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The Impact of Exchange Rate Volatility on Foreign Direct Investment Inflows: Evidence from South Asia

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Abstract:

Purpose: *The purpose of this paper is to empirically assess the impact of exchange rate volatility on foreign direct investment (FDI) inflows in Bangladesh, India, Pakistan, Nepal and Sri Lanka. To this day, neither empirical nor theoretical research has managed to reach any consensus on the nature of this impact.*
Design/Methodology/Approach: *The paper uses panel data from the aforementioned developing South Asian countries over the period 1980-2017. Since volatility is not directly observable, a GARCH (1,1) model is used to generate data on exchange rate volatility. The exchange rate volatility variable is then used along with other control variables to analyze the impact on FDI. The study further proceeds by estimating fixed-effect models on the panel of countries using Driscoll and Kraay (1998) standard errors.*
Findings: *Results suggest that exchange rate volatility has a significant negative impact on FDI inflows in South Asian countries, which are in much need of greater inflow to accelerate their economic growth. However, the negative impact of volatility may be offset via greater trade openness.*
Practical Implications: *South Asia imposes strict trade restrictions but greater trade openness can smoothen the path for FDI inflows.*
Originality/Value: *This paper empirically depicts the negative impact between exchange rate volatility and FDI inflows as well as the importance of trade openness in South Asia.*

Keywords*: FDI, GARCH, exchange rate volatility, trade openness.*

JEL codes: *C32, C33, F13, F21, F31, F41.*

Paper Type: *Research article.*

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1. Introduction

The traditional flow of global Foreign Direct Investment (FDI) had been from one developed country to another. The global financial crises of 2008-2009, however, brought a significant change to this pattern. In 2010, developing countries received approximately 52% of the world's total amount of FDI. Since then both FDI outflows and inflows have continued to grow substantially for all developing countries of the world (World Bank, 2013).

FDI enables the home and host countries to form a symbiotic relationship. The home country is the provider of FDI while the host country is the recipient. Investing firms from the home country can enjoy the benefits of cost effectiveness and efficient allocation of resources via FDI. Simultaneously, the host country enjoys technology and knowledge transfers, greater employment (that enhances the efficiency and sophisticates the skills of local manpower), increased competition and productivity – all benefits that contribute vastly to the development of the host country. Developed nations continue to be formidable home countries while developing countries, in need of greater economic growth, continue to be host countries. However, the lucrative aspects of FDI have led to FDI exchange between developing countries as well.

Eight developing nations constitute the South Asian Region: Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka. It is considered to be the fastest growing region in the world and has been receiving greater FDI inflows over the last decade. Nevertheless, relative to Gross Domestic Product (GDP) among other developing-country regions in the world, the South Asian Region has the lowest FDI inflows. It is known that the economy of South Asia is twice the size of Sub-Saharan Africa. However, during the period 2000-2011, Sub-Saharan Africa had an annual FDI inflow of US$ 19.4 billion while that of South Asia amounted to US$ 18.3 (World Bank, 2013). Numerous factors could explain these outcomes, including trade restrictions, policy constraints, extreme fluctuation in macroeconomic variables, political instability, governance and transparency. However, this study focuses on arguably one of the most conspicuous and important factors that affect the amount of FDI invested in South Asia: exchange rate volatility.

The objective of this study is to explore the effect of exchange rate volatility on FDI in South Asian countries. Macroeconomic variables are considered to be quite volatile in developing countries (Easterly *et al.*, 2000). The uncertainty associated with such volatility is likely to cause both private investment and FDI to diminish. While there are several studies exploring the relationship between private investment and exchange rate uncertainty, evidence on the relationship between FDI and exchange rate uncertainty specific to South Asia is scarce. This study uses different econometric methods (such as GARCH and fixed effects models) and data from different South Asian countries to explore the aforementioned relationship.

2. Literature Review

The effect of uncertainty on investment has different implications under different assumptions (Dhakal *et al.,* 2010). Furthermore, Dhakal *et al.* (2010) find the relationship between uncertainty and investment from a theoretical perspective to be inconclusive. Using an error correction model and analyzing their estimation, the authors conclude a positive impact of exchange rate volatility on foreign direct investment for their sample of East Asian countries. Similar inference is made by Goldberg and Kolstad (1995). However, they use different data and methods. Quarterly data from 1978-1999 are used to assess the impact of exchange rate volatility on bilateral FDI flows to US from Canada, Japan and the UK. The standard deviation of the real exchange rate is computed to act as a measure of exchange rate volatility. A positive impact of exchange rate volatility on FDI is found. The theories of Cushman (1985; 1988) also suggest a positive correlation between greater exchange rate volatility and FDI levels.

Unlike the aforementioned studies, Asmah and Andoh (2013) discover a robust and statistically significant negative impact of exchange rate volatility on FDI. The authors use data from twenty-seven African countries and a dynamic linear panel model to reach to their conclusion.

Schmidt and Broll (2008) analyze US FDI outflow to assess any link between exchange rate and FDI size. They use time-series data on US FDI outflow data set and the standard deviation of the real exchange rate to measure exchange rate risk. Their analysis suggests a negative impact of exchange rate uncertainty on FDI flows throughout all industries. Moreover, they delve further into their analysis by using a risk specification which is an undefined part of real exchange rate volatility. This enables them to divide the industries into two sectors and document heterogeneous effects. For non-manufacturing industries, they find that US FDI outflows are increasing with greater exchange rate risk. For manufacturing industries, the opposite is observed.

Urata and Kiyota (2004) document that the exchange rate has a momentous impact on cost conditions in the host country. They find that a host country attracts greater FDI inflows as its currency depreciates but that FDI inflows decrease with higher exchange rate volatility. Froot and Stein (1991) also support a positive correlation between a depreciation of the host country currency and FDI. Assuming imperfect capital markets, the authors relate exchange rate and wealth positions to FDI for their inference. Likewise, Cushman (1985) suggests a positive link between a depreciation of the host country currency and FDI. An exception is the study conducted by Schmidt and Broll (2008). The authors associate a real appreciation of the host country's currency to larger FDI inflows. Their results show that expectations about the host-country's currency appreciation have a negative impact on FDI flows. Campa (1993) suggests that a currency appreciation of the host country can lead to higher revenue for a foreign firm. This motivates the firm to invest more and results in higher FDI inflows to the host country.

Aizenmann (1992), however, explains the theoretical impact of exchange rate uncertainty on FDI to be ambiguous. Exchange rate volatility likely reduces the FDI for the host country. However, it also enhances the practice of simultaneous investment in different countries and shifting production to the country that offers the cheapest production options.

Furceri and Borelli (2008) emphasize the importance of a country's degree of openness. The effect of exchange rate volatility on FDI is suggested to be highly dependent on the degree of openness. For closed economies, the effect of exchange rate volatility on FDI is either positive or null. A negative impact is found for economies with a high level of openness. According to the authors, such results are especially applicable to transition economies.

The degree of openness also plays a significant role in Serven's (2002) study of a link between real exchange rate uncertainty and private investment in developing countries. The study finds a significant negative link in larger economies with high level of openness.

A strand of literature emphasizes on firms' behavior rather than macroeconomic variables of host countries. One example of such study is the analysis conducted by Chen *et al.* (2006). The authors conclude that motives of investing firms are a crucial factor when analyzing the relationship between FDI and exchange rates. Without this consideration, the analysis will suffer from aggregations bias.

3. Data Variables and Sources

A balanced panel data set using secondary data from five South Asian countries: Bangladesh, India, Nepal, Pakistan and Sri Lanka. The remaining three South Asian countries (Afghanistan, Bhutan and Maldives) were excluded from the analysis due to substantial lack of data. The data set comprised of annual observations over the period 1980-2017.

Data for this study were collected from different sources. Nominal exchange rate data were extracted from the Federal Reserve Economic Data (FRED) database and from the Central Banks of the sample countries. Data on exchange rate volatility were estimated from exchange rate data using a Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model. The remaining macroeconomic variables were obtained from the World Development Indicators of the World Bank database. Summary statistics of data variables used in this study are provided in Table 1.

Table 1. *Summary statistics of data variables*

Variables	*Obs.*	*Mean*	*Standard Deviation*	*Minimum*	*Maximum*
FDI Inflows (BoP, current US$)	186	2.84	8.45	-6660000	4.45e+10
GDP (current US$)	190	2.01	4.38	4.45e+10	
Trade Openness (% of GDP)	190	40.82	17.94	12.35209	88.63644
Inflation Rate (annual %)	190	8.48	4.50	.1555182	24.89115
GDP Growth ((annual %)	190	5.12	2.16	-2.977406	10.25996
Transport Services (%)	190	50.43	14.67	14.70366	80.73713
Exchange Rate (local currency units relative to US$)	190	53.37	31.61	7.8868	152.4346
Exchange Rate Volatility	190	10.54	12.678	1.891997	111.3216

Source: *Author's calculations.*

3.1 Explanation and Relevance of Selected Data Variables

In addition to exchange rate fluctuations, there are various other factors that may affect FDI inflows. In regards to FDI, Mallampally and Sauvant (1999) claim that worldwide the competition for such investment is quite high and developing countries especially seek out FDI inflows to enhance their development process. Thus, to stay ahead in stiff competition, developing host countries require stability with regard to factors such as market size, market growth, economic stability, transportation costs, etc. In this study I consider the sample South Asian countries as host countries and use proxies, such as GDP for market size along with the variables of interest in the regression. Information on all variables used in the analysis are provided below:

Gross Domestic Product **(proxy variable for *market size*)**
Profit-maximizing firms are typically attracted to large markets within a host country. Well-functioning, sizeable markets enable them to maximize their investment returns and enhance greater market intelligence (Balasubramanyam, 2002). To measure market size, the host country's GDP is used. It is measured in current USD.

GDP growth rate **(proxy for *sustained growth of market size*)**
Markets with sustained growth also attract profit maximizing firms worldwide. FDI allows for long-term benefits for both host and home countries. Thus, profit-maximizing firms favor economies with sizeable markets that undergo sustained growth overtime. To measure this growth, annual GDP growth in percent is used.

Inflation Rate **(proxy for *economic stability*)**
A strong predictor of FDI is low inflation rates. Along with stable exchange rates, it can be used as a measurement of the host country's economic strength and stability. The inflation rate can also indicate the future path that host economies will follow (Balasubramanyam, 2002). The inflation rate is considered as a proxy variable for economic stability in this study and expressed in annual percentage.

Trade Openness
Trade openness is typically expressed as the sum of exports and imports of the host country relative to GDP and expressed in percentage. The degree of trade openness indicates an economy's level of global interaction. It is argued that greater trade openness may or may not enhance FDI inflows to a host country. However, reduced trade openness is likely to lead to a reduction in the FDI inflow (Mallampally and Sauvant, 1999).

***Transport Services* (proxy for *transportation cost*)**
This variable is identified as the total expense that the home economy needs to bear to transport a tangible investment into the host economy. It includes expenses such as cost incurred from movement of goods and labor. The variable is expressed as percentage of the host country's imports from the balance of payments. It is assumed to be the transportation cost that foreign investors will recur for setting up their firms in the sample countries.

Exchange Rate
Along with the inflation rate, the exchange rate captures the economic strength and stability of a nation. All the five sample countries pursue floating exchange regimes. The nominal exchange rate is used to generate data for the variable "Exchange Rate Volatility" for analysis. Data for this variable are expressed in terms domestic currency relative to USD. Thus, an increase implies depreciation.

Exchange Rate Volatility
Exchange rate volatility is one of the primary variables of interest for this paper. This variable is not directly observable and has to be generated using econometric measures such as rolling standard deviation or different forms of autoregressive conditional heteroskedasticity models. For greater precision, a GARCH (1,1) model is used. Nations with greater economic strength and stability are assumed to exhibit less exchange rate volatility.

Foreign Direct Investment Inflow
FDI inflow is the dependent variable of this study. It is expressed in USD for each sample country. Mallampally & Sauvant (1999) define FDI as investment made in foreign countries by transnational corporations or multinational enterprises. These corporations/enterprises have control over the assets and can manage production activities in the foreign countries that receive FDI inflows from them. One difference between FDI and portfolio investment is that FDI owners exercise lasting control of the investment. (International Monetray Fund defines lasting control as owning at least 10% of shares.)

Dummy Variables
A set of country dummy variables are included. This is to control country fixed effects and likely to increase efficiency in the estimations.

4. Empirical Methodology

The exchange rate variable for each country is first detected for ARCH effects. The next step is to conduct stationarity tests (Im, Pesaran and Shin test and Fisher-type tests). It is essential to use the stationary form of exchange rate variable to produce the exchange rate volatility variable using the GARCH (1,1) model. Notably, it is the primary explanatory variable for this study.

Having obtained all the variables to conduct this study, data are checked for presence of serial correlation, and heteroskedasticity. Finally, panel data analysis is conducted to estimate parameters of interest. The Breusch-Pagan Lagrangian Multiplier (LM) test (Appendix) helps to decide between using fixed effects model and random effects model. This section provides an explanation on the ARCH/GARCH models and introduces the econometric specification.

4.1 Volatility Clustering and the ARCH/GARCH Models

Volatility clustering is prevalent in financial time series variables such as exchange rates. It is best described as a phenomenon where the variable displays high periods of volatility followed by periods of low volatility for a prolonged time. It cannot be observed directly but can be modeled by using Autoregressive Conditional Heteroskedasticity (ARCH) or Generalized Autoregressive Conditional Heteroskedasticity (GARCH) models. The focus of ARCH and GARCH models is to provide a volatility measure such as variance or standard deviation (Engle, 2001).

In an Ordinary Least Squares (OLS) estimation, hetroskedasticity within data may lead to a false sense of precision by affecting the standard errors and confidence intervals. However, the ARCH and GARCH models do not treat this as a problem that requires correction. Rather, they use heteroskedasticity to be modeled as a variance. This leads to the correction of the deficiencies of least squares. Furthermore, a prediction for the variance of every error term is computed (Engle, 2001). It is also to be noted that GARCH model comprises of weighted average of past squared residuals. It also possesses reducing weights that do not ever completely reach zero. This property makes it a useful generalization of the ARCH model (Engle, 2001).

Introduced by Engle (1982), an ARCH model represents conditional variance as linear function of lagged squared error terms. Specifically, the model comprises of two equations: the mean equation and the variance equation. The mean equation describes the average of a time series. It is a linear regression with a constant and regressor(s). Here only one intercept is considered in equation (1):

$$y_t = \delta + \varepsilon_t \ . \tag{1}$$

The time series will vary about its mean δ. If this mean drifts over time or is explained by other variables then those variables are to be added as regressors in the equation. The error term, ε_t, is normally distributed and heteroskedastic. The variance of current period's ε_t depends on preceding period's error term. The variance of ε_t here is denoted as σ_t^2. Thus, the variance equation can now be expressed as:

$$\sigma_t^2 = \theta + \theta_i\, \varepsilon_{t-1}^2 \ . \qquad (2)$$

Equation (1) defines an ARCH(1) model. More generally, an ARCH(q) model, can be expressed as:

$$\sigma_t^2 = \theta_0 + \theta_1\, \varepsilon_{t-1}^2 + \theta_2\, \varepsilon_{t-2}^2 + \ldots\ldots + \theta_q\, \varepsilon_{t-q}^2$$

where $\theta_i \geq 0$ for i=1,….,q.

Proposed by Bollerslev (1986), the GARCH model is simply an extension of the ARCH model. It is a useful generalization of the ARCH model. A GARCH (1,1) model can be expressed as:

$$\sigma_t^2 = \omega + \theta_1\, \varepsilon_{t-1}^2 + \gamma_1\, \sigma_{t-1}^2$$

Generally, the GARCH (p,q) model is a linear function of q number of lagged residuals (the ARCH terms) as well as p number of lagged conditional variance (the GARCH terms). It can be expressed as:

$$\sigma_t^2 = \omega + \theta_1\, \varepsilon_{t-1}^2 + \theta_2\, \varepsilon_{t-2}^2 + \ldots\ldots + \theta_q\, \varepsilon_{t-q}^2 + \gamma_1\, \sigma_{t-1}^2 + \gamma_2\, \sigma_{t-2}^2 + \ldots\ldots + \gamma_p\, \sigma_{t-p}^2$$
$$\sigma_t^2 = \omega + \textstyle\sum_{i=1}^{q} \theta_i\, \varepsilon_{t-1}^2 + \sum_{j=1}^{p} \gamma_j\, \sigma_{t-1}^2 \ ,$$

where $\theta_i\, , \gamma_j \geq 0$ for i=1,….,q and j=1,….,p.

The GARCH (p,q) model needs to follow the GARCH condition of stationarity:

$$\sum_{i=1}^{q} \theta_i + \sum_{j=1}^{p} \gamma_j < 1 \ .$$

This condition of stationarity must be fulfilled to avoid spurious regression.

For this study, I use the reputed and widely used GARCH (1,1) model to extract the conditional variance from the stationary form of the exchange rate variable. These conditional variances are then used as data for the exchange rate volatility (*exvol*) variable.

4.2 Econometric Specification

Having performed all the econometric steps (mentioned at the introduction of this section), the following empirical specification is used to conduct final analysis:

$$fdi_{it} = \gamma_{0i} + \gamma_1 gdp_{it} + \gamma_2 gdpgr_{it} + \gamma_3 tradeop_{it} + \gamma_4 exrate_{it} + \gamma_5 exvol_{it} + \gamma_6 transcost_{it} + \gamma_7 infla_{it} + \varepsilon_{it} \text{ ,} \quad (3)$$

where,
fdi_{it} = log of FDI inflows in country i at time period t;
gdp_{it} = log of GDP in country i at time period t;
$gdpgr_{it}$ = GDP growth rate in country i at time period t;
$tradeop_{it}$ = Trade openness in country i at time period t;;
$exrate_{it}$ = Exchange rate in country i at time period t;
$exvol_{it}$ = Exchange rate voltility in country i at time period t;
$transcost_{it}$ = Transportation costs for foreign investors to invest in country i at time period t;
$infla_{it}$ = Inflation rate in country i at time period t.

Logs of variables such as FDI inflows and GDP are used to reduce their skewness and simplify the interpretations. The research model is a one-way fixed effects model, i.e., it uses only one set of dummies.

5. Results

During a statistical analysis, it is essential to conduct a significance test within a significance level. The significance level, denoted α, may have critical values of 10% (0.1), 5% (0.05), 1% (0.01) and 0.1% (0.001). The null hypothesis is rejected if the significant test yields a value that is lower than the significance level. The obtained value is then considered to be statistically significant. This core statistical concept is used throughout this study for analysis and inferences.

5.1 ARCH Effects

The analysis commences by investigating the presence of ARCH effects in the exchange rate (*exrate*) for each country separately in its time series settings. The ARCH LM test is suitable for this purpose. The ARCH LM test has a null hypothesis of no ARCH effects. From section 4.1, the ARCH(q) model is:

$$\sigma_t^2 = \theta_0 + \theta_1 \varepsilon_{t-1}^2 + \theta_2 \varepsilon_{t-2}^2 + \ldots\ldots + \theta_q \varepsilon_{t-q}^2$$

where $\theta_i \geq 0$ for i=1,….,q.
So the ARCH LM null hypothesis is that
$H_0: \theta_0 = \cdots = \theta_q \varepsilon_{t-q}^2 = 0, \forall i$
Table 2 shows results for the exrate variable from employing ARCH LM test:

Table 2. *ARCH LM test results for the exchange rate variable*

Country	*Chi2 statistic*	*p-value*
Bangladesh	34.176	0.0000
India	33.802	0.0000
Pakistan	35.100	0.0000
Nepal	34.503	0.0000
Sri Lanka	33.731	0.0000

Source: *Author's calculations.*

Results suggest that for each country exchange rate exhibits an ARCH effect. The p-values are highly significant at 5% critical level and so the null hypothesis can be rejected. This means that the stationary form of *exrate* variable can be used to produce data for exchange rate volatility using GARCH(1,1) model. Thus, to fulfill the GARCH condition of stationarity, stationarity in *exrate* variable is checked next.

5.2 Stationarity Tests

Im-Pesaran-Shin test and the Fisher's type tests are two suitable tests to check stationarity in panel data. Each test includes a trend and has a lag length of 1. These results are presented in Table 3. They show clearly that the *exrate* variable is stationary at its first difference. Thus, its differenced form can be used to produce *exvol* variable from GARCH(1,1) process.

Overall, statistics for each test differ but their inferences are same for data variables. Some data variables are integrated to order 0 (i.e. stationary at their level form). For both tests, these variables are FDI inflow, GDP growth rate, inflation rate, and exchange rate volatility. The remaining variables (such as GDP, trade openness, transportation cost, and exchange rate) are integrated to order 1 (i.e. stationary at their first difference). The variables are declared to be stationary since they are all highly significant at 5% critical level – rejecting the null hypothesis of having unit roots within them.

Table 3. *Results of Im-Pesaran-Shin Test and Fisher's Type Test*

	Im-Pesaran-Shin Test		Fisher's Type Test	
Variables	*Level*	*First Difference*	*Level*	*First Difference*
fdi	-5.1106**	-7.0542**	-5.4235**	-7.4482**
gdp	8.2517	-5.0928**	5.1788	-5.4349**
tradeop	1.3046	-4.8494**	1.5392	-5.2287**
infla	-2.488**	-10.1332**	-2.7639**	-10.0837**
gdpgr	-6.8494**	-13.6530**	-6.9569**	-12.4049**
transcost	-1.1718	-7.3000**	-1.2720	-7.5935**
exrate	-0.6466	-6.1921**	-0.6880	-6.4775**
exvol	-2.3487**	-9.2806**	-4.3710**	-8.0506**

Note: ****, ** and * denote respective significance at 1%, 5% and 10% critical levels.*
Source: *Author's calculations.*

5.3 Diagnostics

Data should be checked for presence of serial correlation (or autocorrelation) and inconstant variance (heteroskedasticity). Autocorrelation in panel data sets affect standard errors of the model and lead to biased results. I use the Wooldridge test for autocorrelation in panel data and obtain a p-value of 0.0050 which is much lower than 0.05 critical value. The null hypothesis of no autocorrelation is rejected.

The Breusch-Pagan and White tests are suitable tests to detect heteroskedasticity. Both the tests assume constant variance (i.e. homoskedasticity) as null hypothesis. The p-values of Breusch-Pagan and White p-values are 0.0023 and 0.0446, respectively. The values are lower than the critical value of 0.05. Hence, the null is rejected and data variables are found to be heteroskedastic. This can be a potential source of bias.

It is apparent that the data are sensitive to hetereoskedasticy and autocorrelation. Under such situation, it is wise to use Driscoll and Kraay (1998) standard errors for the model. Since these are heteroskedastic and autocorrelation consistent (HAC) standard errors, using them diminishes the bias.

5.4 Results of Panel Data Analysis

Using the Breusch and Pagan LM test (Appendix), I decide to use fixed effects model for panel data analysis. Furthermore, Driscroll and Kraay (1998) corrected standard errors are employed to resolve the issues of hetereoskedasticy and autocorrelation in data variables. I employ 5 fixed effects models where each model has different combinations of explanatory variables. In all estimations, the dependent variable is log of FDI inflow (i.e. *fdi*) and all variables contain country fixed effects. The results of all the regressions are presented in Table 4.

Table 4. *Results of fixed effects models*

	Dependent Variable : fdi				
Independent Variables	(1)	(2)	(3)	(4)	(5)
gdp	2.385**	2.700**	1.987**	2.112**	2.090**
	(0 .000)	(0.004)	(0.000)	(0.001)	(0.001)
gdpgr		0.044	0.018		0.011
		(0.300)	(0.557)		(0.712)
tradeop			0.063**	0.066**	0.065**
			(0.001)	(0.001)	(0.001)
exrate		-0.011		-0.001	-.0006
		(0 .468)		(0.894)	(0.941)
exvol	-0.035**	-0.029**	-0.016	-0.014	-0.014
	(0.013)	(0.030)	(0.105)	(0.212)	(0.222)
transcost				0.023	0.022
				(0.119)	(0.118)

infla				-0.005 (0.787)	-0.004 (0.804)
Country dummies	Yes	Yes	Yes	Yes	Yes
R^2 *Within*	0.728	0.734	0.816	0.826	0.826
N	177	177	177	177	177
Probability (F-Stat)	0.00	0.001	0.000	0.000	0.000

Note: ****, ** and * denote significance at 1%, 5% and 10% critical levels respectively.*
Source: *Author's calculations.*

In Table 4, I consider column (1) to be the benchmark specification. The explanatory variables are exchange rate volatility (*exvol*) and the log of GDP (*gdp*). GDP can be considered as one of the most important factors potentially affecting FDI inflows. GDP is an indicator of market size and historically, FDI inflows went from one developed country (i.e. country with substantially large market size) to another developed country.

In regards to results, the specification in column (1) suggests that both regressors are statistically significant at the 5% critical level. The coefficient of GDP has a positive sign. It depicts that if the *GDP* of the sample countries increases by 1 percent then their *FDI* will rise by 2.385%. On the other hand, *exvol* has a negative coefficient - implying that a unit rise in *exvol* will lower *FDI* by 0.035%.

From specification (2) to (5), I continue to add more explanatory variables. Specification (2) is created by adding the GDP growth rate (*gdpgr*) and exchange rate (*exrate*) to specification (1). Both *gdp* and *exvol* maintain their statistical significance (at 5% critical level) as well as their signs in specification (1). However, the coefficient value of *exvol* diminishes a little while that of *gdp* rises. A 1 percent rise in *gdpgr* increases FDI in South Asia by 0.044 % but for *exrate* the FDI value goes down by 0.011%. It is to be noted that neither *gdpgr* nor *exrate* is statistically significant. This trait is seen in other specifications as well. Due to this insignificance, the positive relationship between *fdi* and *gdpgr* is not robust. This can also be said about the negative relationship between *fdi* and *exrate*.

In specification (3), the influence of *gdp*, *gdpgr*, *exvol* and *tradeop* on *fdi* are observed. The variable *tradeop* represents trade openness in this study. It is said that trade openness helps a host country to attract more *fdi*. This is visible in the results from specification (3). A 1% rise in *tradeop* increases *fdi* in South Asia by 0.063 %. The coefficient is significant at the 5% critical level. Both *gdp* and *gdpgr* lead to increases in *fdi* as well although the former is significant but not the latter. The *exrate* variable continues to have a negative impact. Interestingly, compared to other two models, its coefficient decreases and becomes insignificant.

For a foreign investor, an increase in the inflation rate *(infla)* implies erosion in profits from *fdi*. An appreciation of the host country's currency will increase the price of *fdi*. Thus, I include *infla* and *exrate* alongside *gdp*, *exvol* and *tradeop* in specification (4). Both *infla* and *exrate* have negative coefficients. They are, however, statistically insignificant, i.e., do not effect *fdi* statistically. The impact of e*xvol* continues to diminish and remains insignificant as well as negative as in column (3).

Specification (5) includes all the variables from equation (3) in section 4.2. Both *gdp* and *tradeop* continue to exert positive and significant impact on *fdi*. The variable g*dpg*r has a positive impact while *infla* and *exrate* have negative effects. All three are insignificant. The important aspect of this model is that *exvol*'s impact on *fdi* has decreased by more than half compared to specification (1). However, it is to be noted that not all variables yield the expected signs. Transportation costs of *fdi* (i.e *transcost*) have a positive coefficient but it is statistically insignificant.

Table 4 also displays R-squared values for each regression. An R-squared value shows the extent to which data fit a statistical model (Stock and Watson, 2015). To explain broadly, model (5) has an R-squared value of 0.826. This means that model (5) explains 82.6% of the variation in foreign direct investment inflows to my sample of South Asian countries. The remaining 17.4% is explained by variables that are not included in this study.

6. Conclusion

The research question of this study is, "What impact does exchange rate volatility have on FDI inflows in South Asian countries?" To find an answer, data are used from the five South Asian countries (Bangladesh, India, Pakistan, Nepal and Sri Lanka) over the period 1980-2017.

A measure of exchange rate volatility data from exchange rates is produced using the GARCH(1,1) model. While exchange rate volatility data is primary explanatory variable, 6 more control variables and country dummies are used for analysis. Using these data variables, panel one-way fixed effects models are estimated to answer the research question. Evidence of heteroskedasticity and autocorrelation are found in data variables. To address this issue, Driscroll and Kraay standard errors are used for each fixed effects model.

The results suggest that exchange rate volatility has a negative effect on FDI inflows in South Asian countries. However, the relationship is weakened as more macroeconomic variables come into play. The volatility variable loses its statistical significance with higher GDP value and greater trade openness. All the estimated fixed effects models suggest that GDP and trade openness are statistically significant and exert a strong positive influence on FDI inflows. Furthermore, their positive effects appear to be mitigating the negative impact exerted by exchange rate volatility on FDI inflows.

Overall, this study suggests that exchange rate volatility is negatively correlated with FDI inflows in South Asia. However, this impact is not as profound as expected to be. In a broader economic framework, it stops affecting the FDI inflows significantly. Higher GDP and trade openness can significantly offset its impact. In fact, for South Asia, trade openness may play a key role.

It is useful to remember that South Asia's economy is twice the size of that of Sub-Saharan Africa. Yet, it received smaller FDI inflows than Sub-Saharan Africa. This indicates that greater GDP is not enough and South Asian countries may instead seek to increase their trade openness. In 2016, the world average tariff rate was 6.3% while in South Asia the tariff rate was 13.6% (Suneja, 2018). By lowering trade restrictions and making their economies more open to trade, they may substantially mitigate the negative impact of exchange rate volatility on their FDI inflows. However, this conjecture should be supported by further research.

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List of Databases

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Federal Reserve Bank of St. Louis, web page : http://fred.stlouisfed.org
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Central Bank of India, web page: https://www.centralbankofindia.co.in/english/home.aspx
State Bank of Pakistan, web page: http://www.sbp.org.pk/
Nepal Rastra Bank, web page: https://www.nrb.org.np/
Central Bank of Sri Lanka, web page: https://www.cbsl.gov.lk/

APPENDIX

The Breusch and Pagan LM test is a test to detect the presence of random effects. The test statistic it uses is:

$$LM^2 = \frac{nT}{2(T-1)} \left\{ \frac{\sum_{i=1}^{n} (\sum_{t=1}^{T} \hat{\theta}_{it})^2}{\sum_{i=1}^{n} \sum_{t=1}^{T} \hat{\theta}_{it}^2} - 1 \right\}^2 .$$

This statistic tests whether $\sigma_\theta^2 = 0$ in var(ϑ_{it})= var $(\varepsilon_{it} + \theta_{it})$= σ_ε^2+ σ_θ^2. The null hypothesis for the Breusch and Pagan LM test is: H_0: σ_θ^2=0 (i.e. there is no evidence of random effects). I perform the statistical test and receive a p-value of 1.0000.The p value is high and the null cannot be rejected. Thus, there are no random effects and I use a fixed effects model for my analysis.