Empirical Relationship Between Foreign Direct Investments and Exchange Rates in the Post Liberalization Era

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Abstract

This paper tries to investigate the long term and short term causal relationship between foreign direct investment (FDI) and foreign exchange rates (FX) in India's post liberalization period. Econometric models have been used in this study, and the long term relation between FDI and FX is measured by using Johansen's cointegration test, and Granger's causality test is employed to measure the short term relationship. The result of the cointegration test proves that there is a significant long-term relationship between foreign direct investment (FDI) and foreign exchange rates (FX) with the exception of YEN/INR. The short-term relationship test confirms that there exists uni-directional relationship between FX and FDI. Therefore, FX has a stronger ability to predict subsequent FDI inflows, whereas there is no implication vice versa.

Keywords : **FDI, exchange rates, co-integration, casual relationship, foreign investment flows**
JEL Classification : F21, F23, F31

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Over the last two decades, foreign direct investment (FDI) has become an increasingly important channel for resource flows across national borders for economic growth, transferring technology, and knowledge between participating countries. The exchange rate is possibly recognized as the most important determinant and a crucial factor of foreign investment flows. Some of the international studies have revealed that FDI determinants have integrated the exchange rate. Therefore, we wished to study the relationship between FDI and exchange rates in the post liberalization era. In general, the USD/INR exchange rate is mostly co-integrated with the FDI because the major flow of FDI is in terms of USD/INR. In this paper, we have shown a keen interest in the relationship between FDI and other major currency exchange rates (i.e. EUR/INR, GBP/INR, and JPY/INR).

Objectives of the Study

1) To ascertain the trend between FDI and major exchange rates in the post liberalization era.
2) To find the long term relationship and causal directional relationship between FDI and major currency exchange rates.

Review of Literature

Majagaiya (2010) found the linkage between foreign direct investment (FDI) and economic growth in terms of gross domestic product growth rate (GDPGR) for Nepal over the period from 1980-2006 using the Granger causality test,

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unit root test, and the co-integration test. The results showed that there exists a long term relationship between the variable and direction of causality runs from foreign direct investment (FDI) to gross domestic product growth rate (GDPGR). Hossain, A. and Hossain, M. K. (2012) examined co-integration and the causal relationship between foreign direct investment (FDI) and the economic output or gross domestic product (GDP) in both short and long run of Bangladesh, Pakistan, and India over the period from 1972-2008. The results suggested that there is no co-integration between FDI and GDP in both the long and short run in Bangladesh and India. However, they found co-integration between them in both the short and long run in Pakistan. Conversely, Granger's causality results suggested that there was no causality relationship between GDP and FDI for Bangladesh, and one way or unidirectional relationship was found for Pakistan and India, which means FDI caused economic output in Pakistan. Abbott, Cushman, and De Vita (2012) examined the effect of exchange rate regimes on foreign direct investment (FDI) flows to developing countries. Using system generalized methods of moment's estimation on a panel of 70 developing countries for the period from 1985 - 2004, they found that developing countries adopting de facto fixed or intermediate regimes significantly outperformed those opting for a flexible exchange rate system in attracting FDI flows.

No statistically significant differences in the FDI-inducing properties of fixes, intermediates, and floats were found using the International Monetary Fund official classification. Chaudhary, Ali Shah, and Bagram (2012) investigated the effect of volatility in exchange rate upon foreign direct investment in Asian economies. The sample was selected from four main regions of Asia and the countries of Pakistan, India, Bangladesh, and Sri-Lanka were selected for the study from the South-Asian region, whereas from the Southeast Asian region, Malaysia, Indonesia, Singapore, and Thailand were selected. Similarly, from East Asia, China, Japan, and South Korea were selected, while Turkey, Iran, and Israel were selected from West Asia. They found the existence of both long run and short run effect of exchange rate volatility upon foreign direct investment in Pakistan, India, Sri Lanka, South Korea, Turkey, and Israel, while ECM was also found to be statistically significant for Japan. No evidence of relationship was found between the variables for Bangladesh, China, Malaysia, Indonesia, Thailand, Singapore, and Iran.

On the basis of the above discussion, it is observed that no exclusive study has been conducted with reference to exchange rate and FDI in India in the post liberalization period.

Data Source and Methodology

➪ **Data Source :** Foreign direct investment (FDI) and exchange rates, which are the four major currency pairs quoted by Reserve Bank of India namely, USD/INR, EURO/INR, GBP/INR, and JPY/INR were required to fulfill our study objectives. Therefore, the time-series monthly data was collected from the Centre for Monitoring Indian Economy (CMIE) for the period from 1991-2012 for all other study variables except EURO/INR. The EURO currency was introduced in the year 1999, therefore, the EURO/INR exchange rates were taken into consideration from 1999 to 2012.

➪ **Analytical Framework for Econometric Models :** The trends of the FDI and FX (foreign exchange rates) are illustrated by bar and line charts, and the basic characters of the variable are illustrated using descriptive statistics. In general, most of the time series data are non-stationary. Therefore, first, an attempt was made to verify the stationarity properties by using the popular unit root test models namely, Augmented Dickey-Fuller (ADF) test and Phillips-Perron (PP) test for double confirmation of the variables' stationarity. Later, long run and short run relationship were tested by using Johansen's co-integration test and Granger causality test respectively.

➪ **Unit Root Test :** Augmented Dickey-Fuller test is required to check the order of integration through unit root (white noise error or random walk). Unit root tests based on Augmented Dickey-Fuller (ADF) test and non-parametric Phillips-Perron (PP) approaches were used in this study to examine the stationarity of all the currency exchange rates (FX) and FDI inflows series. The test of stationarity of FX and FDI were carried out by estimating the following equation (Ali & Gupta, 2011).

$$\Delta X_t = b_0 X_{t-1} + \sum_{i=1}^{T} bi \Delta X_{t-i} + e_t \quad \ldots\ldots\ldots (1)$$

Where,

X_t represents the base level or the first difference of the variables. The null hypothesis of non-stationarity is $b_0 = 0$. If the null hypothesis is accepted at the base level of the series, but rejected at the first difference of the series, then the series is taken as stationary at the first difference level, and it is denoted by $I(1)$. The above tests were performed using a constant intercept and lag length was determined using Schwarz information criterion.

Johansen Cointegration Test : Cointegration has emerged as a powerful technique for investigating common trends in multivariate time series and provides a sound methodology for modeling both long run and short-run relationship in a system. The purpose of the cointegration test is to determine whether a group of non-stationary series are cointegrated or not, and explores the long-run equilibrium relationship among the variables. Under this study, Johansen's cointegration tests were used to assess the long-run predictability among FDI inflows and currency exchange rates of USD/INR, EURO/INR, GBP/INR, and JPY/INR, using Johansen's cointegration test, assuming a η-dimensional vector X_t with integration of on order I (1), which estimates the vector autoregressive models. Johansen and Juselius (1990) further improved the model by incorporating error correction, which is depicted as follows (Ali & Gupta, 2011).

$$X_t = C + \sum_{i=1}^{k} \prod_i X_{t-1} + \varepsilon_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

$$\Delta X_t = \mu + \sum_{i=1}^{k-1} r_i \Delta X_{t-i} + \prod_i + X_{t-k} + \varepsilon_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3)$$

Where,

X_t is an n x1 vector of the I (1) variables representing FX and FDI inflows respectively, μ is a deterministic component which may include a linear trend term, an intercept term, or both, Δ denotes the first difference operator, Πi is an n x r matrix of parameters, indicating c is a vector of constants, k is the lag length based on the Hannan-Quinn criterion, and it is a ε_t random error term, which indicates how many linear combinations of X_{t-1} are stationary.

The residual vectors of the above model construct two likelihood ratio test statistics, that is, the trace test and the maximal Eigen value test. The trace statistics tests the null hypothesis of r cointegrating relations against the alternative of the k cointegrating relations. The maximum eigenvalue statistics tests the null hypothesis of r cointegrating relations against the alternative of $r + 1$ cointegrating relations. There are varied views on the usefulness of two tests for cointegration. While Johansen and Juselius (1990) argued that the trace test may lack power relative to the maximal eigen value test, Cheung and Lai (1993) viewed that the λtrace test shows more robustness than the maximal eigenvalue test. The Johansen likelihood ratio test statistic, λtrace, and the maximal eigen value, λmax for the null hypothesis that there are at most r cointegrating vectors are given by:

$$\lambda_{trace} = -T \sum_{i=r+1}^{k} \mathrm{In}(1-\hat{\lambda}_i) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4)$$

$$\lambda_{max} = -T \,\mathrm{In}(1-\hat{\lambda}_{r+1}) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (5)$$

Granger Causality Test : Granger causality test was used to analyze the direction and causal relations between exchange rates and FDI inflows in India. The Granger (1969) approach predicts how much of the current value of one variable can be explained by past values of another variable and then tries to see whether adding lagged values of prior variable can improve the explanation. For instance, Y is said to be Granger-caused by X if X helps in the prediction of Y, or equivalently, if the coefficients on the lagged X is statistically significant. Specifically, Y_t is causing X_t if some coefficient, a_i, is non-zero in the following equation (Ali & Gupta, 2011).

$$X_t = C_0 + \sum_{i=1}^{p} a_i Y_{t-1} + \sum_{j=1}^{p} b_j X_{t-j} + \mu_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (6)$$

A time series, Y_t, causes another time series, X_t, if the current value of X_t can be predicted better by using past values of Y_t than by not doing so:

$$Y_t = \gamma_0 + \sum_{i=1}^{p} a_i \, X_{t-1} + \sum_{j=1}^{p} \beta_j X_{t-j} + \mu_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (7)$$

Where,

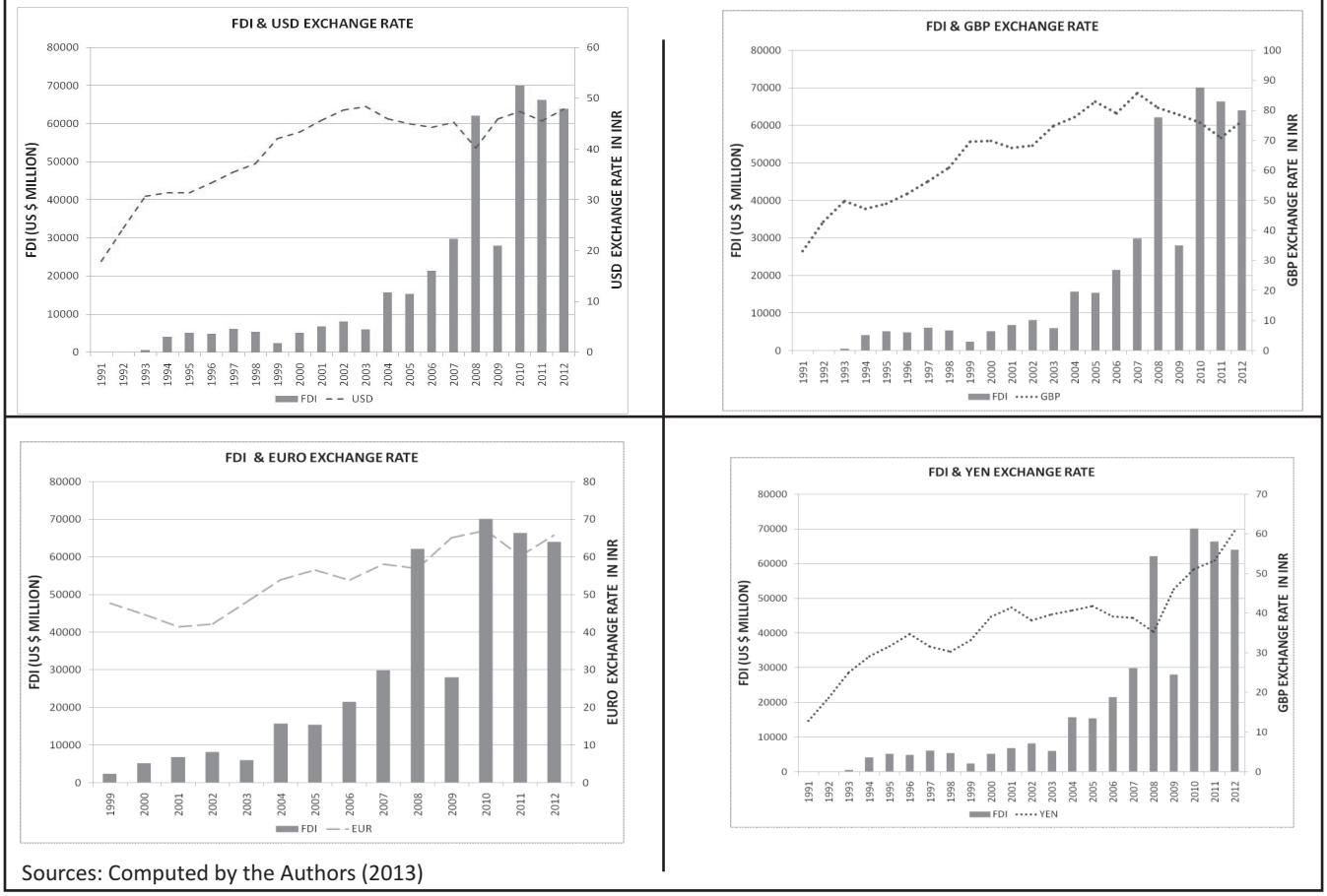
p is the number of lags used for the variable. The regression equations (6) and (7) test the existence of short-term relationship between the variables X and Y. Moreover, if both FX and FDI are co-integrated, then causality must exist in uni-directional or bi-directional direction. The test for causality is based on a F-statistics, which tests whether lagged information on a variable Y provides any statistically significant information about a variable X in the presence of lagged X. The F-statistic is given by:

$$F_1 = \frac{(SSE_0 - SSE_1)/p}{SSE_1/(T-2p-1)} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (8)$$

Where,

SSE_0 and SSE_1 are the sum of squares of residuals, p is the number of lags, and T is the number of observations. It is important to note that the statement "X Granger causes Y" does not imply that Y is the effect or the result of X. This implies that the Granger causality measures precedence and information content, but does not by itself indicate causality in the true sense. The analysis of unit root, co-integration, and causality tests for different commodities were performed using econometric software Eviews Version 6.

Graph 1. FDI and Various Major Currency Exchange Rates from 1991 to 2012 (US $ in millions)



Sources: Computed by the Authors (2013)

Table 1. FDI and Major Currency Exchange Rates from 1991 to 2012 (US $ in millions)

Year	FDI	USD	GBP	EUR	YEN	Year	FDI	USD	GBP	EUR	YEN
1991	103	17.94	33.19	-	12.8	2002	8151	47.694	68.319	42.175	38.17
1992	133	24.47	42.93	-	18.6	2003	6014	48.406	74.835	48.071	39.75
1993	559	30.79	49.832	-	25.09	2004	15699	45.924	77.736	54.005	40.71
1994	4153	31.4	47.264	-	29.11	2005	15366	44.95	82.947	56.549	41.82
1995	5138	31.387	48.854	-	31.66	2006	21453	44.283	79.021	53.885	39.14
1996	4892	33.404	52.217	-	34.77	2007	29829	45.282	85.718	58.109	38.8
1997	6133	35.473	56.401	-	31.57	2008	62106	40.241	80.801	56.99	35.29
1998	5385	37.124	60.971	-	30.34	2009	28018	45.919	78.448	65.127	46.04
1999	2401	42.115	69.618	47.761	33.16	2010	70121	47.416	75.877	67.082	51.12
2000	5181	43.341	69.835	44.768	39.06	2011	66318	45.574	70.889	60.224	53.31
2001	6789	45.697	67.536	41.476	41.43	2012	63963	47.946	76.403	65.894	60.81

Sources: Compiled by the Authors from CMIE (2013)

Results and Discussion

Descriptive Nature of the Study Variables : The Table 1 depicts that FDI shows an increasing trend in the post liberalization period up to 2008 (i.e. US$ 62, 106 million), but FDI fell in the year 2009 (i.e. US$ 28,018 million) due to the global financial crisis. But the investments recovered immediately next year (in 2010, i.e. US$ 70,121 million). In the recent past, FDI showed a diminishing trend in the year 2011 (i.e. US$ 66,318 million) and 2012 (i.e. US$ 63,963 million) respectively. The Table 2 depicts the descriptive statistics of FDI. It shows that within the study period, FDI increased from the lowest limit of US$103 million in 1991 and touched the highest FDI figure of US$ 70,121 million in 2010. During the study period, the average FDI was US$19,450.227 million, with the standard deviation of FDI being US$ 23,778.762 million. The Figure 1 shows the graphical representation of FDI inflows, with the major currency exchange rate in the whole study period except EUR/INR as it was reported from 1999 onwards due to the reason that it was introduced only in the year 1999.

The Table 2 exhibits the descriptive statistics of the major currency exchange rates (i.e. USD/INR, EUR/INR, GBP/INR, and JPY/INR). It reveals that during the study period, the exchange rate was at its lowest at ₹17.94, ₹ 33.19, ₹ 41.476, ₹ 12.8, and touched the highest exchange rate figures at ₹ 48.406, ₹ 85.718, ₹ 67.082, and ₹ 60.81. During the study period, the average exchange rate was ₹ 39.853, ₹ 65.893, ₹ 54.437, and ₹ 36.934, with the standard deviation of the exchange rate being ₹ 8.453, ₹14.676, ₹ 8.597, ₹10.790 for USD/INR, EUR/INR, GBP/INR, and JPY/INR respectively.

Table 2. Descriptive Statistics of the Study Variables

	FDI	USD/INR	GBP/INR	EUR/INR	YEN/INR
Minimum	103	17.94	33.19	41.476	12.8
Mean	19450.227	39.853	65.893	54.437	36.934
Maximum	70121	48.406	85.718	67.082	60.81
Standard Deviation	23778.762	8.453	14.676	8.597	10.790
Range	70018	30.466	52.528	25.606	48.01
Standard Error	5069.649	1.802	3.129	2.298	2.300
Kurtosis	0.384	0.610	-0.571	-1.143	0.846
Skewness	1.367	-1.141	-0.681	-0.065	-0.046

Sources: Computed by the Authors (2013)

Table 3. Unit Root Test Results of the Study Variables

	ADF TEST		PP TEST	
	AT LEVEL	1^{ST} Δ	AT LEVEL	1^{ST} Δ
FDI	-4.927655	-10.44298	-13.75286	135.3325
	(0.0000)**	(0.0000)**	(0.0000) **	(0.0001) **
USD / INR	-1.488704	-10.36611	-1.300089	-10.38878
	(0.5375)	(0.0000) **	-0.6296	(0.0000) **
GBP / INR	-1.998079	-11.85979	-1.933233	-11.68833
	(0.2876)	(0.0000) **	(0.3166)	(0.0000)
EUR / INR	-0.274605	-10.82881	-0.431917	-10.69323
	(0.9248)	(0.0000) **	(-0.8997)	(0.0000) **
YEN / INR	-0.44506	-10.36935	-0.051053	-9.978442
	(0.8976)	(0.0000) **	(-0.9518)	(0.0000) **

*Significant at the 1% level of significance Source : Computed by the Authors

Table 4. Johansen Co-integration Test (Number of lags 4)

Co-integration between Exchange Rates and FDI	Hypotheses	Trace Statistics	Max-Eigen Statistics	Co-integration/ Non co-integration
USD / INR & FDI	H_0: r = 0	20.01203** (0.0097)	15.94789* (0.0268)	Co-integrated
	H_0: r ≤ 1	4.064138* (0.0438)	4.064138* (0.0438)	
GBP / INR & FDI	H_0: r = 0	25.76640** (0.0010)	20.78543** (0.0041)	Co-integrated
	H_0: r ≤ 1	4.980962* (0.0256)	4.980962* (0.0256)	
EUR / INR & FDI	H_0: r = 0	30.40581** (0.0002)	29.97470** (0.0001)	Co-integrated
	H_0: r ≤ 1	0.431110 (0.5114)	0.431110 (0.5114)	
YEN / INR & FDI	H_0: r = 0	12.4785 (0.1354)	12.08051 (0.1077)	Non Co-integrated
	H_0: r ≤ 1	0.397994 (0.5281)	0.397994 (0.5281)	

**Significant at the 1% level of significance & *Significant at the 5% level of significance

Source : Computed by the Authors

Table 5. Granger Causality Test (Number of lags 4)

Null hypothesis	*F* -statistics	Probability	Direction	Relationship
USD / INR does not Granger Cause FDI	3.14542*	0.0155	Uni-directional	USD / INR → FDI
FDI does not Granger Cause USD/ INR	1.64723	0.1639		
GBP/ INR does not Granger Cause FDI	2.92657*	0.0221	Uni-directional	GBP/ INR → FDI
FDI does not Granger Cause GBP/ INR	1.71867	0.1473		
EUR/ INR does not Granger Cause FDI	4.33835**	0.0024	Uni-directional	EUR/ INR → FDI
FDI does not Granger Cause EUR/ INR	0.91496	0.4569		
YEN / INR does not Granger Cause FDI	5.26122**	0.0005	Uni-directional	YEN/ INR → FDI
FDI does not Granger Cause YEN/ INR	1.93495	0.1061		

**Significant at the 1% level of significance & *Significant at the 5% level of significance

Source : Computed by the Authors

Results of the Unit Root Test : The Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) Unit Root test was applied to verify whether the study variables like FDI and major currency exchange rates (i.e. USD/INR, EUR/INR, GBP/INR, and JPY/INR) are stationary or non stationary. Its shows that FDI is stationary at the level and major currency exchange rates (i.e. USD/INR, EUR/INR, GBP/INR, and JPY/INR) are not stationary at level, but in the 1st difference, that is, *I* (1) order, it was stationary. The results of the Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) Unit Root Test are presented in the Table 3.

Results of the Johansen Cointegration Test : After testing the precondition of non-stationary time series (i.e. the series were stationary at their first difference), Johansen and Juselius's (1990) cointegration test was carried out to determine the existence of a long-run relationship between FDI and major currency exchange rates (i.e. USD/INR, EUR/INR, GBP/INR, and JPY/INR). The Table 4 presents the cointegration results which show that FDI and USD/INR, FDI and EUR/INR, and FDI and GBP/INR series are co-integrated. But FDI and JYP /INR series is not co-integrated. The two series are co-integrated means that there is a significant long term relationship between the two series. Therefore, FDI has a long term relationship with USD/INR, EUR/INR, and GBP/INR, but there is no long term relationship with JPY/INR.

Results of the Granger Causality Tests : Since cointegration tests indicate only the existence of a long-run relationship among the two series, Granger (1969) causality tests were used to analyze the direction of relationship among the series. The test results presented in the Table 5 show that all the major currency exchange rates (i.e. USD/INR, EUR/INR, GBP/INR, and JPY/INR) were having uni-directional causality (i.e. Exchange Rate $\rightarrow$ FDI) with FDI. Therefore, exchange rate instability (i.e. USD/INR, EUR/INR, GBP/INR, and JPY/INR) has an influence on FDI inflows. However, FDI inflow does not cause exchange rate variability.

Conclusion

Foreign direct investment (FDI) has become an increasingly important channel for resource flows across national borders for economic growth. In that, the exchange rate is possibly recognized as the most important determinant and a crucial factor of foreign investment flows. The graphical representation depicted in the present paper showed that FDI showed an increasing trend in the post liberalization period up to 2008. But there was a sudden fall in FDI in the year 2009 due to the global financial crisis, and FDI recovered immediately in the year 2010. In the recent past, FDI showed a diminishing trend in the year 2011and 2012 respectively. The unit root test indicates that the exchange rate data are non-stationary in level, but are stationary in first difference. So, the data are integrated in order (1). Similarly, Johansen's co-integration test shows that the null hypothesis - that there is no cointegration - is rejected for rank of zero at the 5% level of significance. This means that there exists a long-run relationship between the FDI and major currency exchange rates. The Granger causality test indicates that all the major currency exchange rates (i.e. USD/INR, EUR/INR, GBP/INR, and JPY/INR) are having uni-directional causality. (i.e. Exchange Rate $\rightarrow$ FDI) with FDI.

Research Implications

There are so many arguments for and against the relationship between foreign direct investment and the exchange rate of a country. Some researchers discovered a stronger relationship between FDI and exchange rate, while the others could not do so. This study found that there is a significant long term relationship between the two series. Therefore, it was observed that FDI has a long term relationship with USD/INR, EUR/INR, and GBP/INR, but there is no long term relationship with JPY/INR. The Granger causality tests results suggest that there is uni-directional causality (i.e. Exchange Rate $\rightarrow$ FDI) with FDI. Therefore, exchange rates instability (i.e. USD/INR, EUR/INR, GBP/INR, and JPY/INR) has an influence on FDI inflows. But FDI inflow does not cause exchange rates variability.

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