Dynamic Linkages of Exchange Rate and Stock Return Volatility Evidence from Pakistan, India and China (PIC)

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Abstract

The paper investigates the dynamic linkages between exchange rate volatility and stock returns volatility of Pakistan, India and China for the period of 2007 to 2012 by employing daily data. GARCH model is applied to extract volatility of exchange rate and stock returns. The Johansen Co-integration test and granger causality approach is applied to investigate the dynamics of relationship of exchange rate and stock returns volatility. The results implied that there is little evidence for the co-integration relationship between exchange rate and stock returns volatility for all the countries of the sample. Furthermore, the granger causality test also confirmed that there is no causal relationship between exchange rate and stock returns volatility for India and China but for Pakistan where we are unable to reject the null hypothesis that the exchange rate does not granger cause KSE stock returns volatility.

Key Words: Co-integration, Granger Causality, Volatility, Stock Returns, Exchange Rate.

Introduction

The relationship of exchange rate and stock return volatility is the hot debate we come often come across in the finance literature. The severe importance of this issue was realized after the crash of Breton Wood System in 1970 and global financial crises. The early studies like the Dufey (1972) argue that the value of firm is affected by the exchange rate shocks. The firm cash flows cost of finance and investment decisions and real worth of firm are dependent on the exchange rate shocks. Studies like Adler and Dumas (1984), there are number of factors that influence the stock return volatility. The variable he found significant is the exchange rate shocks that influence the stock return volatility. The studies like Adler and Dumas (1984) suggest the diversification is the major solution to exchange rate volatility risk. The side results of this study suggest that that the risk is unsystematic. The firm has no control on exchange rate volatility and the firm can only go for management of such risk. The question of how this volatility should be measured and how the exchange rate fluctuation is causing the stock return volatility? Evidence that how the stock returns volatility has impact on the stock return is given by Jorion (1990). This study finds that management of the risk is essential but firm has little control on it. Whether the exchange rate volatility is causing the stock price volatility or the stock price volatility is caused by exchange rate is still topic of debate.

As we find evidence of diversification the risk of exchange rate fluctuation in modern portfolios theories however it is of extreme importance that yet the firm faces major risk where we are exposed to exchange rate fluctuations. The real value of firm stock, assets, dividends and other activities that are subject to exchange rate risk can bring the loss even if they are in safe zone at domestic level. The exchange rate fluctuation is reflected in firm balance sheet, Income statement and cash flows and hence in stock prices.

Brealey et al (2007), the link between the exchange rate and stock return are given by major models of finance that are Capital Asset Pricing Model and Arbitrage Pricing Theory. The theories further define the connection of return and risk associated. If we divide the risk into three main categorize, operational risk, firm specific risk and country risk then one of the important and significant risk is the exchange rate risk which has adverse effect on company where company dealing in international environment.

Jorion (2000), we are not here to classify the risk but to check how the exchange rate fluctuation cause adverse effects on stock returns the stock market plays an important role in the financial health of economy of country and firm real worth is reflected in stock prices. If the firm is acting internationally then it is exposed to exchange rate risk. It has adverse impact on the firm competitiveness in international environment. Ma and Kao (1990), suggest that it not only the international competitiveness of firm but also domestic firm also face exchange rate when the firm deal in import exports.

The study is an attempt to know the dynamic relationship of exchange rate volatility to stock prices. The economists link this relationship in three types of views. The first view is the portfolio approach of exchange rate transmission mechanism. The second argues that exchange rate effects the financial position of firm and hence it is reflected in stock prices. Finally, some economist argues mixed argument of direction of transmission mechanism. That is either the exchange rate can cause the stock return or stock return volatility causing the exchange rate volatility. We are checking the third approaches to know the direction of impact. We are applying Granger Causality procedure to check the direction of effect.

Furthermore, the ARCH-family models are applied to explore the volatility and their impact is checked through the application of Johansen Co-integration approach. We would try to know whether the exchange rate fluctuations are causing the stock return volatility. Keeping in mind the interest of the policy makers and importance of stock market we would explore the dynamic relationship of exchange rate volatility to stock return volatility. For this purpose three Asian countries Pakistan, India and China (PIC) are taken as sample to check the relationship of exchange rate volatility to stock return volatility. The paper is divided in three sections. The second section start with the literature review, third section includes methodology and final section deal with the result and conclusions.

Literature Review

The impact of exchange rate volatility on stock return volatility is largely debated in finance literature. Literature suggests mixed results of the exchange rate link with the stock returns. Some studies suggest application of portfolio approach is valid in transmission mechanism. To other the traditional approach of exchange rate transmission mechanism is valid but some argue that the exchange and stock prices relationship is bidirectional. The pioneer of this relationship Frank and Young (1972) who for the first time check the relationship and found that impact of exchange rate on stock prices and found very little evidence of the impact. This may be true however but according to some researcher the fact is different.

The two factors interest rate and exchange rate are considered to have impact on the stock return volatility. The studies like (Soenen & Hennigar, 1988; Aggarwal, 1981) suggests that exchange rate is significant variable that affects stock return volatility. If the firm is operating internationally then the exchange rate impacts its profit and ultimately its share prices. Fama (1981) argues that there are many factors that reflect in stock prices of firm, the important one that causes the volatility of stock return is mainly dependent on the volatility.

Maysami-Koh (2000) studied impact of interest rate and exchange rate on stock return concluded that both the variable is reflected in stock prices of firm. Najang & Seifert (1992) conducted the similar study as Maysami-Koh (2000), exchange rate significant variable contributing to stock return volatility. Solnik (1987) studied the impact of exchange rate on stock return in two time frames where the exchange rate was appreciated and depreciated.

The study find that the negative shock cause negative volatility in stock prices and positive shocks increase positive fluctuation in stock prices. The study was conducted by applying regression analysis. To some researcher the cause of stock market crises is the impact of globalization. The studies like Gazioglu (2000) suggest that the globalization is the factor that creates the problem as it causes debt crises, balance of payment problems and also impact the operation of firm. The adverse effects are reflected in stock prices. Gormus (2001) conveys its message a bit differently, "The exchange rate is not only the factor that cause the stock market crises". Ma and Kao (1990) studied the link of exchange rate and stock prices the sample was two halves: country where the export where dominant and countries import were dominant. This empirical evidence found that the appreciation have negative impact on stock prices where the depreciation pacts the stock prices positively (for countries where the export were dominant and countries where the import were dominant respectively).

Oskooe and Sohrabian (1992) checked the impact of exchange rate on stock prices by employing co-integration method to explore the long run and short rum dynamics of the two variables and concluded that there is very little evidence of long run relationship of exchange rate with stock prices. But the Granger casualty results confirm that the nature of relationship of the two variables is bi-directional.
Najang and Seifert (1992) suggested that relationship is unidirectional. The exchange rate volatility causes the exchange rate fluctuation. Ajayi and Mougoué in (1996) studied the short and long run dynamics of both variables and concluded that the stock prices fluctuations causes deteriorating impact in short run but in long run the impact is improved and the exchange rate is positively affected. Abdalla and Murinde (1997) used the data exchange rate and stock return of Asian countries and concluded that for some countries the exchange rate was causing stock return volatility where for some countries the stock prices fluctuations were incorporated in exchange rate.

Ajayi et al. (1998) studied the relationship of exchange rate and stock prices and his concluded remarks were that this relationship is uni-directional and support the traditional approach of exchange rate transmission mechanism that reflects in stock prices. Kim (2003) the exchange rate is natively affected by negative shock of stock prices. Smyth and Nandha (2003) studied the relationship and direction of causality of the impact and concluded that in some countries the relationship is supporting the traditional approach of impact of exchange rate; however, in some countries the bi-directional relationship was found. The major finding of this study suggest no relationship in the long of the both the variables. Doong et al. (2005) found no evidence of exchange rate co-integration with the stock prices. The studied concluded that there are two way relationships of exchange rate and stock returns. The two studies conducted in same year in 2006, produced conflicting results of the exchange rate and stock return causality. According Ozair (2006), there is little evidence of co-integration and causality of exchange rate with the stock returns. Where the Vygodina(2006) study suggest the exchange rate is causing the stock return volatility.

As for as the literature is concerned there is no any solid foundation which variable is which variable is causing which one. The literature is mixed about the results of the dynamics of relationship of the exchange rate and stock returns. No composite study is conducted on the countries like Pakistan, India and China (PIC) to explore the relationship and direction of causality. The study is an aim to give fresh insight to the issue discussed.

Research Methodology

Data and Description of variables

The data for two variables, the exchange rate and stock returns of the three countries namely, Pakistan, India and China (PIC) are from different sources. Like the stock price data of the three countries is taken from yahoo finance. The data related to exchange rate is taken from (www.oanda.com). The exchange rate and stock prices data is in daily frequency. The range of data is from 2007 to 2012. Exchange rate data for three countries is in Pakistani Rupee/UD Dollar, Indian Rupee/ US Dollar and Chinese Yuan/Dollar. All variables are natural logarithm. The returns are calculated from stock prices by formula "Ln (Pt/Pt-1).

Figure 1 Stock Return, Exchange rate of Pakistan, India and China
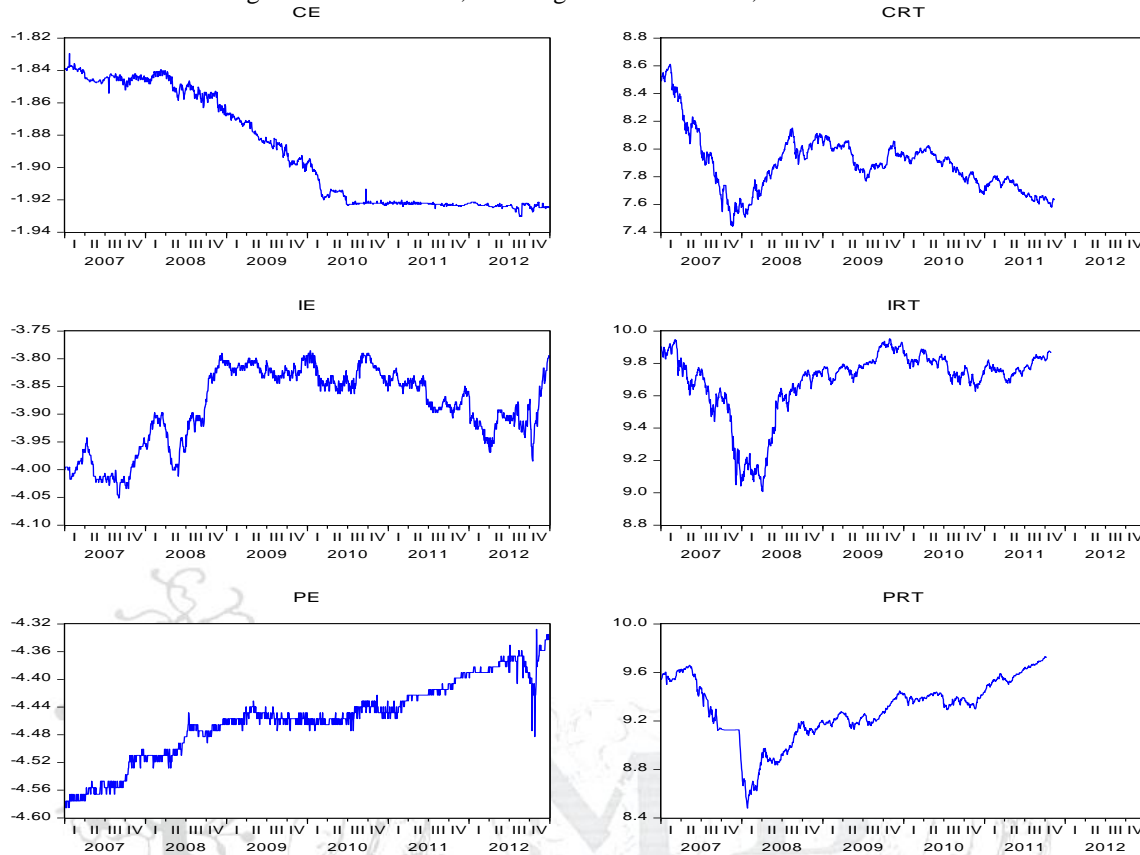
Note: CE is China Exchange rate, CRT is China Stock return, IE is India Exchange Rate, IRT is Indian Stock return, PE is Pakistan exchange rate, PRT Pakistani Stock returns.

Model

The ARCH-Family technique was use for the calculation of volatility of the both the variables. Base on the Akaike*, Schwarz* and adjusted "R" criterion the best model was selected to generate the volatility of each variable. The Granger Causality test (1969) is applied to check the direction of relationship. Furthermore, the pre-requisite of co-integration analysis "unit root test" is applied. For this the well popular (Pillips-Perron, 1988) test is used. Finally, the analysis of long run relationship is checked by the (Johansen, 1988).

Granger Causality Test

Granger (1969) developed the test procedure test the causal linkage between stock return volatility and exchange rate volatility. The Granger causality test investigates the various form of causality relationship between the variable. The causality can be uni-directional, bi-directional. In our case expects both type of the casualty or unidirectional, mean to say that either exchange rate can cause stock return volatility or stock return can cause exchange rate volatility. The null hypothesis suggested by Granger causality test is that one series does not Granger cause the other series. The alternative case would the one series Granger causes other series. This test uses various statistics as "t-statistics or "F-statistics" for possible rejection or acceptance of variable. The simple dynamics of the test can be given by the following equations. In our case the let the exchange rate volatility be "EX" and stock return volatility be "ST" then the equation would be as under,

$$EX_t = \alpha + \beta EX_{t-1} + \ldots + \beta_p EX_{t-p} + \delta ST_{t-1} + \ldots \delta_p ST_{t-p} + \upsilon_t \ldots (1)$$

$$ST_t = \alpha + \beta ST_{t-1} + \ldots\ldots + \beta_p ST_{t-p} + \delta EX_{t-1} + \ldots\ldots \delta p EX_{t-p} + \upsilon_t \ldots\ldots (2)$$

Equation 1 estimates the direction of causality from stock returns to exchange rate while the equation estimates the direction of causality from exchange rate to stock returns.

Pillips Perron Unit Root Test

Pillips Perron (1988) developed the test procedure to check the unit root of time series by giving the null hypothesis that series has unit root and alternative hypothesis that series is stationary. The mechanism for the rejection of null hypothesis is same as other tests (P-value<0.05) we reject the null hypothesis. We have tested each series of stock return volatility, exchange rate volatility one by one for all the countries of the sample. The general simple equation of test on unit root suggested by Pillips Perron is given as under.

$$\Delta y_t = \rho y_{t-1} + \upsilon_t \ldots\ldots\ldots (3)$$

Where error term is expected to correlate however the test automatically corrects the auto correlation and check for the possible unit root.

Johansen Co-integration Test

The pre-requisite of this test is to check the unit root of the entire variable among which we are interested to check co-integration. If all the series are first difference stationary then this test can be applied. Johansen (1988) developed a test for the econometric series to check for possible co-integration. The test develops three or more hypothesis depending on number of variables included. In our case it would have two hypotheses as we have only two variables. The firs hypothesis would check whether there is co-integration exists or not. The second would be the existence of at most one co-integrating vector. The possible rejection and acceptance would be made base on the comparison of Trace statics, Eigen critical values and their respective p-values. The general equation of test is give as under.

$$A_t = \beta_0 + \sum_{j=1}^{k} \beta_j A_{t-j} + \upsilon_t \ldots\ldots\ldots (4)$$

Research Hypothesis

The research hypothesis is developed on the basis of current literature on co-integrating relationship of stock return and exchange rate volatility and the unknown direction of relationship of the exchange rate, stock return volatility. As it is still not clear whether the exchange rate volatility is causing the exchange rate volatility or the stock return volatility is causing exchange rate volatility.

Hypothesis 1
        Ho: There is no long-run relationship between exchange rate and stock return volatility
        H1: There is long-run relationship between exchange rate and stock return volatility
Hypothesis 2
        Ho: Exchange rate volatility does not causing stock return volatility
        H1: Exchange rate volatility causes stock return volatility
Hypothesis 3
        Ho: Stock return volatility does not cause exchange rate volatility
        H1: Stock return volatility cause exchange rate volatility

Results

ARCH-Family model are applied to generate the volatility series of both the variables, exchange rate and stock returns. Base of AIC, Schwarz and adjusted "R" squared criterion different model like GARCH, GRCH-M, and T-GARCH model are used to generate the volatility for three countries in the sample. In the next step the unit root test (Pillips-Perron) is applied as one of the major pre-requisite of applying the Johansen co-integration test. The descriptive statistics are given in table 2 and time series characteristics of

data are reported in Figure1. The lag length selection is done by applying six different criterion reported in table 3. On the basis of these criteria the 8 lag was selected optimal lag length for testing the unit root, co-integration and Granger Causality Test.

Unit root test

The results given in table 1 all the variable of three countries are first differenced stationary. If we look the Philip-Perron T-Stat of China stock return and exchange rate at level would see that both the exchange rate and stock returns has unit root (we are accepting null hypothesis that series has unit at 1%, 5%, and 10% confidence level. But at first difference we are rejecting null hypothesis that series has unit root at 1%, 5% and 10% confidence level. The p-value is highly significant at first difference. Moving on to stock return and exchange rate of Indian has also unit root at level and p-value is very much significant. But at first difference the both series (exchange rate and stock returns) is stationary. In case of Pakistan we have the similar situation as that of India and China as we finds unit root at level and both the series are stationary at first difference. As both the series stock returns and exchange rate for Pakistan, India and China are first difference stationary then we can apply the co-integration test.

Table 1
Unit Root Test of Stock return and Exchange rate of Sample Countries.

Series			Level	Ist Difference
China Exchange Rate				
P-Values			0.7078	0.0001
Philip-Perron T-Stat			-1.125203	-48.45203
Critical Values	*1%*		-3.434325	-3.434328
		5%	-2.863183	-2.863184
		10%	-2.567693	-2.567693
China SSE Index Returns				
P-Values			0.0982	0.0000
Philip-Perron T-Stat			-2.576435	-35.84994
Critical Values	*1%*		-3.435291	-3.435295
		5%	-2.863610	-2.863611
		10%	-2.567922	-2.567923
India Exchange Rate				
P-Values			0.3234	0.0000
Philip-Perron T-Stat			-1.919472	-38.96707
Critical Values	*1%*		-3.434325	-3.434328
		5%	-2.863183	-2.863184
		10%	-2.567693	-2.567693
India BSESN Index Returns				
P-Values			0.4703	0.0000
Philip-Perron T-Stat			-1.623326	-32.81930
Critical Values	*1%*		-3.435336	-3.435340
		5%	-2.863629	-2.863631
		10%	-2.567932	-2.567933
Pakistan Exchange Rate				
P-Values			0.5239	0.0001
Philip-Perron T-Stat			-1.519031	-93.36359
Critical Values	*1%*		-3.434325	-3.434328
		5%	-2.863183	-2.863184
		10%	-2.567693	-2.567693
Pakistan KSE Index Returns				
P-Values			0.7994	0.0000
Philip-Perron T-Stat			-0.865071	-29.37052
Critical Values	*1%*		-3.435394	-3.435398
		5%	-2.863655	-2.863657
		10%	-2.567946	-2.567947

Table 2 Descriptive statistics of data for the period 2007-2012

Descriptive Statistics	CHINA RET	PAKISTAN RET	INDIAN RET	INDIAN EX	PAKISTAN EX	CHINA EX
Mean	7.8943	9.2926	9.6896	-3.8627	-4.4197	-1.8990
Standard Error	0.0060	0.0072	0.0058	0.0021	0.0026	0.0009
Median	7.8874	9.3311	9.7486	-3.8490	-4.4482	-1.9207
Mode	7.9300	9.1256	9.7218	-3.8167	-4.4568	-1.9221
SD	0.2125	0.2536	0.2051	0.0884	0.1099	0.0388
Kurtosis	1.3658	0.2410	2.2665	-0.3752	1.2336	-0.8568
Skewness	0.8530	-0.6724	-1.7005	0.0897	1.2726	0.0717
Minimum	7.4423	8.4796	9.0070	-4.0513	-4.5854	-2.0003
Maximum	8.6121	9.7306	9.9525	-3.6691	-4.1105	-1.8295

Table 3 Lag Selection Criteria for selecting optimal lag length

Lag	Log L	LR	FPE	AIC	SC	HQ
0	9626.491	NA	7.08e-15	-15.55455	-15.52972	-15.54521
1	25517.59	31602.35	5.21e-26	-41.18932	-41.01546*	-41.12393
2	25616.50	195.7255	4.71e-26	-41.29102	-40.96815	-41.16958
3	25723.08	209.8946	4.20e-26	-41.40514	-40.93325	-41.22765
4	25764.81	81.77234	4.16e-26	-41.41440	-40.79349	-41.18086
5	25807.62	83.46659	4.11e-26	-41.42541	-40.65548	-41.13582
6	25890.49	160.7885	3.81e-26	-41.50119	-40.58225	-41.15555
7	25951.25	117.3070	3.67e-26	-41.54124	-40.47327	-41.13954
8	26091.15	268.7057*	3.10e-26*	-41.70921*	-40.49223	-41.25147*

* indicates lag order selected by the criterion, LR: sequential modified LR test statistic (each test at 5% level), FPE: Final prediction error, AIC: Akaike information criterion, SC: Schwarz information criterion, HQ: Hannan-Quinn information criterion

Johansen Co-integration Test

We found no evidence of co-integrating relationship of exchange rate and exchange rate volatility by applying Johansen co-integration test for all countries included in the sample. The results are very much clear from table 4. If we look the trace statistics value (10.10569<15.49471) in case of Pakistan and its probability values is highly insignificant suggesting that the both series are not co-integrated. Similar is the case for one co-integrating vector null hypothesis. The result reported in table 4 (7.897006< 15.49471, 10.83696<15.49471 in case of India and China respectively) also suggests that there is no long run relationship of stock return and exchange rate volatility for India and China as well.

Table 4
Co-integration Test of Exchange Rate and Stock Indices Returns Volatility of PIC for the period 2007-2012

Country	Hypothesized No. of CE(s)	Eigen value	Trace Statistic	5% Critical Value	Prob.**
Pakistan					
	None	0.007821	10.10569	15.49471	0.2727
	At most 1	0.000325	0.401251	3.841466	0.5264
India					
	None	0.004987	7.897006	15.49471	0.4765
	At most 1	0.001317	1.647539	3.841466	0.1993
China					
	None	0.008443	10.83696	15.49471	0.2217
	At most 1	0.000116	0.145658	3.841466	0.7027

Trace test indicates no cointegration at the 0.05 level, * denotes rejection of the hypothesis at the 0.05 level, **MacKinnon-Haug-Michelis (1999) p-values

The p-value is also insignificant suggesting that there is no co-integrating relationship. So in case of our first research hypothesis 1 we are accepting our null hypothesis that there is no co-integrating relationship between the exchange rate and stock return volatility.

Granger Causality Test

The result of Granger Causality test is somewhat interesting. The result presented in table 5 shows that in case of china neither the exchange rate volatility causes the stock return volatility nor the stock return volatility causes the stock return volatility. The p-value is insignificant. In both case we are accepting the null hypothesis. The results of Indian in such case are same as China as p-value is insignificant suggesting that neither exchange rate nor stock return volatility is caused by each other. However, in case of Pakistan we are rejecting the null hypothesis at 5% level of confidence that the alternative is accepted. This clearly states that exchange rate volatility is causing the stock return volatility. We find unidirectional causality of exchange rate volatility to cause the stock return volatility.

Table 5
Pair wise Granger Causality Tests of Exchange Rate and Stock Indices Returns
Volatility of PIC for the period 2007-2012

Country	Null Hypothesis:	Obs	F-Statistic	Prob.
Pakistan				
	PRT does not Granger Cause PE	1237	0.21723	0.9880
	PE does not Granger Cause PRT		2.10496	0.0326*
India				
	IRT does not Granger Cause IE	1251	1.41938	0.1837
	IE does not Granger Cause IRT		1.45436	0.1695
China				
	CRT does not Granger Cause CE	1262	1.04174	0.4023
	CE does not Granger Cause CRT		1.74949	0.0830

*Significant at 5% level

Conclusion

The study investigated the direction and relationship of exchange rate volatility and stock return volatility (using daily data of exchange rate and stock returns) by employing the Granger Causality and Johansen Co-integration approach. Separate equations of Arch-family model are applied to calculate the volatilities of variables, exchange rate and stock returns for all sample countries. Pillips-Perron test is applied to check the unit root test of both the variables as pre-requisite of Johansen method. The direction and causal relationship of both the variables are checked by employing the Granger Causality approach.

We found no causal relationship between the exchange rate volatilities of exchange rate and stock returns for all countries except for Pakistan were the exchange rate volatility is causing stock return volatility. We found unidirectional causality in case of exchange rate and stock returns volatility of Pakistan. The co-integration results confirmed no long-run relationship of exchange rate volatility and stock return volatility for all countries in the sample (Pakistan, India and China).

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