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FII-Flow and Stock Market Volatility

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Abstract: Foreign portfolio investment flow is believed to affect the volatility of stock prices in emerging markets was found trivial although statistically significant. However, a subsample-wise analysis shows that the impact of FII-flow on market volatility has increased during recent years with increasing stake in a significant way. In this paper we analyze the empirical evidence on the impact of Foreign Institutional Investment Flow (FII-flow) on Indian stock market volatility. The results suggest that the unexpected FII-flow affects the market volatility asymmetrically. Unexpected FII-inflow does not cause the market volatility (rather dampens it) while unexpected FII-outflow makes the makes the market more volatile. In contrary to popular perception, the overall impact of unexpected FII-flow on volatility and role of foreign institutional investors in the market.

Key Words: Foreign Portfolio Investment Flow, Market Volatility, ARMA, GARCH, Volatility.

Volatility in the stock return is an important part of stock market dynamics. The ups and downs of share prices determine the return and volatility of the stock market. An increase in stock market volatility brings a large change in stock price in either direction. Volatility is considered a proxy of risk. Since the expected return form an investment is inter alia determined by the risk associated with the investment, volatility also affect the expected returns and hence the asset prices. Investors interpret a raise in stock market volatility as an increase in the risk of equity investment and consequently they shift their funds to less risky assets. It puts a downward pressure on the stock prices making room for higher expected future returns to compensate the higher risk.

With increasing flow of FIIs investment, the issues of volatility have become increasingly important in recent times to the Indian investors, regulators, brokers, policy makers, dealers and researchers. Foreign portfolio investment is considered the 'hot money', quickly flying from one economy to other economy in pursuit of high returns. This flow is very volatile which not only get affected by local economic conditions but also determined by economic conditions elsewhere in the globe. It works as a channel for the transmission of economic shocks and crises from one economy to other economy. Hence the concern is raised in many quarters of the economy that the excessive role of FIIs many turn the market more volatile and susceptible to external shocks. It may expose the economy to the shocks originating in other economies and make the emerging economies vulnerable to global financial crises.

In this study our aim to investigate how the inflow and the outflow of FII investment affect the volatility of stock market. The paper is organized in following manner. The next section presents a brief survey of the literature. Section three discusses the data and methodology used in this study. The results of the study are presented in the fourth section. Finally section fifth concludes the discussion.

Review of literature: The pay-off of all foreign portfolio investors depends on similar set of variables; they are governed by similar motives in their investment and disinvestment decisions. This leads us to believe that the FIIs may exhibit 'herding behaviour', i.e. they may invest in an economy in a lot when there are better expectations and withdraw in bulk when prospects are weak. Herding behaviour of foreign investors may put heavy demand and supply pressure on the stock and forex-market of developing countries where financial markets lack depth. This may make the

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market highly volatile and sometimes may turn a mild financial distress into full-fledged financial crisis. The similar phenomenon was observed in the East-Asian markets during the crisis and understood to be responsible for its deepening (Krugman, 1998; Stiglitz, 1998; Choe et al, 1999; Chakravarty and Roll, 2002; Kim and Wei, 2002).

Issue of market stability Mujumdar (2004) find that FII flow has enhanced liquidity in the Indian stock market but not much evidence is there to support the hypothesis that FII flow has generated volatility in the return. Ahmed et al (2005) also confirm that there has been very little destabilizing effect of FII flow on individual equity return of the firms during their period of study. The experiences of most of the volatility episodes and market crash in India suggest that the FII-flow is not the culprit for them. The FII-flow remained positive during most of such episodes. It is argued that FIIs tend to support stock market during crisis to ensure stability and safety of their own investment.

It is believed that increasing participation of foreign portfolio investment increases the volatility of domestic market in emerging economies. There are two possible channels of volatility-effect. First, the herding behaviour of foreign portfolio investors may cause sudden wide-mismatch in demand and supply equilibrium dragging the prices far away from fundaments. Second, increasing participation of foreign investors increase the ties between domestic markets and foreign markets. The increasing level of market integration may cause volatility spill-over and 'contagion' and the domestic market may become exposed to exogenous volatility shocks from other foreign markets. However, the empirical evidences on this issue are mixed. Levine and Zervos (1995) find the evidence supporting the liberalisation has increased the volatility in emerging markets; while, many other studies have found that there is no systematic effect of liberalisation on stock market volatility (De Santis and Imorohoroglu, 1997; Kim and Singal, 2000). Studies have shown empirically tested instances where foreign investment induces greater volatility in markets compared to domestic investors (Jo, 2002) and stocks mainly traded by such investors experience higher volatility than those in which such investors do not have much interest (Bae et al, 2002). On the contrary, evidences that international investments do not have significant impact in increasing volatility of stock returns (Bakaert and Harvey, 1998) are also there and these render the concern for volatility of such flows largely unwarranted (Errunza, 2001). What comes out from these evidences is that, the issue of volatility cannot be ignored and impacts of portfolio investments differ widely among countries. Hence, the analysis of volatility of such flows is very important from the viewpoint of the policy makers of a country like India where international investment in securities is increasingly assuming importance as external finance.

Virtually no study of the nature of volatility of foreign investment in India has been done so far, though concerns have often been expressed about the possible devastating effect of volatility of such flows on the Indian economy. However, in Gordon and Gupta (2003), an observation is made that the volatility of portfolio flows into India was small in comparison to other emerging markets during 1998 to 2000. While the co-efficient of variation for such flows in India was 1.58, the corresponding figures for the Philippines, Thailand, Korea, Chile and Brazil stood at 1.79, 25.07, 1.82, 1.94 and 2.14, respectively. It should be noted that these figures are only indicative and do not specify the nature of the volatility of the flows. (They have used the quarterly data for 17 emerging markets and measured volatility in terms of co-efficient of variation.)

A survey of the literature shows that existing studies do not account for volatility (the ARCH effect), which can be expected in most of the monthly financial time series data. Yet given the increase in financial market integration, both domestically and in foreign financial markets, accounting for volatility is unavoidable. Further, the existing studies either do not incorporate risk in foreign and domestic markets or make use of realized risk, an approach that does not always yield robust results.

This is because standard deviation/variance (realized risk variable) increases irrespective of the direction in which stock returns move, while movement of FII is determined by bull/bear phases. It is preferable, therefore, to divide the realized risk into ex-ante risk and unpredictable risk. Since investment in stock markets is sentiment driven, and is affected more or less by everything, the crucial task is to identify a few critical determinants.

Methodology and Results:

Data and Descriptive Statistics: This study covers a sample period of more than 10 years from January 2000 to March 2010. The stock prices are represented by S&P CNX Nifty. The closing prices of Nifty have been obtained from website of the National Stock Exchange (NSE) and data of daily FII purchase and sales have been taken from the website of Security and Exchange Board of India (SEBI). Augmented Dickey-Fuller unit-root test (see Table1, Panel A) shows that all these variables are non-stationary at level.

The stock price index series (Nifty) is log-transformed and differenced to obtain the daily index return ( ). The return series is stationary (Table1, Panel A), however, it is negatively skewed and has a very kurtosis, suggesting the tail events have higher frequencies than expected under the normal distribution (Table 1, Panel B). The Jarqui-Bera statistic shows that the distribution of index returns significantly deviates from normal distribution. The Ljung-Box (LB) statistics for cumulative autocorrelations upto 10 lags is significant. Very high value of LB statistic for squared returns suggests a strong presence of ARCH effect in the series.

The net FII-flow ( ) has been obtained taking difference of the logarithmic values of daily FII purchase and daily FII sales. This variable is the logarithmic value of the ratio of FII-purchase and FII-sales. When purchase exceeds sale, there will be a positive FII flow in the market; the ratio will be higher than 1 and its logarithmic value will be positive. On the other hand when sale exceeds purchase, there will be an outflow of FII investment from the market; the ratio will be less than 1 and its logarithmic value will be in negative. Therefore, the variable net FII-flow ( ) is a relative measure of FII-flow in the market.

Table 1, Panel A shows that the series is stationary. It is positively skewed and has a higher than normal kurtosis (Table 1, Panel B). The distribution of the series significantly deviates from normal distribution (Jarque-Bera statistic is quite high). High value of Ljung-Box (LB) statistic for cumulative autocorrelations up to lag 10 suggests that the series is highly autocorrelated and can possibly be modeled as an ARMA (p, q) process. Significant value of LB statistic in squared series suggests the presence of ARCH effect is the series.

Table 1 about here

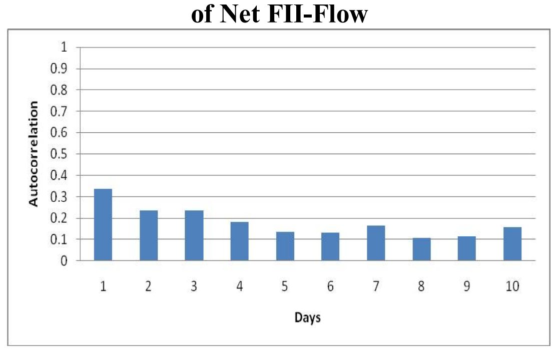
Panel A: Unit-root test

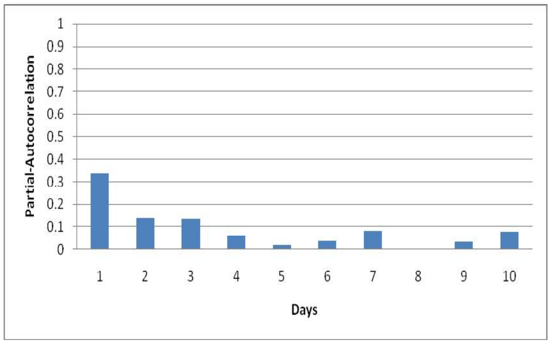
Series	ADF Tests	
	t-statistic	p-value
Nifty	-0.43	0.90
Returns	-36.24	0.00
FII-Purchase	-2.21	0.23
FII-Sales	-2.26	0.19
Net FII-flow	-9.98	0.00

Expected and Unexpected Net FII-Flow: The market is believed to react to unexpected changes in relevant exogenous (economic or non-economic variables). Therefore, the net FII-flow is separated into expected and unexpected components using ARMA (p, q) model. A closer inspection of the patterns of autocorrelations in the correlogram of the series (Figure 1) suggest that series can possibly be modeled as AR(4) process; however, a more parsimonious model can be obtained using a mixture of AR and MA terms.

Figure 1 about here

Autocorrelations and Partial Autocorrelations of Net FII-Flow





Using a recursive process AR(2)-MA(1) model was found the best fit for data based on Akaike information criteria. However, residuals of this model shows strong presence of ARCH effect (LM statistic for ARCH (1) effect = 21.06, p=0.00. This statistic follow -distribution). Therefore GARCH (1,1) specification is also included in the more. More precisely, net FII-flow is modeled as follow:

$$FII_t = c_1 + \phi_1 FII_{t-1} + \phi_2 FII_{t-2} + u_t - \theta u_{t-1} \quad \ldots (1.a)$$

$$u_t = z_t \sigma_t \text{ where, } z_t \sim N(0,1) \quad \ldots (1.b)$$

$$\sigma_t^2 = w + a u_t^2 + b \sigma_{t-1}^2 \quad \ldots (1.c)$$

Where, , the residuals from the model are the unexpected shocks in FII-flow.

The results of the AR(2) MA(1) with GARCH (1,1) model are reported in Table: 2. We have used Bollerslev-Wooldridge robust standard errors for computation of t-statistics.

Table 2 about here

Modeling Net FII-Flow as AR(2) MA(1) Process

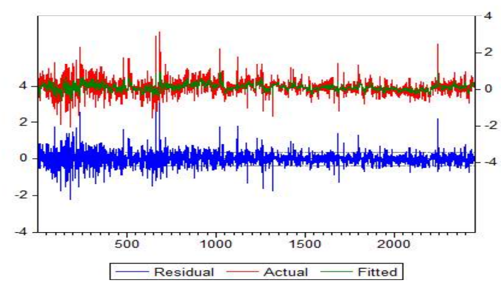
Variable .	Coefficient	t-Statistic
Mean Equation		
Intercept, c_1	0.12	5.92**
AR(1), ϕ_1	1.11	29.70**
AR(2), ϕ_2	-0.17	5.94**
MA(1), θ	-0.80	24.66**
Variance Equation		
Intercept, w	0.002	7.22**
a	0.07	12.91**
b	0.91	177.24**
Diagnostics		
Adjusted R-Square	0.15	
F-Statistics	73.49**	
Akaike Information Criterion	0.675	
Residual Mean	0.01	
Standard Deviation	1.00	
Jarqui-Bera Statistic	2216	
Box-Jenkins Statistic(10)	9.11	
Box-Jenkins Statistic for Squared Values(10)	8.89	

** p<0.01
t-statistics are based on Bollerslev-Wooldridge robust standard errors.

The unexpected FII flow, by definition, should follow a white noise process. This, inter-alia, implies that the process should be free from autocorrelations. We use LB statistic to check the cumulative significance of autocorrelations in the series up to order 10; which suggests that the residuals are free from autocorrelations. Similarly, the squared residuals also do not show significant autocorrelations, which indicates that no further ARCH effect is present in unexpected FII-flow. The ARCH LM test also confirm this observation (LM statistic for ARCH(1) effect in residuals = 0.16, p=0.68).

Figure 2 present the net FII-flow (actual) and its decomposition into expected (fitted) and unexpected (residual) flow based on above model.

Figure 2 about here



Before using the unexpected FII-flow as a variable explaining the volatility of market returns, the residuals obtained from equation (1) are standardized using time varying standard deviation obtained from the GARCH model. More precisely, the standardized unexpected FII flow is obtained as follow:

Modeling the Volatility of Market Returns: We use GARCH family models to capture the volatility of market returns and the impact of unexpected shocks in FII-flow on it. It is a well documented stylized fact that the volatility of asset returns reacts asymmetrically to return shocks. A negative shock in return produces higher volatility in comparison to a positive shock of the same magnitude. Many variants of GARCH model have been suggested in the literature to capture this asymmetric reaction of the volatility. In this study we use a Threshold GARCH (TGARCH) model as suggested by Glosten, Jagannathan and Runkle

(1993), popularly known as GJR model, to capture this phenomenon. We model the conditional mean of the return as AR (1) process. First, a AR(1)-TGARCH (1,1) model of return series is estimated without including the unexpected shocks of FII-flow as a explaining variable in the volatility equation. More precisely the following specification is used for this purpose.

$$R_t = c + \rho R_{t-1} + \varepsilon_t \quad \ldots (2.a)$$

$$\varepsilon_t = \zeta_t \sqrt{h_t} \quad \text{where } \zeta_t \sim N(0,1) \ldots (2.b)$$

$$h_t = \omega + \alpha\, \varepsilon_{t-1}^2 + \beta h_{t-1} + \delta D_{t-1}\varepsilon_{t-1}^2 \ldots (2.c)$$

$$D_t \begin{cases} =1 & \text{if } \varepsilon_t < 0 \\ =0 & \text{otherwise} \end{cases} \quad \ldots (2.d)$$

The results of model are presented in Table 3. The t-statistics are based on Bollerslev-Wooldridge robust standard errors. Although, the estimated AR (1) parameter, is statistically significant, the model explains only 0.1 % variation in returns. In fact the adjusted is negative. This observation is quite consistent to the efficient market hypothesis. In the variance equation the coefficient of asymmetry is quite high and statistically significant. In fact the impact of positive return shock on the volatility, captured by coefficient , is statistically non-significant. A positive return shock of 1 unit, increase the volatility by 0.06 units; on the other hand, a negative shock of same magnitude increases the volatility by 0.24 units (i. e.). The LB statistic for residuals of the model for cumulative autocorrelations up to lag 10 is small, but significant at 5 percent. However, the LB statistic for squared residuals is not significant which shows that the TGARCH (1, 1) is sufficient to capture the ARCH effect in the return series.

Table 3 about here

AR(1)-TGARCH(1,1) Model of Daily Returns

Variable	Coefficient	t-Statistic
Mean Equation		
Intercept, c	8.64×10^{-4}	2.73**
AR(1), ρ	0.10	4.27**
Variance Equation		
Intercept, ω	1.15×10^{-5}	3.69**
α	0.06	1.59
β	0.82	30.36**
δ	0.18	3.25**
Diagnostics		
R-Square	0.001	
Akaike Information Criterion	5.51	
Residual Mean	-0.02	
Standard Deviation	1.00	
Jarqui-Bera Statistic	1549**	
Box-Jenkins Statistic(10)	20.22*	
Box-Jenkins Statistic for Squared Values(10)	4.37	

** $p<0.01$, * $p<0.05$
t-statistics are based on Bollerslev-Wooldridge robust standard errors.

Now we include the lagged value of squared standardized unexpected FII flow ( ) in the conditional variance equation of return series. The Equation (2.c) is replaced by following equation (3):

… (3)

The results of the estimation are presented in Table 4. The coefficient of unexpected FII-flow ( ) is negative but statistically insignificant. The negative sign of this coefficient is intuitively unexpected, as is believed to increase the market volatility rather than to dampen it. However, it is not statistically significant, which suggests that the unexpected shocks in FII flow do not affect the market volatility.

Table 4 about here

Impact of Unexpected Net-FII Flow on Volatility

Variable	Coefficient	t-Statistic
Mean Equation		
Intercept, c	8.64×10^{-4}	2.72**
AR(1), ρ	0.10	4.24**
Variance Equation		
Intercept, ω	1.20×10^{-5}	3.28**
α	0.06	1.52
β	0.82	30.73**
δ	0.18	3.21**
Squared Unexpected FII(-1), λ	-6.55×10^{-7}	1.02
Diagnostics		
R-Square	0.001	
Akaike Information Criterion	5.51	
Residual Mean	-0.02	
Standard Deviation	1.00	
Jarqui-Bera Statistic	1609**	
Box-Jenkins Statistic(10)	20.14*	
Box-Jenkins Statistic for Squared Values(10)	4.27	

** $p<0.01$, * $p<0.05$
t-statistics are based on Bollerslev-Wooldridge robust standard errors.

Now we take another possibility. It is possible that the reaction of the volatility towards shocks in FII flow is asymmetric similar to its reaction to return shocks. To test if the market volatility reacts differently towards unexpected FII-inflow and unexpected FII-outflow, another interactive dummy ( ) variable, difined as follows, is introduced:

Then the conditional variance equation- Equation (3) is replaced by following equation (4):

$$h_t = \omega + \alpha\, \varepsilon_{t-1}^2 + \beta h_{t-1} + \delta D_{t-1}\varepsilon_{t-1}^2 + \lambda_1 z_{t-1}^2 \quad \ldots (4)$$

The parameter shows the impact of a positive shock in FII-flow on market volatility; while parameter shows the differential impact of a negative shock of FII-flow excess over . Therefore, the total impact of a negative shock on the volatility is equal to ( ).

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Table 5 about here

Asymmetric Impact of Unexpected Net-FII Flow on Volatility of Returns

Variable	Coefficient	t-Statistic
Mean Equation		
Intercept, c	8.70×10^{-4}	2.77^{**}
AR(1), ρ	0.10	4.20^{**}
Variance Equation		
Intercept, ω	1.27×10^{-5}	2.95^{**}
α	0.06	1.64
β	0.82	30.02^{**}
δ	0.17	3.06^{**}
Squared Unexpected FII(-1), λ_1	-8.76×10^{-7}	1.02
Squared Negative Unexpected FII(-1), λ_2	4.79×10^{-6}	2.15^{*}
Diagnostics		
R-Square	0.001	
Akaike Information Criterion	5.51	
Residual Mean	-0.02	
Standard Deviation	1.00	
Jarqui-Bera Statistic	1496^{**}	
Box-Jenkins Statistic(10)	20.25^{*}	
Box-Jenkins Statistic for Squared Values(10)	4.36	

** $p<0.01$, * $p<0.05$
t-statistics are based on Bollerslev-Wooldridge robust standard errors.

Table 5 presets the result if estimation. The estimated value of is not significant, while is statistically significant at 5 percent level (but not at 1 percent level) of significance. It suggests that an unexpected FII-inflow does not affect the market volatility (the negative sign of the coefficient suggest that it may dampen the volatility, but effect is not statistically significant). The estimated value is statistically significant, which suggest that the impact of a negative shock in FII-flow is different from the impact of a positive shock. However, the actual impact of a negative shock depends on the value of , which is equal to 3.91×10-6 (standard error of the estimate is 2.01×10-6). The Wald test for parameter restriction , rejects the restriction only at 0.05% (=3.82, p=0.05). It suggests that the market volatility increases after an unexpected FII-outflow, however this impact is quite trivial.

Stability of Relationship: As discussed earlier the role of FIIs in Indian stock market is gradually increasing in terms of their stake (cumulative investment in the market) and turnover. Therefore it is possible the influence of FII-flow on market volatility is not stable rather it is increasing with time. To explore on these lines we divide the sample period into two sub-sample periods. The first subsample includes the period of five years from January 2000 to December 2004 and remaining sample period (from January 2005 to March 2010) is included in second subsample. The AR(1)-TGARCH(1,1) model is estimated using Equation (4) for volatility specification. The results are presented in Table 6.

Table 6 about here

Asymmetric Impact of Unexpected Net-FII Flow on Volatility of Returns: Subsample-wise Analysis

	First Subsample		Second Subsample	
Variable	Coefficient	t-Statistic	Coefficient	t-Statistic
Mean Equation				
Intercept, c	5.63×10^{4}	1.27	14.05×10^{-4}	3.13^{**}
AR(1), ρ	0.13	4.03^{**}	0.05	1.37
Variance Equation				
Intercept, ω	2.82×10^{-5}	3.50^{**}	1.46×10^{-5}	2.90^{**}
α	0.03	0.83	0.18	2.42^{*}
β	0.72	9.93^{**}	0.69	12.37^{**}
δ	0.19	3.05^{**}	0.05	0.53
Squared Unexpected FII(-1), λ_1	-1.80×10^{6}	1.54	-4.51×10^{-6}	7.02^{**}
Squared Negative Unexpected FII(-1), λ_2	1.61×10^{6}	0.34	7.25×10^{-5}	2.45^{*}
Diagnostics				
Box-Jenkins Statistic(10)		12.84		15.03
Box-Jenkins Statistic for Squared Values(10)		2.91		7.25

** $p<0.01$, * $p<0.05$
t-statistics are based on Bollerslev-Wooldridge robust standard errors.

Sub-sample 1 includes the period from January 2000 to December 2004 and sub-sample 2 includes the period from January 2005 to March 2010.

In the first sub-sample the sign of and are consistent with our observations for entire sample period. has a negative sign implying that the unexpected FII-inflow reduces the volatility while has positive sign implying that the volatility after a negative shock in FII-flow is higher that after a positive shock of the same magnitude. However both of these coefficients are statistically non-significant. The net impact of negative shock in FII-flow measured by is also not significant (=-1.90×10-6, SE=4.61×10-6) as the null hypothesis that =0, could not be rejected based on Wald test (=0.002, p=0.96).

In the second sub-sample, both the coefficients and are statistically significant and showing consistent signs. The dampening effect of unexpected FII-inflow looks quite robust (=-

4.51×10-6, t=7.02). The asymmetric impact of negative shock in FII-flow is also significant (=7.25×10-5, t=2.43). The net impact of unexpected FII-outflow captured by is positive (=-6.80×10-5, SE=2.97×10-5); which suggests that the volatility increases after unexpected FII-outflow. The Wald test suggest that this impact is also statistically significant (=5.25, p=0.02).

Conclusion: FII flow is believed to be an important factor affecting market volatility. In this paper we have examined this hypothesis using daily data for a period of more than 10 years. The relative daily FII-flow (logarithmic value of the ratio of FII purchase and FII-sales) is segregated into expected and unexpected components using AR (2)-MA (1)-GARCH (1, 1) model. The daily returns of S&P CNX Nifty have been modeled using AR (1)-TGARCH (1, 1) specification. The model is augmented with lagged value of squared unexpected FII-flow to capture the impact of unexpected FII-flow. The results suggest that the unexpected FII-flow does not affect stock market volatility. Then we used an interactive dummy variable to explore the impact of unexpected FII-inflow and outflow separately. The results suggests that market volatility is not affected by unexpected FII-inflow, however, it increases when FIIs unexpectedly withdraw there money from the market.

In the overall sample period of about ten years (from January 2000 to March 2010) the impact of unexpected FII-flow on market volatility is quite trivial although statistically significant. However, when the period is divided in two sun-sample periods, we observe a significant impact of unexpected FII-flow on market volatility in the recent sub-sample (January 2005 to March 2010). The study suggests that in contrary to popular believe variation in FII-flow does not affect market volatility in a significant way. However, the influence of FIIs in market is increasing with their accumulated investment and their share in the trading volume in the market.

This study is based on the daily data. In an efficient market where the information is quickly adjusted, one day period is too long to capture the impact of the shocks in FII-flow on stock market volatility. A study using high frequency data may through on this dynamics. Although high frequency data on market prices are available the data on FII trading are not available for high frequency. Moreover, this study is confined to the impact of FII trading on aggregate market volatility. It may be a useful area of further research how the trading by FIIs affects the volatility of an individual stock.

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