Indian Journal of Economics and Business
Vol. 20 No. 3 (December, 2021)

http://www.ashwinanokha.com/IJEB.php

Asymmetric Nexus between Stock Price and Exchange Rate: Empirical Evidence through NARDL

Dr. Rabia Luqman[1], Datuk Dr Kasim Bin HJ. MD. Mansur[2], Mariashams Khakwani[3], Shanza Tabasum[4], & Dr Saadia Irshad[5]

[1]*Post-Doctoral Fellow at Universiti-Malaysia-Sabah (UMS), Malaysia/Lecturer, Department of Management Sciences, COMSATS Vehari Campus*

[2]*Professor of Economics at Faculty of Business, Economics and Accountancy*

Universiti Malaysia Sabah. Kota Kinabalu Sabah.

[3]*Lecturer, Institute of Management Sciences, The Women University, Multan, Pakistan.*

[4]*Lecturer, Department of Management Sciences, COMSATS University Islamabad, Vehari Pakistan*

[5]*Assistant Professor, Institute of Management Sciences, The Women University, Multan, Pakistan*

Corresponding Author: Datuk Dr Kasim Bin HJ. MD. Mansur, Email: Email: kmansur@ums.edu.my

Received: 18th August 2021
Revised: 19th September 2021
Accepted: 08th October 2021

Abstract: Symmetric relationship between currency and equity markets has gained much attention among academicians and policy makers in the recent era. Many studies conducted on this relationship have concluded that there is short-run relationship between these variables and foundless evidence about a long-run relationship. Moreover, all previous studies supposed the linear or symmetrical relationship between these variables. This study aims to investigate that either stock price affects the exchange rate and exchange rate affect the stock price. Daily data of stock indices and real exchange rate for 14 countries includes Canada, France, Germany, Italy, Japan, UK, USA, Russia, Brazil, China, India, Mexico and South Africa and Pakistan has been considered as sample data for this study.

Unit root test (ADF &PP), Johansen's Cointegration test, Error Correction Model and Granger Causality is applied to test the short and long run relationship between the variable of study. To check the symmetrical and asymmetrical relationship between currency and equity markets, linear and non-linear autoregressive distributed lag (ARDL) are applied. Results have shown that there are asymmetrical linkages between the currencyand equity markets.

Keywords: Unit root test (ADF &PP); Johansen's Cointegration; VECM; Asymmetric linkages; linear and non-linear autoregressive distributed lag (ARDL & NARDL)

1. Introduction

The global financial crisis has raised many questions concerning the future of global economic growth. One of the major global challenges is to find out possible ways to avoid such crisis in future. This challenge is further exacerbated because of the integration and interdependence of financial markets. Financial crisis in one economy creates similar results in other economies. Due to these high interdependence, markets have to suffer because such crisis are widely spread, among the economies of developed and under-developed regions. As a result of this volatility transmission between stock markets and exchange rates, financial markets are facing higher fluctuations in asset prices due to asymmetric information in emerging markets than those of developed markets. Volatility transmission produces instability in financial markets, hinders developments in emerging markets. Investors also exploit the markets by speculation about the abnormal profits which cause other investors to lose confidence in financial markets while they try to adjust their international portfolios. This also results in drastic decline in stock prices and thus followed by fluctuations in exchange rates of different economies. By such interaction among the financial markets, momentum effect are transmitted in one market to other.

Asymmetry phenomenon is mainly connected with nonlinearity as financial theory given by Bartram (2004). According to this theory, if companies' future cash flows follow nonlinear pattern of exchange rate then changes in foreign exchange rate will be nonlinear. As expected future cash flow does not flow at certain pattern, there is great uncertainty attached with future cash flows. So, companies also respond in different ways to absorb these changes in exchange rates by setting their market prices, amending their sales, product quantities and shift towards the new market share. Due to default risk, nonlinearity can be caused. If domestic currency depreciates then cost of production, which is based on imported raw material, will be increased. So, it would be difficult to pay for the domestic company but this will not the case if domestic currency is going to appreciate. This information of interdependence, symmetric and asymmetric relationship among the economies can be helpful for the investors and portfolio managers for efficient investment.

Investors are compensated against the risk that they bear in any security. This is the basic rule for all the models used for asset pricing. If investors bear the high risk then will earn the high profit. This risk is measured by the variation in the security's return and if two securities are having the same variation then they provide the same level of profit. But if one security variations are high among the other then it will provide the higher return as compared to other securities.

Pretorious (2002), Lin and Cheng (2008) concluded that stock market volatility can be considered as main determinant of correlations among the different economies and markets. Understanding transmission mechanism among the financial markets of different economies are important from the perspective of investors.

For risk management practices, portfolio managers have to forecast the expected volatility of different securities so one can invest efficiently and earn the highest return based on the expected forecast. If return's on securities are frequently changing over the time then security will be considered as risky. Investors speculate the expected return on the basis of volatility information about the security. Market participants, fund manager and investors deal with financial markets either at stock market or foreign exchange market. If one has the information about the expected returns then can better manage the risk and earn high profit. Financial markets are interdependent so if there is change in one market then it will lead the other market in either direction. To investigate the spillover among the financial markets is an important issue so investors can better manage their portfolios and earn highest returns. Therefore, the information regarding exchange rate and stock price volatility transmission becomes equally important for the academicians, as it is for the investors, policy makers and portfolio managers.

Policy makers are concerned about the transmission mechanism between these two markets because this may affect their decisions regarding the policies related to these markets. As stock price rises, it may increase the value of currency and in turn exchange rate will be appreciated as compared to other countries. In some cases, policy makers depreciate the value of currency which results in increasing exports. So, policy makers can better decide that which policy is favorable at the time of crisis and at normal times after knowing the transmission mechanism between these two markets (Dimitrova, 2005).

It is very important to predict about the crisis in future for the regulator i-e- central bank of respective country, because now crisis occur and spread all over the world due to interdependence between countries. Every country becomes affected. But if one country knows about the future crisis then it may take steps to overcome the problems that arise at the back of such crisis and do make policies to overcome those problems. Over the periods, there is increasing trend of equity investment among different countries. Therefore, Investors and investment companies invest in different countries and try to minimize the risk but due to interaction between markets, they also suffer from huge losses. Investors start speculations over the markets and earn the abnormal profits so other investors also lose confidence and start selling out the securities and this in turn result in the crash of markets. So, it is important to know about the shocks transmission mechanism between the markets (Kumar, 2010; Dimitrova, 2005).

MNC's are working at international levels and they suffer from such crisis because of globalized world. Multinational companies have to manage their cross border sale from different countries and have to tackle with the issues of capital budgeting, short term investment and long-term financing. They have to face the exposure from different economies and if they know about the mechanism that how shocks are transmitted and what are the effects of their magnitude, then it will be beneficial for them to earn the maximum profits.

To test the relationship between currency and equity market, there are two theoretical approaches. Flow oriented approach focuses on the balance of payment existing account. According to the theory, exchange rate changes have dynamic effects that can be transposed towards the trade balances of respective country.

Not only this, rather the firms whose products are traded through many countries also contributing in effecting the exchange rate. Because of confronting with transaction, translational and economic exposures. On the basis of this theory, it may be concluded that changes in exchange rates affect the stock prices of the companies(Dornbuschand Fisher, 1980).

Portfolio approach suggests that exchange rate changes due to changes in capital account. As stock prices of the firm rise, investors becomes more willing to buy the stocks and hence the demand for money increases. In result of increasing demand for money, interest rate increases and because capital inflow will be higher which lead to overall appreciation of domestic currency and vice versa. The latter situation may cause stock price to rise given low exchange rate. According to this approach, stock price changes will affect the exchange rates negatively (Kumar, 2010).This study aims to investigate the long-term relationship between currency and equity through Johansen's cointegration and short-term relationship through Vector Error Correction Method(VECM) and also emphasize on the causal relationship among the currency and equity market which is tested by the Granger Causality. Linear & Non-Linear ARDL are applied to check the symmetric and asymmetric relationship between currency and equity markets. Empirical results will also help in strengthening the theoretical background of the stock market and exchange rate relationship from the G8 plus 5 countries including Pakistan.

2. Literature Review

After implementation of floating exchange rate system, academicians in 1970s start to examine the volatility of exchange rate market and stock market and further to check the relationship among these markets. Studies were conducted on both emerged and emerging economies but no exact relationship is still confirmed. Relationship of stock market and exchange has been considered for achieving the profit and predictions are made on the basis of researches that has been done. According to flow approach by Dornbusch and Fisher (1980), exchange rate leads stock prices. Granger, Huang and Yang (2000) also studied that in South Korea exchange rate affects the stock price. According to portfolio approach, changes in stock prices affect the exchange rate. Tabak (2006) reported that stock prices led exchange rate with negative relationship. Stavarek (2004) resulted in unidirectional causality running from stock market prices to exchange rate.

The first study on the relation of stock price and exchange rate was conducted by Aggarwal (1981) and concluded that these variables had positive relationship. According to Solnik (1987) there is no statistical relationship among the variations of stock price and exchange rates. But on contrary, Soenen and Hennigar (1988) concluded that these variables had strong negative relationship. Jorion (1990) established a connection between exchange rate and stock prices. Another study conducted by Ma and Kao (1990) explained the different factors of a country as Imports and exports strength of a country and nature of economies. Bahmani, Oskooee and Sohrabian (1992) tested the relationship of these variables and found the positive relation between these two. Most of empirical studies at the starting time ignore the fact that variables are not stationary. This study checked the integration and causality among the variables and reported the bi-directional causality among the variables in short run. Many other researchers also studied the causality among these variables and showed the uni and bi-directional causality among different countries like Yu (1997) for Hong Kong, Tokyo and Singapore and Abdalla and Murinde (1997) for four Asian countries.

Other studies also conducted on this relation and supported the results as Granger et al. (2000); Nieh and Lee (2001) ; Smyth and Nandha (2003); Lean et al. (2013); Phylaktis and Ravazzolo (2005); Obben et al. (2006); Yau and Nieh (2006); Pan et al. (2007); Ismail and Isa (2009); Rahman and Uddin (2009); Kutty (2010); Zhao (2010); Alagidede et al. (2011); Lean et al. (2013); Lee et al. (2011); Eita (2012); Inegbedion (2012); Kollias et al. (2012); Tsai (2012); Wickremasinghe (2012); Abidin (2013); Buberkoku (2013); Khan et al. (2013) ; Boonyanam (2014) ; Caporale et al. (2016) ; Moore and Wang (2014) and Yang et al. (2021). All the given studies did not find the long-term relationship among the variables ut there are studies which reported the long-term relationship between these two variables like Richards et al. (2017); Yau and Nieh (2009); Tian and Ma (2010); Chortareas et al. (2011); Harjito and McGowan (2018); Parsva and Lean (2011) and Lin (2012). Groenewoldand Paterson (2013); Tsagkanos and Siriopoulos (2013); Unlu (2013); and Roy (2019).

Bahmani-Oskooee and Saha (2015) reviewed all the studies on the relation of currency and equity market and propose a new method to estimate the relation. All researches had the same assumption that currency market changes had symmetric effect on the equity market. If currency increase or decrease in value, it had the impact on stock price. According to Miller and Reuer (1998), if firms practice the risk management techniques to hedge the exposure of exchange rate like real options, then it will affect to firms in different way as currency appreciates or depreciates. This creates asymmetric effect due to hedging. If one is going to study in international scenario, they can find asymmetric changes in exchange rate. They concluded that Canada, Japan and Mexico currency appreciation and depreciation had the asymmetric effect on stock returns for these countries.

According to (Obben, Pech & Shankur, 2006), there exists bi directional causality among the vaiables by applying the VAR approach on the sample data of New Zealand. Same relationship has been proved by applying the data of Bangladesh, Sri Lanka, Taiwan and Japan (Yau&Nieh, 2009). Granger causality has been applied in 13 countries by using the same variables from 1997 to 2012. Results has been proved that stock market causes the exchange rate in some countries and in other countries exchange rate causes the stock market. Due to the impact of financial crisis, relationship among these variables has been changes and shows no long run relationship among the stock market and exchange rate by using the seven countries data from 1988 to 1998 (Pan *et al.*, 2018). Same conclusions have been drawn by Ismail and Isa (2009); Rahman and Uddin (2009); Kutty (2010); Zhao (2010); Alagidede, Panagiotids and Zhang (2017); Wickremasinghe (2012); Buberkoku (2013); and Unlu (2013) by using Johansen cointegration test and Granger Causality test.

From the last decade, many researches have been conducted on the relationship between exchange rate and stock price by using the causality test. Researches has been conducted to test the long run relationship by using the Johansen cointegration test and short run test by using the Granger causality test.Bahmani-Oskooee and Sohrabian (1992) test the long run and short run relationship among the stock market and exchange rate by using the cointegration and Granger causality test.VECM (vector error correction model) has been applied by using the less developed countries i-e- India, Korea, Pakistan, and Philippines and concluded the unidirectional link between the exchange rate and stock market. In India there is unidirectional relationship found but in case of Philippines there exist no relationship among the variables Sohrabian (1992). Other researchers also supported the results of Bahmani-Oskooee and Sohrabian (1992) and Sohrabian (1992) and concluded that there exists no long run relationship among the variables by using the G-7 economies Nieh and Lee (2001). Phylaktis and Ravazzolo (2005) concluded that there exists no long run relationship by using the sample data of six Pacific Basin countries. Abdelaziz et al. (2008) examined the relationship among the stock indices and exchange rate and found no support for cointegration between the variables.

There are studies that used the international data to test the relationship among stock market and exchange rate like Zhao (2010) employed the monthly data and used VAR and MGARCH model to test the volatility of these variables and concluded that if there comes change in stock market then it will affect the

exchange rate volatility as well. Kutty (2010) also concluded that exchange rate was led by the stock price and there is no cointegration vector among these variables. Abdulla et al; (2017) examined the same relationship and found the unidirectional causality that exchange rate granger cause stock price. Sinha et al; (2019) employed the OLS regression to test the relationship among the stock market and exchange rate and concluded the negative relationship among the variables. Basher, Haug & Sadorsky (2012) employed the VAR model to check the association among the variables and resulted that stock prices lead the exchange rate as stock price changes then exchange rate will also be affected. Agrawal, et al; (2010) and Abdalla et al; (2012) examined the relationship and concluded with the negative association between the variables by using the granger causality test.Rahman et al; (2009) tested the relationship and found no causal association among the variables by using the granger causality test.

Apergis and Rezitis (2001) supported the asymmetric effect between currency and equity market. Moreover, asymmetry phenomenon is mainly connected with nonlinearity as financial theory given by Bartram (2004), According to this theory, if companies' future cash flows follow nonlinear pattern of exchange rate then changes will be in foreign exchange rate will be nonlinear. As expected future cash flow doesn't flow the certain pattern, there is great uncertainty attached with future cash flows then companies also respond in different ways to absorb these changes in exchange rates by setting their market prices, amending their sales and product quantities and shift towards the new market share. Due to default risk, nonlinearity can be caused. If domestic currency depreciates then cost of production which is based on imported raw material will be increased so it would be difficult to pay for the domestic company but this will not the case if domestic currency is going to appreciate. Bartram (2004) studied both symmetric and asymmetric relationship between currency and equity markets and concluded that there exists asymmetric relation between these variables. Koutmos and Martin (2003) also confirmed the asymmetric relationship. Though there are studies that didn't find the asymmetric linkages as Hsu, Yau, and Wu (2009). Some studies focused on short run and long run effects by using the asymmetry cointegration, error-correction method and bounds testing approach which is given by Pesaran, Shin, and Smith's (2001) in which variables included in analysis can be stationary at different order are Shin, Yu, and Greenwood-Nimmo (2014) and Cuestas and Tang (2015).

Shin et al. (2014) apply the Nonlinear Autoregressive Distributed Lag (NARDL) method to check the short and long run effects of exchange rate and stock price. Bahmani-Oskooee and Saha (2015) studied the asymmetric effects by using the US data as sample and suggested to apply at other countries. Bahmani-Oskooee and Saha (2016) apply the same bivariate model for the nine countries to check the both symmetric and asymmetric effect between the equity market and currency market. Bahmani-Oskooee and Saha (2017) apply the nonlinear ARDL to check the asymmetries between the exchange rate and stock price by using the monthly data for 24 countries included in the sample. The main objective is to check the long term and short run relationship and checking the symmetric and asymmetric effect between these two variables and simple linear ARDL is applied for the symmetric effect and Nonlinear ARDL is applied for checking the asymmetric effect. Sample countries are G-8 Countries (Canada, France, Germany, Italy, Japan, UK, USA and Russia), five emerging economies (Brazil, China, India, Mexico and south Africa) and Pakistan for this study. There is no study conducted for daily data by using these countries.

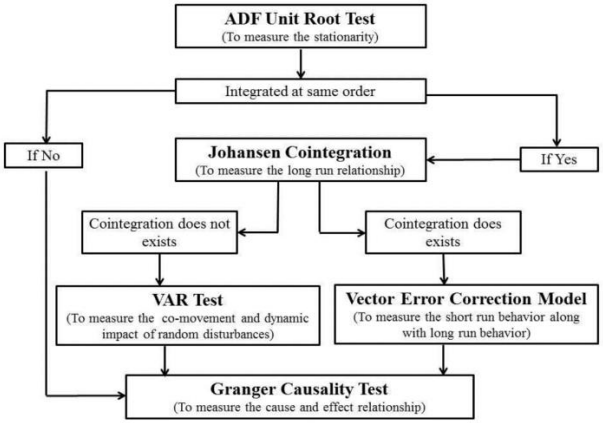
3. The models and methods

Daily data of exchange rate and stock indices will be used to check the relationship among the variables for the sample countries i-e- G-8 Countries (Canada, France, Germany, Italy, Japan, UK, USA and Russia), five emerging economies (Brazil, China, India, Mexico and South Africa) and Pakistan. ADF and Ng-Perron Test for Unit Root, Johansen Cointegration test, Vector Error Correction Model (VECM) and Granger causality test will be applied to check the long run and short run relationship for the selected countries. Equationsare given in Table 1:

Table 3.1: Methods and Formula

Sr.N	*Methods Employed*	*Formula Used*	*Purpose*
1	Unit Root Tests(ADF)	$\Delta Y_t = \delta Y_{t-1} + \sum_{i=1}^{k} \beta_i \Delta Y_{t-i} + u_t$ $\Delta Y_t = \alpha_0 + \delta Y_{t-1} + \sum_{i=1}^{k} \beta_i \Delta Y_{t-i} + u_t$ $\Delta Y_t = \alpha_0 + \alpha_1 t + \delta Y_{t-1} + \sum_{i=1}^{k} \beta_i \Delta Y_{t-i} + u_t$	It is used to check whether the dataselected for this study are stationary ornon-stationary.
2	Unit Root Tests (*Ng-Perron Test)*	$\Delta \tilde{y}_t = \sum_{i=0}^{p} \alpha_i t^i + \delta \tilde{y}_{t-1} + \sum_{i=1}^{k} \beta_i \Delta \tilde{y}_{t-i} + u_t$	It is used to check whether the dataselected for this study are stationary ornon-stationary.
3	Johansen's Cointegration Test	Trace Test Statistic $\lambda_{trace}(r) = -T \sum_{i=r+1}^{n} \ln(1 - \lambda_i)$ Maximum Eigenvalue Test Statistic $\lambda_{max(r,r+1)} = -T \ln(1 - \lambda_{r+1})$	It is applied to test the presence oflong-run equilibrium relationshipbetween the selected time series data.
4	Granger Causality Test	$y_t = \alpha_0 + \sum_{i=1}^{m} a_i y_{t-i} + \sum_{j=1}^{n} \beta_j x_{t-1} + \varepsilon_t$ $x_t = \omega_0 + \sum_{i=1}^{m} \gamma_i y_{t-i} + \sum_{j=1}^{n} \theta_j x_{t-1} + \varepsilon_t$	It is applied to find the direction ofcausality and short-run relationshipbetween selected time series data.

Figure 3.1: Flow Diagram of Research Methodology



Source: (Attari, M. I. J. etal 2014)

To check the long run relationship between the stock price indices and real exchange rate, following equation is used as given by Bahmani-Oskooee and Sohrabian (1992):

$$\mathrm{LnSP_t} = \alpha + \beta \mathrm{LnEX_t} + \varepsilon_t \qquad (1)$$

β slope coefficient will be statistically significant if residuals of equation 1 are stationary at order less than the variables given in the equation. If variables are stationary at order 1 then residual must be stationary at level that also indicate that there is long term integration between the variables Engle and Granger (1987). To check the short run integration, error correction model can be applied as following:

$$\Delta \mathrm{LnSP_t} = \alpha + \sum_{i=1}^{n} \beta_i \Delta LnSP_{t-i} + \sum_{i=0}^{n} \delta_i \Delta LnEX_{t-i} + \lambda \varepsilon_{t-1} + \mu_t \quad (2)$$

By the equation 1, we can obtain the error correction variable; the slope of the ECM must be negative and significant to confirm that there is short run relationship between the variables. That also indicates the speed of adjustment towards the long run relationship Banerjeeet al. (1998). When order of integration is not same of all variables then use the lagged variables as proposed by Pesaran et al. (2001).

$$\Delta LnSP_t = \alpha + \sum_{i=1}^{n} \beta_i \Delta LnSP_{t-i} + \sum_{i=0}^{n} \delta_i \Delta LnEX_{t-i} + \lambda_1 LnSP_{t-1} + \lambda_2 LnEX_{t-1} + \mu_t \quad (3)$$

F-test used to check the joint significance of all variables included in the equation 3. By this equation, both short run and long run effects between the variables can be measured. To check the asymmetries, we have to make separate series for appreciation and depreciation as given by Bahmani-Oskooee and Saha (2015, 2016). Series of exchange rate will be divided in its positive movements or appreciation as indicated by POS^EX and negative movements or depreciation as indicated by NEG^EX are given as follows:

$$POS_t^{EX} = \sum_{j=1}^{t} \Delta LnEX_j^{+} = \sum_{j=1}^{t} \max\left(\Delta LnEX_j, 0\right) \quad (4)$$

$$NEG_t^{EX} = \sum_{j=1}^{t} \Delta LnEX_j^{-} = \sum_{j=1}^{t} \min\left(\Delta LnEX_j, 0\right) \quad (5)$$

To check the impact of positive and negative movements of one variable on other variable, equation 3 will be transformed as:

$$\Delta LnSP_t = \alpha + \sum_{i=1}^{n} \beta_i \Delta LnSP_{t-i} + \sum_{i=0}^{n} \delta_i^1 \Delta POS_{t-i}^{EX} + \sum_{i=0}^{n} \delta_i^2 \Delta NEG_{t-i}^{EX} + \lambda_1 LnSP_{t-1} + \lambda_2 POS_{t-1}^{EX} + \lambda_3 NEG_{t-1}^{EX} + \mu_t \quad (6)$$

Due to nature of variables of POS^EX and NEG^EX, Linear ARDL model is now converted in Non-Linear ARDL. By using this model, we can check the asymmetries as positive and negative changes have same effect or the different impact on stock prices Shin et al. (2014).

We can change the dependent variable to check the asymmetric impact of stock prices on exchange rate. Linear ARDL and Non-Linear ARDL model can be described as following:

$$\Delta LnEX_i = \alpha + \sum_{i=1}^{n} \beta_i \, \Delta LnEX_{t-i} + \sum_{i=0}^{n} \delta_i \Delta LnSP_{t-i} + \lambda_1 LnEX_{t-i} + \lambda_2 LnSP_{t-1} + \mu_t \quad (7)\, \Delta LNEX_t$$

$$= \alpha + \sum_{i=1}^{n} B_i \, \Delta LNEX_{t-i} + \sum_{i=0}^{n} \delta_i^1 \Delta POS_{t-i}^{SP} + \sum_{i=0}^{n} \delta_i^2 \Delta NEG_{t-i}^{SP} + \lambda_1 LnEX_{t-1} + \lambda_2 POS_{t-1}^{SP} + \lambda_3 NEG_{t-1}^{SP} + \mu_t \quad (8)$$

In these equations, series of stock price is divided in partial sums of positive and negative changes. They are created by using the same formula as used by equation 4. Error-correction models (3) and (5) as well as (6) and (7) are estimated in the next section for each of the 14 countries in our sample.

4. Empirical Results

4.1 Unit Root Test

Dickey and Fuller (1979) and Phillips and Perron (1988) test applied to check the stationary of sample data and results have shown that all series of stock indices and exchange rate for 14 sample countries are non-stationary at level but both series are stationary at first difference with one percent significance level. These results are supported by Sinha et al; (2015) and Nieh et al; (2001). Results are given in following tables:

Table 4.1: Unit Root Analysis Stock Price

Countries	Level ADF test statistics	1st Difference ADF test statistics	Level PP test statistics	1st Difference PP test statistics
BRAZIL	-1.389	-68.838***	-1.307	-69.034***
CANADA	-1.320	-32.139***	-1.173	-66.801***

CHINA	-1.961	-30.475***	-1.892	-63.589***
FRANCE	-2.498	-68.845***	-2.266	-69.683***
GERMANY	-0.641	-66.308***	-0.563	-66.369***
INDIA	-0.438	-63.242***	-0.363	-63.161***
ITLAY	-2.271	-68.544***	-2.248	-68.576***
JAPAN	-1.802	-68.749***	-1.730	-68.792***
MEXICO	-2.929	-2.929***	-2.538	-58.901***
PAKISTAN	-0.150	-67.081***	0.318	-69.331***
RUSSIA	-1.614	-65.253***	-1.586	-65.276***
UK	-2.352	-42.306***	-2.098	-69.351***
USA	-0.044	-71.198***	0.113	-71.570***
SOUTH_AFRICA	-2.375	-5.559***	-2.405	-5.557***

Table 4.2: Unit Root Exchange Rate

Countries	**Level ADF test statistics**	**1st Difference ADF test statistics**	**Level PP test statistics**	**1st Difference PP test statistics**
BRAZIL	-0.453	-51.120***	-0.5406	-65.132***
CANADA	-1.394	-75.666***	-1.371	-76.068***
CHINA	-1.327	-34.989***	-1.330	-71.278***

FRANCE	-1.615	-65.595***	-1.632	-65.595***
GERMANY	-1.615	-65.595***	-1.632	-65.595***
INDIA	-0.187	-12.832***	0.074	-68.857***
ITLAY	-1.615	-65.595***	-1.632	-65.595***
JAPAN	-1.353	-54.370***	-1.417	-81.714***
MEXICO	0.044	-70.262***	0.176	-70.521***
PAKISTAN	-0.182	-12.592***	-0.426	-119.335***
RUSSIA	-0.928	-9.255***	-0.200	-69.922***
UK	-0.549	-49.907***	-1.181	-64.312***
USA	-1.154	-64.348***	-1.293	-67.088***
SOUTH_AFRICA	-1.298	-67.089***	-0.356	-68.813***

4.2 Johansen's Cointegration Test

Johansen (1988) and Johansen & Juselius (1991) has given this test to check the long run relationship among the variables. Because all series are integrated at order one so we can apply cointegration test to further examine the long run relationship. Results on the basis of trace test statistics and maximum eigenvalue shows that null hypothesis is rejected which means that both study variables are long term correlated. Trace and maximum eigenvalue test values are greater than their critical values which shows that there is long term association between the variables and these variables can be predicted on the basis of their past values. You & Nieh (2006) also supported the results but Rahman & Uddin (2009) gave the contradictory results as they do not find any long run relationship among these variables.

Table 4.3: Cointegration Analysis

Country	No. of Hypothesized CE(s)	Trace Test			Maximum Eigenvalue Test		
		Test Stat	Crit. Value	Prob**	Test Stat	Crit. Value	Prob**
BRAZIL	None	1700.172	12.32090	0.0000	865.3483	11.22480	0.0001
	At Most 1	834.8241	4.129906	0.0001	834.8241	4.129906	0.0001
CANADA	None	1800.566	12.32090	0.0000	938.1313	11.22480	0.0001
	At Most 1	862.4347	4.129906	0.0001	862.4347	4.129906	0.0001
CHINA	None	1454.065	12.32090	0.0000	750.6695	11.22480	0.0001
	At Most 1	703.3951	4.129906	0.0001	703.3951	4.129906	0.0001
FRANCE	None	1743.285	15.49471	0.0000	948.3556	14.26460	0.0001
	At Most 1	794.9294	3.841466	0.0001	794.9294	3.841466	0.0000
GERMANY	None	1684.481	12.32090	0.0000	891.1038	11.22480	0.0001
	At Most 1	793.3777	4.129906	0.0001	793.3777	4.129906	0.0001
INDIA	None	1729.871	12.32090	0.0000	912.6267	11.22480	0.0001
	At Most 1	817.2442	4.129906	0.0001	817.2442	4.129906	0.0001
ITLAY	None	1651.576	12.32090	0.0000	853.8429	11.22480	0.0001
	At Most 1	797.7331	4.129906	0.0001	797.7331	4.129906	0.0001
JAPAN	None	1726.045	12.32090	0.0000	903.0947	11.22480	0.0001
	At Most 1	822.9504	4.129906	0.0001	822.9504	4.129906	0.0001

MEXICO	None	1915.478	12.32090	0.0000	1005.546	11.22480	0.0001
	At Most 1	909.9320	4.129906	0.0001	909.9320	4.129906	0.0001
PAKISTAN	None	2327.148	12.32090	0.0000	1423.621	11.22480	0.0000
	At Most 1	903.5272	4.129906	0.0001	903.5272	4.129906	0.0001
RUSSIA	None	1785.867	12.32090	0.0000	918.1238	11.22480	0.0001
	At Most 1	867.7431	4.129906	0.0001	867.7431	4.129906	0.0001
UK	None	1785.082	12.32090	0.0000	946.5045	11.22480	0.0001
	At Most 1	838.57764	.129906	0.0001	838.5776	4.129906	0.0001
USA	None	1671.600	12.32090	0.0000	888.7812	11.22480	0.0001
	At Most 1	782.8189	4.129906	0.0001	782.8189	4.129906	0.0001
SOUTH_AFRICA	None	2646.926	12.32090	0.0000	1779.128	11.22480	0.0000
	At Most 1	867.7981	4.129906	0.0001	867.7981	4.129906	0.0001

4.3 range r Causality Test

Test is used to check the causal relationship among the variables and to further examine that either one variable can be used to forecast the other variable. Results have shown that there is unidirectional causality exists among some countries but there is no evidence of bi directional causality among the variables. Uni-directional Causality exists in Brazil, India and USA from stock price to exchange rate. But from exchange rate to stock price causality also exists for the Japan. Canada, France, Germany, Italy, UK, Russia, China, Mexico and Pakistan show no causality among the study variables. These results are also supported by Kutty (2010) and Pan et al. (2007). But some studies provide the contradictory results as Granger et al. (2000) and Bahmani Oskooee & Sohrabian (1992). Results for the granger causality test are given in table

Table 4.4: Causality Analysis

Pairwise Granger Causality Tests

Null Hypothesis:	Obs	F-Statistic	Prob.
BRAZIL ER does not Granger Cause DBRAZIL_SP	4426	0.22013	0.8024
DBRAZIL_SP does not Granger Cause DBRAZIL		26.4136	4.E-12
DCANADA does not Granger Cause DCANADASP		0.24829	0.7801
DCANADASP does not Granger Cause DCANADA		0.13737	0.8716
DCHINA does not Granger Cause DCHINASP		0.39766	0.6719
DCHINASP does not Granger Cause DCHINA		0.32109	0.7254
DFRANCE does not Granger Cause DFRANCESP		0.34469	0.7085
DFRANCESP does not Granger Cause DFRANCE		0.06901	0.9333
DGERMANY does not Granger Cause DGERMANYSP		0.03197	0.9685
DGERMANYSP does not Granger Cause DGERMANY		0.5282	0.63843
DINDIA does not Granger Cause DINDIASP		1.32177	0.2668
DINDIASP does not Granger Cause DINDIA		3.18437	0.0415
DITLAY does not Granger Cause DITLAYSP		0.16341	0.8493

DITLAYSP does not Granger Cause DITLAY	0.54335	0.5808
DJAPAN does not Granger Cause DJAPANSP	4.64203	0.0097
DJAPANSP does not Granger Cause DJAPAN	1.59993	0.2020
DMEXICO does not Granger Cause DMEXICOSP	1.33277	0.2639
DMEXICOSP does not Granger Cause DMEXICO	1.66342	0.1896
DPAKISTAN does not Granger Cause DPAKISTANSP	0.26977	0.7636
DPAKISTANSP does not Granger Cause DPAKISTAN	0.01851	0.9817
DRUSSIA does not Granger Cause DRUSSIASP	0.49331	0.6106
DRUSSIASP does not Granger Cause DRUSSIA	0.28887	0.7491
DUK does not Granger Cause DUKSP	0.65414	0.5199
DUKSP does not Granger Cause DUK	1.01173	0.3637
DUSA does not Granger Cause DUSASP	0.38189	0.6826
DUSASP does not Granger Cause DUSA	18.4097	1.E-08

4.4 Long run estimates

Long run estimates for stock indices and exchange rate and given and shows that stock indices of Canada, France, Germany, Italy, Japan, UK, USA, Russia, Brazil, China, India, Mexico, South Africa and Pakistan has long term statistically significant relationship with real exchange rate of all these countries. Stock

indices of Brazil, China, Canada, France, Italy, UK and USA have negative significant relationship and all other counties are having the positive statistically significant relationship.

Table 4.5: Long run estimates

	Brazil	China	India	Mexico	South Africa	Pakistan	Canada
CONSTANT	75086.60***	6890.091*	-23325.23*	17128.80*	50296.57*	-38403.95*	22846.66*
ER	-14619.46****	-626.109***	749.024***	2106.868***	0.362***	686.057**	-9628.912***

	Germany	Italy	Japan	UK	USA	Russia	France
CONSTANT	5033.804*	41765.05*	2273.734*	5914.022*	15838.97*	392.030*	6073.705*
ER	1353.288***	-13608.03***	101.587***	-177.187***	-40.529***	24.327***	-1461.909***

(10% level is identified by * and at the 5% level by ** and 1% by ***)

4.5 Vector error correction model (VECM)

Vector error correction model (VECM) is applied to check the short run relationship between the stock indices and real exchange. ECM shows the speed of adjustment and it is negative and statistically significant in all the countries that shows that these two variables are having the short run relationship and having short term cointegration between these two variables. Table 5 shows the results of Vector error correction model (VECM).

Table 4.6: Vector Error Correction Method

	Brazil	China	India	Mexico	South Africa	Pakistan	Canada
CONSTANT	11.980*	0.404*	5.043*	4.344*	-0.096*	10.213*	1.559*
ECM (-1)	-0.06**	-0.001***	-0.003***	-0.003***	-0.368***	-0.01***	-0.002***

	Germany	Italy	Japan	UK	USA	Russia	France
CONSTANT	0.847*	-5.592*	0.049*	5914.544*	1.931*	0.409*	0.847*
ECM (-1)	-0.004***	-0.001***	-0.001***	-0.997***	-0.001***	-0.001***	-0.004***

(10% level is identified by * and at the 5% level by ** and 1% by ***)

Then to check the symmetric and short run relationship Linear Auto Regressive distributed lag (ARDL) is applied.

Table 4.7: ARDL DEPENDENT VARIABLE: Stock price

Variables	Brazil	China	India	Mexico	South Africa	Pakistan	Canada	France	Germany	Italy	Japan	UK	USA	Russia
SP(-1)	0.946*	1.049*	1.051*	1.182*	0.712*	0.990*	0.946*	0.959*	1.003*	0.968*	0.966*	0.961*	0.925*	1.017*
SP(-2)	0.052*	-0.105*	-0.066*	-0.294*	-0.170*	0.013*	0.052**	0.005*	-0.006**	0.029*	0.028*	-0.014*	0.042*	-0.022*
SP(-3)	-0.050*	0.108*	0.004*	-0.002*	0.225*	0.019*	-0.050*	-0.013*	0.018*		-0.022*	0.003*	0.045*	-0.003
SP(-4)	0.051	-0.053	0.009*	0.111	-0.241	-0.025*	0.051	0.045	-0.007*		0.025	0.047	-0.0124*	0.006
ER	-516.217*	73.850*	9.688	78.586**	38.878*	-0.289**	-5168.217*	631.730**	5.043*	15.363**	0.140**	575.917**	-19.730**	-0.175*
ER(-1)	548.354**	2.334**	19.115**	-122.58**	-11.080***	-0.099**	5438.354**	-562.986*	53.295*		10.300*	-691.94*	20.837*	-0.363**

ER(-2)	-989.918*	4.565**	28.669**	-71.507*	101.351	9.116**	-989.918*	-134.382**	-51.912*		-12.135**	101.143**	-4.178*	0.968**

Variables	Brazil	China	India	Mexico	South Africa	Pakistan	Canada	France	Germany	Italy	Japan	UK	USA	Russia
ER(-3)	440.491**	-85.540	-32.728	100.816*	-75.525	-7.272	440.491*	62.125	-168.796		8.275*	-21.625	0.739	1.597
ER(-4)	299.660	38.719*	13.831	18.969*	36.783	0.124*	299.661	3.873	171.858*		-6.591	34.641*	2.215	-1.981*
C	-11.972*	10.048**	-6.707	98.138*	239.51*	-85.220**	-11.975*	7.903*	-7.447**	10.572*	18.742**	14.433**	12.212**	0.640*
R Square	0.998	0.997	0.999	0.996	0.441	0.999	0.998	0.995	0.998	0.998	0.996	0.991	0.998	0.998
F Stats	353270.2	188.4	806.1	135.9	387.24	556.7	350.2	1164.7	2856.9	7731.8	162306.3	95887.73	27131.6	320609.2
F (Prob)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

(10% level is identified by * and at the 5% level by ** and 1% by ***)

In table 4.7 stock indices are taken as dependent variable and results have shown that stock indices depend on its lagged terms and also have short run relationship with exchange rate in all sample countries

Table 4.8: ARDL DEPENDENT VARIABLE: Exchange Rate

SP	-6.7E-06*	-3.67E-07*	1.31E-05*	1.61E-07*	-1.10E-06*	2.89E-07*	1.06E-07**	1.02E-05**				1.33E-05*	-0.000267*	5.78E-06*
SP(-1)	2.50E-06*8		-4.2E-05**					-1.04E-05**	-5.99E-08**	-7.24E-09*	7.11E-06*	-1.34E-05*	-8.43E-05*	
SP(-2)	4.21E-06*		6.36E-05**										0.003**	
SP(-3)			-3.33E-05*											
ER(-1)	1.075**	0.927**	0.962**	0.943***	0.966*	0.481*	0.870*	0.998*	0.990*	0.998*	0.792*	1.034*	0.999*	0.949*
ER(-2)	-0.097*	0.098*	-0.046	0.023	-0.015*	0.154	0.129*				0.149*	-0.041		-0.007*
ER(-3)	0.093*	0.073	0.083*	0.0327*	0.018	0.205*					0.055	-0.022*		0.015*
ER(-4)		-0.100*			0.026*	0.158*						0.029*		0.041
C	0.0015*	0.003**	0.024*	-0.001*	0.058*	0.036*	-0.001*	0.002*	0.001*	0.001*	0.100*	0.002*	0.007*	0.007*
R Square	0.997	0.999	0.999	0.998	0.997	0.999	0.998	0.998	0.998	0.998	0.997	0.997	0.998	0.998
F Stats	361934.6	6563187	729431.2	562696.6	413609.4	123025	1010879	788714	1175828	117554	387782.1	255209.2	792247.5	638360.3
F (Prob)	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000

(10% level is identified by * and at the 5% level by ** and 1% by ***)

In table 4.8 *exchange rates are taken as dependent variable and show that exchange rate can also be predicted by its lagged term. If exchange rate changes that will also lead towards the* change in stock price in short run.

Table 4.9: NARDL DEPENDENT VARIABLE: EXCHANGE RATE

Variables	Brazil	China	India	Mexico	South Africa	Pakistan	Canada	France	Germany	Italy	Japan	UK	USA	Russia
dER(-1)		-0.076*	-0.033*		-0.031*	-0.530*	-0.141*				-0.205*	0.0346*		-0.057*
dER(-2)		0.059*	-0.088*		-0.049*	-0.396*					-0.050*			-0.058*
dER(-3)		0.094*	0.024*		-0.027*	-0.203*						-0.026*		-0.043*
dER(-4)		0.021*				-0.090*								-0.033*
ER(-1)	-0.004*	0.002*	-.001*	0.042*	-.008*	0.087*	0.003*	o.0.47*	-1.50*	-0.087*	0.043*	-0.079*	-0.048*	-0.007*
ER(-2)	-0.074*								1.74*					
ER(-3)									1.58*					
ER(-4)	0.043*						0.05*		-1.89E-15*					
POS(SP)	-9.59E-05*	5.60E-06*		6.987**			1.08E-07***	1.07E-18**	-3.03E-19**			1.52E-05**	-0.005**	
POS(SP-1)		-3.78E-06*	-1.16E-06*	5.879**		1.03E-06**		9.28E-19**	-3.04E-19*	-2.02E-08*	0.005**	-1.38E-05**	-0.004*	-3.00E-05*
POS(SP-2)		-3.77E-06*			2.73E-06*			-5.98E-18	-2.86E-19*				0.087	
POS(SP-3)								5.36E-18	-1.06E-18*			-1.04E-05*		
POS(SP-4)		3.65E-06						-1.38E-18*	1.96E-18		-0.037	8.98E-06*		
NEGSP	0.006**			1.68**			1.09E-	-1.17E-	1.32E-					

							07*	18*	19*					
NEGSP(-1)		-1.99E-06*	-4.91E-05*	1.12*	-7.88E-06*	1.32E-06*		8.67E-19*	-1.05E-18*	-1.92E-08*	9.80E-05*	-1.12E-08*	-0.007*	-3.32E-05**
NEGSP(-2)	-0.023*		9.84E-05*					4.90E-18*	3.26E-18*		-0.009*			
NEGSP(-3)			-5.08E-05*					-8.81E-18*	-3.38E-18*		0.070*		0.034**	
NEGSP(-4)					1.06E-05			4.21E-18	1.05E-18				-0.069	
C	0.027*	-0.002	0.074*	0.089	-0.004*	0.986	-0.4378	-6.94E-17*	1.98E-16	0.001*	0.364	0.013	0.123*	0.035
F STAT	31.236	8.539	6.422	6.980	3.122	4.987	8.986	4.28E+29	4.22E+29	1.198	25.763	4.106	5.650	5.852
F prob	0.000	0.000	0.000	0.000	0.003	0.000	0.000	0.000	0.000	0.309	0.000	0.000	0.000	0.000

(10% level is identified by * and at the 5% level by ** and 1% by ***)

4.6 NONLINEAR ARDL: Exchange Rate

In Table 09results are shown from the nonlinear ARDL estimation, taking the exchange rate as dependent variable and asymmetric changes in stock prices are observed by taking negative and positive series for all sample countries. Wald test is applied to check the asymmetric impact of stock prices on exchange rate. Results have shown that there is asymmetric impact on exchange rate by positive and negative changes in stock prices. Short run asymmetric impact of stock price changes on exchange rate are significant among all the countries Canada, France, Germany, Italy, Japan, UK, USA, Russia, Brazil, China, India, Mexico and South Africa and Pakistan at different lag orders. Wald test results have shown that positive and negative coefficients have different impact on exchange rate in all sample countries.

4.7 NONLINEAR ARDL: Stock Price

In Table 4.10 results are shown from the nonlinear ARDL estimation, first taking the stock price as dependent variable and asymmetric changes in exchange rate changes are observed by taking negative and positive series for all sample countries. Wald test is applied to check the asymmetric impact of exchange rate on stock prices. Results have shown that there is asymmetric impact on stock prices by positive and negative changes in stock prices. Short run asymmetric impact of exchange rate changes on stock prices are significant among all the countries Canada, France, Germany, Italy, Japan, UK, USA, Russia, Brazil, China, India, Mexico and South Africa and Pakistan at different lag orders. Wald test results have shown that positive and negative coefficients have different impact on stock prices in all sample countries.

Table 4.10: NARDL DEPENDENT VARIABLE: Stock price

Variable	Brazil	China	India	Mexico	S-Africa	Pakistan	Canada	France	Germany	Italy	Japan	UK	USA	Russia
SP(-1)	-0.088***	-0.094**	-0.010**	-0.008**	-0.513**	-0.008**	-0.004**	-0.002**	-0.003**	-0.002**	-0.002**	-0.004**	-0.003**	-0.001**
DSP (-1)	-0.074*	0.048*	0.052*	0.185*	0.205***			-0.037*		-0.028*	-0.032*	-0.036*	-0.072*	
DSP (-2)		-0.050*		-0.108	0.054*		-0.032*	-0.032				-0.049*	-0.033	
DSP (-3)	-0.046	0.050*		-0.110*	0.265***	0.027		-0.047*			-0.025*	-0.048*		
DSP (-4)		0.062			0.084***	-0.038	0.024			0.046*				-0.026
POSEX	-5829.44**	-0.374**	-13.256**	-3.127**	0.222*	-2.50**	-175.88**	1.356**	146.684**	26.767**	0.464**	2.149**	-29.03**	0.038**
POSER(1)	342.064												24.412*	

POSER(2)			48.125*				-558.74		-638.07			263.861		
POSER(3)			-36.301				452.10*						-19.49	
POSER(4)							256.49		484.09				24.639*	
NEGER	-4323.8*	-0.549**	-1.854**	45.690**	0.249**	-3.199**	27.201**	1260.120**	-120.65*	29.18	-6.96**	957.84***	-8.38**	0.719*
NEGER-1)	330.85*							128.8***			20.222	-1220.211***	21.020	
NEGER-2)				-226.374			466.726*		693.448		-15.77*		-17.991	
NEGER-3)							-520.97		-582.56*		17.227		24.68	
NEGER-4)				177.02*							-14.371		-18.985	
C	62.146*	4.150*	19.039*	154.42	25840.8**	7.531**	37.821**	12.637**	14.665**	55.993**	21.481**	20.64**	38.316*	1.911**
F STAT	25.225	7.937	4.118	37.351	207.18	6.464	2.438	9.703	2.599	3.98	3.490	9.406	6.511	1.973
F prob	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

(10% level is identified by * and at the 5% level by ** and 1% by ***)

5. Conclusion:

Series of daily stock indices and real exchange rate have found non-stationary at level but both are stationary at first difference. Cointegration test shows the existence of long run relationship among all the countries for both series. After the cointegration test, Vector Error Correction Method (VECM) is applied to test the short run relationship as in our sample data short run relationship can be changed due to financial crisis of 2007-2008. Results of VECM shows that there is short run relationship exists among all the countries. Granger causality test is also applied to check the causal relationship among the variables of study and results have shown less evidence for bi directional causality and found no causal relationship among the variables from the Canada, France, Germany, Italy, UK, Russia, China, Mexico and Pakistan. Uni-directional Causality exists in Brazil, India and USA from stock price to exchange rate. But from exchange rate to stock price causality also exists for the Japan. Based on the results, we can conclude that investors can make predictions based on the previous information.

If firms are export oriented, then will have higher sales and enjoy high profits. But if firms are not export oriented they may suffer decline in their profits. If company benefits from the increase in sales due to currency depreciation, then it will lead towards the high stock prices and vice versa can also be applied. Currency appreciation will also lead to changes in stock prices. Results from the sample countries also support the flow-oriented model that exchange rate changes lead changes in stock price. On the other side, if stock prices change that will also leads towards the changes in exchange rate. This is also supported by the results and supports the portfolio approach that emphasizes the changes in stock price also lead towards the changes in exchange rate.

Results clearly shows that there is asymmetric relationship between the stock price and exchange rate. Further studies can be conducted by adding more countries, more variables and at different period. This study contributes in policy making that a country can depreciate their currency to improve their trade balance and must be aware of asymmetric effects on stock price and exchange rates of their future policies.

6. References

Abdalla, I. S., & Murinde, V. (1997). Exchange rate and stock price interactions in emerging financial markets: evidence on India, Korea, Pakistan and the Philippines. *Applied financial economics*, 7(1), 25-35.

Abdalla, S. Z. S., & Winker, P. (2012). Modelling stock market volatility using univariate GARCH models: Evidence from Sudan and Egypt. *International Journal of Economics and Finance*, *4*(8), 161-176.

Abdelaziz, M., Chortareas, G., & Cipollini, A. (2008). Stock prices, exchange rates, and oil: Evidences from Middle East oil-exporting countries. *Topics in Middle Eastern and North African Economies*, *10*.

Abdulla, Y., Dang, V. A., & Khurshed, A. (2017). Stock market listing and the use of trade credit: Evidence from public and private firms. *Journal of Corporate Finance*, *46*, 391-410.

Abidin, S., Walters, C., Lim, K. L., & Banchit, A. (2013). Cointegration between stock prices and exchange rates in Asia-Pacific countries. *Investment management and financial innovations*, (10, Iss. 2 (contin.)), 142-146.

Agrawal, G., Srivastav, A. K., & Srivastava, A. (2010). A study of exchange rates movement and stock market volatility. *International Journal of Business and Management*, *5*(12), 62.

Alagidede, P., Panagiotidis, T., & Zhang, X. (2011). Causal relationship between stock prices and exchange rates. *The Journal of International Trade & Economic Development*, *20*(1), 67-86.

Ansari, T., Kumar, M., Shukla, A., Dhar, J., & Tiwari, R. (2010). Sequential combination of statistics, econometrics and Adaptive Neural-Fuzzy Interface for stock market prediction. *Expert Systems with Applications*, *37*(7), 5116-5125.

Apergis, N., & Rezitis, A. (2001). Asymmetric cross-market volatility spillovers: Evidence from daily data on equity and foreign exchange markets. *The Manchester School*, *69*, 81-96.v

Attari, M. I. J., Taha, R., & Farooq, M. I. (2014). Tax revenue, stock market and economic growth of Pakistan. *Acta Universitatis Danubius. Œconomica*, *10*(5).

Bahmani-Oskooee, M., & Saha, S. (2015). On the relation between stock prices and exchange rates: a review article. *Journal of Economic Studies*.

Bahmani-Oskooee, M., & Saha, S. (2016). Do exchange rate changes have symmetric or asymmetric effects on stock prices?. *Global finance journal*, *31*, 57-72.

Bahmani-Oskooee, M., & Saha, S. (2017). Asymmetric response of the US–India trade balance to exchange rate changes: Evidence from 68 industries. *The World Economy*, *40*(10), 2226-2254.

Bahmani-Oskooee, M., & Sohrabian, A. (1992). Stock prices and the effective exchange rate of the dollar. *Applied economics*, *24*(4), 459-464.

Banerjee, A., Dolado, J., & Mestre, R. (1998). Error-correction mechanism tests for cointegration in a single-equation framework. *Journal of time series analysis*, *19*(3), 267-283.

Bartram, S. M. (2004). Linear and nonlinear foreign exchange rate exposures of German nonfinancial corporations. *Journal of international money and finance*, *23*(4), 673-699.

Basher, S. A., Haug, A. A., & Sadorsky, P. (2012). Oil prices, exchange rates and emerging stock markets. *Energy Economics*, *34*(1), 227-240.

Boonyanam, N. (2014). Relationship of stock price and monetary variables of Asian small open emerging economy: Evidence from Thailand. *international Journal of financial research*, *5*(1), 52.

Buberkoku, O. (2013). The Relationship Between Stock Prices and Exchange Rates Evidence from Developed and Developing Countries. *Istanbul Stock Exchange Review*, *13*(52), 1-16.

Caporale, G. M., Gil-Alana, L. A., & Plastun, A. (2016). The weekend effect: an exploitable anomaly in the Ukrainian stock market?. *Journal of Economic Studies*.

Chiang, S. J., Tsai, L. J., Shu, P. G., & Chen, S. L. (2012). The trading behavior of foreign, domestic institutional, and domestic individual investors: Evidence from the Taiwan stock market. *Pacific-Basin Finance Journal*, *20*(5), 745-754.

Chortareas, G., Cipollini, A., & Eissa, M. A. (2011). Exchange rates and stock prices in the MENA countries: what role for oil?. *Review of Development Economics*, *15*(4), 758-774.

Darby, J., & Roy, G. (2019). Political uncertainty and stock market volatility: new evidence from the 2014 Scottish Independence Referendum. *Scottish Journal of Political Economy*, *66*(2), 314-330.

Dickey, D. A., & Fuller, W. A. (1979). Distribution of the estimators for autoregressive time series with a unit root. *Journal of the American statistical association*, *74*(366a), 427-431.

Dimitrova, D. (2005). The relationship between exchange rates and stock prices: Studied in a multivariate model. *Issues in political Economy*, *14*(1), 3-9.

Eita, J. H. (2012). Modelling macroeconomic determinants of stock market prices: Evidence from Namibia. *Journal of Applied Business Research (JABR)*, *28*(5), 871-884.

Engle, R. F., & Granger, C. W. (1987). Co-integration and error correction: representation, estimation, and testing. *Econometrica: journal of the Econometric Society*, 251-276.

Ersoy, E., & Unlu, U. (2013). Energy consumption and stock market relationship: Evidence from turkey. *International Journal of Energy Economics and Policy*, *3*, 34.

Granger, C. W., Huangb, B. N., & Yang, C. W. (2000). A bivariate causality between stock prices and exchange rates: evidence from recent Asianflu☆. *The Quarterly Review of Economics and Finance*, *40*(3), 337-354.

Groenewold, N., & Paterson, J. E. (2013). Stock Prices and Exchange Rates in A ustralia: Are Commodity Prices the Missing Link?. *Australian Economic Papers*, *52*(3-4), 159-170.

Gul, S., Khan, M. T., Saif, N., Rehman, S. U., & Roohullah, S. (2013). Stock market reaction to political events (Evidence from Pakistan). *Journal of Economics and Sustainable Development*, *4*(1), 165-174.

Hsu, C. C., Yau, R., & Wu, J. Y. (2009). Asymmetric exchange rate exposure and industry characteristics: evidence from Japanese data. *Hitotsubashi Journal of Economics*, 57-69.

Huang, B. N., Yang, C. W., & Hu, J. W. S. (2000). Causality and cointegration of stock markets among the United States, Japan and the South China Growth Triangle. *International Review of Financial Analysis*, *9*(3), 281-297.

Huang, C., Wen, S., Li, M., Wen, F., & Yang, X. (2021). An empirical evaluation of the influential nodes for stock market network: Chinese A-shares case. *Finance Research Letters*, *38*, 101517.

Inegbedion, H. E. (2012). Macroeconomic determinants of stock price changes: Empirical evidence from Nigeria. *Indian Journal of Finance*, *6*(2), 19-23.

Ismail, M. T., & Bin Isa, Z. (2009). Modeling the interactions of stock price and exchange rate in Malaysia. *The Singapore Economic Review*, *54*(04), 605-619.

Johansen, S. (1988). Statistical analysis of cointegration vectors. *Journal of economic dynamics and control*, *12*(2-3), 231-254.

Johansen, S. (1991). Estimation and hypothesis testing of cointegration vectors in Gaussian vector autoregressive models. *Econometrica: journal of the Econometric Society*, 1551-1580.

Jorion, P. (1990). The exchange-rate exposure of US multinationals. *Journal of business*, 331-345.

Kalainathan, K., Pratheepan, T., & Selvamalai, T. (2017). The Nexus between Stock Price and Exchange Rates: Empirical Evidence from Sri Lanka. *Global Journal of Management and Business Research: C Finance*, *17*(6).

Kollias, C., Mylonidis, N., & Paleologou, S. M. (2012). The nexus between exchange rates and stock markets: evidence from the euro-dollar rate and composite European stock indices using rolling analysis. *Journal of Economics and Finance*, *36*(1), 136-147.

Koutmos, G., & Martin, A. D. (2003). Asymmetric exchange rate exposure: theory and evidence. *Journal of international Money and Finance*, *22*(3), 365-383.

Kutty, G. (2010). THE RELATIONSHIP BETWEEN EXCHANGE RATES AND STOCK PRICES: THE CASE OF MEXICO. *North American Journal of Finance & Banking Research*, *4*(4).

Lean, H. H., & Teng, K. T. (2013). Integration of world leaders and emerging powers into the Malaysian stock market: A DCC-MGARCH approach. *Economic Modelling*, *32*, 333-342.

Lin, C. M., & Cheng, W. H. (2008). Economic determinants of comovement across international stock markets: the example of Taiwan and its key trading partners. *Applied Economics*, *40*(9), 1187-1205.

Lin, C. S., Chiu, S. H., & Lin, T. Y. (2012). Empirical mode decomposition–based least squares support vector regression for foreign exchange rate forecasting. *Economic Modelling*, *29*(6), 2583-2590.

Ma, C. K., & Kao, G. W. (1990). On exchange rate changes and stock price reactions. *Journal of Business Finance & Accounting*, *17*(3), 441-449.

Miller, K. D., & Reuer, J. J. (1998). Asymmetric corporate exposures to foreign exchange rate changes. *Strategic Management Journal*, *19*(12), 1183-1191.

Mookerjee, R., & Yu, Q. (1997). Macroeconomic variables and stock prices in a small open economy: The case of Singapore. *Pacific-Basin Finance Journal*, *5*(3), 377-388.

Moore, T., & Wang, P. (2014). Dynamic linkage between real exchange rates and stock prices: Evidence from developed and emerging Asian markets. *International Review of Economics & Finance*, *29*, 1-11.

Nieh, C. C., & Lee, C. F. (2001). Dynamic relationship between stock prices and exchange rates for G-7 countries. *The Quarterly Review of Economics and Finance*, *41*(4), 477-490.

Obben, J., Pech, A., & Shakur, S. (2006). Analysis of the relationship between the share market performance and exchange rates in New Zealand: A cointegrating VAR approach. *New Zealand Economic Papers*, *40*(2), 147-180.

Pan, M. S., Fok, R. C. W., & Liu, Y. A. (2007). Dynamic linkages between exchange rates and stock prices: Evidence from East Asian markets. *International Review of Economics & Finance*, *16*(4), 503-520.

Pan, W. F. (2018). Does the stock market really cause unemployment? A cross-country analysis. *The North American Journal of Economics and Finance*, *44*, 34-43.

Parsva, P., & Lean, H. H. (2011). The analysis of relationship between stock prices and exchange rates: Evidence from six Middle Eastern financial markets. *International research journal of finance and economics*, *66*, 157-171.

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of applied econometrics*, *16*(3), 289-326.

Phillips, P. C., & Perron, P. (1988). Testing for a unit root in time series regression. *Biometrika*, *75*(2), 335-346.

Phylaktis, K., & Ravazzolo, F. (2005). Stock market linkages in emerging markets: implications for international portfolio diversification. *Journal of International Financial Markets, Institutions and Money*, *15*(2), 91-106.

Pretorius, E. (2002). Economic determinants of emerging stock market interdependence. *Emerging Markets Review*, *3*(1), 84-105.

Rahman, A. A., Sidek, N. Z. M., & Tafri, F. H. (2009). Macroeconomic determinants of Malaysian stock market. *African Journal of Business Management*, *3*(3), 095-106.

Rahman, M. L., & Uddin, J. (2009). Dynamic relationship between stock prices and exchange rates: Evidence from three South Asian countries. *International Business Research*, *2*(2), 167-174.

Raj, J. F., & Roy, S. (2014). Empirical Evidence on the Relationship Between Stock Market Development and Economic Growth: A Cross-Country Exploration in Asia. In *Analytical Issues in Trade, Development and Finance* (pp. 395-403). Springer, New Delhi.

Richards, D. W., Rutterford, J., Kodwani, D., & Fenton-O'Creevy, M. (2017). Stock market investors' use of stop losses and the disposition effect. *The European Journal of Finance*, *23*(2), 130-152.

Shin, Y., Yu, B., & Greenwood-Nimmo, M. (2014). Modelling asymmetric cointegration and dynamic multipliers in a nonlinear ARDL framework. In *Festschrift in honor of Peter Schmidt* (pp. 281-314). Springer, New York, NY.

Sikiru, A., Abolaji, D. A., & Shah, S. K. B. (2018). DYNAMICS OF EXCHANGE RATE AND STOCK PRICE INDEX IN EMERGING MARKETS: AN EMPIRICAL EVIDENCE FROM NIGERIA AND SOUTH AFRICA. *Journal of Business Strategies*, *12*(1), 1.

Singh, P., Kumar, B., & Pandey, A. (2010). Price and volatility spillovers across North American, European and Asian stock markets. *International Review of Financial Analysis*, *19*(1), 55-64.

Sinha, A. (2015). Modeling energy efficiency and economic growth: evidences from India. *International Journal of Energy Economics and Policy*, *5*(1), 96.

Smyth, R., & Nandha, M. (2003). Bivariate causality between exchange rates and stock prices in South Asia. *Applied Economics Letters*, *10*(11), 699-704.

Soenen, L. A., & Hennigar, E. S. (1988). An analysis of exchange-rates and stock-prices-the united-states experience between 1980 and 1986. *Akron Business and Economic Review*, *19*(4), 7-16.

Solnik, B. (1987). Using financial prices to test exchange rate models: A note. *The journal of Finance*, *42*(1), 141-149.

Stavarek, D. (2004). Linkages between stock prices and exchange rates in the EU and the United States. *Czech Journal of Economics and Finance*, *55*(4), 141-161.

Tabak, B. M. (2006). The dynamic relationship between stock prices and exchange rates: Evidence for Brazil. *International Journal of Theoretical and Applied Finance*, *9*(08), 1377-1396.

Tian, G. G., & Ma, S. (2010). The relationship between stock returns and the foreign exchange rate: the ARDL approach. *Journal of the Asia Pacific economy*, *15*(4), 490-508.

Tsagkanos, A., & Siriopoulos, C. (2013). A long-run relationship between stock price index and exchange rate: A structural nonparametric cointegrating regression approach. *Journal of International Financial Markets, Institutions and Money*, *25*, 106-118.

Unlu, U. (2013). Oil price, exchange rate and stock market in ASEAN-5 countries. *The Empirical Economics Letter: A Monthly International Journal of Economics*, *12*(5), 551-557.

Wickremasinghe, G. B. (2012). Stock prices and exchange rates in Sri Lanka: some empirical evidence. *Investment management and financial innovations*, (9, Iss. 4), 8-14.

Yau, H. Y., & Nieh, C. C. (2006). Interrelationships among stock prices of Taiwan and Japan and NTD/Yen exchange rate. *Journal of Asian Economics*, *17*(3), 535-552.

Yau, H. Y., & Nieh, C. C. (2009). Testing for cointegration with threshold effect between stock prices and exchange rates in Japan and Taiwan. *Japan and the World Economy*, *21*(3), 292-300.

Yeh, C. Y., Huang, C. W., & Lee, S. J. (2011). A multiple-kernel support vector regression approach for stock market price forecasting. *Expert Systems with Applications*, *38*(3), 2177-2186.

Zafar, M. W., Zaidi, S. A. H., Sinha, A., Gedikli, A., & Hou, F. (2019). The role of stock market and banking sector development, and renewable energy consumption in carbon emissions: Insights from G-7 and N-11 countries. *Resources Policy*, *62*, 427-436.

Zhao, H. (2010). Dynamic relationship between exchange rate and stock price: Evidence from China. *Research in International Business and Finance*, *24*(2), 103-112.

Zhou, X., Pan, Z., Hu, G., Tang, S., & Zhao, C. (2018). Stock market prediction on high-frequency data using generative adversarial nets. *Mathematical Problems in Engineering*, *2018*.