International Journal of Science and Research (IJSR)
ISSN: 2319-7064
Impact Factor (2018): 7.426

Impact of Stock Market on FOREX: An Empirical Study

Basavaraju P.S[1], Dr. B. Bakkappa[2]

[1]Assistant Professor, Department of Studies in Management, G M Institute of Technology, Davangere-577006, India

[2]Director, Department of Studies in Management, G M Institute of Technology, Davangere-577006, India

Abstract: ***This article investigates the interaction between stock market and foreign exchange market. Stock market is represented by stock index NIFTY, which represents the weighted average of 50 Indian company stocks in 12 sectors. Foreign exchange market is represented by US dollar price. Required data collected between Jan 2005 to Jul 2018. Variables are tested for stationary and found at 1st difference. Both Trace test and Max Eigen value indicates two co-integration equation in our model. Johansen cointegration. shows that Long run association between USD and NIFTY exists. VECM results shows that there is no short run causality . Wald test identifies existence of short run relationship. There is no evidence of autocorrelation. Granger-causality test shows that there is a bi-directional causality between exchange rate and stock index in both long run and short run.***

Keywords: Stationary, Co-integration, Causality, Exchange rate, NIFTY

1. Introduction

The relationship between a FOREX market and its stock market has been a subject of theoretical and empirical investigation for 40 years . Stock market is one of the tool to measure country's economy. During economic crisis period stock market crashed and there was a high volatility in FOREX market. Hence it is very interesting topic to find the relation. Possible interaction between the stock and the FOREX markets explained by –Flow-oriented approach and Stock-oriented approach – as illustrated by Dornbusch R and Fischer S (1980). He has considered a third approach, viz., asset market approach which concludes no such interaction between the markets. Since exchange rate risk and its association with the stock market is an important component of the overall portfolio risk, this trend can be expected to link the stock market and the FOREX market more closely

1.1. Objectives of the Study

This article intends to achieve the following objectives:
1) To find out the relationship between Stock index and Dollar exchange rate; and.
2) To explore the causality relationship between Stock index and dollar exchange rate.

1.2. Hypotheses of the Study

This research is accompanied by the following hypotheses.
1) **Ho:** Stock Index has no relationship with Dollar exchange rate
2) **Ho:** There is no causality relationship between Stock Index and Dollar exchange rate

2. Literature Review

Y.V Reddy and A Sebastin (2008)[1] in their research paper on "Interaction between FOREX market and stock market in India: An entropy approach" spoke about the various representations of relationships and their interaction existing in the foreign exchange market and the stock market of a country are considered to be an important internal force of the markets in a financially liberalized environment.

This paper studies more on "the temporal relationship between the forex market and the stock market of developing and developed countries has been studied, especially after the East Asian financial crisis of 1997–98, using various methods like cross-correlation, cross-spectrum, and error correction model, but these methods identify only linear relations."

Santosh Kumar et al (2012)[2] emphasized on the contagion linkages (a contagion can be explained as a situation where a shock in a particular economy or region spreads out and affects others) between forex market and stock market which have been the focus area of research in recent times. They investigated the impact of the change in exchange rate on the return of indices in terms of sensitivity coefficient and the presence and direction of the lead-lag relationship between these two variables.

They investigated the coexistent and dynamic interaction of return on indices and change in exchange rate. They found an appreciation of rupee with respect to the dollar and also found that euro had an adverse impact on the returns of indices and vice versa. Another very important finding was that the exposure of euro is justified only in large and liquid stocks as compared to the wider exposure of dollar.

Chen Yin Kuo (Year)[3] conducted an in-depth study of the interaction between current account, stock price and exchange rates of ten Asian countries for a 30 year period

[1] Reddy, Y. V., & Sebastin, A. (2008). The interaction between forex and stock markets in India: An entropy approach. *Vikalpa*, *33*(4), 27-46.

[2] Kumar, S., Raju, G., & Shahab, T. (2012). Contagion Effect of Dollar and Euro on the Indian Stock Market. *IUP Journal of Applied Finance*, *18*(3), 84.

[3] Chen Yin Kuo (Year), An empirical study on current account, exchange rate, stock price: further evidence from east asian countries, conference proceedings: sarajevo (ices, 126-149)

(1970-2010). The author applied cointegration test based on the vector autoregressive (VAR) framework and maximum likelihood ratio. This study examined trivariate cointegration relationships using Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests to examine stationarity among stock price indices, real exchange rates, and current account. The author used monthly stock price indices, monthly real exchange rates as local currency per dollar, and quarterly current account from the AREMOS database. The study concluded that among ten Asian countries, India and Thailand have the strongest cointegration relationship. The author also confirms that the Asian financial crisis of 1997 has had an impact on the cointegration. The results of the study implied that when the mobility of foreign portfolio investment occurs through stock markets, then by cointegration relationship, exchange rate and current accounts proceed to be influenced. Therefore, the governments need to establish financial institutions to induce long-term foreign capital into domestic stock markets.

Kuo (2013)[4] attempts to find bivariate relationships between current accounts, stock markets, and currency exchange markets in 10 Asian countries- Korea, Malaysia, Indonesia, the Philippines, India, Thailand, Hong kong, Japan, and Singapore for the period 1970 to July 2010. In this study, cointegration method proposed by Johansen (1988) and Johansen and Juselius (1990) including maximum likelihood ratio test and trace test was employed. All the sample countries have at least one cointegration and Korea and the Philippines have two cointegrations. India is only one country which has both cointegration and bi-directional cause relationship. The study found that three country characteristics- the degree to which capital is controlled, flexibility in foreign exchange mechanisms and the ratio of trade to GDP influence these cointegrations. The author constructed a bivariate VECM framework to provide evidence of cointegration relationship between any two of the above-mentioned three economic indicators in Asian countries.

Prakash G. Apte(2001) in their research paper on "The Interrelationship Between the Stock Markets and the Foreign Exchange Market" spoke about relationship between the volatility of the stock market and that of the nominal exchange rate in India. The study uses daily closing data SENSEX, and the NIFTY50 and the daily closing USD/INR exchange rate. The data collected for the period of January 2 1991 to April 24,2000. The model employed in the present study is Exponential GARCH model. The GARCH term in the stock returns equation is significant suggesting volatility persistence. They carried out a separate estimation exercise for the sub-sample covering the period March 1998 to April 2000 since Foreign institutional investors were permitted to directly invest in the Indian stock market only after 1997.There is no evidence expected significant spillovers from the foreign exchange market to the stock market and vice versa. And also no evidence of any ARCH-GARCH effects.

2.1 Source of Data/Description of variable

Stock market is represented by stock index NIFTY . Data collected from National Stock Exchange(NSE). Foreign exchange market is represented by US dollar price. Reference data collected from RBI between Jan 2005 to Jul 2018. NIFTY is independent variable and US dollar price is a dependent variable.

2.2 Model Specification

Change in Dependent variable is to be a function of not only previous changes in Dependent variable but also past changes of independent variable.

$$\Delta Y_t = \beta_0 + \sum_{i=1}^{n} \beta_i \Delta Y_{t-i} + \sum_{i=1}^{n} \delta_i \Delta X_{t-i} + \varphi Z_{t-i} + \mu$$

Z is the error correction term and is the OLS residuals from the following long run co integration regression

3. Analysis and Interpretation

3.1 Unit root test

Generally time series data faces unit root problem i.e., non-stationary of data. Both NIFTY and US dollar are tested for the same using Augmented Dickey-Fuller test including trend and intercept. It has been found that both the variables shows the presence of Unit root at level . Graphically presented in the following Figure 1 & 2

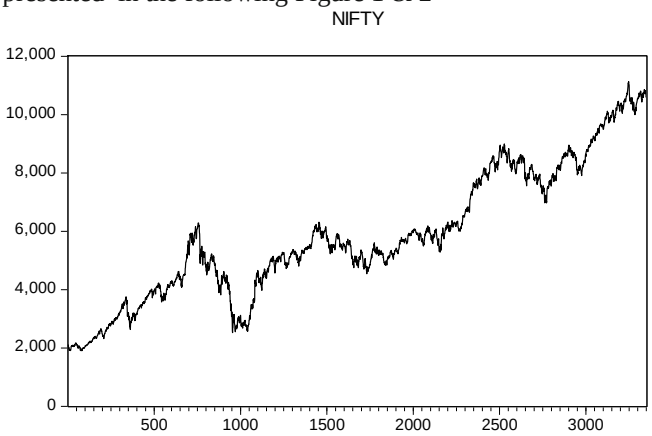

Figure 1: Graphical representation of NIFTY at level

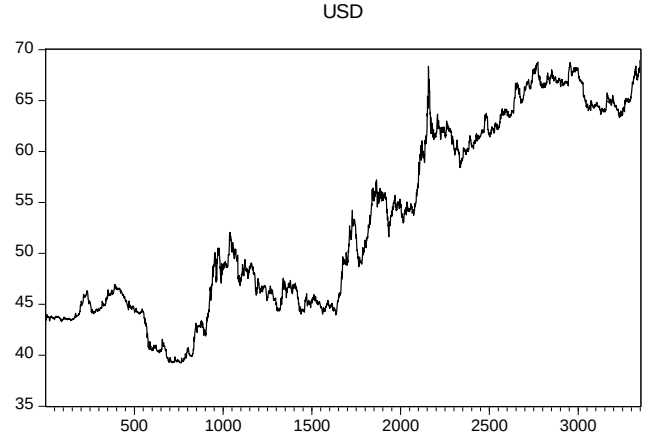

Figure 2: Graphical representation of Dollar at level

Results of Unit root test are presented in Table 1 &2

[4] Kuo, C. Y. (2013). Is the liberalization policy effective on improving bivariate cointegration of current accounts, foreign exchange, stock prices? Further evidence from Asian markets. *Quality & Quantity*, 1-19.

Table 1: Unit Root test results of NIFTY at level

Null Hypothesis: NIFTY has a unit root			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.486338	0.8914
Test critical values:		-3.432114	
		-2.862205	
		-2.567168	

Sources: Authors' computation from E-View, Ver 9.0

Table 2: Unit Root test results of dollar at level

Null Hypothesis: USD has a unit root			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.235227	0.9316
Test critical values:		-3.432114	
		-2.862205	
		-2.567168	

Sources: Authors' computation from E-View, Ver 9.0

After taking 1st difference both the variables become stationary. Graphically presented in the following Figure 3 & 4

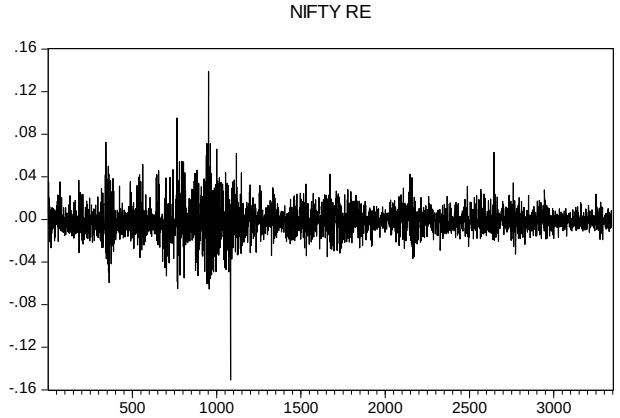

Figure 3: Graphical representation of NIFTY at 1st Difference

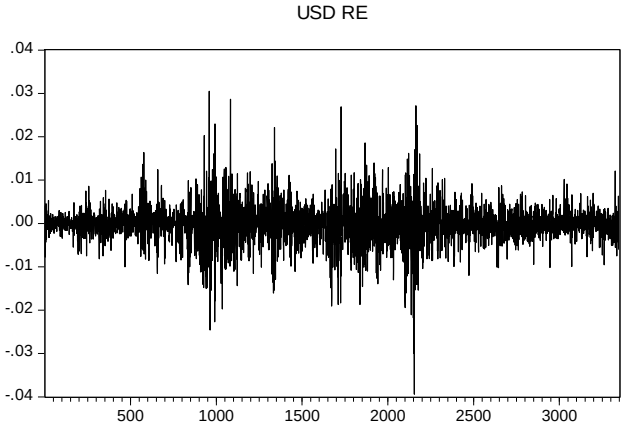

Figure 4: Graphical representation of Dollar at 1st Difference

Results of Unit root test after taking 1st difference are presented in Table 3 & 4

Table 3: Unit Root test results of NIFTY at 1st difference

Null Hypothesis: D(NIFTY) has a unit root			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-54.37336	0.0001
Test critical values:		-3.432114	
		-2.862205	
		-2.567168	

Sources: Authors' computation from E-View, Ver-9.0

Table 4: Unit Root test results of dollar at 1st difference

Null Hypothesis: D(USD) has a unit root			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-42.79614	0.0000
Test critical values:		-3.432115	
		-2.862205	
		-2.567168	

Sources: Authors' computation from E-View, Ver 9.0

Thus both variable become stationary after taking 1st difference.

4.2 Co-Integration test

Since both the variables are stationary at 1st difference then we have to find out whether long run equilibrium between NIFTY and US dollar exists or not using Johansen Cointegration test.

Table 5: Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.096665	649.2374	15.49471	0.0001
At most 1 *	0.088445	309.4819	3.841466	0.0000
Trace test indicates 2 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

Sources: Authors' computation from E-View, Ver 9.0

Trace Test: Indicates 2 co integrating equation at 5% level

Table 6: Unrestricted Cointegration Rank Test (Maximum Eigen value)

Hypothesized No. of CE(s)	Eigen value	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.096665	339.7555	14.26460	0.0001
At most 1 *	0.088445	309.4819	3.841466	0.0000
Max-eigen value test indicates 2 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

Sources: Authors' computation from E-View, Version 9.0

Max Eigen Test: Indicates 2 co integration equation at 5 % level

Johansens cointegration test results presented in Table 5 (Trace test) and in Table 6 (Maxium Eigenvalue) shows that existence of Co integrating equation in our model. That means Long run association between USD and NIFTY exists. Hence we have go for Vector Error Correction Model(VECM) instead of Vector Auto Regressive (VAR)

4.3 Vector Error Correction Model(VECM): We have to run the VECM to examine short-run dynamics of the series.

Vector Error Correction Model for co integrated series is mentioned below

$$\Delta Y_t = \beta_0 + \sum_{i=1}^{n} \beta_i \Delta Y_{t-i} + \sum_{i=1}^{n} \delta_i \Delta X_{t-i} + \varphi Z_{t-i} + \mu$$

Z is the error correction term and is the OLS residuals from the following long run co integration regression

$$Z_{t-i} = y_{t-i} - \beta_0 - \beta_1 X_{t-1}$$

Error correction, relates to the last period deviation from long run equilibrium influences the short run dynamics of the dependent variable

Thus the coefficient of error correction, φ, is the speed of adjustment, it measures the speed at which Y(USD) returns to equilibrium after a change in X(NIFTY)

Table 7: Vector Error Correction Estimates

Cointegrating Eq:	CointEq1	
USD(-1)	1.000000	
NIFTY(-1)	-0.003833	
	(0.00086)	
	[-4.47139]	
C	-30.59654	
Error Correction:	D(USD)	D(NIFTY)
CointEq1	-0.001071	0.611504
	(0.00078)	(0.22098)
	[-1.36681]	[2.76725]
D(USD(-1))	-0.064267	-7.305435
	(0.01825)	(5.14846)
	[-3.52059]	[-1.41895]
D(USD(-2))	-0.067948	-1.896270
	(0.01831)	(5.16347)
	[-3.71146]	[-0.36725]
D(USD(-3))	-0.005350	-10.19460
	(0.01834)	(5.17379)
	[-0.29164]	[-1.97043]
D(USD(-4))	0.051647	-2.312692
	(0.01833)	(5.17018)
	[2.81742]	[-0.44731]
D(NIFTY(-1))	-0.000762	0.061684
	(6.5E-05)	(0.01823)
	[-11.7863]	[3.38383]
D(NIFTY(-2))	-7.74E-05	-0.018016
	(6.6E-05)	(0.01859)
	[-1.17459]	[-0.96934]
D(NIFTY(-3))	-0.000103	-0.016865
	(6.6E-05)	(0.01858)
	[-1.55911]	[-0.90781]
D(NIFTY(-4))	8.60E-06	-0.039443
	(6.6E-05)	(0.01858)
	[0.13051]	[-2.12321]
C	0.009996	3.002664
	(0.00434)	(1.22415)
	[2.30296]	[2.45285]

Sources: Authors' computation from E-View, Version 9.0

$\Delta Y_t = 0.009996 - 0.064267\Delta \text{ USD}_{t-1} - 0.064267\Delta \text{ USD}_{t-2} - 0.005350\Delta \text{ USD}_{t-3} + 0.051647\Delta \text{ USD}_{t-4} - 0.000762\Delta \text{ NIFTY}_{t-1} - 7.74E\text{-}05\Delta \text{ NIFTY}_{t-2} - 0.000103\Delta \text{ NIFTY}_{t-3} + 8.60E\text{-}06\Delta \text{ NIFTY}_{t-4} + 0.033399Z_{t-i}$

Cointegrating equation is (long run model)

$Z_{t-i} = 1.00000USD_{t-1} - 0.003833NIFTY_{t-1} - 30.59654$

Table 8: Vector Error Correction Equation

Dependent Variable: D(USD)				
Method: Least Squares (Gauss-Newton / Marquardt steps)				
Date: 02/19/19 Time: 10:22				
Sample (adjusted): 10 3352				
Included observations: 3343 after adjustments				
D(USD) = C(1)*(USD(-1) - 0.00383294877263*NIFTY(-1) - 30.5965390398)+C(2)*D(USD(-1))+C(3)*D(USD(-2)) + C(4) *D(USD(-3)) + C(5) *D(USD(-4)) + C(6)* D(NIFTY(-1)) + C(7)* D(NIFTY(-2)) + C(8) *D(NIFTY(-3)) + C(9)*D(NIFTY(-4)) + C(10)				
	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.001071	0.000784	-1.366814	0.1718
C(2)	-0.064267	0.018255	-3.520593	0.0004
C(3)	-0.067948	0.018308	-3.711460	0.0002
C(4)	-0.005350	0.018344	-0.291640	0.7706
C(5)	0.051647	0.018332	2.817416	0.0049
C(6)	-0.000762	6.46E-05	-11.78632	0.0000
C(7)	-7.74E-05	6.59E-05	-1.174587	0.2402
C(8)	-0.000103	6.59E-05	-1.559106	0.1191
C(9)	8.60E-06	6.59E-05	0.130506	0.8962
C(10)	0.009996	0.004340	2.302961	0.0213

Sources: Authors' computation from E-View, Version 9.0

A result of VECM is in the form of equation. Presented in Table 7. It is very difficult to conclude. We use system equation to find P value for the model. System equation presented in Table 8. C1 is the coefficient of error correction model i.e., the speed of adjustment towards long run equilibrium. Negative sign indicates that any deviation in one direction leads to correction in another direction to keep model in equilibrium. But p-value is not significant at 5% . We can conclude that there is no short run equilibrium

4.4 Coefficient Diagnostic Test

Null hypothesis for short run = c(6)=c(7)=c(8)=c(9)=0

Table 9: Wald Test Results

Equation: Untitled			
Test Statistic	Value	df	Probability
F-statistic	18.21538	(8, 3325)	0.0000
Chi-square	145.7230	8	0.0000
Null Hypothesis: C(6)=C(7)=C(8)=C(9)=0			

Sources: Authors' computation from E-View, Version 9.0

The Wald test is a parametric statistical test named after the statistician Abraham Wald. To find out short term causality between dependent variable US dollar and independent variable NIFTY we can run coefficient diagnostic test. Wald test result presented in Table 9. The coefficient of independent variable NIFTY is c(6), c(7), c(8) & c(9). Since P-value is less than 5% we should reject the null hypothesis. Hence there is a short term causality running from USD to NIFTY.

4.5 Residual Diagnostic test

Residual Diagnostic test for assessing model adequacy

Table 10: Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.257022	Prob. F(8,3317)	0.2615
Obs*R-squared	10.10437	Prob. Chi-Square(8)	0.2578
Test Equation:			
Dependent Variable: RESID			
Method: Least Squares			
Date: 02/23/19 Time: 12:23			
Sample: 10 3352			
Included observations: 3343			
Presample missing value lagged residuals set to zero.			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.001269	0.002582	-0.491497	0.6231
C(2)	-1.569826	1.354458	-1.159006	0.2465
C(3)	-0.846455	0.733347	-1.154236	0.2485
C(4)	1.129365	0.534015	2.114857	0.0345
C(5)	0.039647	0.398078	0.099595	0.9207
C(6)	-8.10E-06	6.54E-05	-0.123825	0.9015
C(7)	-0.001191	0.001036	-1.149379	0.2505
C(8)	-0.000679	0.000586	-1.158936	0.2466
C(9)	0.000750	0.000445	1.684128	0.0923
C(10)	0.011274	0.023184	0.486272	0.6268
RESID(-1)	1.571475	1.356942	1.158100	0.2469
RESID(-2)	0.746494	0.685365	1.089193	0.2761
RESID(-3)	-1.286149	0.506040	-2.541593	0.0111
RESID(-4)	-0.017685	0.377689	-0.046823	0.9627

Sources: Authors' computation from E-View, Version 9.0

Since p-value is greater than 5% . Null hypothesis accepted. There is no evidence of serial correlation. Our model looks good.

4.6 Granger Causality Tests

The results of Granger causality test are presented in Table 11. There is a causality between NIFTY and US dollar , and vice-versa..

Pairwise Granger Causality Tests			
Date: 03/12/19 Time: 00:08			
Sample: 1 3352			
Null Hypothesis:	Obs	F-Statistic	Prob.
USD_RE does not Granger Cause NIFTY_RE	3343	2.35169	0.0161
NIFTY_RE does not Granger Cause USD_RE		21.2906	8.E-32

The null hypothesis: US dollar does not Granger-cause NIFTY is rejected as p- value (0.0161) is less than 0.05 . Similarly, the null hypothesis: NIFTY does not Granger-cause US dollar is rejected as the p- value (8E-32) is also less than 0.05. Granger-causality test shows that there is a bi-directional causality between exchange rate and stock index .

4. Conclusion

This study examines the relationship between stock index NIFTY and FOREX represented by US dollar for the period of January 2005 to July 2018. Daily data on stock index NIFTY which was collected from National Stock Exchange and daily reference rate collected from RBI . NIFTY is independent variable and US dollar rate is dependent variable. Both variables are non stationary at level. After taking 1st difference both variables become stationary. Johansen cointegration. shows that existence of Co integrating equation in our model. That means Long run association between USD and NIFTY exists. VECM results shows that there is no short run equilibrium. Granger causality test was also conducted to identify the level of causation between stock index and FOREX rate . It shows that there is a bi-directional causality between exchange rate and stock index .

References

[1] Reddy, Y. V., & Sebastin, A. (2008). The interaction between forex and stock markets in India: An entropy approach. Vikalpa, 33(4), 27-46.
[2] Kumar, S., Raju, G., & Shahab, T. (2012). Contagion Effect of Dollar and Euro on the Indian Stock Market. IUP Journal of Applied Finance, 18(3), 84.
[3] Chen Yin Kuo (Year), An empirical study on current account, exchange rate, stock price: further evidence from east asian countries, conference proceedings: international conference of the faculty of economics sarajevo (ices, 126-149)
[4] Kuo, C. Y. (2013). Is the liberalization policy effective on improving bivariate cointegration of current accounts, foreign exchange, stock prices? Further evidence from Asian markets. Quality & Quantity, 1-19.
[5] Prakash G. Apte (March 30, 2001) "The Interrelationship Between the Stock Markets and the Foreign Exchange Market" . IIM Bangalore Research Paper No. 169.
[6] Rudiger Dornbusch and Stanley Fischer . "Exchange Rates and the Current Account" The American Economic Review Vol. 70, No. 5 (Dec., 1980), pp. 960-971
[7] Rudiger Dornbusch (Dec 1976), " Expectations and Exchange Rate Dynamics". The Journal of Political Economy, Vol 84, No.6, PP 1161-1176
[8] Gurmeet Singh(2015) " The Relationship Between Exchange Rate and Stock Price in India: An Empirical Study." The IUP Journal of Financial Risk Management, Vol. XII, No. 2,
[9] Srinivasan P & Karthigai Prakasam (2014) "Gold Price, Stock Price and Exchange Rate Nexus: The Case of India." The IUP Journal of Financial Risk Management, Vol. XI, No. 3
[10] Panda, P., & Deo, M. (2014). Asymmetric cross-market volatility spillovers: evidence from Indian equity and foreign exchange markets. Decision, 41(3), 261-270.
[11] Kumar, S., Raju, G., & Shahab, T. (2012). Contagion Effect of Dollar and Euro on the Indian Stock Market. IUP Journal of Applied Finance, 18(3), 84
[12] Chen Yin Kuo (Year), An empirical study on current account, exchange rate, stock price: further evidence from east asian countries, conference proceedings: international conference of the faculty of economics sarajevo (ices, 126-149)
[13] Kuo, C. Y. (2013). Is the liberalization policy effective on improving bivariate cointegration of current accounts, foreign exchange, stock prices? Further evidence from Asian markets. Quality & Quantity, 1-19.

[14] Kumar, M. (2014). The impact of oil price shocks on Indian stock and foreign exchange markets. ICRA Bulletin: Money & Finance, 57-88.
[15] Srinivasan, P., & Prakasam, K. (2014). Gold price, stock price and exchange rate nexus: The case of India. The IUP Journal of Financial Risk Management. Vol. XI, No. 3.
[16] Walid C, Chaker A, Masood O and Fry J (2011), "Stock Market Volatility and Exchange Rates in Emerging Countries: A Markov-State Switching Approach", Emerging Markets Review, Vol. 12, pp. 272-292

Author Profile

P. S. Basavaraju Basavaraju holds B.E.(Mech) from Mysore University , MBA(Finance) from Kuvempu University and secured 3rd Rank. He also holds M.Sc(IT) from Kuvempu University. Having 13 years industry experience. He is persuing Ph.D under the guidance of Dr.B.Bakkappa. Presently working as Assistant Professor in GMIT, Davangere.

Dr. B. Bakkappa, Senior Professor of Management & Former Registrar(Evaluation), Davangere University. Presented research papers in International seminars at London UK, New York USA and China. Recently visited KEAN University New Jersey, USA. Served National Assessment and Accreditation Council (NAAC)-UGC New Delhi as a Peer committee member, visited different parts of the country to assess institutions and Universities for accreditation. Presently he is a Director, Department Studies in Management, GMIT, Davangere