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Article

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International journal of business & management

Provided in Cooperation with:
International Institute of Social and Economic Sciences, Prague

Reference: Benli, Muhammed/Durmuskaya, Sedat et. al. (2019). Asymmetric exchange rate pass-through and sectoral stock price indices : evidence from Turkey. In: International journal of business & management 7 (1), S. 25 - 47.
doi:10.20472/BM.2019.7.1.003.

DOI: 10.20472/BM.2019.7.1.003

ASYMMETRIC EXCHANGE RATE PASS-THROUGH AND SECTORAL STOCK PRICE INDICES: EVIDENCE FROM TURKEY

MUHAMMED BENLI, SEDAT DURMUSKAYA, GOKBERK BAYRAMOGLU

Abstract:

In this study, we empirically investigate the impact of exchange rate changes on sectoral stock price indices in Turkey in a multivariate model controlling for consumer price index, industrial production index and money supply. For this purpose, we adopt nonlinear autoregressive distributed lags (NARDL) model developed by Shin et al. (2014). The empirical results indicate an incomplete pass-through effect of exchange rate to stock prices both in the long- and short-run. The results also support short-run asymmetry for all sectors considered in this study, except for ISE Information Services. Regarding the effect of CPI, IPI and M2, our findings indicate that, for majority of industries, consumer price index is significantly negatively correlated with stock prices in the long-run whereas the long-run impact of money supply and industrial production index on stock prices is positive.

Keywords:

Nonlinear ARDL, Nonlinearity, Multivariate model, Cointegration, Stock market

JEL Classification: F31, C10, O16

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Citation:

MUHAMMED BENLI, SEDAT DURMUSKAYA, GOKBERK BAYRAMOGLU (2019). Asymmetric exchange rate pass-through and sectoral stock price indices: Evidence from Turkey. International Journal of Business and Management, Vol. VII(1), pp. 25-47., 10.20472/BM.2019.7.1.003

Introduction

The link between stock prices and exchange rates have received significant attention in the economic and finance literature following integration of economies with the global economy, particularly through limited government control of interest and exchange rates, banking sector, and trade and capital flows in 1980s and 1990s. A few studies from the literature that analyze the dynamics of exchange rates and stock prices have been able to confirm the presence of long run relationship between the two, such as Chorteas et al. (2011) for Saudi Arabia, Oman, Kuwait and Egypt,; Richards et al. (2009), and Groenewold and Peterson (2013) for Australia; Yau and Nieh (2009) for Taiwan and Japan; Tian and Ma (2010) for China; Tuncer (2014) for Turkey; Harjito and McGowan (2011) for Thailand, Indonesia, Singapore, and Philippines; and Tsagkanos and Siriopoulos (2013) for the US and the EU, among others (Bahmani-Oskooee and Saha, 2018). The common feature of these studies is that they have all focused on the linear models suggesting that if depreciation of a currency causes stock prices to decline, appreciation is assumed to cause it to rise, or vice versa (Bahmani-Oskooee and Saha, 2018). However, recently, the attention of researchers has moved towards the use of nonlinear approaches which seem to be better suited to capture the effect of exchange rates on stock prices. This is due to the fact that, since most of the participants in the stock market take their decisions based on their expectations, it is likely that exchange rate changes could have asymmetric impact on stock prices (Bahmani-Oskooee and Saha (2015).

Considering these arguments, the main objective of this paper is to study the long run dynamics of exchange rates and sectoral stock price indices, in a multivariate model controlling for consumer price index, industrial production index, and money supply. To do so, we employ monthly industrial stock market data for Turkey over the period 2003:M1 to 2016:M12. The motivation for using sectoral data is that different industrial sectors might react differently to changes in exchange rates and other macroeconomic variables considered in this paper. Furthermore, the study period is motivated by the fact that, following the 2000-2001 financial crisis in Turkey, financial markets have been regulated and integrated with global capital structures in accordance with the world standards especially after 2003 (Tezer, 2016). For our purpose, we analyze 10 sectors[1] and we employ nonlinear autoregressive distributed lags (NARDL) model.

The rest of this paper is organized as follows. The second section provides the literature review while section three describes the data and the methodology. The fourth section presents the empirical results and finally, section five concludes the study and discusses

[1] ISE National 100 (ISE 100), ISE National 30 (ISE 30), ISE Main Metal (ISE MANA), ISE Metal Goods (ISE MESYA), ISE Textile (ISE TEKST), ISE Chemistry (ISE KMYA), ISE Communication (ISE ILTSM), ISE Transportation (ISE ULAS), ISE Insurance (ISE SIGORTA), ISE Information Services (ISE BILISIM), ISE Bank Index (ISE BANKA).

the policy implications.

Literature review

Since the early 1980s, there has been a great volume of studies exploring the association between stock prices and exchange rates (for a comprehensive literature review, see Bahmani-Oskooee and Saha, 2015).

One of the earliest attempts examining the relationship between exchange rate and stock prices is Franck and Young (1972). Using six different exchange rates, they do correlation regression analysis and they find no significant association between stock prices and exchange rates.

Aggarwal (1981), on the other hand, using monthly U.S. stock price data for the period 1974-1978, argue that trade-weighted exchange rate of dollar has a positive effect on stock prices. He also argues that, for the heavily import oriented firms, the cost of production goes up with the currency depreciation and might reduce the sales and profits of the firms, resulting stock prices to decline.

The findings of Aggarwal (1981), for the U.S., are supported by Giovanni and Jorion (1987), but are in contrast with Soenen and Hennigar (1988) reporting a strong relation between U.S. dollar effective exchange rate and U.S. stock prices for the period 1980-1986.

Solnik (1987), on the other hand, estimates a multivariate model for the nine industrial countries. His findings indicate no significant effect of exchange rates on stock prices.

Furthermore, Jorion (1990) analyze the interaction between stock returns and exchange rates and finds a moderate relationship between the effective US dollar exchange rate for the period 1971–1987 and stock returns of US multinational companies.

However, these early studies mentioned above might suffer from spurious regression as they do not account for the integrating properties of the variables (Bahmani-Oskooee and Saha, 2015). As sophisticated econometric procedures appear in early nineties, since then many other papers have analyzed the dynamics of stock prices and exchange rates for various countries and have reported variety of results. For example, Bahmani-Oskooee and Sohrabian (1992) apply Engle and Granger (1987) cointegration analysis and conclude that there is no long run relationship between effective exchange rate and S&P 500 index but a short run relationship.

Gay (2008) analyzes the linkage between some macroeconomic variables and some stock prices in emerging economies (İndia, China, Russia, and Brazil) using Box-Jenkins

ARIMA model. The findings imply no significant effect of oil prices and exchange rates on stock market. He argues that this might due to the weak-form of market efficiency in these countries.

Rahman and Uddin (2009) examine the association between stock prices and exchange rate in three emerging economies of South Asia (India, Pakistan and Bangladesh). Their results indicate no causal and cointegration relationship between exchange rates and stock prices in these countries for the period 2003-2008.

Regarding the studies that consider a nonlinear relationship between stock prices and exchange rate, Yau and Nieh (2009), apply threshold error correction model to analyze the effect of exchange rate of the New Taiwan Dollar against the Japanese Yen on stock prices in Japan and Taiwan. The findings indicate a long run equilibrium relationship between NTD/JPY and the Japanese and Taiwanese stock markets over the period January:1991 – March:2008. On the other hand, the results imply an asymmetric threshold cointegration relationship only in Taiwan.

Ismail and Isa (2009) investigate non-linear interactions between exchange rate and stock prices in Malaysia using a two regimes multivariate Markov switching vector autoregression (MS-VAR) model with regime shifts in both the variance and the mean. The estimated model reveals that as the stock price index goes up the exchange rate appreciate and vice versa. They also argue that the MS-VAR model fits the data better than the linear VAR does.

Bahmani-Oskooee and Saha (2016), using NARDL approach to cointegration and error correction modeling, investigate the asymmetric impact of exchange rate changes on stock prices in U.K, Japan, Mexico, Korea, Brazil, Canada, Chile, Indonesia, and the Malaysia. Their findings support asymmetric impact of exchange rate changes on stock prices, though the impacts are mostly short-run. This study is extended by Bahmani-Oskooee and Saha (2018) using monthly time series data from 24 countries to examine the possible asymmetric interaction between exchange rate changes and stock prices. The empirical results indicate that introducing nonlinearity yields relatively more support for asymmetric cointegration compared to symmetric cointegration.

Akanni and Isah (2018) use firm level weekly closing stock prices of Nigerian firms and adopt NARDL model to investigate a possible asymmetric relationship between stock prices and exchange rate. The empirical results suggest, for most of the firms, a nonlinear interaction between the two.

Overall, starting early 1970s, especially since 1980s, there has been a large volume of studies exploring the relationship between stock prices and exchange rates in both developing and developed countries. Early studies mostly focus on developed countries, while the concentration has moved towards the developing countries after the Asian financial crisis 1997. Furthermore, most of the studies have solely focused on the symmetric relationship between exchange rate changes and composite stock price indices and achieved statistically significant empirical relationship between these two, especially in the short run. To date a few studies have been able to confirm any long run relationship. However, recently the attention of researchers has moved towards the asymmetric effect of exchange rates.

Data

In this study, we investigate the nonlinear dynamics of stock prices and exchange rate to capture the asymmetric impact of exchange rate changes on stock prices, controlling for consumer price index, industrial index and money supply. For our purpose, we employ Turkish data. Specifically, we employ monthly data of twelve sectoral stock price indices for the period 2003:M1 to 2016:M12, extracted from Istanbul Stock exchange (ISE) database. On the other hand, the data series of money supply (M2) and nominal effective exchange rate are obtained from The Central Bank of Turkey and the data source for consumer price index (CPI, 2010=100) and industrial production index (IPI, 2010=100) is the Turkish Statistical Institute (TURKSTAT). All the variables are transformed into natural log prior to the analysis.

Econometric Methodology

In this paper, following Bahmani-Oskooee and Saha (2015 and 2016), we consider a multivariate model as follows, where the stock price index (SPI) is the function of nominal effective exchange rate (EX), industrial production index (IPI),consumer price index (CPI), and money supply (M2).

$$\mathrm{lnSPI}_t = \alpha + \beta_1 \mathrm{EX}_t + \beta_2 \mathrm{CPI}_t + \beta_3 \mathrm{IPI}_t + \beta_4 \mathrm{M2}_t + \varepsilon_t \quad (1)$$

where ε_t is an i.i.d stochastic process.

The sign of β_1 depends on whether more firms gain international competitiveness and export more and more firms are hurt by increase in production costs due to the exchange rate depreciation (decline in nominal effective exchange rate). The sign of β_2 is expected to be negative as high inflation and low stock prices generally tend to go together due to increase in cost of production and increase in nominal risk-free rate of return (Fama, 1981; DeFina, 1991; Geske and Roll, 1983; Chen et al., 1986; Mukherjee and Naka, 1995; Sharpe, 1999). However, there are studies arguing a possible positive relationship between stock prices and inflation (Ioannidis et al., 2005; Boonyanam, 2014).

Regarding the sign of β_3, even though the role of industrial production in determining of stock prices is still an open question, the literature mostly finds that stock prices and economic activity are positively related (Chen et al., 1986; Ratanapakorn and Sharma, 2007; Cutler et al., 1989; Maysami et al., 2004; Mukherjee and Naka, 1995; Rahman et al., 2009; among others). This is due to the argument that increase in industrial production might enhance stock prices by increasing the earnings of firms raising the present value of firms and therefore inducing the investment in stock market (Pramod-Kumar and Puja, 2012).

In theory, money supply has either negative or positive effect on stock prices (Sellin, 2001; Bernanke and Kuttner, 2005). However, empirical studies mostly support positive relationship between stock prices and money supply. However, Fama (1980) leaves the question open as money supply triggers inflation which in turn might cause stock prices to decline (Bahmani-Oskooee and Saha, 2016). Therefore, the sign of β_4 might be either positive or negative.

In Equation 1, the estimated coefficients only capture the long run impact of explanatory variables on stock prices. Therefore, an error correction model is used for each sector to estimate both short run and long run effects of the time series variables. In our context, the ARDL (p, q) error correction model (Pesaran and Shin 1999; Pesaran, Shin, and Smith 2001)) will have the following form:

$$\Delta \ln SP_t = \alpha + \omega \ln SP_{t-1} + \Omega \ln EX_{t-1} + \theta x_{t-1} + \sum_{i=1}^{p-1}(\varphi_i \Delta \ln SP_{t-i}) + \sum_{i=0}^{q-1}(\gamma_i \Delta \ln EX_{t-i}) + \sum_{i=0}^{q-1}(\gamma_i \Delta x_{t-i}) + \mu_t \quad (2)$$

where x_t is a vector of macroeconomic variables considered in this paper(money supply-M2, industrial production index and consumer price index) and $\mu_t$is an i.i.d. stochastic process.

The ARDL model in Equation (2) suggests symmetric adjustment in the short- and the long run. It becomes, therefore, inappropriate when the relationship between dependent variable and regressors are nonlinear (asymmetric).

To account for this issue, Shin, Yu, and Greenwood-Nimmo (2011) introduced the NARDL model in which $\ln EX_t$ can decomposed into negative and positive partial sums[2]:

$$\ln EX_t = \ln EX_0 + \ln EX_t^{+} + \ln EX_t^{-} \quad (3)$$

where

[2]Since Nominal Effective Exchange Rate is calculated as a weighted average of bilateral nominal exchange rates of national currency against foreign currencies, a positive change in exchange rate implies an appreciation of home currency while a negative change indicates the depreciation of home currency.

$$\ln EX_t^+ = \sum_{i=1}^{t} \Delta \ln EX_i^+ = \sum_i^t \max(\Delta \ln EX_i^+, 0), \quad (4)$$

$$\ln EX_t^- = \sum_{i=1}^{t} \Delta \ln EX_i^- = \sum_i^t \min(\Delta \ln EX_i^-, 0) \quad (5)$$

Then the long-run equilibrium relationship can be expressed as

$$y_t = \beta^+ \ln EX_t^+ + \beta^- \ln EX_t^- + u_t \quad (6)$$

where β^+ and β^- are the asymmetric long-run parameters associated with negative and positive changes in x_t, respectively. As shown in Shin et al. (2011), combining Equations (7) and (2) we can obtain the following asymmetric error correction model which is known as NARDL (p, q) model:

$$\Delta \ln SP_t = \alpha + \omega y_{t-1} + \Omega^+ \ln EX_{t-1}^+ + \Omega^- \ln EX_{t-1}^+ + \delta x_{t-1} + \sum_{i=0}^{p-1} (\varphi_i \Delta \ln SP_{t-i}) + \sum_{i=0}^{q-1} (\theta_i^+ \Delta \ln EX_{t-i}^+ + \theta_i^- \Delta \ln EX_{t-i}^-) + \sum_{i=0}^{q-1} (\gamma_i \Delta x_{t-i}) + \mu_t \quad (7)$$

where $\Omega^+ = -\omega\beta^+$ and $\Omega^- = -\omega\beta^-$are the long-run effects positive and negative changes in nominal exchange rate on stock prices, whereas the short run impacts of changes in nominal exchange rate on stock prices are measured by $\sum_{i=0}^{q-1} \theta_i^+$ and $\sum_{i=0}^{q-1} \theta_i^-$. Hence, in this setting, NARDL model enables us to capture asymmetric long-run as well as short-run impacts of changes in exchange rate on the stock prices.

In the economic literature, the empirical studies on non-linear cointegration have primarily relied on regime switching type models. However, NARDL approach has a number of advantages over the existing class of regime-switching techniques (Greenwood-Nimmo et al., 2011). First, the NARDL (p, q) model can be estimated simply by the standard OLS. Second, the test for an asymmetric (nonlinear) cointegration relationship between the variables can be easily carried out by means of bounds-testing procedure advanced by Pesaran et al. (2001) and Shin et al. (2011), based on a modified F-test (denoted as FPSS), which remains valid irrespective of whether the regressors are I(0), I(1) or mutually cointegrated. Third, short- and long-run asymmetries can be estimated using standard Wald tests. In particular, the associated joint null hypothesis for the long-run symmetry is $\beta^+ = \beta^-$ whereas for short-run symmetry, the joint null hypothesis is $\sum_{i=0}^{q-1} \theta_i^+ = \sum_{i=0}^{q-1} \theta_i^-$(Greenwood-Nimmo et al., 2011).

Empirical findings and Discussion

We first start the analysis by conducting unit root tests for the variables at level and first difference using ADF test since the cointegration test procedure requires that no I(2) variables are involved in the model. The results are presented in Table 1 - 2 and the findings of ADF test confirm that none of the variables is I(2).

Table 1: Unit Root Test Results (ADF) – Explanatory Variables

TABLE 1.1: Level

Deterministic Component	*lnEX*	*lnCPI*	*lnIPI*	*lnM2*
C	0.710 (2)	-0.699 (12)	-1.794 (13)	-2.640* (0)
C/T	-2.868 (2)	-2.080 (12)	-3.526** (13)	-1.738 (0)

TABLE 1.2: First differenced

Deterministic Component	Δ*lnEX*	Δ*lnCPI*	Δ*lnIPI*	Δ*lnM2*
C	-9.684*** (1)	-4.859*** (13)	-2.797* (12)	-13.494*** (0)
C/T	-9.898*** (1)	-4.971*** (13)	-2.874 (12)	-13.919*** (0)

Table 2: Unit Root Test Results (ADF) – Dependent Variable

TABLE 2.1: Level

	Deterministic Component	*lnSP*
ISE National 30	C	-2.491 (0)
	C/T	-2.634 (0)
ISE National 100	C	-2.434 (0)
	C/T	-2.514 (0)
ISE BANK	C	0
	C/T	-2.355 (0)
ISE INFORMATION SERVICES	C	-0.924 (1)
	C/T	-2.103 (1)
ISE COMMUNICATION	C	-3.602*** (2)
	C/T	-2.361 (2)
ISE MAIN METAL	C	-2.320 (1)
	C/T	-3.143
ISE METAL GOODS	C	-1.013 (1)
	C/T	-2.303 (1)
ISE INSURANCE	C	-2.227 (0)
	C/T	-2.627 (1)
ISE TEXTILE	C	-0.958 (1)
	C/T	-2.449 (1)
ISE TRANSPORTATION	C	-1.228 (1)
	C/T	-2.835 (4)
ISE TECHNOLOGY	C	-0.065 (1)
	C/T	-2.058 (1)

TABLE 2.2: First differenced

	Deterministic Component	*ΔlnSP*
30	C	-13.608*** (0)
	C/T	-13.731*** (0)
ISE National 100	C	-13.253*** (0)
	C/T	-13.373*** (0)
ISE BANK	C	-13.276*** (0)
	C/T	-13.483*** (0)
ISE INFORMATION SERVICES	C	-11.838*** (0)
	C/T	-11.826*** (0)
ISE COMMUNICATION	C	-10.866*** (1)
	C/T	-11.389*** (1)
ISE MAIN METAL	C	-12.038*** (0)
	C/T	-12.099*** (0)
ISE METAL GOODS	C	-11.025*** (0)
	C/T	-10.991*** (0)
ISE INSURANCE	C	-12.455*** (0)
	C/T	-12.501*** (0)
ISE TEXTILE	C	-11.941*** (0)
	C/T	-11.907*** (0)
ISE TRANSPORTATION	C	-11.320*** (0)
	C/T	-11.306*** (0)
ISE TECHNOLOGY	C	-11.636*** (0)
	C/T	-11.673*** (0)

Regarding the estimation of Equation 8, applying general to specific procedure to determine the lag length in each case by fixing max p = max q = 12, we arrive at the final model specification and the results are reported in Table 3.

Table 3: Estimation Results of the NARDL Final Model

Table 3.1

Variable	*30*	*ISE National 100*	*ISE BANK*
constant	-1.860 (1.178)	-2.019 (1.062)*	1.417 (1.342)
$SP_{(t-1)}$	-0.331 (0.047)***	-0.347 (0.044)***	-0.221 (0.040)***
$EX\_POS_{(t-1)}$	-0.147 (0.122)	-0.223 (0.110)**	-0.077 (0.142)
$EX\_NEG_{(t-1)}$	0.154 (0.143)	0.100 (0.130)	-0.272 (0.172)
$CPI_{(t-1)}$	0.299 (0.294)	0.248 (0.267)	-0.782 (0.333)**
$IPI_{(t-1)}$	0.279 (0.100)***	0.282 (0.091)***	0.113 (0.084)
$M2_{(t-1)}$	0.165 (0.043)***	0.191 (0.039)***	0.206 (0.055)***
$\Delta SP_{(t-9)}$	0.147 (0.062)**	0.139 (0.058)**	0.173 (0.064)***
$\Delta SP_{(t-10)}$			-0.118 (0.066)*
$\Delta EX\text{-}POS_{(t-1)}$		-0.792 (0.384)**	-1.117 (0.499)**
$\Delta EX\_POS_{(t-3)}$	-1.463 (0.439)***	-1.294 (0.392)***	-1.710 (0.511)***

$\Delta EX\_POS_{(t-4)}$	-1.210 (0.433)***	-1.316 (0.388)***	
$\Delta EX\_POS_{(t-8)}$	-1.173 (0.421)***	-1.408 (0.391)***	-1.750 (0.574)***
ΔEX_NEG_{t}	2.644 (0.268)***	2.904 (0.252)***	2.766 (0.307)***
$\Delta EX\_NEG_{(t-2)}$	0.528 (0.270)*	0.900 (0.248)***	1.589 (0.340)***
$\Delta EX\_NEG_{(t-3)}$	1.447 (0.283)***	1.324 (0.258)***	1.337 (0.338)***
$\Delta EX\_NEG_{(t-5)}$	0.758 (0.257)***	0.856 (0.235)***	0.848 (0.317)***
$\Delta EX\_NEG_{(t-8)}$		0.583 (0.244)**	0.864 (0.336)**
$\Delta EX\_NEG_{(t-10)}$			0.644 (0.317)**
$\Delta EX\_NEG_{(t-11)}$		0.534 (0.211)**	0.614 (0.293)**
$\Delta CPI_{(t-1)}$		-1.556 (0.651)**	
$\Delta CPI_{(t-2)}$			1.990 (0.967)**
$\Delta CPI_{(t-4)}$	-2.128 (0.738)***	-1.945 (0.684)***	
$\Delta CPI_{(t-7)}$	-3.905 (0.766)***	-3.345 (0.694)***	-2.052 (0.829)**
$\Delta CPI_{(t-9)}$		-1.451 (0.720)**	
ΔIPI_{t}	0.235 (0.078)***	0.196 (0.069)***	
$\Delta IPI_{(t-2)}$	0.148 (0.063)**	0.220 (0.056)***	0.225 (0.074)***
$\Delta IPI_{(t-5)}$	0.353 (0.079)***	0.344 (0.070)***	0.154 (0.075)**
$\Delta IPI_{(t-6)}$	0.206 (0.074)***	0.180 (0.067)***	
$\Delta IPI_{(t-7)}$			-0.273 (0.090)***
$\Delta IPI_{(t-8)}$			-0.308 (0.101)***
$\Delta IPI_{(t-9)}$			-0.195 (0.093)**
$\Delta M2_{(t-6)}$	0.377 (0.146)***	0.391 (0.132)***	
F_{PSS}	20.16	24.719	15.367
W_{LR}	3.373*	4.869**	0.931
W_{SR}	68.798***	91.667***	74.908***
L^{+}	-0.445	-0.643**	-0.348
L^{-}	0.465	0.289	-1.23
LM(1)	1.942	0.846	0.037
LM(2)	2.277	1.097	1.163
LM(12)	10.318	13.26	7.752
BPG	0.71	0.52	0.898
RESET	0.517	0.007	1.608

The subscripts "+" and "–" denote positive and negative partial sums, respectively. L^{+} and L^{-} are the estimated long-run coefficients defined by $\beta^{+} = -{\Omega^{+}}/{\omega}$ and $\beta^{-} = -{\Omega^{-}}/{\omega}$, respectively. F_{PSS} is the F-test proposed by Pesaran, Shin and Smith (2001) for the joint null of $\omega = \Omega^{+} = \Omega^{-} = 0$. W_{LR} is the long-run symmetrical Wald test, respectively, on the null of $\Omega^{+} = \Omega^{-}$.LM test is the Lagrange multiplier test for serial correlation, BPG is the Breusch-Pagan-Godfrey test for conditional heteroscedasticity and RESET is Ramsey's test for misspecification. p – values are displayed in brackets. ***, ** and * denote significance at the %1, %5 and %10 levels, respectively.

Table 3.2

Variable	*ISE INFORMATION SERVICES*	*ISE INSURANCE*	*ISE TRANSPORTATION*
Constant	5.606 (1.440)***	-3.834 (1.791)**	-1.262 (1.884)

$SP_{(t-1)}$	-0.121 (0.023)***	-0.200 (0.043)***	-0.110 (0.027)***
$EX\_POS_{(t-1)}$	0.045 (0.165)	-0.519 (0.155)***	-0.177 (0.186)
$EX\_NEG_{(t-1)}$	-0.720 (0.163)***	0.024 (0.175)	0.146 (0.203)
$CPI_{(t-1)}$	-1.117 (0.354)***	0.240 (0.372)	0.825 (0.510)
$IPI_{(t-1)}$	0.211 (0.107)**	0.156 (0.090)*	-0.414 (0.174)**
$M2_{(t-1)}$	-0.056 (0.053)	0.244 (0.064)***	0.046 (0.062)
$\Delta SP_{(t-4)}$	0.133 (0.066)**		0.160 (0.074)**
ΔEX_POS_{t}	2.356 (0.613)***		
$\Delta EX\_POS_{(t-1)}$			-2.662 (0.593)***
$\Delta EX\_POS_{(t-3)}$		-2.171 (0.542)***	-1.969 (0.624)***
$\Delta EX\_POS_{(t-10)}$		1.050 (0.501)**	
$\Delta EX\_POS_{(t-12)}$	1.061 (0.489)**	1.061 (0.492)**	
ΔEX_NEG_{t}	1.311 (0.335)***	2.898 (0.310)***	2.300 (0.355)***
$\Delta EX\_NEG_{(t-2)}$	1.669 (0.368)***		0.913 (0.382)**
$\Delta EX\_NEG_{(t-3)}$		0.937 (0.344)***	
$\Delta EX\_NEG_{(t-5)}$	0.605 (0.312)*		
$\Delta EX\_NEG_{(t-6)}$	0.790 (0.308)**	0.595 (0.304)*	
$\Delta CPI_{(t-1)}$	-1.738 (0.902)*		
$\Delta CPI_{(t-2)}$	2.934 (1.034)***		
$\Delta CPI_{(t-3)}$	-3.408 (1.022)***		-2.056 (1.069)*
$\Delta CPI_{(t-6)}$		1.990 (0.939)**	
$\Delta CPI_{(t-7)}$	-4.090 (0.964)***	-4.206 (0.885)***	
$\Delta CPI_{(t-8)}$	-1.768 (0.916)*		
$\Delta CPI_{(t-9)}$	-3.271 (0.913)***		
$\Delta IPI_{(t-1)}$			0.401 (0.190)**
$\Delta IPI_{(t-2)}$	0.293 (0.080)***	0.209 (0.079)***	0.714 (0.182)***
$\Delta IPI_{(t-3)}$			0.469 (0.170)***
$\Delta IPI_{(t-4)}$			0.428 (0.169)**
$\Delta IPI_{(t-5)}$		0.260 (0.093)***	0.349 (0.152)**
$\Delta IPI_{(t-6)}$		0.288 (0.091)***	0.238 (0.121)*
$\Delta IPI_{(t-7)}$	0.159 (0.082)*		
$\Delta IPI_{(t-9)}$		0.191 (0.191)**	
$\Delta IPI_{(t-11)}$	0.319 (0.109)***	-0.209 (0.081)**	
$\Delta IPI_{(t-12)}$	0.273 (0.111)**		
$\Delta M2_{t}$	0.390 (0.160)**		
$\Delta M2_{(t-1)}$	0.344 (0.164)**	0.358 (0.166)**	
$\Delta M2_{(t-2)}$	0.374 (0.166)**		
$\Delta M2_{(t-8)}$	0.484 (0.175)***		
$\Delta M2_{(t-10)}$	0.385 (0.167)**		
$\Delta M2_{(t-12)}$	0.432 (0.177)**		
F_{PSS}	13.297	10.926	5.775
W_{LR}	8.476***	7.397***	1.462
W_{SR}	0.944	16.100***	43.384***
L^{+}	0.372	-2.599***	-1.605

L^-	-5.963***	0.122	1.322
LM(1)	2.041	0.123	0.424
LM(2)	2.159	0.257	0.434
LM(12)	7.96	19.732*	7.305
BPG	0.599	0.879	0.581
RESET	0.255	11.425***	0.387

The subscripts "+" and "–" denote positive and negative partial sums, respectively. L^+ and L^- are the estimated long-run coefficients defined by $\beta^+ = -{\Omega^+}/{\omega}$ and $\beta^- = -{\Omega^-}/{\omega}$, respectively. F_{PSS} is the F-test proposed by Pesaran, Shin and Smith (2001) for the joint null of $\omega = \Omega^+ = \Omega^- = 0$. W_{LR} is the long-run symmetrical Wald test, respectively, on the null of $\Omega^+ = \Omega^-$.LM test is the Lagrange multiplier test for serial correlation, BPG is the Breusch-Pagan-Godfrey test for conditional heteroscedasticity and RESET is Ramsey's test for misspecification. p – values are displayed in brackets. ***, ** and * denote significance at the %1, %5 and %10 levels, respectively.

Table 3.3

Variable	*ISE METAL GOODS*	*SINAI*	*TECH*
Constant	-1.111 (1.291)	-0.066 (0.967)	4.692 (1.247)***
$SP_{(t-1)}$	-0.076 (0.029)***	-0.227 (0.043)***	-0.080 (0.022)***
$EX\_POS_{(t-1)}$	-0.454 (0.143)***	-0.353 (0.105)***	-0.322 (0.153)**
$EX\_NEG_{(t-1)}$	-0.132 (0.139)	-0.242 (0.115)**	-0.858 (0.154)***
$CPI_{(t-1\_}$	0.327 (0.359)	-0.106 (0.250)	-1.128 (0.322)***
$IPI_{(t-1)}$	-0.198 (0.124)	0.293 (0.089)**	-0.067 (0.080)
$M2_{(t-1)}$	0.083 (0.043)*	0.091 (0.034)**	0.053 (0.043)
$\Delta SP_{(t-5)}$			-0.181 (0.070)**
$\Delta SP_{(t-8)}$	-0.103 (0.062)*	-0.229 (0.066)***	
$\Delta SP_{(t-9)}$	0.115 (0.064)*		
ΔEX_POS_{t}			2.415 (0.546)***
$\Delta EX\_POS_{(t-1)}$	-0.921 (0.455)**	-0.787 (0.348)**	
$\Delta EX\_POS_{(t-3)}$	-1.182 (0.457)***	-1.193 (0.363)***	-1.440 (0.509)***
$\Delta EX\_POS_{(t-4)}$		-0.710 (0.361)**	
$\Delta EX\_POS_{(t-7)}$	0.881 (0.464)*		
$\Delta EX\_POS_{(t-8)}$			-0.907 (0.472)**
$\Delta EX\_POS_{(t-10)}$	0.872 (0.424)**		
$\Delta EX\_POS_{(t-11)}$			-0.916 (0.476)**
$\Delta EX\_POS_{(t-12)}$			0.801 (0.420)**
ΔEX_NEG_{t}	2.717 (0.273)***	1.881 (0.205)***	1.597 (0.293)***
$\Delta EX\_NEG_{(t-2)}$		0.472 (0.235)**	1.433 (0.326)***
$\Delta EX\_NEG_{(t-3)}$	0.862 (0.302)***	1.070 (0.248)***	1.177 (0.321)***
$\Delta EX\_NEG_{(t-5)}$		0.417 (0.212)**	1.041 (0.304)***
$\Delta EX\_NEG_{(t-6)}$		0.510 (0.211)**	0.672 (0.276)**
$\Delta EX\_NEG_{(t-8)}$		0.952 (0.232)***	0.632 (0.307)**
$\Delta EX\_NEG_{(t-11)}$		0.527 (0.199)***	0.781 (0.298)***
ΔCPI_{t}	1.678 (0.873)*		
$\Delta CPI_{(t-2)}$			2.540 (0.865)***

$\Delta CPI_{(t-3)}$			-2.366 (0.877)***
$\Delta CPI_{(t-6)}$			1.925 (0.842)**
$\Delta CPI_{(t-7)}$	-3.425 (0.819)***	-2.461 (0.625)***	-4.640 (0.820)***
$\Delta CPI_{(t-9)}$		-1.768 (0.650)***	-2.377 (0.813)***
$\Delta CPI_{(t-12)}$		-1.327 (0.576)**	
ΔIPI_{t}	0.300 (0.089)***	0.193 (0.066)***	
$\Delta IPI_{(t-1)}$	0.537 (0.114)***		
$\Delta IPI_{(t-2)}$	0.604 (0.113)***	0.099 (0.050)**	0.203 (0.067)***
$\Delta IPI_{(t-3)}$	0.346 (0.089)***		
$\Delta IPI_{(t-5)}$	0.182 (0.068)***	0.187 (0.062)***	0.241 (0.067)***
$\Delta IPI_{(t-6)}$		0.141 (0.064)**	
$\Delta IPI_{(t-7)}$	-0.292 (0.083)***		
$\Delta IPI_{(t-8)}$	-0.310 (0.078)***		
$\Delta M2_{t}$			0.575 (0.142)***
$\Delta M2_{(t-1)}$	0.512 (0.144)***		0.301 (0.142)**
F_{PSS}	4.66	14.599	13.098
W_{LR}	2.961*	0.687	3.887**
W_{SR}	12.906***		
L^{+}	-5.938***	-1.554***	-4.003**
L^{-}	-1.729	-1.066**	-10.663***
LM(1)	1.197	0.005	1.927
LM(2)	1.771	0.053	2.024
LM(12)	16.384	11.748	21.788**
BPG	0.512	0.561	0.821
RESET	6.391**	5.132**	1.105

The subscripts "+" and "–" denote positive and negative partial sums, respectively. L^+ and L^- are the estimated long-run coefficients defined by $\beta^+ = -{\Omega^+}/{\omega}$ and $\beta^- = -{\Omega^-}/{\omega}$, respectively. F_{PSS} is the F-test proposed by Pesaran, Shin and Smith (2001) for the joint null of $\omega = \Omega^+ = \Omega^- = 0$. W_{LR} is the long-run symmetrical Wald test, respectively, on the null of $\Omega^+ = \Omega^-$.LM test is the Lagrange multiplier test for serial correlation, BPG is the Breusch-Pagan-Godfrey test for conditional heteroscedasticity and RESET is Ramsey's test for misspecification. p – values are displayed in brackets. ***, ** and * denote significance at the %1, %5 and %10 levels, respectively.

Table 3.4

Variable	*ISE COMMUNICATION*	*ISE MAIN METAL*	*ISE TEXTILE*
constant	-0.897 ((1.163)	-6.698 (1.807)***	1.777 (1.064)*
$SP_{(t-1)}$	-0.236 (0.046)***	-0.235 (0.043)***	-0.048 (0.022)**
$EX\_POS_{(t-1)}$	-0.056 (0.139)	-0.856 (0.182)***	-0.087 (0.122)
$EX\_NEG_{(t-1)}$	0.124 (0.154)	0.175 (0.184)	-0.307 (0.122)**
$CPI_{(t-1)}$	0.032 (0.302)	0.929 (0.427)**	-0.545 (0.271)**
$IPI_{(t-1)}$	0.113 (0.085)	0.122 (0.173)	-0.021 (0.074)
$M2_{(t-1)}$	0.144 (0.046)***	0.275 (0.064)***	0.055 (0.040)

$\Delta EX\_POS_{(t-3)}$		-1.813 (0.550)***	-1.297 (0.450)***
$\Delta EX\_POS_{(t-10)}$			0.862 (0.409)**
$\Delta EX\_POS_{(t-11)}$	-0.930 (0.422)**		
ΔEX_NEG_{t}	1.501 (0.277)***	1.685 (0.326)***	1.687 (0.249)***
$\Delta EX\_NEG_{(t-1)}$	-1.252 (0.301)***		
$\Delta EX\_NEG(t-2)$	1.131 (0.297)***		
$\Delta EX\_NEG_{(t-3)}$			0.960 (0.285)***
$\Delta EX\_NEG_{(t-4)}$			-0.682 (0.258)***
$\Delta EX\_NEG_{(t-11)}$			0.513 (0.246)**
$\Delta CPI_{(t-4)}$	-3.127 (0.793)***		
$\Delta CPI_{(t-5)}$			-2.587 (0.761)***
$\Delta CPI_{(t-6)}$			
$\Delta CPI_{(t-7)}$	-2.755 (0.740)***	-2.099 (1.087)*	-2.266 (0.726)***
$\Delta CPI_{(t-8)}$		-2.497 (1.085)**	
$\Delta CPI_{(t-9)}$			-1.839 (0.788)**
ΔIPI_{t}		0.335 (0.108)***	
$\Delta IPI_{(t-1)}$	-0.249 (0.079)***	0.388 (0.175)**	
$\Delta IPI_{(t-2)}$		0.443 (0.173)**	
$\Delta IPI_{(t-3)}$		0.449 (0.156)***	
$\Delta IPI_{(t-4)}$		0.419 (0.157)***	
$\Delta IPI_{(t-5)}$		0.354 (0.146)**	
$\Delta IPI_{(t-6)}$		0.214 (0.214)*	
$\Delta IPI_{(t-8)}$		-0.312 (0.093)***	
$\Delta M2_{(t-3)}$		-0.336 (0.189)*	
$\Delta M2_{(t-7)}$	-0.399 (0.145)***	-0.501 (0.195)***	-0.300 (0.134)**
$\Delta M2_{(t-8)}$		-0.547 (0.190)***	
$\Delta M2_{(t-9)}$		-0.657 (0.190)***	
$\Delta M2_{(t-11)}$	-0.346 (0.138)**		
F_{PSS}	11.351	15.846	4.263
W_{LR}	1.097	15.466***	1.224
W_{SR}	16.049***	29.754***	11.354***
L^{+}	-0.236	-3.648***	-1.806
L^{-}	0.526	0.748	-6.372**
LM(1)	1.207	0.139	0.005
LM(2)	2.423	0.219	0.099
LM(12)	10.074	7.99	11.939

BPG	0.928	0.613	1.467
RESET	0.149	0.065	1.233

The subscripts "+" and "–" denote positive and negative partial sums, respectively. L^+ and L^- are the estimated long-run coefficients defined by $\beta^+ = -\Omega^+/\omega$ and $\beta^- = -\Omega^-/\omega$, respectively. F_{PSS} is the F-test proposed by Pesaran, Shin and Smith (2001) for the joint null of $\omega = \Omega^+ = \Omega^- = 0$. W_{LR} is the long-run symmetrical Wald test, respectively, on the null of $\Omega^+ = \Omega^-$.LM test is the Lagrange multiplier test for serial correlation, BPG is the Breusch-Pagan-Godfrey test for conditional heteroscedasticity and RESET is Ramsey's test for misspecification. p – values are displayed in brackets. ***, ** and * denote significance at the %1, %5 and %10 levels, respectively.

As a starting point, the long run coefficient of industrial production is significantly positive in 4 sectors (ISE National 100, ISE National 30, ISE Information Services, ISE Insurance), and significantly negative only for ISE Transportation. In three industries (ISE Bank, ISE Communication, ISE Main Metal) the coefficient for industrial production is positive but insignificant. For ISE Textile, on the other hand, the coefficient is negative but insignificant.

The results also suggest that consumer price index is significantly negatively correlated with stock prices in 4 sectors (ISE Bank, ISE Information Services and ISE Textile) but the coefficient for CPI is significant and positive in ISE Main Metal. On the other hand, for the other sectors the results produce insignificant coefficients which are positive for ISE National 30, ISE National 100, ISE Communication, ISE Metal Goods, ISE Insurance, ISE Transportation.

Furthermore, for seven sectors (ISE National 30, ISE National 100, ISE Bank, ISE Communication, ISE Main Metal, ISE Metal Goods, ISE Insurance), the empirical results indicate significant and positive effect of money supply on stock prices. Only for ISE Information Services, this effect is negative but statistically insignificant. For ISE Textile and ISE Transportation, the coefficients for money supply are positive but insignificant.

Regarding the impact of exchange rate changes in the long run, the empirical results suggest an asymmetric effect of exchange rate changes on stock prices in six sectors (ISE National 30, ISE National 100, ISE Information Services, ISE Main Metal, ISE Metal Goods, ISE Insurance). In particular, for ISE National 100, ISE Main Metal and ISE Insurance the appreciation of national currency has a positive impact on stock prices of a larger magnitude than that of national currency depreciation, with the latter being statistically insignificant. However, in ISE Information Services sector, the appreciation of national currency has a negative effect on stock prices of a larger magnitude than that of depreciation of national currency, with the latter being statistically insignificant. In ISE Metal Goods sector, the effects of both the appreciation and depreciation of national currency are negative. However, only the coefficient of positive change in nominal effective exchange rate is statistically significant. On the other hand, the empirical results indicate no asymmetric impact of exchange rate on stock prices for the other sectors (ISE Bank, ISE Communication, ISE Transportation and ISE Textile). Therefore, the findings indicate an incomplete pass-through effect of exchange rate on stock prices for six sectors and no asymmetric adjustment in the long run for four sectors. In addition, concentrating on the effect of exchange rate changes in the short run; our findings support a short run asymmetry in all sectors but in ISE Information Services.

In sum, our results reveal that firms in over half the industries respond asymmetrically to appreciations and depreciations in the long- and short-run. One of the explanations for this asymmetry is firms' pricing strategies to maintain market share. Import oriented firms may tend to adjust their markups to increase their market share when national currency appreciates and absorb the increased cost of imported inputs when national currency depreciates to maintain their market share. In both cases, the profits decline but in different magnitude. Another explanation for asymmetry is production switching. Importing firms may switch to domestically produced inputs when national currency depreciates and switch to imported inputs when national currency appreciates. This leads to an incomplete pass-through of exchange rates to import prices and therefore firms' profits. On the other hand, exporting firms may not be able to expand their capacity and may not fully react to national currency depreciation as they respond to appreciation of national currency.

On the other hand, regarding the adequacy of the dynamic specification of the model, the Breusch-Godfrey Lagrange Multiplier (LM) test for serial correlation and the Breusch-Pagan-Godfrey (BPG) test for conditional heteroscedasticity indicate that the model is correctly specified for all the sectors. Furthermore, the Ramsey Regression Equation Specification Error (Ramsey RESET) test results imply that the model is correctly specified for most of the sectors. Moreover, the CUSUM and CUSUM of squares tests provided in the appendix suggest that the models are stable for most of the industries.

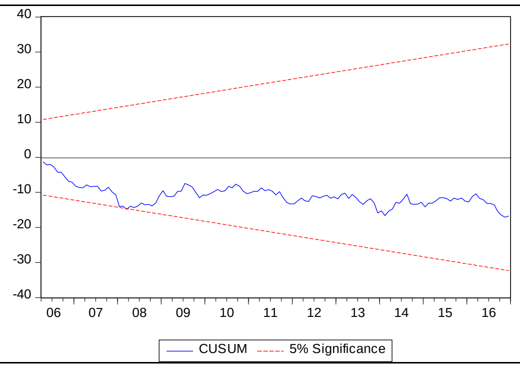
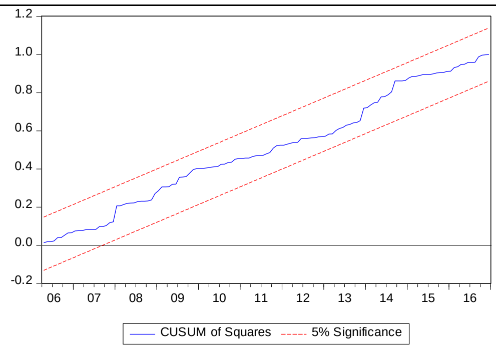
Conclusion

Since the early 1980s, there has been a large volume of studies exploring the relationship between stock prices and exchange rates. Most of these studies have assumed that the association between these two is linear. However, recently, the attention of researchers has moved towards the use of nonlinear approaches which seem to be better suited to capture the impact of exchange rates on stock prices

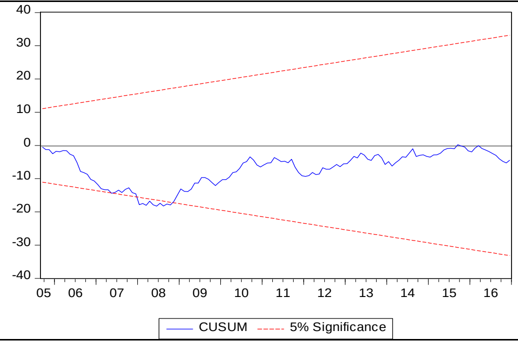
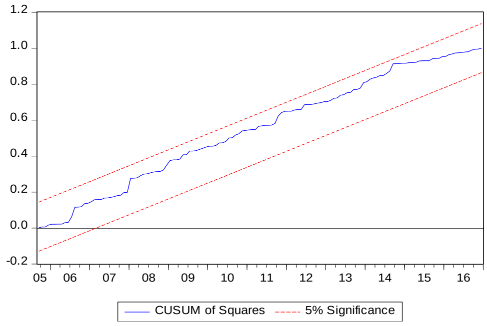
In light of this knowledge, we empirically research the impact of nominal effective exchange rate changes on sectoral stock price indices in Turkey in a multivariate model controlling for industrial production index, money supply and consumer price index. For this purpose, we adopt nonlinear autoregressive distributed lags (NARDL) model developed by Shin et al. (2014).

Our findings affirm the presence of a nonlinear impact of exchange rate on stock prices in the long run for ISE National 100, ISE National 30, ISE Information Services, ISE Main Metal, ISE Metal Goods, ISE Insurance. The results also support short-run asymmetry for all sectors considered in this study, except for ISE Information Services. Therefore, these findings indicate an incomplete pass-through impact of exchange rate to stock prices both in the long- and short-run.

Regarding the effect of CPI, IPI and M2, our findings indicate that, for majority of industries, consumer price index is significantly negatively correlated with stock prices in the long-run whereas the long-run impact of money supply and industrial production index on stock prices is positive.

ISE 100 Index	
Plot of Cumulative Sum of Recursive Residuals	Plot of Cumulative Sum of Squares of Recursive Residuals
	

Appendix (Structural Break Tests)

ISE 30 Index	
Plot of Cumulative Sum of Recursive Residuals	Plot of Cumulative Sum of Squares of Recursive Residuals
	

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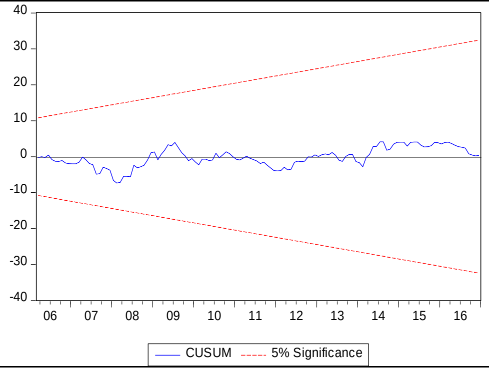
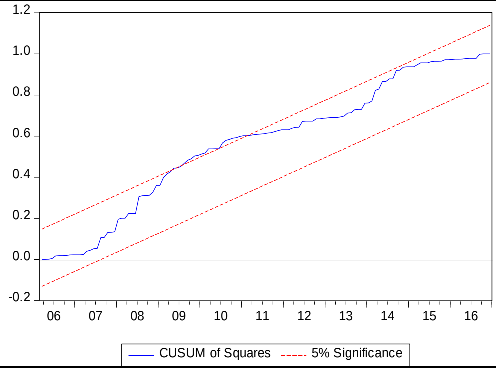
<tr><td>
</td><td>
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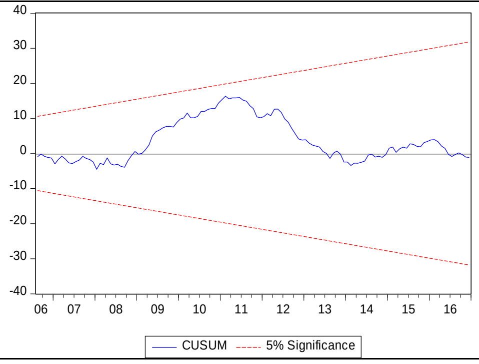
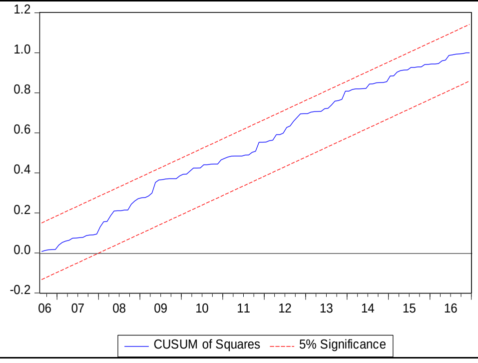
<tr><td>
</td><td>
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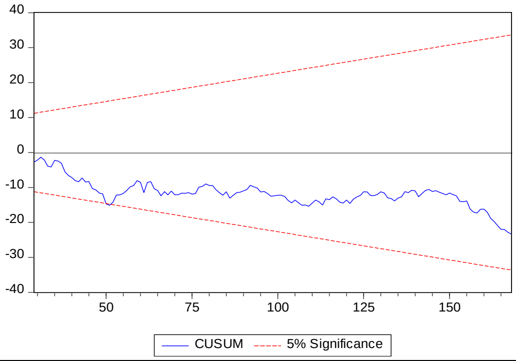
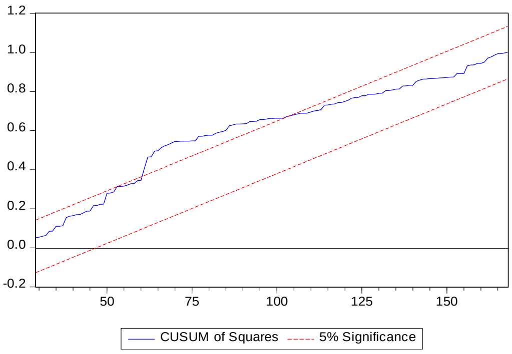
<tr><td>
</td><td>
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ISE Main Metal Index	
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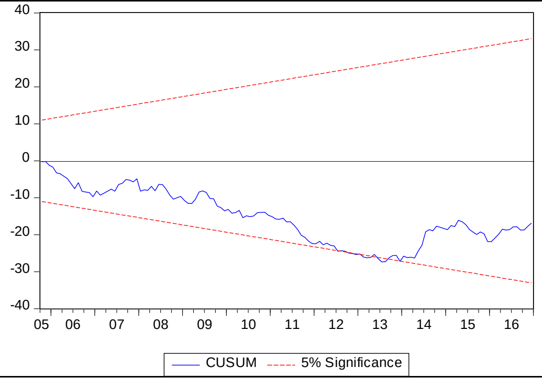	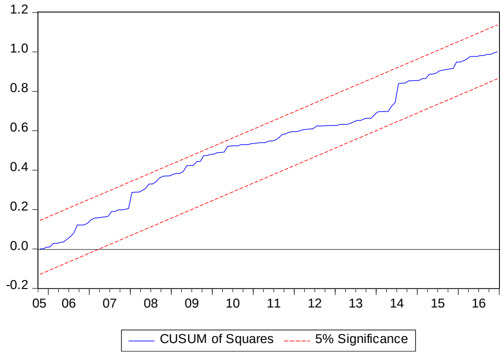

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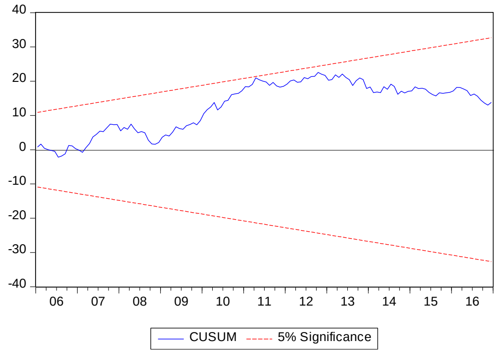	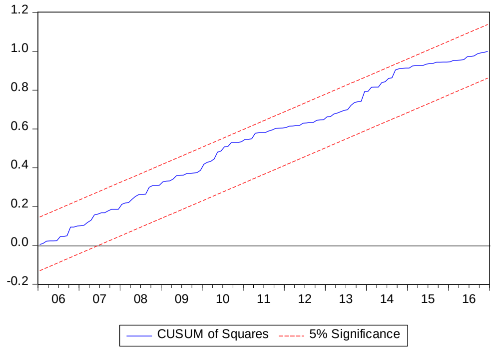

ISE Insurance Index	
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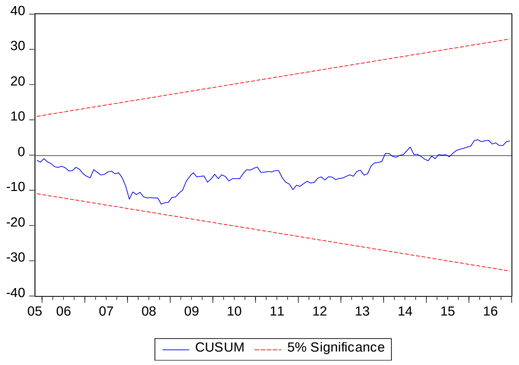	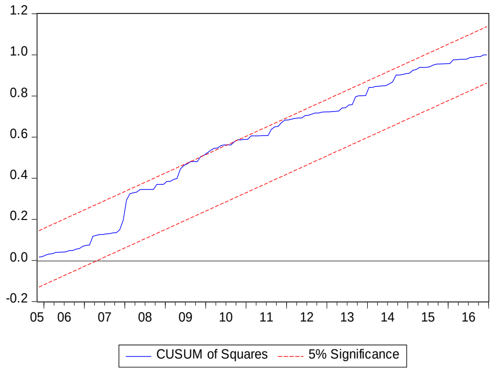

ISE Technology Index	
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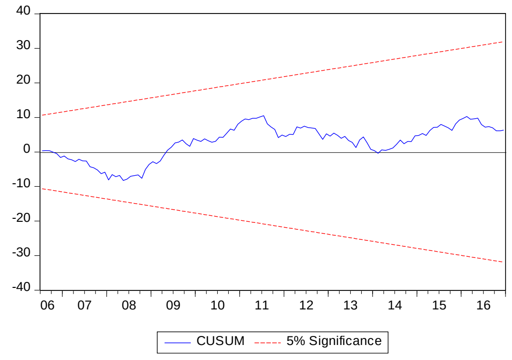
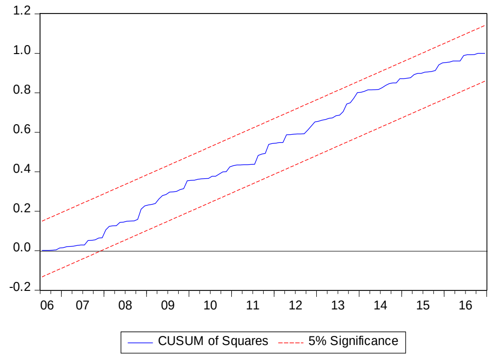
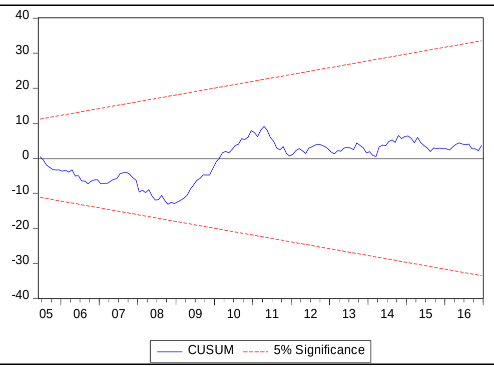
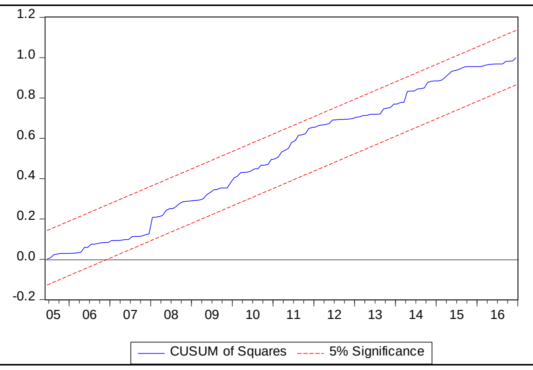
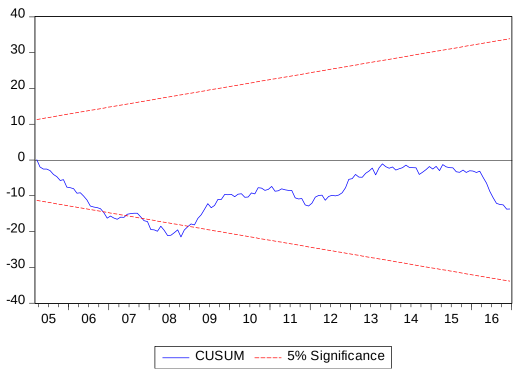
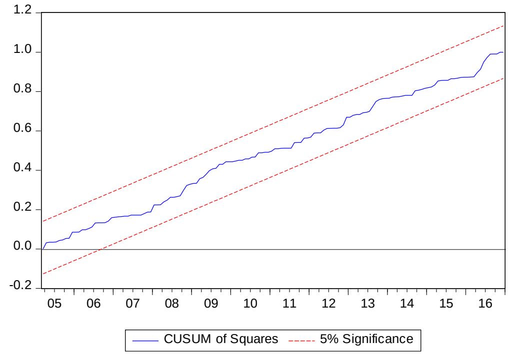
	

ISE Textile Index	
Plot of Cumulative Sum of Recursive Residuals	Plot of Cumulative Sum of Squares of Recursive Residuals
	

ISE Transportation Index	
Plot of Cumulative Sum of Recursive Residuals	Plot of Cumulative Sum of Squares of Recursive Residuals
	

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