

A Bivariate Causality Test Between Exchange Rates and Equity Markets in BRIC Countries

Ghulam Ali, Melati Binti Ahmad Anwar and Sayyed Mahdi Ziaei

Faculty of Management and Human Resource Development (FPPSM),
Universiti Teknologi Malaysia, Johor Bahru, Malaysia

Abstract: In this paper, the causal relation between stock prices and exchange rates is examined through applying Toda and Yamamoto causality test using weekly data from Brazil, Russia, India and China (BRIC countries). The sample period started from 5th May, 2003 to 6th September, 2010. The whole sample period was divided into three sub-periods: Pre-crisis, during crisis and Post-crisis. The series were not found stationary while applied Kwiatkowski, Phillips, Schmidt and Shin (KPSS) Tests. In the pre-crisis period, Brazil showed bidirectional and Russia and India showed uni-directional relation moving from stock market to exchange market. During crisis period, Russia evidenced the bidirectional causality while Brazil and India showed unidirectional relation running from stock prices to exchange rates. In post crisis period, Brazil and Russia revealed the stability in the relationship during crisis and post-crisis but causality was running from exchange rates to stock prices in pre-crisis period in the case of India. Hence, China is not provided any evidence of relationship between exchange rates and stock prices during all three sub-periods. Overall results of study proved unilateral and bilateral relationship between the variables whereas during the entire period of the study, no interaction between variables was highlighted in China.

Key words: Exchange rates • Stock prices • Stationarity • Granger causality • BRIC

INTRODUCTION

In the era of globalization and financial liberalizations, investigation on intertwine between exchange rate and stock prices have increased because a lot of structural changes are going to introduced at micro and macro level. Most of countries on the face of globe have shifted their exchange rate system from pegging to floating exchange rate system [1]. Integration of financial markets has been increased very sharply due to financial liberalization. That becomes the cause of financial crises. In the last three decades, world has to face three main financial crises i.e., crisis 1987, Asian financial crisis 1997 and global financial crisis 2007. It is interesting that all crises appeared in the second half of every decade.

According to Granger, Huang and Yang [2], interaction of exchange rates with stock prices exert spillover effects on each other that become the cause of financial crises. It is suggested in previous studies that reasons should be investigated about the lead-lag behavior of foreign exchange markets and stock markets

[3-5]. Furthermore, investigation about lead-lag behavior of both markets is beneficial in the perspective of arbitrage hunters.

This study focused the global crisis period to investigate the causal relation of exchange rates and stock prices in BRIC countries which is the ignored area in the financial literature. BRIC countries include Brazil, Russia, India and China that have become industrial economies very sharply. The study endeavored to investigate the effects of global financial crisis, 2007 over the causal intertwine of exchange rates and stock prices in these countries.

Before the crisis period, a large capital flow was emerging in US from Petroleum exporters as well as from Middle East countries. In the result of this, Sub-prime mortgage was introduced as a financial innovation and similarly, the surging trend was seen in US equity market. In summer 2007, low credit-worthy borrowers started high default which appeared in shape of deterioration in US credit market. This contagion of default was disseminated so badly that no sector of the economy can be evacuated

and specifically, it exposed magnificent effect in the financial sector. Resultantly, nontransparent financial innovations put forwarded the financial crisis, 2007[4].

After financial liberalization, the equity markets are supposed to be effected by the movement of capital funds internationally. This inflow and outflow of funds is also affects the exchange rates of the country. Therefore, the comovement of exchange rates and stock prices is empirically investigated in the literature [6, 7]. The global financial crisis 2007 was appeared in the context of series of financial crisis which appeared in 1987, 1997 and now in 2007. But consistency is relationship is not yet confirmed because Asian crisis 1987 was considered as the currency crisis whereas financial crisis, 2007 is believed to be an equity crisis [8-11]. We have attempted to investigate the direction of causal relation in BRIC countries to provide useful information to international portfolio investors, participants of financial markets and to economic policy makers.

The remaining paper is divided as: Review of previous studies is discussed in Section 2; the details of data and methodology is written in section 3; Results and discussion regarding results is reported in section 4; and conclusion and suggestions are given in the last section.

Literature Review: Theoretically, linkage between exchange and stock prices is explained through micro and macroeconomic perspectives [1]. The first theory is recognized as the flow-oriented model which considers the current account of the economy and second theory is identified as stock-oriented model [12]. According to Granger, Huang and Yang [2], these theories are renowned as traditional and portfolio approaches. First theory argues that causality runs from exchange to stock prices [13]. It is stated that exchange rate changes influence competitiveness of Multinational Companies (MNCs) and in the result of this, company earnings changes that make changes in the share value of the company. Suppose, if the local currency depreciates that makes exports of that economy cheaper in the international market which leads to upsurge in demand for exports. As a result, earnings of company increase which gives positive impact over the value of the company [10, 14].

Contrarily, the second theory describes that changes in equity market affects the exchange market. This phenomenon relates with the capital account not with current account of economy. It is argued that an innovation in stock market is reflected in the exchange

market. The demand for exchange rates is increased if rising trend is found in stock prices. This upsurge attracts the foreign as well as the local investor (who has foreign investment) to sell their foreign investments and make investments in the local market. This flow of capital fund will directly influence the exchange rates [12, 15]. As a result, adjustment in portfolio by the investors will lead the appreciation in the exchange rates. This means that equity prices Granger cause to exchange rates [16].

In the early empirical studies used data from developed economies including US markets to examine the interrelationship between exchange rates and stock prices. Mixed results have been postulated by studies. Some of the studies found positive relationship between exchange rates and stock prices [14, 17, 18]. Hence a negative relation was reported by [19]. While comparing the interrelationship between stock return differential and real exchange rates during the period of two crises 1997 and 2008, a negative relationship between is reported. The data is used from 11 economies comprising from developed and some emerging Asian economies. It is further mentioned that a stable relationship could not be investigated between both variables [4].

Furthermore, Bahmani-Oskooee and Sohrabian [20] found short-run bi-directional causality between exchange rates and stock prices through applying cointegration and Granger Causality tests since long-run relationship was not supported by the results. The study by Nieh and Lee [21] found the similar results in respect of long-run relation while using the data from G-7 countries. They also suggested that future cannot be predicted with help of previous stock prices and exchange rates in US neither in the short-run nor in the long-run. They also revealed that the evidence of significant relation is not found between exchange rate and stock prices in these countries. The findings of study by Morley and Pentecost [22] provided the support that exchange rates and stock prices are interconnected, but they mentioned that this connection is not due to common trends rather it is due to only common cyclical pattern.

Abdalla and Murinde [1] postulated that unilateral causality is found which was initiated by exchange rates to stock price in Pakistan, South Korea and India. Feedback relationship was reported in Taiwan, Hong Kong, Thailand, Singapore and Malaysia, while examining the bilateral causality in East Asian counties during Asian crisis [2]. Lu, Metin and Argac [23] examined the long-run linkage between stock returns with monetary variables using the data from an emerging market. The findings

displayed there is no long-run relationship between stock prices and all the group of variables. Whereas, Smyth and Nandha [24] examined the linkage of exchange rates and stock prices in the four countries of Asia (Pakistan, Sri Lanka, Bangladesh and India). Findings of study identified that long-run relationship is not found between exchange rates and stock prices. These findings were supported in the context of Bangladesh since no evidence of causality is found between these variables [25].

Hatemi-J and Roca [26] suggested that exchange rates and stock prices were not shown any relationship during the period of crisis. However, all markets showed signs of significant relation before crisis except Philippines and direction of causality was running from exchange rates to stock prices in Indonesia and Thailand but opposite in Malaysia. Chang and Kuo [27] concluded that cointegration does not exist between FX market and stock prices either in crisis period or in non-crisis period. Additionally, the results revealed that bidirectional causality is found between both markets during Asian Financial crisis, 1987 and financial crisis, 2007. The similar results were reported by Ali, Ziaei and Anwar [28] Brazilian exchange rates and stock prices to examine the impact of financial crisis 2007. The proof of cointegration is not found between both series. However, the crisis and post crisis period showed the causality that moves from stock prices to exchange rates

Lee, Doong and Chou [29] also indicated that equity markets of Taiwan, Thailand, Malaysia, Korea and Indonesia expelled spillovers on exchange market exclusive of Philippine. Moreover, the correlation between exchange markets with stock markets turned out to be higher in case if there is high volatility in stock prices. Adjasi, Biekpe and Osei [30] suggested that no long-run relationship exists between exchange rates and stock prices in the seven African countries except Tunisia. Although, it is revealed in the results that exchange rates were influencing the stock prices in short-run.

Many studies recorded that causality relation runs from equity markets to exchange markets in the developed economies. Smith [17] suggested that equity prices have shown significant influence on exchange rates of Germany, Japanese and US dollar during the period of 1974 to 1988. Ong and Izan [31] concluded that they could not investigate any significant result from the data used from US, Australia, UK and France. But they claimed that a little of currency movement is found over the equity markets during crash period of 1987. A unidirectional causality was found by Hatemi-J and Irandoust [32]

between exchange rates and stock price which was moved from stock prices to exchange rates using data from Sweden. Ajayi and Mougoue [33] reported the same findings about main equity markets of developed countries. Contrarily, a recent study by Alagidede, Panagiotidis, Zhang [34] reported that causality is running from exchange rates to stock prices in UK, Switzerland and Canada. Nevertheless, a long-run linkage was not evidenced in the results.

During the review of previous studies, we see that Group of BRIC countries is not examined to investigate the causal relationship between exchange rates and stock prices. This study has filled this gap in the literature.

Data and Methodology: According to National Bureau of Economic Research (NBER), The U.S. Crisis started in December, 2007 and ended in June, 2009 [35]. We used weekly data of foreign exchange rate with dollar and stock prices from 5th May, 2003 to 6th September, 2010 by dissecting into three sub-groups (Pre-crisis period, during crisis period and post-crisis period) for the thorough examine of causal relationship between the variables in Brazil, Russia, India and China (BRIC) countries. The stock price for Brazil is obtained from Bovespa, for Russia: Moscow Times, for India: Bombay Sensex and for china: Shanghai Composite. This raw dataset was attained from *DataStream* and the data was transformed through applying natural log as it is recommended in literature of econometric techniques [36].

The standard bivariate Granger causality test can be used if the test series are stationary at the same degree of difference such as level or first difference. The traditional application of standard VAR methodology cannot be applied in case of integrated series due to spurious regression [37]. Furthermore, the F-test is valid only in a case if cointegration exists between variables in the same levels.

Alternatively, Toda and Yamamoto [38] proposed the Modified WALD (MWALD) test to analyze the linear restriction on the parameters. This methodology allows the asymptotic χ^2 distributions while estimating VAR ($k+d_{max}$) where k is used for lag-length and d_{max} is maximum order of integration supposed to be occurred in the system. It is indicate by Toda and Yamamoto that the lag selection process is valid for all the time where $K \geq 1=d$. The process is also valid if $d = 2$, unless $k = 1$. The MWALD test is applicable, although the series are $I(0)$, $I(1)$, $I(2)$ or even in case of non-cointegration or cointegrated at any arbitrary order. Zapata and Rambaldi

[39] pointed out that MWALD statistic given better performance in size and power comparing with WALD and LR statistic. Rambaldi and Doran [40] suggested that Toda and Yamamoto causality test can easily be applied through seemingly unrelated regression (SUR).

The VAR model is specified for Toda and Yamamoto [38] non-causality test in the following two equations where SP is denoted for stock prices and EX is used for exchange rates.

$$SP_t = a_0 + \sum_{i=1}^k a_i SP_{t-i} + \sum_{j=k+1}^{k+d_{max}} a_j SP_{t-j} + \sum_{i=1}^k \beta_i EX_{t-i} + \sum_{j=k+1}^{k+d_{max}} \beta_j EX_{t-j} + u_{1t} \quad (1)$$

And

$$EX_t = a_1 + \sum_{i=1}^k \gamma_i EX_{t-i} + \sum_{j=k+1}^{k+d_{max}} \gamma_j EX_{t-j} + \sum_{i=1}^k \delta_i SP_{t-i} + \sum_{j=k+1}^{k+d_{max}} \delta_j SP_{t-j} + u_{2t} \quad (2)$$

The error terms is supposed be white noise in above VAR model, therefore, we can include extra lagged variables in this model. The causality can be tested with zero restriction on the coefficients of all lag variables.

Empirical Results: To start with stationary test, we have applied Augmented Dickey-Fuller (ADF) and Phillip-Perron (PP) test which are frequently used in the previous studies [10, 41]. The null hypothesis shows the proof of unit root in both tests while analyzing the time series. Due to low power of estimation, these tests have been criticized. As the null hypothesis is allowed to accepted against alternate hypothesis [42, 43]. We also have applied KPSS Tests purposed by Kwiatkowski, Phillips [44] to verify the results of other two tests. In this test the null hypothesis is stationary that's why it is assumed the superior test for cross-checking of unit root.

Table 3 shows the results of Tado-Yamamoto Causality (Modified WALD) Test. Pre-crisis period, bidirectional causality exists between exchange rates and stock prices which suggest that both markets were depending on each other and were affecting each other. However, only stock prices were indicating uni-directional causality in the periods of during and post crisis but no feedback causality was found as our results are in accordance with [45].

Table 1: Results of ADF and PP stationarity test

Countries	Brazil		Russia		India		China	
Stationary	Level	1 st D	Level	1 st D	Level	1 st D	Level	1 st
Augmented Dickey Fuller Test								
Pre-crisis period								
FX	-0.004	-10.76*	-0.668	-11.27*	-1.656	-9.979*	3.021	-9.434*
SP	-0.931	-16.37*	-0.910	-13.62*	-1.760	-13.18*	1.948	-14.85*
During crisis period								
FX	-0.848	-3.580*	-2.708	-6.024*	-0.721	-7.879*	-2.922	-7.142*
SP	-1.361	-11.30*	-0.866	-9.335*	-1.410	-5.190*	-0.781	-9.325*
Post-crisis period								
FX	-2.347	-6.817*	-2.029	-6.369*	-1.669	-6.361*	2.927	0.340
SP	-2.785	-8.140*	-2.480	-9.716*	-2.048	-9.416*	-1.344	-8.342*
Phillips Perron Test								
Pre-crisis period								
FX	0.006	-12.68*	-0.942	-11.41*	-1.137	-10.25*	3.220	-9.524*
SP	-0.909	-16.32*	-0.919	-13.62*	-1.724	-13.20*	1.598	-15.26*
During crisis period								
FX	-1.187	-8.083*	-0.767	-7.532*	-0.489	-7.823*	-2.739	-7.410*
SP	-1.373	-11.26*	-0.866	-9.332*	-1.210	-10.07*	-0.878	-9.373*
Post-crisis period								
FX	-2.392	-6.871*	-2.175	-6.360*	-1.824	-6.262*	-0.233	-3.037*
SP	-2.855	-8.147*	-2.568	-9.946*	-1.796	-9.726*	-1.403	-8.360*

Table 2: The Kwiatkowski, Phillips, Schmidt and Shin (KPSS) Tests

Series	Brazil			Russia			India			China		
	Level	1 st D	2 nd D	Level	1 st D	2 nd D	Level	1 st D	2 nd	Level	1 st D	2 nd D
Pre-crisis period												
FX	1.75	0.13*	-	1.63	0.08*	-	0.52*	-	-	1.66	0.99	0.50*
SP	.82	0.05*	-	1.79	0.08*	-	1.86	0.16*	-	0.76	0.86	0.25*
During crisis period												
FX	0.56*	-	-	0.81	0.18*	-	1.01	0.23*	-	1.11	0.90	0.22*
SP	0.59*	-	-	0.79	0.16*	-	0.72*	-	-	0.89	0.31*	-
Post-crisis period												
FX	0.28*	-	-	0.18*	-	-	0.50*	-	-	0.59*	-	-
SP	0.48*	-	-	0.64*	-	-	0.88	0.08*	-	0.63*	-	-

*Significant at 1% critical value

Table 3: Tado-Yamamoto Causality (Modified WALD) Test Results

Countries	Brazil		Russia		India		China	
	χ^2	P-Value	χ^2	P-Value	χ^2	P-Value	χ^2	P-Value
Pre-crisis period								
Stock→Forex	30.000	0.000*	6.415	0.040*	13.691	0.008*	1.588	0.811
Forex→ Stock	7.660	0.053*	3.598	0.165	1.424	0.840	6.185	0.186
During crisis period								
Stock→Forex	17.496	0.001*	24.549	0.011*	19.650	0.001*	3.642	0.161
Forex→ Stock	6.101	0.192	23.283	0.016*	5.589	0.232	2.023	0.364
Post crisis period								
Stock→Forex	44.233	0.000*	17.609	0.040*	7.521	0.111	1.670	0.644
Forex→ Stock	16.511	0.086	17.089	0.047*	13.098	0.011*	3.220	0.359

*Shows significance of the results.

Bidirectional causality was demonstrated between exchange rates and stock prices within the period of during and post-crisis in Russia. However, unidirectional causality was running from stock prices to exchange rates in post-crisis period. The result of this study suggests that comovement between exchange rates and stock prices proved stronger and it can also be derived that both markets were not self-determining. However, the causality was directed by stock prices to exchange during pre-and post-crisis period in India. But direction of causality was moving from exchange rates to stock prices in Post-crisis period which became reverse compare with crisis and pre-crisis periods. No proof causality was indicated in China in all periods of time. It is evident from the results that both markets were functioning independently and these are interacting with each other during crisis period and non-crisis period.

Discuss on Practical Implications: Impact of current financial crisis witnesses that bust in equity markets have severely influenced the investment portfolios of global investors in European and American markets. Recently, their priority for investment diverted towards emerging markets to enhance the returns for their investments. BRIC countries, a fresh track for investment, attract these investors for the reason of their emerging economic growth demonstrated during few last decades. Global investors' diversions from turbulent economies towards BRIC economies prove an additive support for the continuation of their economic growth. Investigation of financial market linkage, specially, the linkage of equity markets and currency markets can guide the policy makers, portfolio managers and prospective investors. Fresh results of this study would highlight the movement connectivity across equity and exchange markets in BRIC

countries to find clear pattern between these markets for the updating strength of their bright future decisions. Additionally, global investors vis-à-vis their portfolio can utilize these results while formulating their investment decision policies. This study results are dual purpose gadget as a counteractive measure to forecast future financial crisis and used for the escape of this financial calamity. In future research, this study can be extended to examine the interaction between monetary and fiscal policies among Brazil, Russia, India and China (BRIC) countries. Financial literature witnesses that scant attention is given by researchers to evaluate contradictory monetary and fiscal policy measures in BRIC countries.

CONCLUSION

The focus of current research is to examine the causal relation of stock prices and exchange rates in Brazil, Russia, India and China (BRIC countries) before, after and during the financial crisis, 2009. Toda and Yamamoto causality test was applied since series were not found stationary at same level while applying KPSS unit root test. In the pre-crisis period, Russia and India showed unidirectional relation moving from stock market to exchange market, whereas, Brazil showed bidirectional and no relation was found in China. During crisis period, Brazil and India showed unidirectional relation running from stock prices to exchange rates. However, Russia evidenced the bidirectional relation and china showed no relationship. In post crisis period, no changes in the results of China and Brazil and Russia revealed the stability in the relationship during crisis and post-crisis. On the other hand, the relation between exchange rates and stock prices were change in India after crisis period. Overall results of study are proving the relationship between the variables in shape of unilateral and bilateral except China where both variables are not intertwining to each other. Further research is required for these groups of countries to investigate the long-run relationship between both variables.

REFERENCES

1. Abdalla, I.S.A. and V. Murinde, 1997. Exchange rate and stock price interactions in emerging financial markets: evidence on India, Korea, Pakistan and the Philippines. *Applied Financial Economics*, 7: 25-35.
2. Granger, C.W.J., B.N., Huang and C.W. Yang, 2000. A Bivariate Causality Between Stock Prices and Exchange Rates: Evidence from Recent Asian Flu. *Quarterly Review of Economics and Finance*, pp: 40.
3. Reinhart, C.M. and K.S. Rogoff, 2008. Is the 2007 U.S. Sub-prime financial crisis so different? An international historical comparison. NBER, Working Paper No, pp: 13761.
4. Wong, D.K.T. and K.W. Li, 2009. Comparing the performance of relative stock return differential and real exchange rate in two financial crises. *Applied Financial Economics*, 20: 137-50.
5. Zhong, L. and Z. Di-xin, 2009. An Empirical Research on the Relationship Between Foreign Exchange Market and Stock Market Under Financial Crisis. *Collected Essays on Finance and Economics*, pp: 4.
6. Ooi, A.Y., S.A.W.S.K. Wafa, N. Lajuni and M.F. Ghazali, 2009. Causality between Exchange Rates and Stock Prices: Evidence from Malaysia and Thailand. *International Journal of Business and Management*, pp: 4.
7. Shew, J.A., 2008. Causality Relationship between Foreign Exchange Rates and Stock Market Close: Evidence in Singapore. *Bryant Economic Research Paper*, pp: 1.
8. Mishkin, F.S., 1999. Lessons from the Asian crisis. *Journal of International Money and Finance*, 18: 709-23.
9. Tabak, B.M., 2006. The Dynamic Relationship Between Stock Prices And Exchange Rates: Evidence For Brazil. *1 International Journal of Theoretical and Applied Finance*, 09: 1377-96.
10. Pan, M., R. Fok and Y. Liu, 2007. Dynamic linkages between exchange rates and stock prices: Evidence from East Asian markets. *International Review of Economics and Finance*, 16: 503-20.
11. Saha, S. and G. Chakrabarti, 2011. Financial Crisis and Financial Market Volatility Spill-Over. *The international journal of applied economics and finance*, 5: 185-99.
12. Ajayi, R.A., J. Friedman and S.M. Mehdian, 1998. On the relationship between stock returns and exchange rates: Tests of granger causality. *Global Finance Journal*, 9: 241-51.
13. Dornbusch, R. and S. Fischer, 1980. Exchange Rates and the Current Account. *The American Economic Review*, 70: 960-71.
14. Aggarwal, R., 1991. Exchange Rates and Stock Prices: A Study of U.S. Capital Market under Floating Exchange Rates. *Akron Business and Economic Review*, pp: 7-12.
15. Bartov, E. and G.M. Bodnar, 1994. Firm Valuation, Earnings Expectations and the Exchange-Rate Exposure Effect. *The Journal of Finance*, 49: 1755-85.
16. Krueger, A.O., 1983. *Exchange rate determination*, Cambridge, Cambridge University Press.

17. Smith, C.E., 1992. Stock markets and the exchange rate: A multi-country approach. *Journal of Macroeconomics*, 14: 607-29.
18. Solnik, B., 1987. Using Financial Prices to Test Exchange Rate Models: A Note. *The journal of Finance*, 42: 141-9.
19. Soenen, L. and E. Hennigar, 1988. An Analysis of Exchange Rates and Stock Prices: The US Experience between 1980 and 1986. *Akron Business and Economic Review*, 19: 7-16.
20. Bahmani-Oskooee, M. and A. Sohrabian, 1992. Stock prices and the effective exchange rate of the dollar. *Applied Economics*, 24: 459-64.
21. Nieh, C.C. and C.F. Lee, 2001. Dynamic relationship between stock prices and exchange rates for G-7 countries. *The Quarterly Review of Economics and Finance*, 41: 477-90.
22. Morley, B. and E.J. Pentecost, 2000. Common trends and cycles in G-7 countries exchange rates and stock prices. *Applied Economics Letters*, 7: 7-10.
23. Lu, G.M., K. Metin and R. Argac, 2001. Is there a long run relationship between stock returns and monetary variables: evidence from an emerging market. *Applied Financial Economics*, 11: 641-9.
24. Smyth, R. and M. Nandha, 2003. Bivariate causality between exchange rates and stock prices in South Asia. *Applied Economics Letters*, 10: 699-704.
25. Bashar, O., A. Noman and S. Kabir, 2012. Causality Between Stock and Foreign Exchange Markets in Bangladesh. *Studies in Economics and Finance*, pp: 29.
26. Hatemi, J.A. and E. Roca, 2005. Exchange rates and stock prices interaction during good and bad times: evidence from the ASEAN4 countries. *Applied Financial Economics*, 15: 539-46.
27. Chang, H.Y. and Y.C. Kuo, 2009. The impact of subprime mortgage on correlation between stock and FX markets. *Applied Economics Letters*, 17: 1309-12.
28. Ali, G., S.M. Ziaei and M.B.A. Anwar, 2012. A Bivariate Causality Between Brazilian Stock Prices and Foreign Exchange Rates: Evidence from Global Financial Crisis, 2007. *World Applied Sciences Journal*, 20: 438-44.
29. Lee, C.H., S.C. Doong and P.I. Chou, 2011. Dynamic correlation between stock prices and exchange rates. *Applied Financial Economics*, 21: 789-800.
30. Adjasi, C.K.D., N.B. Biekpe and K.A. Osei, 2011. Stock prices and exchange rate dynamics in selected African countries: a bivariate analysis. *African Journal of Economic and Management Studies*, 2: 143-64.
31. Ong, L.L. and H.Y. Izan, 1999. Stocks and currencies: are they related? *Applied Financial Economics*, 9: 523-32.
32. Hatemi, J.A. and M. Irandoust, 2002. On the causality between exchange rates and stock prices: A note. *Bulletin of Economic Research*, 54: 197-203.
33. Ajayi, R.A. and M. Mougoue, 1996. On the Dynamic Relation between Stock Prices and Exchange Rates. *Journal of Financial Research*, 19: 193-207.
34. Alagidede, P., T. Panagiotidis and X. Zhang, 2011. Causal relationship between stock prices and exchange rates. *The Journal of International Trade and Economic Development*, 20: 67-86.
35. Bartash, J. and R. Mantell, 2010. U.S. recession ended June 2009. NBER finds. In: http://articles.marketwatch.com/2010-09-20/economy/30792294_1_nber-recession-james-poterba.
36. Brooks, C., 2008. *Introductory Econometrics for Finance*. 2nd ed, Cambridge University Press.
37. Toda, H.Y. and P.C.B. Phillips, 1993. Vector Autoregressions and Causality. *Econometrica*, 61: 1367-93.
38. Toda, H.Y. and T. Yamamoto, 1995. Statistical inference in vector autoregressions with possibly integrated processes. *Journal of Econometrics*, 66: 225-50.
39. Zapata, H.O. and A.N. Rambaldi, 1997. Monte Carlo Evidence on Cointegration and Causation. *Oxford Bulletin of Economics and Statistics*, 59: 285-98.
40. Rambaldi, A. and H. Doran, 1996. Testing for Granger non-causality in cointegrated systems made easy. In: *Working Paper in Econometrics and Applied Statistics No. 88*, Department of Econometrics, University of New England.
41. Kumar, M., 2009. A Bivariate Linear and Nonlinear Causality between Stock Prices and Exchange Rates. *Economics Bulletin*, 29: 2884-95.
42. DeJong, D.N., J.C. Nankervis and N.E. Savin, 1992. Whiteman, C.H. Integration Versus Trend Stationary in Time Series. *Econometrica*, 60: 423-33.
43. Schwert, G.W., 1987. Effects of model specification on tests for unit roots in macroeconomic data. *Journal of Monetary Economics*, 20: 73-103.
44. Kwiatkowski, D., P.C.B. Phillips, P. Schmidt and Y. Shin, 1992. Testing the null hypothesis of stationarity against the alternative of a unit root: How sure are we that economic time series have a unit root? *Journal of Econometrics*, 54: 159-78.
45. Lin, C.H., 2012. The comovement between exchange rates and stock prices in the Asian emerging markets. *International Review of Economics and Finance*, 22: 161-72.