Impact of foreign portfolio investments on market comovements: Evidence from the emerging Indian stock market

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Paper to be presented in the Emerging Market Group ESRC Seminar on International Equity Markets Comovements and Contagion
11 May 2007
Cass Business School, London
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Abstract

This paper examines the influence of foreign institutional investments in explaining the short and long run relationship of the Indian equity market with the main developed equity markets of the US and the UK. Using daily return series and portfolio investments made by foreign institutional investors and employing the VAR and Johansen’s cointegration framework, we find that the mobility of foreign portfolio contains significant information in explaining the short and long term comovements of the Indian equity market with that of the US and the UK equity markets. We conclude that the rapid growth in the flow of the foreign portfolio investments is leading to greater integration of the Indian equity market with the main developed markets and this may have significant implications for asset pricing and international portfolio diversification benefits.

Key word: Foreign portfolio investments, emerging stock markets, comovements, integration, VAR.

JEL Classification: G11, G15, F12
Impact of foreign portfolio investments on equity market comovement: Evidence from emerging Indian stock market

1. Introduction

Research documenting comovements amongst the international stock markets has been growing. Many studies have been undertaken to identify important determinants of market comovements (see for example, Hamao et al., 1990, Becker et al 1990, Lin, Engle and Ito, 1994, Lognin and Solnik, 1995, Hsin, 2001, Bekaert and Harvey, 2003, W Dungey, 2004, Steeley, 2005, etc.). One of the main conclusions of the aforementioned studies is that the US and the UK stock markets are often found to lead the market comovements because they transmit shocks not only to their developed counterparts but also to the emerging stock markets in developing countries. Dungey et al (2004) concludes that equity markets in Australia are affected by shocks common to all other markets around the world. They find that the US market plays a significant role in explaining the Australian equity market’s movement whilst Australia’s domestic output has a very small impact that wanders away in the long run. Hsin (2004) examines the comovements in stock indices amongst the major developed markets incorporating American, European and Asia-Pacific developed markets. Consistent with previous findings, Hsin (2004) concludes that US plays a significant part in transmitting shocks to the other markets. Hsin also finds a strong linkage supported by evidence of transmission effects among the regional participants in Europe, such as Germany, Britain and France and Asia-Pacific markets of Japan, Australia, Hong Kong, and Singapore. On the other hand, Soydemir (2000) investigates the pattern of comovements between developed and emerging market economies using the economic fundamentals and trade linkages. He concludes that Mexico and USA show stronger linkages whereas Argentina and Brazil reveal a weaker association and attributes this variation to the trade flow differences. Soydemir also finds that the response to a shock from the US market has
longer effect than the one from the UK market. However, despite an overwhelming volume of studies on transmission of information flow and volatility shocks, there is a lack of consensus on whether it is economic fundamentals or contagion effects that cause comovements amongst the international stock markets. For instance, King and Wadhwani (1990) argue that in tracking market movements, most international investors ignore the fundamental factors and only track the mobility of some leading markets such as the US stock market.

It is widely known that emerging economies have been undertaking reform activities primarily to attract foreign capital to meet the growing demand for investment in infrastructure, institution building, etc. In his paper, Errunza (2001) suggests that the increase in foreign investment portfolio augments market integration further supplementing information to explain equity market comovements. Despite the rapid economic growth witnessed in the emerging markets, there is very little research that has been devoted in understanding the role and impact of the foreign portfolio investments on the comovements of the emerging equity markets with the developed stock markets. The research on role of portfolio investment flows is of topical interest particularly in light of the empirical evidence that portfolio investment flows to developing countries have been on the rise and exceeded US$100 billion in 2005 (UNCTAD, 2006). As suggested by Soydemir (2000), if flow of foreign capital integrates the transitional economies with the world, the capital mobility itself should be one of the fundamental sources influencing their comovements. This paper aims to address this gap by documenting evidence from the emerging Indian stock market by investigating the relationship between foreign portfolio investment flows and its impact on the short and long run comovements with the two major developed stock markets i.e., US and the UK.
Research on emerging stock markets like India has important theoretical and policy implications. Emerging markets such as India have long been viewed by international investors as segmented markets offering excellent diversification benefits to international investors because of their relatively low correlation with developed stock markets. However, if it is found that the Indian stock market is well integrated with the main developed markets, then this would imply reduced diversification benefits. In this context previous empirical research by Bekaert and Harvey (2000) has made attempts to investigate the implications of integration of emerging stock markets with the global markets using asset pricing framework. Other researchers such as Lane and Milesi-Ferretti (2003) have done research highlighting the impact of foreign portfolio and direct investments on the financial integration for a sample of industrialized countries. There are relatively fewer studies involving emerging markets and even fewer on the emerging Indian stock market. For example, Lamba (2005) using data from July 1997 to December 2003 reports that the Indian market is being increasingly influenced by the US and UK market and their impact have been persistent since the September 11 attack in the US. Sharma (2003) investigates the impact of foreign investment on India’s export performance and finds no statistically significant relationship between the two. However, research that directly relates the role of foreign institutional investor’s buying activities on comovements of the Indian emerging equity market with its developed counterparts is lacking.

This paper examines the influence of foreign institutional portfolio investments in explaining the short and long run relationship of the Indian equity market with the main developed equity markets of the US and the UK. Using daily return series and portfolio investments made by foreign institutional investors and employing the VAR and Cointegration tests, we find that the mobility of foreign portfolio contains significant information in explaining
the short and long term comovements of the Indian equity market with that of US and the UK equity markets. We conclude that the rapid growth in the flow of the foreign portfolio investments is leading to greater integration of the Indian equity market with the main developed markets and this may have significant implications for asset pricing and international portfolio diversification benefits.

The paper is organized as follows. The following section explains the data and methodology. Section 3 reports the empirical findings, and section 4 concludes the paper.

2. Data and Methodology

2.1 Data

We use daily data in our analysis for a sample period of six years beginning 1 January 2001 through 15 January 2007. We calculate equity returns from the MSCI price index for US, U.K and India. The MSCI index time series have been obtained from Datastream international. Net daily investment data of the portfolio investments made by foreign institutional investors is obtained from CNBC’s Moneycontrol.com.

2.2 Methodology

2.2.1 Vector Autoregression

We employ a Vector Autoregressive model to investigate the impact of foreign portfolio investor on comovement of the Indian economy. A non-structural modeling approach developed by Sims (1980) such as VAR is widely used in investigating relationship among economic variables especially because structural frameworks require economic theory which is often not rich enough to provide a dynamic specification adequate to identify relationships among
variables. The VAR is an effective framework for forecasting systems of interrelated time series and enables analysis of the dynamic impact of shocks on the system of variables. The VAR approach also overcomes the need for structural modeling by treating every endogenous variable in the system as a function of the lagged values of all endogenous variables considered in the system and is specified as follows:

\[ y_t = A_1 y_{t-1} + \ldots + A_p y_{t-p} + B x_t + \varepsilon_t \]  

(1)

where \( y_t \) is a \( K \) vector of endogenous variables, \( x_t \) is a \( d \) vector of exogenous variables, \( A_1, \ldots, A_p \) and \( B \) are matrices of coefficients to be estimated, and \( \varepsilon \) is a vector innovations that may be contemporaneously correlated with all of the right-hand side variables.

We estimate the following OLS model in VAR system:

\[ R_{i,t} = \alpha_i + \sum_{i=1}^{I} \beta_i R_{i,t-L} + \sum_{j=1}^{I} \gamma_j R_{j,t} + \sum_{i=1}^{I} \theta_i FFC_{i,t} + \varepsilon_t \]  

(2)

Where,

- \( R_{i,t} \) is return on country \( i \) (i.e., India) at time \( t \).
- \( R_{i,t-L} \) is return on country \( i \) for lag \( t-L \).
- \( R_{j,t} \) is return on country \( j \) at time (i.e., US and UK).
- \( FFC_{i,t} \) is flow of foreign capital for country \( i \) at time \( t \).
- \( \varepsilon_t \) is the white noise error term.

In our model, since only lagged values of the endogenous variables appear on the right hand side of the equations, simultaneity is a non-issue. The Ordinary Least Squares (OLS) in VAR framework provide consistent and efficient estimates even though the error term (\( \varepsilon_t \)) may be contemporaneously correlated because all equations have identical regressors.

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2.2.2 Impulse Response Function

The F statistic provided by VAR by construction does not facilitate identification of the sign of relationship (i.e. whether changes in one return index will have negative or positive effect on the other return variable). Also, VAR is not able to explain how long it takes for the change in one variable permeating through the system to have an effect on the other variable. Impulse response function identifies the responsiveness of one factor in the VAR system to shocks or innovations of each of the other variables. It explains how a unit shock in one variable in isolation of the others, affects the movement in other variables. In each of the equation one unit shock is applied to detect the change in the VAR system over time by representing the VAR as VMA (Vector Moving Average) representation:

$$\begin{align*}
R_{i,t} &= b_{11}^0 \varepsilon_{.,t} + b_{11}^1 \varepsilon_{.,t-1} + b_{12}^1 \varepsilon_{.,t-1} + \ldots \\
&= \sum_{j=1}^{\infty} b_{1j}^j \varepsilon_{.,t-j} \\
\end{align*}$$  \hspace{1cm} (3)

Where, $b_{ij}$ are unit normalized innovation coefficients of impulse response function following the normalization by the Cholesky factor\(^1\) and $b_{11}^0$ is the simultaneous effect of a unit shock to $\varepsilon_{.,t}$. The contemporaneous innovation is stated in standard deviation form and have non-unit coefficient in contrast to its unit coefficient in equation

2.2.3 Variance Decomposition Analysis

Previous research has shown that variance decomposition analysis is an effective way to examine the dynamic interactions amongst economic time series. Whilst impulse response function traces the effects of a shock to one endogenous variable on to other variables in the VAR, variance decomposition enables further analysis by separating the variation in an endogenous variable.

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\(^1\) See Diebold (2004).
The variance decomposition thus offers greater insights about the relative significance of each random innovation that affects the variables in VAR. Decomposing the variance offers slightly different perspective on the relationship of the identified variables since it shows what proportion of the variance is due shock of its own lags against the shocks of other variables. A shock to variable $i$ will not only affect its own future outcomes but will also be transmitted to other variables. Variance decomposition provides the magnitude of the effect on itself and others in the system. Studies have shown that most of the shocks in the h-step error variance are attributed to its own shocks.

2.2.4 Cointegration

We examine the long run relationship between Indian, US, UK equity markets and net flow of foreign institutional investment using the VAR analysis proposed by Johansen (1988) and Johansen and Juselius (1990). We follow Johansen-Juselius (JJ) because their approach is considered superior to the regression-based approach suggested by Engle and Granger in 1987 (Cheung and Lai, 1993). Another reason for using the JJ approach is that it utilizes the maximum likelihood estimates and allows testing and estimation of more than one cointegrating vector in the multivariate system without requiring a specific variable to be normalised. This way, the JJ tests overcome the problem of carrying over the errors from the first step into the second step commonly encountered in Engle and Granger’s (1987) approach to cointegration. Further, Johansen’s method is independent of the choice of the endogenous variable within a vector autoregression (VAR) framework which enables testing for various structural hypotheses.

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2 The Johansen-Juselius procedure resolves the problem of endogeneity in that we do not need to normalise the cointegrating vector on one of the variables as required in the Engle and Granger (EG) test.
involving restricted versions of cointegrating vectors and speed of adjustment parameters using likelihood ratio tests.

The VAR equation in 2.2.1 can be rewritten as,

\[ \Delta y_t = \Pi y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + Bx_t + \varepsilon_t \]  

Equation (4)

Where:

\[ \Pi = \sum_{i=1}^{p} A_i - I, \text{ and } \]  

Equation (5)

\[ \Gamma_i = - \sum_{j=i+1}^{p} A_j \]  

Equation (6)

Since our objective is to investigate the long-run relationship, we will focus on the elements of matrix \( \Pi \). If vector \( y \) contains \( m \) variables, matrix \( \Pi \) will be of the order \( m \times m \), with a maximum possible rank of \( m \) (or full rank). Equation (4), except for the \( \Pi y_{t-k} \) term, is in the form of the traditional VAR with first difference. The \( \Pi \) term determines whether the system of equations is cointegrated, i.e., whether a long-run equilibrium relationship exists. The feature to note is that the rank of matrix \( \Pi \) is equal to the number of independent cointegrating vectors. If rank of matrix \( \Pi = 0 \), the matrix is null, i.e., all the elements in this matrix are zero, which implies no cointegration or in other words lack of a long-run equilibrium relationship and the error correction mechanism, \( \Pi y_{t-k} \), therefore, does not exist. In determining the rank of matrix \( \Pi \) (number of cointegrating vectors), we calculate the characteristic roots or eigenvalues, \( \hat{\lambda}_i \), of \( \Pi \).

Johansen (1988) and Johansen and Juselius (1990) propose trace (\( \lambda_{trace} \)) and maximum eigenvalue (\( \lambda_{max} \)) test statistics to establish whether the characteristics roots are significantly different from zero. The likelihood ratio statistic for the trace test (\( \lambda_{trace} \)) is:
\[ \lambda_{\text{trace}}(r) = -T \sum_{i=r+1}^{m} \ln(1 - \hat{\lambda}_i) \]  

(7)

where \( \hat{\lambda}_i \) are the estimated values of the characteristic roots (also known as eigenvalues) obtained from the estimated \( \Pi \) matrix. The null hypothesis to be tested is that the number of cointegrating vectors is less than or equal to \( r \) against the alternative hypothesis that the number of cointegrating vectors is more than \( r \). For example the null hypothesis \( r \leq 0 \) against alternative \( r = 1 \), \( r \leq 1 \) against alternative \( r = 2 \), and so forth. The computed values of \( \lambda_{\text{trace}} \) statistics are evaluated using the critical values provided by Osterwald-Lenum (1992). The optimal system lag length is determined by using the Schwarz Information Criteria (SIC). Specifically, the appropriate number of lags for each variable is obtained by computing the SIC over different lag schemes in the range from 1 to 20 and by choosing the number of lags that yields the lowest value for the SIC. We report the eigenvalue and trace statistic, with the interpretation of the latter to investigate the long term relationship.

2.2.5 Granger Causality

The short-term relationship is examined using the Granger causality between the endogenous variables in the following way:

\[
R_{y,t} = a + \sum_{i=1}^{n} \beta_i R_{y,t-i} + \sum_{i=1}^{n} \gamma_i R_{x,t-i} + \epsilon_t \quad (8)
\]

\[
R_{x,t} = a + \sum_{i=1}^{n} \delta_i R_{x,t-i} + \sum_{i=1}^{n} \zeta_i R_{y,t-i} + u_t \quad (9)
\]

where \( R_{y,t} \) and \( R_{x,t} \) are the returns of index \( y \) and \( x \) at time \( t \) accordingly.

In the above regressions we examine whether the coefficients \( \gamma_i \) and \( \zeta_i \) are equal to zero using a standard F test. If \( \gamma_i \) and \( \zeta_i \) coefficients are different from zero then we conclude that there
is a bi-directional causality between and $R_{y,t}$ and $R_{x,t}$. Alternatively, if both coefficients are found to be equal to zero, then we are able to conclude that there is no causality. Finally, in equation (9) $R_{y,t}$ Granger causes $R_{x,t}$ if $\gamma_i = 0$ for $i=1,2,\ldots,n$. Similarly, in (10) causality implies that $R_{x,t}$ Granger causes $R_{y,t}$, provided that $\zeta_i \neq 0$ for $i=1,2,\ldots,n$. Our causality test also uses FII data to test the causality with returns.

3. Empirical Results

Figure 1 presents the time series plot of log values of price index (price) and log of net investments made by foreign institutional investors (FII). In isolation of other confounding factors, intuitively the figure indicates that there is a strong association between the flow of foreign portfolio investments and the movement of the Indian stock price index (correlation coefficient of 0.9). Figure 2 presents the plot of gross monthly portfolio investments by US investors which on average constitute 16\% of the total gross portfolio investments during the period of January 2001 to November 2006\(^3\).

In table 1, we provide descriptive statistics for all time series considered in our analysis. Data presented in Table 1 shows that average daily returns from the Indian market are higher than those offered by the US or the UK. However as expected, higher returns come with relatively higher risk in the Indian market as confirmed by higher standard deviation of 1.46\% as opposed to 1.12\% for the US and 1.08\% for the UK. Further, we find that kurtosis for all the return series and foreign flow of investment are above 3 which confirm that distribution of return is not normal as the Jarque-Bera statistic is significant in all cases.\(^4\) This is further confirmed by

\(^3\) See CNBC, MoneyControl.com and U.S. Treasury International Capital

\(^4\) One of the assumptions of the VAR which uses the OLS estimation method is violated. However, since sample sizes are sufficiently large, the violation from the normality assumption does not significantly affect the estimation. Following the central limit theorem, the statistics will asymptotically converge to normality.
skewness statistic which shows that the US and Indian returns are negatively skewed. However, daily return from the UK are positively skewed suggesting that on average and in terms of frequency greater positive returns were available from the UK market during the sample period.

It is a common practice to investigate whether the time series are stationery in its level form. For testing this, we use the Augmented Dickey Fuller (ADF) test. The results reported in Table 2 show that all series in the logarithmic level form are non-stationery as confirmed by the insignificant ADF statistic. However, the first differenced series are integrated to the order I (1) with ADF statistic being significant at 5% level. Hence, all series are transformed to log of first difference for the VAR analysis and level data are used for the cointegration analysis.

**Short Run Relationship**

As explained in section 2.2.5, the Granger causality model can be effectively used in investigating for the short term causal interrelationships between variables. It gives us a practical approach to assess whether short term movements in daily equity returns and foreign investments are related. It also indicates the direction of causality, i.e. whether there is unidirectional, or bidirectional, or no causality.

Results reported in Table 3 demonstrate that the null hypothesis that changes in the portfolio investment flows do not cause changes in the Indian stock price index returns and vice versa can be rejected at 5 per cent level of significance. The results also show that the UK and the US markets seems to Granger cause the portfolio investment flows into India. Consistent with previous findings, the US and the UK markets do seem to influence the movements in the Indian stock market in the short run and also influence the flow of foreign capital. The findings
lend support to the hypothesis that that the foreign portfolio investments are contributing to the
greater integration of the Indian equity markets with equity markets of the US and the UK.

**Long Run Relationship**

Table 4 presents the eigenvalues and the trace statistics estimated by employing Johansen
and Juselius maximum likelihood estimation. The cointegration tests examine that there are \( r \) 
cointegrating relationship against the \( r + 1 \) and hence, not accepting the null implies that the
cointegrating relationship exceeds \( r \) number of relationships by one. Results in Panel A show
that most trace statistics are significant at 1% level leading us to reject the null hypothesis that
there is no cointegrating relationship between daily equity returns from India, US, and UK as
well as the portfolio investment flows. Since we are interested in investigating the relationship of
foreign portfolio investment flows and the Indian stock market, we employ a bivariate
cointegration test which shows that the null hypothesis of no cointegration between the daily
movements in the Indian equity markets and portfolio investment flows can be rejected at 1%
and 5%. Thus, results so far seem to confirm that foreign portfolio investment flows not only
influence daily movements in the Indian equity market in the short run but they also seem to
influence the long-run returns.

**Impulse Response Function**

Figure 3-8 show the impulse responses and their upper and lower level bands. The
impulse response is considered statistically insignificant if the upper and lower level bands cross
the horizontal axis. Figure 3 represent the response of innovations in foreign portfolio investment
flows (FII) to its own innovations. It is clear that the peak effect occurs on day one and remains
significant for up to a week. However, neither the upper nor the lower band crosses the
horizontal axis indicating that changes in the portfolio investment flows are significantly influenced by shocks in its own time series.

Figure 4 show how innovations in the FII influence the Indian stock market returns. The upper and lower bands do not cross the horizontal axis and thus confirm that innovations in the FII significantly influence the Indian stock market returns. The response of the Indian market to the foreign portfolio investment flows is highest on day one which gradually declines until the 6th day before it fades off.

Figure 5 presents the response of the FII to the innovations in the Indian stock market returns. The impulse response function is once again significant peaking on day 2 before it starts to decline and fades off from day 6. This suggests a positive feedback trading by international investors and is consistent with those reported by previous studies (see, Froot et al., 2001).

Figure 6 shows the response of the Indian stock market returns to its own shocks. The peak effect occurs on day one which remains significant on day 2. The lower bound crosses the horizontal axis between day 2 and 3 and the upper bound follows on day 3 suggesting that the response of the Indian stock returns to its own innovations is short lived and only lasts for couple of days. The dispersion around the mean response is also quite small.

Figure 7 shows the response of the Indian stock market to the changes in the UK stock market. The Indian stock market response seems to peak on day 2 before it begin to decline suggesting that the market responds to the news and events in the UK market one day later which is consistent with the time differences in trading hours between Indian and the UK stock markets.

Figure 8 presents the innovations in the US markets and the response of the Indian stock market. The upper and lower responses are closer to the mean response and also the lower bound crosses the horizontal axis on day 2. This suggests that the response coming in from the US
market is somewhat less significant than those observed in the case of UK stock market shocks to the Indian stock market. However, consistent with the results in figure 7, the peak response of the Indian market to the innovations in the US market occurs on day 2 (one day late) which declines and fades away rapidly.

Overall, the impulse response tests confirm that movements in the US and the UK markets do seem to impact the movements in Indian stock market and more significantly they are consistent with those observed for the innovations in net portfolio investment flows and response of the Indian market to those innovations. The short term impact in all figures appears significant. Our results are robust because the confidence bands around the impulse response functions are calculated by using the Monte Carlo method. The results are consistent with the findings of the Granger causality test and lead us to conclude that the US and the UK markets not only influence the movement of Indian stock market but they also significantly affect the mobility of portfolio investment flows in India. This suggests that the comovements in the Indian equity market are explained by the net portfolio investment flows by foreign institutional investors who seem to be influencing the integration process of the Indian stock markets with the developed equity markets of the US and the UK.

**Variance Decomposition**

A further tool is available in the VAR system which uses the recursive scheme so that the MA representation mentioned in the above section with white noise innovations could also be utilized to examine the degree of variance in the $h$-step error due to its own innovation and innovation in other variables.
Table 5 and 6 show the forecast error variance decompositions of return from Indian market and portfolio investment flows. Our results do not seem to be affected by changing the order factorization, despite the possibility of the error variance of the VAR system being contemporaneously correlated, particularly due to the high correlation between US and UK returns. However, since the main purpose of our study is to examine the influence of the foreign investment portfolio flows and innovations in the UK and the US stock markets on the Indian stock market, the contemporaneous relationship of the VAR residuals owing to the high correlation between US and UK returns will not significantly influence the interpretation of the results. Results in Table 5 show that the fraction of error variance in forecasting returns in the Indian stock market due to innovation in the foreign institutional portfolio investments is zero in the one step horizon but gradually builds in long horizon which reflects that it takes time to transmit the effects of information contained in the foreign institutional portfolio investment flows into the Indian stock market returns. Since we use daily data, even 0.7% in the 5 step horizon could be considered quite significant. We also observe that both the US and the UK market carry relatively substantial information in sharing the $h$-step ahead variance in the Indian stock market. The US return accounts for almost 3% error variance right from the second period and it gradually increases with time.

In table 6, we observe that FII future error variance is accounted for by the innovations in return in Indian, the US and the UK stock markets which suggest that foreign institutional investors are return chasers. The results also confirm that the movements in returns from the US and the UK contribute to the error variance in returns from the Indian stock market. Thus we conclude that Indian returns are not only influenced by returns in the US and the UK but the foreign institutional portfolio investment flows play a significant part in explaining the
comovements of the Indian equity market with the developed equity markets of the US and the UK.

Additional Tests

In order to further support our above result, we ran two separate bivariate regressions using the logarithmic level data. We regress the Indian log index values on the index values of the US and the UK. The residuals from the two bivariate regressions, which are non stationary (as confirmed by the ADF test) and linear combination of the two markets (proxy for comovement and long run relationship) are then used as exogenous variables to investigate how well they explain the foreign investment portfolio flows (FII). Results (not reported here but available on request) are highly significant, which further complement the empirical results obtained through VAR, Impulse Response Function and the Variance Decomposition analysis and confirm that the foreign portfolio investment flow significantly influence the comovements of the Indian market with that of US and the UK.

5. Conclusions

This study examines the comovements of the Indian stock market with the major developed stock markets of the US and the UK and the how the foreign portfolio investment flows in the Indian stock market influence this process. Using VAR (Impulse Response Function and Variance Decomposition) analysis, on daily data from January 2001 till 15 January 2007, we find that Indian stock returns are significantly influenced by the short and long term innovations in the US and UK stock markets. The short term and long term relationship of the Indian stock market with the developed UK and the US stock markets as well as foreign portfolio investment flows is confirmed using the Granger causality and Johansen and Jesulius Cointegration tests.
Further examination of the robustness of the results is achieved by employing the impulse response analysis which confirms that the Indian stock returns respond significantly to the innovations in the UK and the US stock markets as well as to the innovations in foreign portfolio investment flows. Further, variance decomposition analysis results suggest that both the US and the UK markets carry relatively substantial information in sharing the $h$-step ahead variance of the Indian Stock Market and FII future error variance is accounted for by the innovations in equity returns in the Indian, the US and the UK stock markets. Our results thus suggest that the impact of the foreign portfolio investment flows on Indian stock returns is significant and these flows seem to explain and influence the short and long run comovements of the Indian stock markets with the developed stock markets of the US and the UK.
References


Lane, P. R. and Milesi-Ferretti, G. M. (2003), "International financial integration", *IMF Staff Papers*, vol. 50, pp. 82.


### Table 1
**Descriptive**

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<th>UK</th>
<th>USA</th>
<th>FII</th>
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<td>0.0033</td>
<td>0.0213</td>
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<td>8.6149</td>
<td>5.7713</td>
<td>5.3966</td>
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<tr>
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<td>-5.0738</td>
<td>-5.1239</td>
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**Note**

FII is the daily net purchase by foreign institutional investor (in millions local currency)
IND, USA and UK are daily returns (in %) from India, US, and the UK MSCI indices.

### Table 2
**ADF Test Statistic**

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<td>Critical Value (5%)</td>
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<tr>
<td>IND</td>
<td>2.415804</td>
<td>-0.843257</td>
</tr>
<tr>
<td>FII</td>
<td>3.230412</td>
<td>-0.819944</td>
</tr>
</tbody>
</table>
### Table 3
**Pair wise Granger Causality Tests**

<table>
<thead>
<tr>
<th>Null Hypothesis</th>
<th>F-Statistic</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>IND does not Granger Cause FII</td>
<td>10.1076</td>
<td>0.0000</td>
</tr>
<tr>
<td>FII does not Granger Cause IND</td>
<td>4.03195</td>
<td>0.01792</td>
</tr>
<tr>
<td>IND does not Granger Cause USA</td>
<td>0.56311</td>
<td>0.56955</td>
</tr>
<tr>
<td>USA does not Granger Cause IND</td>
<td>9.11082</td>
<td>0.00012</td>
</tr>
<tr>
<td>IND does not Granger Cause UK</td>
<td>0.88006</td>
<td>0.41496</td>
</tr>
<tr>
<td>UK does not Granger Cause IND</td>
<td>28.9015</td>
<td>0.0000</td>
</tr>
<tr>
<td>FII does not Granger Cause USA</td>
<td>2.44604</td>
<td>0.08696</td>
</tr>
<tr>
<td>USA does not Granger Cause FII</td>
<td>5.2678</td>
<td>0.00525</td>
</tr>
<tr>
<td>FII does not Granger Cause UK</td>
<td>1.40781</td>
<td>0.24499</td>
</tr>
<tr>
<td>UK does not Granger Cause FII</td>
<td>15.9834</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

### Table 4
**Panel A: Cointegration Test (U.S.A, U.K., FII and IND)**

<table>
<thead>
<tr>
<th>Null Hypothesis</th>
<th>Eigenvalue</th>
<th>Trace Statistic</th>
<th>5%</th>
<th>1%</th>
</tr>
</thead>
<tbody>
<tr>
<td>$r \leq 0$</td>
<td>0.019788</td>
<td>54.65325</td>
<td>47.21</td>
<td>54.46</td>
</tr>
<tr>
<td>$r \leq 1$</td>
<td>0.014943</td>
<td>30.05022</td>
<td>29.68</td>
<td>35.65</td>
</tr>
<tr>
<td>$r \leq 2$</td>
<td>0.005983</td>
<td>11.51601</td>
<td>15.41</td>
<td>20.04</td>
</tr>
<tr>
<td>$r \leq 3$</td>
<td>0.003348</td>
<td>4.128526</td>
<td>3.76</td>
<td>6.65</td>
</tr>
</tbody>
</table>

**Panel B: For series FII and IND only**

<table>
<thead>
<tr>
<th>Null Hypothesis</th>
<th>Eigenvalue</th>
<th>Trace Statistic</th>
<th>5%</th>
<th>1%</th>
</tr>
</thead>
<tbody>
<tr>
<td>$r \leq 0$</td>
<td>0.013170</td>
<td>22.43145</td>
<td>15.41</td>
<td>20.04</td>
</tr>
<tr>
<td>$r \leq 1$</td>
<td>0.004952</td>
<td>6.111430</td>
<td>3.76</td>
<td>6.65</td>
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</tbody>
</table>

### Table 5
**India**

<table>
<thead>
<tr>
<th>Period</th>
<th>FII</th>
<th>IND</th>
<th>UK</th>
<th>USA</th>
<th>FII</th>
<th>IND</th>
<th>UK</th>
<th>USA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>96.69</td>
<td>0.02</td>
<td>3.29</td>
<td>0</td>
<td>96.69</td>
<td>0.83</td>
<td>2.48</td>
</tr>
<tr>
<td>2</td>
<td>0.32</td>
<td>92.92</td>
<td>2.16</td>
<td>4.61</td>
<td>0.32</td>
<td>92.92</td>
<td>4.18</td>
<td>2.59</td>
</tr>
<tr>
<td>3</td>
<td>0.63</td>
<td>92.40</td>
<td>2.40</td>
<td>4.56</td>
<td>0.63</td>
<td>92.4</td>
<td>4.41</td>
<td>2.56</td>
</tr>
<tr>
<td>4</td>
<td>0.65</td>
<td>92.36</td>
<td>2.41</td>
<td>4.59</td>
<td>0.65</td>
<td>92.36</td>
<td>4.43</td>
<td>2.57</td>
</tr>
<tr>
<td>5</td>
<td>0.65</td>
<td>92.35</td>
<td>2.41</td>
<td>4.59</td>
<td>0.65</td>
<td>92.35</td>
<td>4.43</td>
<td>2.57</td>
</tr>
</tbody>
</table>
Table 6

<table>
<thead>
<tr>
<th>Period</th>
<th>FII</th>
<th>IND</th>
<th>UK</th>
<th>USA</th>
<th>FII</th>
<th>IND</th>
<th>UK</th>
<th>USA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>96.43</td>
<td>3.32</td>
<td>0.07</td>
<td>0.18</td>
<td>96.43</td>
<td>3.32</td>
<td>0.17</td>
<td>0.08</td>
</tr>
<tr>
<td>2</td>
<td>93.06</td>
<td>4.38</td>
<td>1.45</td>
<td>1.12</td>
<td>93.06</td>
<td>4.38</td>
<td>2.35</td>
<td>0.21</td>
</tr>
<tr>
<td>3</td>
<td>92.06</td>
<td>4.87</td>
<td>1.75</td>
<td>1.31</td>
<td>92.06</td>
<td>4.87</td>
<td>2.83</td>
<td>0.24</td>
</tr>
<tr>
<td>4</td>
<td>91.79</td>
<td>4.97</td>
<td>1.88</td>
<td>1.36</td>
<td>91.79</td>
<td>4.97</td>
<td>3.00</td>
<td>0.24</td>
</tr>
<tr>
<td>5</td>
<td>91.72</td>
<td>5.00</td>
<td>1.90</td>
<td>1.38</td>
<td>91.72</td>
<td>5.00</td>
<td>3.03</td>
<td>0.24</td>
</tr>
</tbody>
</table>

Ordering 1: USA, UK, IND, FII
Ordering 2: UK, USA, IND, FII

Fig 1

Net foreign institutional investors' purchase and Index

Daily Observation (01/01/2001 - 15/01/2007)

Fig 2

U.S vs Total Purchase

USD in Millions

Year-Month
Average Monthly Gross Purchase from January 2001 to November 2006

<table>
<thead>
<tr>
<th>Year-Month</th>
<th>U.S. Purchase (Millions USD)</th>
<th>Total Gross Purchase (Million USD)</th>
<th>U.S share in %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>525</td>
<td>3,230</td>
<td>16.27</td>
</tr>
</tbody>
</table>

Source: CNBC, MoneyControl.com and U.S. Treasury International Capital

Fig 3
Response of FII to FII

Fig 4
Response of IND to FII
Fig 5
Response of FII to IND

Fig 6
Response of IND to IND
Fig 7
Response of IND to UK

Fig 8
Response of IND to US