or not.

[6] *By focusing on the Turkish market this paper will add new evidence for the nonlinear relationship between stock prices and macro-financial variables in countries subject to higher volatility and uncertainty. The findings from this study could be extended to other emerging markets which have been subjected to volatility in their key macro-financial variables (money supply, interest rate and exchange rate).*

The KSS nonlinear unit root test is based on the null hypothesis of a unit root against the alternative hypothesis of nonlinear but globally stationary exponential STAR (ESTAR) process. Consider the following ESTAR process:

$$\Delta x_t = \alpha x_{t-1} + \gamma x_{t-1}\{1 - exp\{-\theta(x_{t-1} - c)^2\} + \varepsilon_t \quad (9)$$

where: x_t is the series of examined variables, $\varepsilon_t \sim iid\ (zero\ mean, constant\ variance)$, c location parameter is set to zero and $\theta \geq 0$ is the smoothness parameter that governs the speed of transition. The null hypothesis here will be Ho: $\theta = 0$ versus the alternative of $\theta > 0$.

$$\Delta x_t = \xi + \delta x_{t-1}^3 + \sum_{i=1}^{k} b_i \Delta x_{t-i} + \varepsilon_t, \quad t = 1,2, \ldots . T. \quad (10)$$

In Equation (9) if $\boldsymbol{Ho}: \boldsymbol{\delta} = \mathbf{0}$, then $\boldsymbol{x_t}$ contains a unit root hence non-stationary, while if $\boldsymbol{Ho}: \boldsymbol{\delta} < \mathbf{0}$, $\boldsymbol{x_t}$ is a non-linear stationary with ESTAR process.

Table 1

ESTAR Nonlinear Unit Root Test Results

		t-statistic			
		Level			1st Diff.
SR		-1.848 (1)			-3.529[a] (1)
REX		-2.581(1)			-4.813 [a] (2)
MS		-1.989(0)			-3.166 [b] (0)
IR		-4.387 [a] (1)			-9.575 [a] (0)

Notes: The critical values are obtained from Kapetanios et al. (2003) Table 1 p.363. The superscripts [a], [b] and [c] are 1%, 5% and 10% significance levels, respectively. The numbers in the parentheses are the appropriate lag length selected by MAIC (Modified AIC). The critical values at 1%, 5% and 10% are -3.48; -2.93 and -2.66, respectively.

The results of the KSS unit root tests are summarized in Table 1, which shows that the KSS test fails to reject the null hypothesis of unit root for the stock prices, real effective exchange rate and money supply, while interest rate is found to be I (0). Our findings stress that money supply displays a nonlinear stationary ESTAR process, while stock prices, real effective exchange rate and money supply become nonlinearly stationary with an ESTAR process after first differencing I (1). This implies that the Turkish stock and foreign exchange markets are efficient and cannot be predicted by previous prices movements, which is consistent with the efficient market hypothesis (Fama, 1970). Nonlinear behavior of the series is strongly evidenced from Table 2, thus, accounting for nonlinearity is especially important in analyzing the linkages between stock and foreign exchange markets. Thus, previous studies that have ignored the presence of nonlinearity in investigating the relationship between both markets have provided quite misleading results. The estimation results also provide evidence of the permanent effect of shocks to stock and foreign exchange markets in Turkey supporting the efficient market hypothesis for Turkey's financial market.

4.2 Nonlinear ARDL Estimation Results

Once the time series properties of the data have been established, we next turn to examine the asymmetric impact of exchange rate, money supply and interest rates on stock returns. The short-run and long-run asymmetric tests for exchange rate, interest rates, money supply

and stock returns are detected using the Wald test and the results are shown in Table 2 (W_{LR}, W_{SR}). These results show that stock return reacts to exchange rate shocks in a nonlinear and asymmetric manner both in the long-run and short run. In addition, the responsiveness of stock return to interest shocks is asymmetric in the short-run but symmetric in the short-run, while the reaction of stock return to money supply variations is symmetric in the short and long-run. Due to the existence of asymmetries in the stock return-exchange rate nexus in both the long and short-runs and stock return-interest rate in the short-run, we explore the long-run relationship between underlying variables employing the nonlinear bound testing approach proposed by Shin *et al.* (2014).The results of bound testing for asymmetric cointegration are shown in Table 4 (see F_{PSS} and t_{BDM}). The results of asymmetric cointegration, as calculated by the F_{PSS} and t_{BDM} tests are greater than the critical upper bounds in all specifications at 5% significance level. This result is confirmed regardless of the selected model. This indicates the presence of three significant asymmetric long-run relationships between the variables and confirm the findings of Bahmani-Oksooee and Suha, (2016).

Following these results, we next turn to estimate the nonlinear ARDL model. To estimate the nonlinear ARDL model we decompose exchange rate, interest rates and money supply movements into partial sum of negative change and partial sum of positive changes so one can judge whether negative and positive shocks to exchange rate, interest rates and money supply have symmetric or asymmetric effects on stock returns. Table 4 presents the findings of three models including stock returns-exchange rate nexus (model 1), stock returns-interest rate nexus (model 2) and stock returns-money supply nexus (model 3). In model 1, we examine the effects of Lira appreciation and depreciation on stock returns using money supply and interest rate as control variables. Model 2 looks at the effects of interest rate shocks on stock returns considering the real effective exchange rate and money supply as control variables. Finally, model 3 explores the effect of money supply shocks on stock returns considering real exchange rate and interest rate as control variables. In all cases, the appropriate lag length of the nonlinear autoregressive distributed lag model has been determined by applying the general-to-specific criterion (Pesaran and Shin, 1999). After estimating our appropriate model equation, we perform some diagnostic tests to assess the adequacy of the dynamic model. The results of the diagnostic tests are quite satisfactory (see Table 2). In terms of normality in error term, the Jarque-Bera statistic test indicates that the error tends to follow normal distribution. In addition, the null hypotheses of serial correlation and heteroskedasticity are rejected for the estimated nonlinear ARDL model in all cases. Most of the parameters are statistically significant indicating that the dynamic nonlinear modelling is much more efficient. The results in Figure 1 (see the Appendix) show that CUSUM and CUSUM squared are between the upper and lower critical bounds, confirming the stability of the nonlinear ARDL estimates. Furthermore, the empirical results show that the loading lagged dependent variable is negative and statistically significant in the three considered models, implying that the stability condition of our estimated ARDL model is satisfied across specifications.

Turning now to the results of the long-run estimates of the nonlinear ARDL model reported in Table 2 (model 1), the estimated long-run coefficients associated with L_{REX^+} and L_{REX^-} are -1.64 and 0.86, respectively. These coefficients are statistically significant, implying that a 1% increase in the real effective exchange rates reduces stock returns by 1.64%, while a 1% negative shock in exchange rate increases stock returns by 0.86. Theoretically, our findings mean that currency depreciation would lead to competitiveness improvements of exporting firms, which in turn will positively affect stock returns. The positive effect of

currency depreciation is comparatively less than the negative effects of currency appreciation in absolute term, indicating that Turkish Lira fluctuations are likely to reduce stock returns. This finding is consistent with Badhani *et al*. (2009); Seong, (2013), and Hajj *et al*. (2018). For model 2, only the estimated long-run coefficients with L_{IR^-} are found to be negative and statistically significant. Negative shocks in the interest rate have a negative impact on stock market return, while the effect of positive shocks in the interest rate is not statistically significant. A 1% decrease in interest rate will depress stock market returns by 0.38. This finding can be explained by the fact that the decrease in interest rates can be perceived as a negative signal for stock market participants. This can result in a decline in stock market returns. Finally, we find that positive shocks to money supply positively affect stock returns, while the effect of negative shocks is not statistically significant. A 1% increase in money supply leads to 1.25% increase in stock returns. This positive sign suggests that the excess liquidity makes investors better off because they use money supply to predict stock returns, thus firms may expect stock returns to grow. Higher economic activity implies higher cash flows, which causes stock prices to rise. Therefore, Turkish companies could have a much higher stock returns in the presence of a higher money supply. This result is consistent with Muradoglu and Metin (1996). They found a positive and significant relationship between stock returns and money supply in Turkey.

From the short-run estimates we can see that the size and the sign of ΔREX^+ and ΔREX^- coefficients are different giving support for short-run asymmetric effects. A positive shock in interest rate is negatively related to stock returns, while the effect of a negative shock in interest rates on stock returns is found to be statistically non-significant. Theoretically, a higher interest rate will lead to a higher cost of funds which eventually impacts the shareholders' values. These findings are similar to Thang (2009). Finally, positive(negative) shocks in money supply are negatively(positively) related to stock market returns. This finding shows the primal role of money supply in stock returns in the short-run.

Table 2

Nonlinear ARDL Results

	Model 1		Model 2			Model 3		
Var	Coeff.	p-value	Var.	Coeff.	p-value	Var.	Coeff.	p-value
L.SR	-0.1371[a]	0.000	L.SR	-0.1770[a]	0.000	L.SR	-0.1365[a]	0.000
REX^+	-0.2260[b]	0.024	IR^+	0.0250	0.608	MS^+	0.1718	0.112
REX^-	0.1180	0.115	IR^-	-0.0686[b]	0.012	MS^-	0.5533	0.177
ΔSR_{t-1}	0.2745[a]	0.000	ΔSR_{t-1}	0.2877[a]	0.000	ΔSR_{t-1}	0.2192[a]	0.007
ΔSR_{t-5}	0.1512[a]	0.007	ΔSR_{t-5}	0.1500[b]	0.045	ΔSR_{t-5}	0.2164[a]	0.005
ΔSR_{t-8}	0.1168[b]	0.039	ΔSR_{t-8}	0.1220	0.109	ΔSR_{t-8}	0.1077	0.154
ΔREX^+	1.2227[a]	0.000	ΔIR^+	-0.2385[c]	0.063	ΔMS^+	-2.3326[a]	0.000
ΔREX^+_{t-1}	-0.5945[c]	0.061	ΔIR^+_{t-1}	0.1040	0.393	ΔMS^+_{t-1}	-0.3369	0.618
ΔREX^-	1.9699[a]	0.000	ΔIR^-	0.1639	0.289	ΔMS^+_{t-7}	-0.5924	0.347
ΔREX^-_{t-2}	0.4208[c]	0.055	ΔIR^-_{t-2}	0.2000	0.246	ΔMS^-	1.288	0.297
ΔREX^-_{t-3}	0.4129[c]	0.051	ΔIR^-_{t-2}	0.1111	0.475	ΔMS^-_{t-2}	0.7037	0.531
ΔREX^-_{t-11}	0.3780[b]	0.050	ΔIR^-_{t-9}	0.1477	0.475	ΔMS^-_{t-3}	-2.0566[c]	0.090
IR	-0.0245[c]	0.094	REX	0.176	0.557	ΔMS^-_{t-11}	0.3398	0.723
MS	0.5767[a]	0.001	MS	-0.1109	0.314	REX	0.1426	0.113
Const.	1.3119[a]	0.000	Const	0.0902	0.818	IR	-0.2061	0.286
L_{REX^+}	-1.648[b]	0.039	L_{IR^+}	0.142	0.615	Const.	0.2345	0.549
L_{REX^-}	0.862[c]	0.069	L_{IR^-}	0.388[b]	0.015	L_{MS^+}	1.259[c]	0.087

	Model 1		Model 2			Model 3		
Var	Coeff.	p-value	Var.	Coeff.	p-value	Var.	Coeff.	p-value
W_{LR}	12.92 (0.000)		W_{LR}	2.10	0.149	L_{MS^-}	4.053	0.170
W_{SR}	15.97 (0.000)		W_{SR}	4.95	0.015	W_{LR}	1.54	0.215
F_{PSS}	11.19		F_{PSS}	8.75		W_{SR}	1.68	0.196
t_{BDM}	-5.23		t_{BDM}	-4.86		F_{PSS}	7.324	
χ^2_{HET}	0.625(0.429)		χ^2_{HET}	1.236 (0.456)		t_{BDM}	-4.3575	
χ^2_{AUT}	0.793(0.672)		χ^2_{AUT}	2.094(0.350)		χ^2_{HET}	8.245 (0.765)	
						χ^2_{AUT}	0.014(0.985)	

Notes: a, b and c denote 1%, 5% and 10% significance levels, respectively. L_{REX^+} and L_{REX^-} denote the long-run coefficients associated with positive and negative changes of real effective exchange rate. L_{IR^+} and L_{IR^-} refers to long-run coefficients associated with positive and negative changes of interest rates. L_{MS^+} and L_{MS^-} denote long-run coefficients associated with positive and negative changes of money supply. W_{LR} refers to the Wald test of long-run symmetry while W_{SR} denotes the Wald test of the short run symmetry condition. F_{PSS} and t_{BDM} are the F-statistic proposed by Pesaran et al. (2001) and t-statistic developed by Banerjee et al. (1998). The relevant 5% critical values of the F_{PSS} and t_{BDM} when k=3 are 4.01 and -3.41, respectively. χ^2_{HET} and χ^2_{AUT} refer to ARCH-LM heteroscedasticity and serial correlation LM tests, respectively.

5. Discussion

Our findings report an asymmetric long-run relation between stock returns and macroeconomic fundamentals. Specifically, there is an asymmetric long-run relationship between stock returns-real effective exchange rate nexus, stock returns-interest rate nexus and stock returns-money supply nexus. These results suggest that stock market participants should adjust their investment decisions to changes in the real effective exchange rates, interest rates and money supply when predicting and managing the adverse effects of unexpected events. Our empirical findings are consistent with Erdogan and Tiryaki (2016). They showed the existence of long-run asymmetric cointegration relationship between stock returns and macroeconomic variables such as industrial production index, real effective exchange rate, consumer price index, interest rates and oil prices for all G7 countries. In contrast to their study, we examine the asymmetric cointegration between variables separately in order to keep our model as parsimonious as possible.

Our results reveal an asymmetric impact of changes in real effective exchange rate and interest rate on stock return, while stock return reacts symmetrically to money supply changes. This finding serves as confirmation that the stock market returns are related in a nonlinear way to macroeconomic fundamentals such as real effective exchange rate, interest rates and money supply. The results of this study are consistent with the findings of Dhaoui *et al*. (2018). They reported that real industrial production, oil prices and interest rates are nonlinearly related to stock market prices. Thus, nonlinearity plays a key role in the relationship between macroeconomic and financial variables. A similar, study was conducted by Jammazi *et al*. (2014). Their results were also in accordance with our findings. They found a significant nonlinearity on financial and macroeconomic data. From our empirical findings, one might claim that researches can estimate the impact of macroeconomic variables on stock market considering a nonlinear time series framework. Otherwise, the relevant estimation output might be biased. Unlike previous studies which yield limited empirical evidence about the asymmetric responses of stock returns, we provide more efficient empirical evidence through a consistent estimation methodology.

The findings of this study further report that the response of stock return is highly sensitive to whether the changes in macroeconomic variables are positive and negative. For instance, real effective exchange depreciation positively affects stock returns while the effect of exchange rate appreciation on stock returns is found to be negative. The main policy implication of this result is that efforts to improve trade balance could lead to currency depreciation which would positively affect stock market returns and investors. This result has led regulators to strongly argue that the depreciation of Turkish Lira helps to improve the competitiveness of Turkey and this leads Central Bank to do so in order to increase exports, stock returns and foreign earnings. While currency depreciation would lead to competitiveness improvements of exporting firms, it is important to notice that exports are strongly dependent on imported inputs in Turkeys, which may cause currency depreciation to increase the cost of production in Turkey.

Given the negative effects of interest rates shocks on stock returns in short and long-run it is important for policy makers to take necessary measures to limit higher fluctuations in interest rates. This finding is in line with Turkey's Central Bank interest rate policy, which aims at limiting volatility in short-term interest rates. Also, findings are in line with Akhtaruzzaman *et al*. (2014). They showed that Australian bank stock returns show a negative exposure to changes in the both domestic bank interest rates and US interest rate volatility. We found a positive a symmetric impact of money supply on stock returns over the long-run and short-run, which can be explained by the fact that money supply is linearly related to stock returns.

6. Conclusion

Based on the nonlinear ARDL estimations approach, we investigated the effects of shocks in exchange rate, interest rate and money supply on stock returns in Turkey between January 2003 and May 2017. The nonlinear ARDL results confirm the existence of a long-run asymmetric relationship in some cases. For instance, the stock returns response asymmetrically to exchange rate shocks over both short and long-run, while the responsiveness of stock returns to interest rate shocks is asymmetric only in the short-run. In addition, we showed a symmetric response of stock returns to money supply in Turkey. These results indicate that Turkey's stock market is inefficient, hence, very sensitive to macro-financial fluctuations. Our findings are in line with the past literature on developing/emerging stock market. Our results show that an increase in interest has a negative impact on stock returns in the short-run and a similar effect is found in the long-run when interest rates decrease. This means that interest rate fluctuations have harmful effects on stock returns in Turkey. Furthermore, money supply is symmetrically related to stock returns in both the short and long-run, with a positive effect on stock returns only in the short run. From a policy perspective, the knowledge of the response of stock markets to macro-finance variables could be used as a tool to improve stock market performance and attract more foreign investment in Turkey. Going by the importance of asymmetry evidenced in this study, our study concludes that the wave of policy interventions should implement a different economic policy reaction towards positive or negative shocks in the real effective exchange rate, and interest rate. This provides central bankers the opportunity to initiate appropriate policy reactions capable of mitigating the volatility of the stock market. Also, investors should consider the existence of an asymmetric benefit-loss structure of their expected returns when dealing with the risk management strategies in the stock market. Further accounting for asymmetry would help investors to manage their portfolio allocation better during periods of Turkish Lira depreciation compared to Turkish Lira appreciation periods. More so, a ful

understanding of asymmetry is required to successfully implement a new policy response to Turkish Lira fluctuations and enhance the forecast accuracy of the predictive model of stock returns. Policy makers should also consider interest rate when implementing financial market policies. Given the negative effects of interest rates shocks on stock returns in the short and long-run, it is important for policy makers to take necessary measures to limit higher fluctuations in interest rates. Policy makers should consider that short-run asymmetry exposure does not last into the long-run when implementing measure to protect stock market to interest rates shocks. Regulators should consider the positive symmetric effect of the money supply on the stock market when regulating money supply. These reforms would increase the performance of Turkey's stock markets and hence generate positive spillover effects across the whole economy. Stock market participants could use exchange rates, interest rates and money supply as leading indicators to predict stock prices. While asymmetry was expected as likely in the Turkish financial market, our paper aims at providing empirical evidence on the strength and size of this asymmetry for the key drivers of stock market returns in Turkey. It is important to model adequately this asymmetry in order to elaborate a comprehensive set of policy proposals to tackle the adverse effects of asymmetry on stock returns.

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Appendix

Figure 1

Plot of Cumulative Sum (of Squares) of Recursive Residuals