Unchecked manipulations, price-volume relationship and market efficiency: Evidence from Emerging Markets

Abstract

This paper investigates how unchecked manipulations could cause frequent trade-induced manipulations and weak-form market inefficiency in South Asian stock markets [Bombay Stock Exchange (BSE), Dhaka Stock Exchange (DSE) and Karachi Stock Exchange (KSE)]. Specifically, the paper analyses the price-volume relationship as one of the many cases of market inefficiency. By employing various econometric tests, this paper first provides conclusive evidence of market inefficiency in these markets. It then extracts evidence of manipulation periods from legal cases and analyses price-volume relationship during these periods. The paper finds that there exists market-wide trading-induced manipulations, where excessive buying and selling causes prices to inflate artificially before crashing down. The paper concludes that South-Asian markets are inefficient in the weak-form.

Key Words: Trade-induced Manipulation; Price-volume relationship; Market efficiency; Emerging markets; South Asia;
JEL Classification: G14; G15;

1. Introduction

Anecdotal evidence has always existed regarding manipulative practices taking place in the South-Asian stock markets of Bangladesh, India and Pakistan. Recent studies also have found empirical evidence of such manipulations, ranging from insider information to "pump and dump" and excessive speculation in these markets (see Khwaja and Mian (2005); Khanna and Sunder (1999). This paper analyses price volume relationship to investigate whether trading-induced or volume-driven manipulation exists in the South Asian stock markets. A trading-induced or volume-driven manipulation as identified by Allen and Gale (1992) is analogous to "pump and dump" of Khwaja and Mian (2005)). It involves manipulators buying excessive stocks in order to artificially inflate prices, thus giving the uninformed trader the impression of higher future prices, then selling the stocks, causing the price to fall sharply. Theoretical studies, including those of Allen and Gale (1992) and Jarrow (1992), have argued that it is not possible to have profitable volume-driven manipulations in the presence of market efficiency. The presence of market manipulations therefore suggests that South-Asian markets are inefficient. To corroborate this, the first part of the paper employs empirical testing. It uses three different tests, namely the Ng-Perron unit root test (which is argued to have better power than Dickey Fuller or Augmented DF unit root tests), variance-ratio tests (both traditional and rank and sign based tests), and the modified GPH (Geweke and Porter-Hudak (1983) test proposed by Andrews and Guggenberger (2003). Since prior literature provided the results based on the unit root tests (but not the NG-Perron test) and Lo and McKinlay's variance ration tests, in this paper, we only report the results based on Wright's

(2000) variance ratio test and the modified GPH test of Andrews and Guggenberger.[1] This not only helps us to conserve the space but also removes a misconception that unit root tests can be used to evaluate the random walk. In effect, the unit root tests are designed only to determine whether a series is difference stationary or trend stationary. Since the errors are allowed to be an arbitrary zero-mean stationary process under both the unit root null and alternative hypothesis, the focus of the unit root test is not on the predictability of stock prices, as it is under the random walk hypothesis. Unit root tests are therefore not designed to detect predictability, but are insensitive to it by construction. If the price sequence follows a random walk, however, it must not only contain a unit root, but the increments must be unpredictable (uncorrelated). A test of the random walk is therefore concerned with predictability of the increments and not simply whether the process is a unit root. Hence, this paper does not include the unit root test results.[2] Nonetheless, our results from all variants of tests provide conclusive evidence of weak-form market inefficiency in the South Asian stock markets.

The second part of the paper attempts to understand the nature of price-volume relationships as a case of market inefficiency and trade-induced manipulations. To facilitate this, the study uses evidences from legal cases to identify manipulation periods. Here, it is to be noted that this study focus on the cases where the manipulations were big enough to cause the entire price index to move.[3] The paper then analyses the contemporaneous volume-price relationship during these manipulative periods, in order to show that there is a strong positive relationship between prices and volume during the "pumping" period, and a strong negative relationship between them during the "dumping" period. It is also found that the volume was significantly higher during the manipulation period than in the pre- and post-manipulation periods. These results corroborate the case evidence that manipulative bubbles were caused by excessive buying, and later burst by the selling of stocks. The paper concludes that South-Asian markets are inefficient, and hence are a breeding ground for market manipulations.

The remainder of the paper is organized as follows. Section 2 provides the background and literature review. Section 3 discusses the market background and the presence of manipulative practices in South-Asian markets. Section 4 describes the data. The methodology for testing for market efficiency is analysed in Section 5, and its empirical results are presented in Section 6. Section 7 provides the methodology and empirical evidence for volume-driven relationships during the manipulation periods. Finally, Section 8 summarises the discussion.

2. Background and Literature Review

This section discusses the concept of market manipulation and market efficiency, and looks into the literature which establishes the relationship between the two. It then analyses the literature which asserts that South-Asian markets are (weak-form) efficient and argues why these results might be misleading. The focus then shifts to the literature on the price-

[1] Prior literature that uses unit root and variance ratio (VR) tests includes Azad (2009b), Cooray and Wickremasinghe (2007) and Islam and Khaled (2005). These two test statistics are not reported in this paper but can be obtained from authors on request.

[2] We thank an anonymous referee for this suggestion to explain why unit root test is not needed to detect whether a time series process follows a random walk.

[3] Many such cases are reported, but we chose the cases which are big enough to have been reported by many newspapers and the SEC (Securities and Exchange Commission) of the respective countries. We use the Factiva database to find such news releases. In this paper, we only consider the price index and not stock level price because we want to show that the manipulation is so intense that it even causes large movements in price index of those emerging markets.

volume relationship, to show why some of the purported results might not hold during manipulation periods.

Broadly speaking, market manipulations fall into three categories (Allen and Gale (1992). The first can be defined as action based manipulation, which involves a situation where one party's deliberate action affects the value of the assets. The second can be defined as information based manipulation; it involves the release of false information or rumours in order to manipulate the market. The third type involves trade based or trading-induced manipulation, where the manipulator buys the stock to drive up the price artificially, and then sells it at the higher price, leaving the uninformed traders with an overvalued stock. This is also referred to as the "pump and dump" scheme. Another variant involves dumping the stock first, to drive down the prices, and then buying the undervalued stock. These manipulative practices are quite common in young markets. There were serious concerns regarding such manipulative practices in the Amsterdam stock exchange in the 1700s and the New York stock exchange in the 1900s (Gordon (1999). The purpose of the US Securities and Exchange Act of 1934 was to eliminate the practice of stock pooling, where the joint trading of particular stocks was undertaken to manipulate prices (Mahoney (1999).

Emerging markets have also been found to be particularly susceptible to manipulative practices (see Zhou and Mei (2003)). Examples of manipulations in South Asian markets abound. The pump and dump scheme is considered common practice in the Indian market (see Khanna and Sunder (1999). However, the lack of a regulatory framework in these markets suggests that some of these practices are hard to catch, and hence, there is very little empirical evidence regarding them. In a rare empirical study, Khwaja and Mian (2005) were able to capture the effect of these manipulations. They show that in the Pakistani market, brokers obtain 50 to 90 percentage points higher earnings than outside investors, and assert that they have been able to achieve this high differential through "pump and dump" schemes. The following section discusses the impact of these manipulative practices on market efficiency.

The research into market efficiency investigates the idea of weak-form informational efficiency. The theory suggests that, in an informationally efficient market, prices fully reflect all available information (Fama (1970). This makes the investors react aggressively to any informational advantage at their disposal, thus allowing the prices to incorporate new information.[4] In such efficient markets, it is impossible for an investor to gain excessive returns through speculation, as the prices reflect all available information (Aguirre and Saidi (1998). A number of theoretical and empirical studies have even shown that profitable manipulations are impossible in efficient markets (see Allen and Gale (1992); Aggarwal and Wu (2006). However, the opportunity for manipulative practices arises when markets cease to be efficient.

When markets are inefficient, returns are non-random, and prices are mean reverting and do not reflect all available information. This enables investors to generate excessive/abnormal returns through a competitive informational advantage, speculation or even manipulations. In these markets, the excessive returns are no longer irregular or abnormal, and market players are compensated for the additional costs of gathering superior

[4] This paper only tests the hypothesis but does not attempt to establish any explicit link between the random walk/martingale hypothesis and the efficient market hypothesis. As was argued by LeRoy (1973) and Lo (2004), the two hypotheses are not exactly the same, the market is not absolutely frictionless, and the trading is not entirely costless (Azad (2009a).

information (Grossman and Stiglitz (1980). This motivates investors to constantly strive to obtain new information or kinds of manipulations.

Thus, the question of whether a financial market is efficient, follows a random walk or is mean reverting is of considerable interest to both researchers and investors. From the econometric point of view, the random walk hypothesis (RWH) implies both that a series has a unit root component and that the increments of a series are uncorrelated (or a series has a martingale property). While the unit root tests capture the first property of the RWH, the variance-ratio (VR) tests capture its second property. Thus, the variance-ratio tests and the unit root tests are complementary in testing the random walk hypothesis. However, Lo and MacKinlay (1988) and Cecchetti and Lam (1994), among others, argue that the variance-ratio test is more reliable than traditional unit root tests.

Among the studies which examine the random walk behaviour of the South Asian stock markets, Cooray and Wickremasinghe (2007) and Islam and Khaled (2005) apply the unit root tests and the variance-ratio tests. Cooray and Wickremasinghe (2007) find that the stock markets of India, Pakistan and Sri Lanka follow a random walk, but the Bangladesh stock market does not. Islam and Khaled (2005) find that the DSE (Dhaka Stock Exchange) follows a random walk behaviour following the market crash. In an earlier study, Gupta (1990) finds evidence of random walk behaviour for the Bombay Stock Exchange. As has been argued previously these results, are contrary to our expectations, as the presence of market manipulations suggests that these markets are inefficient. Moreover, these studies have a number of short-comings which have led to this incorrect assertion. Firstly, all of these studies apply traditional unit root tests, and only Islam and Khaled (2005) use the variance ratio tests of Lo and MacKinlay (1988) to examine the random walk behaviour of the South Asian stock markets. Moreover, no research has used the Ng and Perron (2001) unit root test to identify the unit root components in the series. This test has better power properties than other unit root tests. Also, no study has applied the Wright (2000) variance-ratio tests and fractional integration tests to the South Asian case. Secondly, none of these studies has explicitly analysed the mean-reversion behaviour for the South Asian case. This makes the results of the previous literature unreliable. To compensate for this shortcoming, this study employs a battery of traditional and new tests in the areas of unit roots, variance ratios and fractional integration specifications to test the following hypothesis:

H1: South Asian markets are informationally inefficient.

2.1 Volume-Price Relationships

The analysis of price-volume relationship has received a considerable amount of attention from both investors and academics over the last two decades (see Karpoff (1987) for a review). The price-volume relationship can be defined by two Wall Street adages. First, a price increase accompanied by a high volume is an indication of bullish sentiments. Second, a price decline accompanied by a volume is an indication of bearish sentiments.

While many studies have attempted to establish the empirical and theoretical relationship between price and volume, a consensus is yet to be reached. On the theoretical frontier, a number of models exist in the literature. Copeland (1976) and Jennings, Starks and Fellingham (1981) developed a sequential information model which implies a positive bi-directional relationship between the volume and stock prices. In Epps and Epps (1976) model, the trading volume is used as a measure of the disagreement between traders, with a large trading volume implying a large degree of disagreement among them. Their model suggests a positive causal link between the trading volume and price. Clark (1973) uses the trading volume as measure of the speed of information flow, but fails to show a causal relationship from volume to stock returns. Blume, Easley and O'hara (1994) use past prices and volume as a measure of valuable information.

A number of empirical studies have tested the empirical relationship between price and volume. Most studies agree that a causal relationship from price to volume exists, although some have objections with regard to reverse causality from volume to price (for example, see Smirlock and Starks (1988). However, recent studies have used non-linear tests to show such bi-directional causality (see Lee and Rui (2002); Rashid (2007). However, to the best of the authors' knowledge, no study has yet extended this analysis of the price-volume relationship to periods of trading-induced manipulations.

2.2 Market Inefficiency and Trade Induced Manipulations

This section discusses how market inefficiency can result in trading-induced manipulations, and, further, it develops hypotheses which can be used to test for the presence of trading-induced manipulations in South-Asian markets.

In efficient markets, profitable trading-induced manipulations are impossible (see Allen and Gale (1992); Jarrow (1992), because, in markets which exhibit efficiency, the participants are well informed about the nature of the underlying stocks. This implies that if manipulators try to influence prices by excessive pumping (buying) of stocks at higher prices, they will be matched by a set of traders who will be willing to sell any amount of stocks, and even short-sell it, knowing that the prices are over-valued, thus causing the manipulators to suffer a loss. It is only when the market ceases to be efficient and traders are ill-informed that trading-induced manipulations can occur. In inefficient markets, there is a high level of heterogeneity in the information possessed by different groups of traders. Uninformed traders in these markets use different measures as a reflection of vital information. Two important measures of information used by traders are the volume and previous period prices (see Copeland (1976); Jennings et al. (1981); Clark (1973); and Epps and Epps (1976). Uninformed traders take high volumes and rising prices as signals of higher future stock prices. This asymmetry can result in profitable volume based manipulations. A number of stylised facts characterize the "pumping" and "dumping" of the manipulators. The manipulators, by buying stock at increasingly high prices, can send false signals regarding the future prices of the stocks. The uninformed traders, hoping for the future price increase, responds to this deceptive signal and tend to buy more stocks. This results in an upsurge of artificial demand and price. When manipulators realise that the stocks are already overvalued to make excessive profits, they decide to exit the market by selling the stock at much higher prices than the purchase price. Once manipulator exits, there is a sharp decrease in buying volume, causing the prices to plummet. This sends signals to the uninformed trader, who runs for cover, trying to salvage whatever little s/he can of her/his wealth. So, the volume-price relationship which is positive at pre and during the manipulation periods gets reverse at the post manipulation. The eventual decline in stock prices after the bubble burst (post manipulation) also benefits the manipulator. Manipulator now buys the stocks at much lower prices.

Another way the manipulator sends the deceptive news is "dumping". To burst the bubble with a view to buying at low prices in the future, manipulator dumps the stock by selling it at lower than fundamental/peak prices, causing fear and an eventual crash.

Based on the above discussion, we can develop several hypotheses related to trade-induced manipulations. First, at the start of the manipulation period, there is a sharp increase in the buying volume, which causes the price to increase. This motivates the following hypothesis:

H2: Trading volume increases significantly during the manipulation period.

Second, if there exists an information asymmetry amongst uninformed traders, then an increase in the buying volume of the manipulator would be accompanied by an increase in the price. This implies that a positive volume-price relationship exists before the price crashes. This stylized fact motivates the following hypothesis:

H3: A positive volume-price relationship exists before the crash.

Third, after the manipulator has sold most of its share of the stock, the total volume should decrease slightly during the last phase of the crisis, and considerably in the post manipulation period, as the period of artificially inflated volume comes to an end. This stylized fact leads to following hypothesis:

H4: The trading volume declines during the post manipulation period.

Finally, in the last phase of the manipulation period, when the manipulative bubble bursts, there is an excessive selling of the stock, which causes the prices to decline. This implies that a strong negative price-volume relationship exists in the last phases of the crisis. This motivates the following hypothesis:

H5: At the end of the manipulation period, a negative price-volume relationship exists.

To test the aforementioned hypotheses, we choose three South-Asian markets and select the periods of manipulation using evidence from legal cases. In the next section, we discuss the background of the South-Asian markets, as well as the selected examples of manipulations in the markets.

3. Market Background and Manipulation Cases in South-Asian Markets

This section provides a brief market background, followed by a discussion of some manipulative practices in the South-Asian markets of Bangladesh, Pakistan and India.

3.1 Bangladesh

Stock trading in Bangladesh started in 1956. However, its major stock exchange, the Dhaka Stock Exchange (DSE), was not registered as a Public Limited Company until 1969. The Chittagong Stock Exchange (CSE), the country's second largest stock exchange, began its journey on 10th October, 1995. The Bangladeshi market is speculative in nature. The market participants in the 1990s had very little knowledge about stock markets. Being motivated by rumours, most players withdrew money from other investments and banks in order to invest in the share markets. Even Bangladeshi residents who were working in the Middle East and other countries fuelled the market with their remittances. During the 1990s, the players traded on noise, not on fundamentals. As a consequence, speculators had opportunities to manipulate the prices and gain abnormal returns. The market experienced its first (manipulation-led) bubble, followed by an immediate burst, in 1996, as can be seen from panel (a) of Figure 1.

<<<<< Figure 1 approximately here >>>>>

This major market crash occurred in December 1996. One of the reasons for the crash was the large scale repatriation of foreign investments, which inflated the market. According to statistics released by the Bangladesh Bank (Central Bank of Bangladesh), during the period 1992–95, the purchase of shares by foreign investors exceeded the amount of shares sold. The statistics also indicate that there was a massive outflow of foreign investment during the period 1996–97 (more than BD Taka 6 billion a year), compared to Taka 0.6 billion of investments by foreign investors during the corresponding period, which caused the market to crash. The Securities and Exchange Commission (SEC) investigated the crash, as it suspected that brokerage houses (both domestic and foreign) and individual investors had deliberately manipulated the market.[5] On 2nd April, 1997, the Bangladeshi court ordered the arrest of thirty-six brokers, dealers and company executives, for causing the market crash of December 1996.[6]

Evidence of pumping and dumping by stock brokers in the shares of DSE was also found in March 2005.[7] This caused the index to decline by 23% in a matter of few days. Both of these manipulations are analysed in Section 7.

3.2 Pakistan

Pakistan's stock market has been in existence since 1947, when the country's first exchange, the Karachi Stock Exchange (KSE), was established. The other stock exchanges in Pakistan, namely the Lahore Stock Exchange (LSE) and the Islamabad Stock Exchange (ISE), were established in 1974 and 1997, respectively. The KSE accounts for approximately 85% of the turnover, followed by LSE (14%) and ISE (1%).

Like other emerging markets, the KSE is also characterized by speculative and manipulative bubbles. Due to manipulation by stock brokers, the KSE market price index fell by around 19% in the month of May (2000) alone[8] (see panel (e) of Figure 2). Similar acts of manipulation by stock brokers were observed in March 2005, when the index fell by around 25% (see panel (f) of Figure 2). It took several months to recover and to regain the confidence of the stock investors after the March crash. The crashes of May 2000 and March 2005 have both been the subject of criminal enquiry, and both are analysed in Section 7.

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3.3 India

India's equity market is the largest in the South Asian region in terms of market capitalization. The history of her equity trading dates back to the late 1800s, when the Native Share and Stock Broker's Association was formed. There are currently twenty-two stock exchanges in India. The Mumbai (Bombay) Stock Exchange is the oldest in Asia; it was

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[5] See *Financial Times*, April 23, 1999.
[6] See *Reuters*, April 3, 1997.
[7] *United News of Bangladesh*, April 18 and May 5, 2005.
[8] *Business Recorder*, June 24, 2007

established in 1875. The Bombay Stock Exchange Limited (BSE) was formed under the Securities Contract Regulation Act 1956. Our focus is on the BSE, as it represents the total securities trading in India. A number of manipulative crises have taken place in India, including the notorious 1992 crash. However, the focus of this study is on the manipulation of 2001, when the actions of certain stock brokers caused the market to decline by 21% in March alone (see panel (e) of Figure 3).

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4. Data

The study uses the closing price indices of three South-Asian stock exchanges: Bombay Stock Exchange (BSE, India), Dhaka Stock Exchange (DSE, Bangladesh) and Karachi Stock Exchange (KSE, Pakistan). The daily data cover the period from January 1990 to September 2010, giving a total of 5000 observations. Different sub-samples are analysed for the different examples of manipulations discussed in Section 3. For the examination of the price-volume relationship, daily trading volume data are also collected. The return series are constructed as the log first difference of the indices. All data are collected from DataStream. Note that the volume data for all three markets are also found to be stationary in levels. The results for the volume stationarity tests are not reported, but can be obtained from authors on request. The unit root test results for the return series are presented in the next section.

5. Methodologies for Testing Market Efficiency

In this section, we explain the methodologies which are used for investigating the random walk version of weak-form efficiency and mean-reversion in the South-Asian stock markets. As noted, three types of tests are employed to provide conclusive evidence of market inefficiency (or non-randomness) in our South-Asian markets. However, only variance ratio and the modified GPH tests are explained below.

5.1 Variance-ratio tests

According to Lo and MacKinlay (1988), if y_t is a time series with a sample of size T, the variance-ratio for testing the hypothesis that y_t is *iid* or that it is an *mds* is defined as:

$$\text{Variance-ratio} = \left\{ \frac{1}{Tk} \sum_{t=k+1}^{T} (y_t + y_{t-1} \ldots + y_{t-k} - k\hat{\mu})^2 \right\} \div \left\{ \frac{1}{T} \sum_{t=1}^{T} y_t - \hat{\mu})^2 \right\} \tag{1}$$

where $\hat{\mu} = T^{-1} \sum_{t=1}^{T} y_t$. The numerator of the variance-ratio is $1/k$ times the variance of y_t, after aggregation by a factor of k. This statistic should be close to 1 if y_t is *iid*, but not if it is serially correlated. Lo and MacKinlay (1988) show that if y_t is *iid*, then $T^{1/2}(VR-1) \rightarrow_d N\left(0, \frac{2(2k-1)(k-1)}{3k}\right)$. Two tests (see equations 2 and 3) are then proposed by Lo and MacKinlay (1988).

$$M_1 = (VR-1)\left(\frac{2(2k-1)(k-1)}{3kT}\right)^{-1/2} \tag{2}$$

$$M_2 = (VR-1)\left(\sum_{j=1}^{k-1}\left[\frac{2(k-j)}{k}\right]^2 \delta_j\right)^{-1/2} \quad (3)$$

where $\delta_j = \left\{\sum_{t=j+1}^{T}(y_t-\hat{\mu})^2(y_{t-j}-\hat{\mu})^2\right\} \div \left\{\left[\sum_{t=1}^{T} y_t - \hat{\mu})^2\right]^2\right\}$. M_1 is asymptotically standard normal under the *iid* null (homoscedasticity), while M_2 is a robust test statistic which accounts for conditional heteroscedasticity.

Wright (2000) proposes ranks (R_1 and R_2) and signs (S_1 and S_2)[9] as alternatives to M_1 and M_2, and argues that the new tests are capable of decisively rejecting the martingale model of stock returns for which the M_1 and M_2 tests give ambiguous results. Wright (2000) proposes the following tests:

$$R_1 = \left(\frac{\frac{1}{Tk}\sum_{t=k+1}^{T}(r_{1t}+r_{1t-1}\cdots+r_{1t-k})^2}{\frac{1}{T}\sum_{t=1}^{T} r_{1t}^2} - 1\right) \times \left(\frac{2(2k-1)(k-1)}{3kT}\right)^{-1/2} \quad (4)$$

$$R_2 = \left(\frac{\frac{1}{Tk}\sum_{t=k+1}^{T}(r_{2t}+r_{2t-1}\cdots+r_{2t-k})^2}{\frac{1}{T}\sum_{t=1}^{T} r_{2t}^2} - 1\right) \times \left(\frac{2(2k-1)(k-1)}{3kT}\right)^{-1/2} \quad (5)$$

$$S_1 = \left(\frac{\frac{1}{Tk}\sum_{t=k+1}^{T}(s_t+s_{t-1}\cdots+s_{t-k})^2}{\frac{1}{T}\sum_{t=1}^{T} s_t^2} - 1\right) \times \left(\frac{2(2k-1)(k-1)}{3kT}\right)^{-1/2} \quad (6)$$

where $r_{1t} = r(y_t) - \frac{T+1}{2} \Big/ \sqrt{\frac{(T-1)(T+1)}{12}}$ and $r_{2t} = \Phi^{-1}\left(r(y_t)/(T+1)\right)$. Φ is the standard normal cumulative distribution function. $\{s_t\}_{t=1}^{T}$ is an *iid*/*mds* sequence, each element of which is 1 with probability 0.5 and –1 otherwise.

Since the critical values for Wright (2000) tests are not readily available, we obtain the critical values for R_1, R_2 and S_1 by simulating their exact sampling distributions. Table 1 shows the critical values for the R_1, R_2 and S_1 test statistics associated with each sample size (T = 1500, T = 2500 and T = 4000) and holding period.

Considering the sample size, the variance-ratio tests are examined for several values of k. The random walk or martingale hypothesis can be rejected strongly when the test statistics are rejected for all k. However, recent studies suggest that one can also reject the hypothesis if there are more than two rejections (see for instance Azad (2009a).

<<<<< Table 1 approximately here >>>>>

[9] The sign based test S_2 is not considered because, in a Monte Carlo simulation, Wright (2000) found that the size and power properties of S_2 are inferior to those of S_1.

5.2 Modified GPH test

The Geweke and Porter-Hudak (1983) (hereafter, GPH) test examines the fractional integration or long-memory in the series, as well as the mean reversion. However, instead of using the tradition GPH test, we use its modified version, as it has better power properties. This test has not been used in the literature previously to examine the market efficiency of South-Asian stock markets. The tests of fractional integration supplement the results of the unit root tests and the variance ratio tests, and are applied in order to avoid the stringent $I(1)$ of the standard integration/cointegration tests. With regard to this, Cheung and Lai (1993) argue that, analytically, the strict $I(1)$ or $I(0)$ distinction is arbitrary. However, the analysis of fractional integration allows the equilibrium error to follow a fractionally integrated process. Another feature of the fractional integration test is that it tells us about the persistence properties of the data.

Recently, Andrews and Guggenberger (2003) modified the GPH test and proposed a simple bias-reduced log-periodogram regression estimator, $\hat{d}_r$, of the long-memory parameter *d*, which eliminates the first- and higher-order biases of the GPH estimator. Hypothesis testing regarding *d* can be conducted by means of the *t*-statistic of the regression coefficients. Table 2 shows the different hypothesis tests under Andrews and Guggenberger (2003) modified GPH test.

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6. Empirical Results and Discussion on Market Efficiency

6.1 Results from the variance-ratio tests

Table 4 shows the test statistics for daily stock returns for four South Asian stock markets. While M_1 and M_2 are the variance-ratio test statistics of Lo and MacKinlay (1988), R_1, R_2 and S_1 are the variance-ratio test statistics of Wright (2000). The critical values assume that the test is conducted for a single value of *k*. Wright (2000) mentions that "if the test is conducted for several values of *k*, the probability of rejecting the null for some value of *k* is greater than the size of the test, even asymptotically" (p. 8).

<<<<< Table 3 approximately here >>>>>

Under the conditions of homoscedasticity and heteroskedasticity, the results from the variance-ratio tests of Lo and MacKinlay (1988) are mixed. The L-M tests fail to reject the *iid/mds* null hypothesis for the DSE for some values of *k* (k = 2 and k = 30), but not all. However, Wright's (2000) tests give fairly consistent results in terms of *iid/mds* null violations for all stock exchanges except for the BSE. For the BSE, Wright's (2000) tests give mixed results, rejecting the *iid/mds* null strongly for $k < 30$. Excluding the DSE and BSE, Wright's tests reject the *iid/mds*. Almost all of the existing literature on VR tests, including the studies by Wright (2000) provides the same inferences from the tests, rejecting the *iid/mds* null for some values of *k* but not all.

6.3 Results from the fractional integration tests

Table 4 shows the Andrews and Guggenberger (2003) or modified GPH test results. The test statistics with $r = 0$ are the GPH estimate of the long-term memory parameter (*d*), and the test statistics with r > 0 are the Andrews and Guggenberger (2003) estimates of the long-term memory parameter (*d*). The results do not alter the inferences from the choice of *r*. The fractional integration/long-term memory parameter for the Andrews and Guggenberger

(2003) test changes between – .23449 (for DSE at $r = 0$) and 0.43790 (for KSE at $r = 2$). We find sufficient evidence that the South Asian stock markets are stable (stationary) and that the shock period is finite (returnable in the average of series). The results from the fractional integration support the inferences from those of the unit root tests. Hence, these series are characterized by stationary processes (both mean-reverting and covariance stationary) and are fractionally integrated.

<<<<< Table 4 approximately here >>>>>

The *p*-value for $r = –0.23449$ indicates that we can significantly reject the null hypothesis that $r = 0$ at the 0.05 significance level. Therefore, the short-run deviations are mean-reverting and follow a stationary process in the long run.

Table 5 summarizes the results from the different types of tests which are performed. The results are robust for all tests performed. The South Asian stock markets neither follow the random walk nor show sufficient evidence of market efficiency. All of these markets are mean-reverting, and investors can forecast the returns from these markets. The evidence shown here regarding the inefficiency of the South-Asian markets matches the anecdotal and empirical evidence regarding the existence of market manipulations in these markets.

<<<<< Table 6 approximately here >>>>>

7. Manipulations and the Price-Volume Relationship

This section discusses the methodology and the results of hypotheses H2 to H5, which were developed to test the nature of the price and volume during periods of market manipulation. Following Aggarwal and Wu (2006), equation (7) below estimates how the volume changes before, during and after the manipulation period. The pre-manipulation period is used as the base case, while dummy variables are included for the manipulation and post-manipulation periods.

$$V_t = a_0 + \sum_{i=1}^{n} a_{1i} SM_{i,t} + \sum_{i=1}^{n} a_{2i} C_{i,t} + a_3 PM_{i,t} + e_t \qquad (7)$$

where V_t is the volume on day t. $SM_{i,t}$ stands for dummies capturing the start of the manipulation period, $C_{i,t}$ represents the crash period dummies and $PM_{i,t}$ indicates the post-manipulation period dummies. A positive (and significant) coefficient of dummy variables $SM_{i,t}$ that capture the start of the manipulation period would support hypothesis H2. This would suggest that there was a significant increase in volume during the manipulation period. A relatively small or statistically insignificant coefficient for the dummy variables ($C_{i,t}$) that capture the crash period and the post-manipulation period ($PM_{i,t}$) would answer hypothesis H4 in the affirmative. This would in turn support the assertion that the volume fell in the post-manipulative period when the manipulators exited the market.

Following Lee and Rui (2002), equation (8) is set up to determine the relationship between the price and volume during the manipulation period. However, we expand Lee and Rui (2002) equation by including slope dummies in order to capture the effect of manipulation. The slope dummy is calculated by multiplying the volume by the time-period dummy. This enables the testing of hypotheses H3 and H5.

$$R_t = b_0 + b_1 \mathrm{V_t} + b_2 \mathrm{V_{t-1}} + b_3 \mathrm{R_{t-1}} + \sum_{i=1}^{n} b_{4i} SLOPE_{it} + e_t \qquad (8)$$

where, R_t is the return on day t. The lagged volume ($\mathrm{V_{t-1}}$) and lagged returns ($\mathrm{R_{t-1}}$) are included following Lee and Rui (2002). The pre-manipulation period is used as the base case in equation (8), while the slope dummies capture the effect of the manipulation and post-manipulation periods on the price-volume relationship. If the slope dummy capturing the start of the manipulation is positive and significant, this confirms hypothesis H3, suggesting that the increase in volume was accompanied by an increase in price. If the slope dummy which captures the crash period is significant and negative, this supports hypothesis H5. That is, excessive selling at the end of the manipulation period caused the prices to crash.

7.1 Results and Analysis of Manipulation Cases

This section presents the results associated with the four hypotheses established in Section 2. We begin by reporting the results for Bangladesh and Pakistan, as there are some similarities in manipulation periods between the two countries. After this, the results for the Indian manipulation period are presented.

7.1.1 Manipulation in Bangladesh

While the Bangladeshi stock market experienced several manipulations, we only consider two periods: one occurred in the 1996–97 financial year and the other one in 2005. Table 6 shows the results estimated from the equation (7) for Bangladesh for the period 1996–1997. The table shows that the monthly dummies capturing the period preceding the December crash are statistically significant and have high coefficients. This supports hypothesis H2 that the trading volume experienced a significant increase before the crash and during the start of the manipulation period. These months, from August to November, mark the start of the manipulation period. The coefficient value for the December dummy shows that there was a significant decrease in trading during the crash month. Moreover, comparing the coefficients of the JAN (standing for January), FEB (standing for February), MAR (standing for March) and post-manipulation dummies with the manipulation period suggests that there was a significant decline in the trading volume in the post-crisis period. This supports hypothesis H4.

<<<<< Table 6 approximately here >>>>>

The results in Table 7 show that the October slope dummy and the first half (first two weeks) of the November dummy are statistically significant with a very high slope coefficient, showing that the increase in volume in these months was accompanied by a significant large increase in price. This supports hypothesis H3, suggesting that the high volume at the start of the manipulation period is accompanied by a large increase in price. The coefficients for the second half of November, December and January are statistically significant and negative, showing that the increase in volume was accompanied by negative returns (falling prices). The size of the coefficient for December is quite large, reflecting the severity of the crisis. The negative results support hypothesis H5, suggesting that the large volume of sales at increasingly low prices caused the market to crash. The positive result for the February and March slope dummies suggests that the market became normal again in the post-crisis period. The coefficient of the volume variable (V_t) is found to be insignificant. This shows that there is no relationship between volume and price for the period between 1995 and 1999 which is not captured by the dummy variables in the equation. One reason for this odd result could be that sub-periods of positive and negative relationships cancelled each other out.

<<<<< Table 7 approximately here >>>>>

We now report the March 2005 crisis in Bangladesh. The results in Table 8 suggest that the start of the manipulation period is not very obvious in this crisis, as there is no large increase in volume in February, the month before the crisis. To reflect the crisis week, the March dummy is divided into three variables, with MAR1&2_05 capturing the first two weeks of March, MAR3_05 capturing the third week and MAR4_05 capturing the fourth week. The results suggest that there is an increase in volume in the first two weeks, followed by an even larger increase in week three. These three weeks before the crisis week can be viewed as the start of the manipulation period. These results also support hypothesis H2 that there was a sharp increase in volume before the crisis. In week 4, when the crisis happened, the volume was still high, but was down to almost half that of week 3. Moreover, in the following months of April, May and June, and in the six months of the post-manipulation period, the volume decreased considerably, thus supporting hypothesis H4 that the volume decreases in the post-crisis period. As explained before, the negative relationship during the post-manipulation period is due to higher trading volume as the investors aggressively seek to salvage whatever left from the sale of stocks they hold.

<<<<< Table 8 approximately here >>>>>

As Table 9 shows, the results support the assertion made above, namely that the manipulation period starts in the first two weeks of March (2005), as the coefficients for the volume-price relationship are statistically insignificant for the months preceding March. The coefficient for the first two weeks of March is very large and statistically significant, supporting hypothesis H3 that high volume is accompanied by increasing prices at the start of the crisis. The negative sign in week 3 suggests that the crisis might have started to unfold in week 3, but the result cannot be relied on, as the coefficient is not statistically significant. The large negative statistically significant coefficient in week 4 (the crash week), however, supports hypothesis H5 that during the crash, increasing selling would have caused the prices to fall.

<<<<< Table 9 approximately here >>>>>

7.1.2 Manipulation in Pakistan

We begin by reporting the results of the May (2000) manipulation in Tables 10 and 11. The results in Table 10 support hypotheses H2 and H4. They also suggest that the manipulation period started in around January, as all of the months between January and May (2000) experienced large increases in volume, while the post-manipulation periods registered declines in volume. The results in Table 11, however, do not offer convincing support for hypothesis H3, since the variables capturing the period January to April are statistically insignificant. Nevertheless, the coefficients of the dummy variables from January to March have the expected positive sign. The statistically insignificant results could be due to excessive volatility in this period which is not accounted for by the OLS. The coefficient for the crash month of May has the expected negative sign and is statistically significant, proving hypothesis H5, that an increase in selling during the crash period was accompanied by lower prices. The positive and significant coefficient on the volume variable (V_t) also suggests that a positive volume-price relationship exists in the base case.

<<<<< Tables 10 and 11 approximately here >>>>>

The results in Tables 12 and 13 support hypotheses H2 to H5. In some respects, this crisis was very similar to the Bangladesh March 2005 crisis. The manipulation period before the crash started in February and escalated in the first two weeks of March (as captured by the MAR1 dummy in Table 12). The significant high volume accompanied by a positive price-volume relationship supports hypotheses H2 and H3. The decline in volume in the second week of March (as captured by the MAR2 dummy in Table 12), April and the post-manipulation period, along with the negative price-volume relationship, supports hypotheses H4 and H5. The positive and significant coefficient on the volume variable (V_t) also suggests that a positive volume-price relationship exists in the base case.

<<<<< Tables 12 and 13 approximately here >>>>>

7.1.3 Manipulation in India

The results in Tables 14 and 15 support hypotheses H2 to H5 in the Bombay (Mumbai) Stock Exchange. The results suggest that the manipulation period started in January and escalated in the first ten days of February (Table 14). During this period, the market experienced a large increase in trading volume. This was also accompanied by a positive change in prices, reflected in the positive and statistically significant coefficients of the price-volume regression for January and the first ten days of February (Table 15). Signs of dumping began in the second ten days of February, and escalated in March. During this period, the price-volume relationship was negative. As expected, the results show that the volume declined in the crisis month of March and the post-manipulation period. The coefficient for the volume variable (V_t) suggests that no price-volume relationship exists in the base case.

<<<<< Tables 14 and 15 approximately here >>>>>

8. Conclusion

Market manipulation practices have been a challenge to regulators and market practitioners for many years. This paper sheds light on the manipulative practices that have recently affected the efficiency of South-Asian stock markets. We investigated how unchecked manipulations could cause frequent trade-induced manipulations (for example, “pump and dump”), continuity of market inefficiency and backwardness of capital market development. When a market is inefficient, a trade-induced manipulation (pump and dump) could occur frequently and manipulators could generate excessive profits. Manipulators use the “pumping” to make profits in two ways: (1) at the start of the manipulation, when they pump the market by excessive buying to give deceptive signal to the market and (2) at the post manipulation, when they buy back the shares as the market/price is already at the lowest of the low. Similarly, they use the “dumping” scheme to make profits in the following ways. At the start of the manipulation, they “dump” the market by selling at low prices causing fear and rumours among the investors to sell and salvage from whatever they can. When they find the prices are already low enough to make profits, they start to buy back those shares leaving the general investors in the dark. Our empirical analysis which uses daily stock price and volume data from 1990 to 2010, finds that all these happened in the South Asian stock markets. Using results from different tests of market efficiency, we provided conclusive evidence, quite contrary to many other studies, that South-Asian markets are inefficient. Findings of our study not only removes the confusion that some previous studies had created by suggesting that South-Asian markets are efficient but also prove that these markets are inefficient. Moreover, by analysing different manipulative periods, this study provides evidence of trading-induced manipulation.

The paper finds a common pattern in the different manipulation episodes in the South-Asian markets. The start of the manipulation period coincides with excessive stock trade which creates an upward price trend. In the hope of making gains from the price increase the uninformed trader enters the market and reinforces the trend. This gives the manipulator the opportunity to gradually sell her/his stocks and exit the market. When there is not enough momentum left, the manipulator crashes the market by selling excessively. A plummeting price gives the manipulator the option to buy back her/his stocks and keep the original ownership undiluted. The whole exercise allows the informed trader having market power to make super normal profits without losing ownership of their stock portfolios. Given the small size of the South-Asian markets, these illicit practices are means to generate considerable gains by both big local and foreign market participants.

Thus, the study draws the regulators' attention to the need for appropriate reforms in order to prevent market manipulation in these markets. Such manipulations harm public confidence in capital markets and prevent their growth and development. Furthermore, the unchecked manipulations are found to encourage subsequent pumping and dumping of the markets, which discourage both domestic and foreign investments as well as encourage corruptions that could do more long-term harms to these emerging markets. These practices are extremely unethical as they result in unfair wealth redistribution from the uninformed trader to the informed manipulator. Exemplary punishments against the manipulators need to be implemented to protect small and weak players in the market. In the absence of these practices, the South-Asian markets would operate in an environment of fair exchange and experience higher efficiency.

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Figure 1: DSE Price-Return Index, Return Volatility, Volume and Manipulations

This figure has six panels. Panel (a) shows the DSE price index in Bangladeshi Taka. The return indices (expressed in logarithms) are shown in panel (b), and the volatility in panel (c). The DSE daily volume is displayed in panel (d), while panels (e) and (f) show the DSE indices during two selected periods of manipulation (1996 and 2005). In panel (f), 2005m2 and 2005m3 indicate February and March, respectively. The sample covers the period from January 1990 to September 2010.

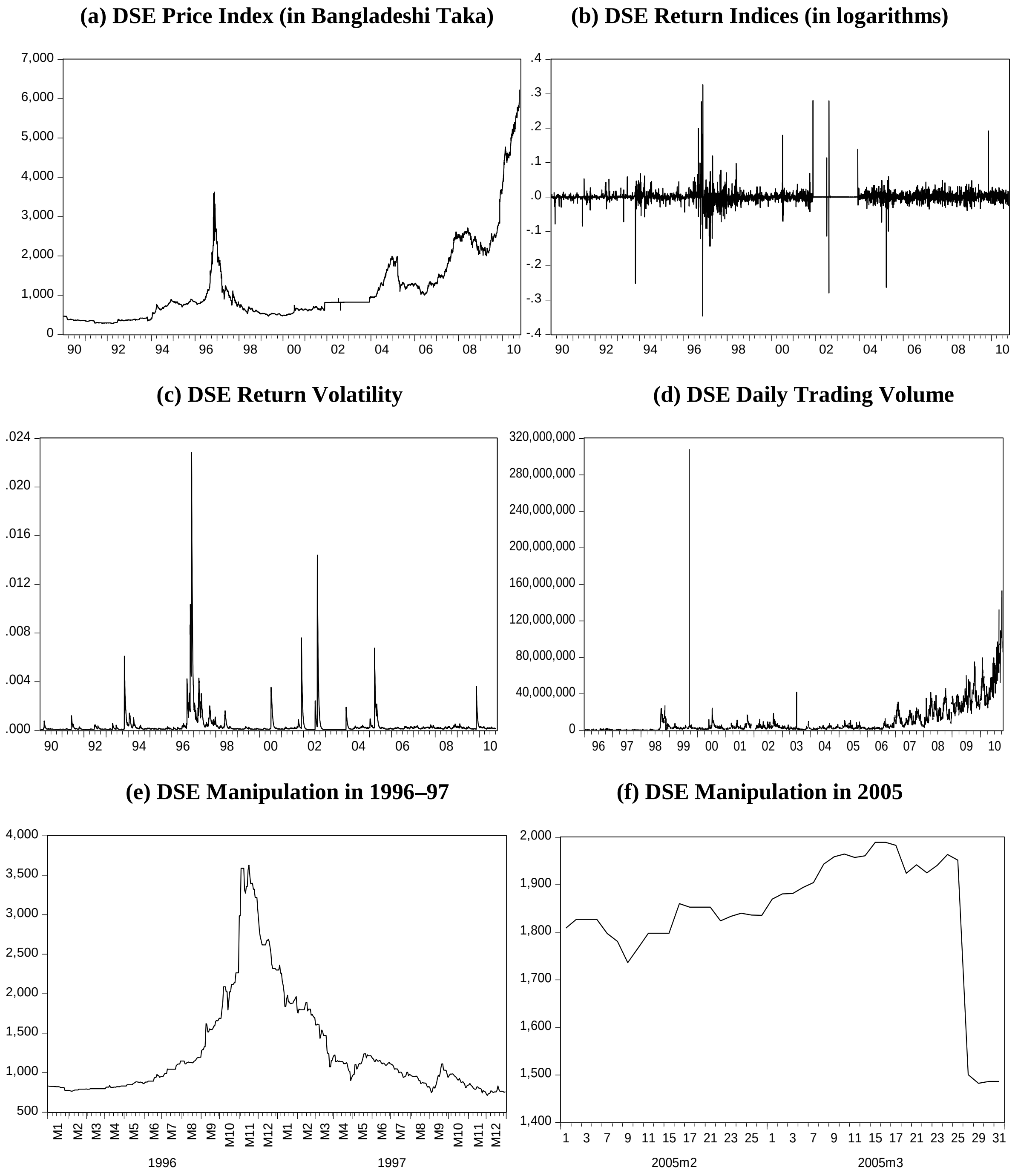
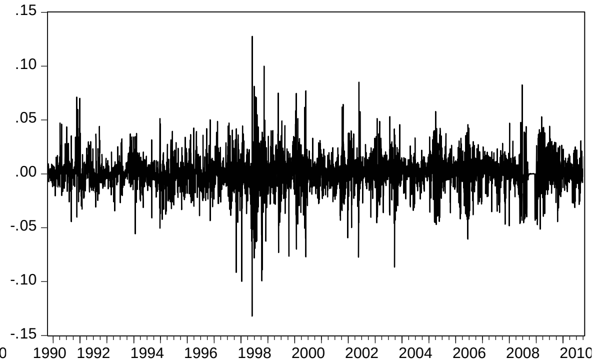


Figure 2: KSE Price-Return Index, Return Volatility, Volume and Manipulations

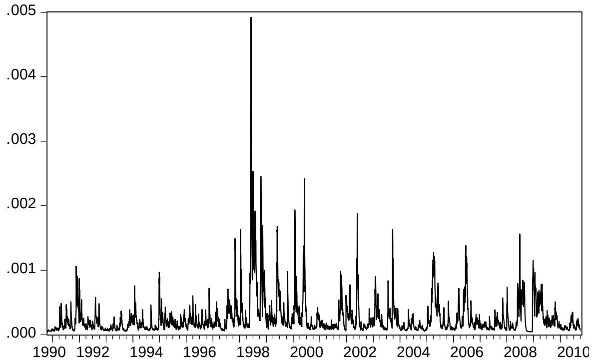
This figure has six panels. Panel (a) shows the KSE price index in Pakistani rupees. The return indices (expressed in logarithms) are shown in panel (b), and the volatility in panel (c). The KSE daily trading volume is displayed in panel (d), while panels (e) and (f) indicate the KSE indices during two periods of manipulation: 2000 and 2005, respectively. The sample covers the period from January 1990 to September 2010.

(a) KSE Price Index (in Pakistani Rupees)

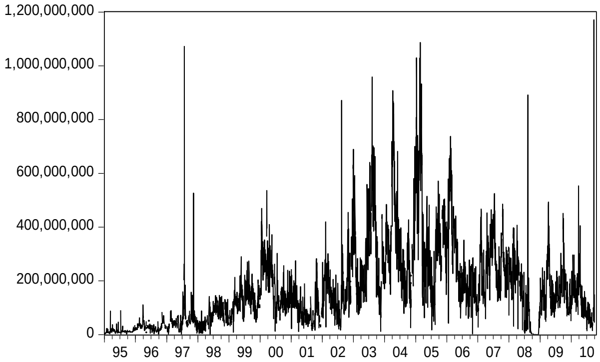
(b) KSE Return Indices (in logarithms)



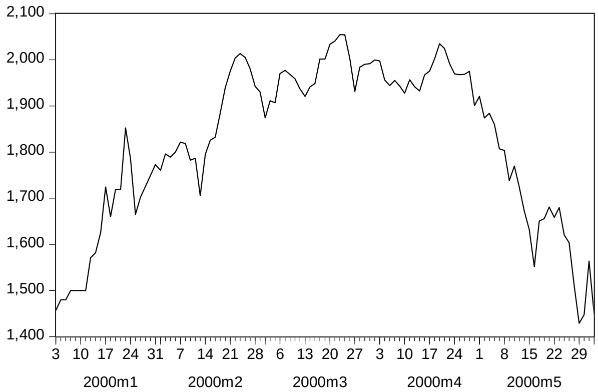
(c) KSE Return Volatility



(d) KSE Daily Trading Volume



(e) KSE Index in 2000 Manipulation



(f) KSE Index in 2005 Manipulation

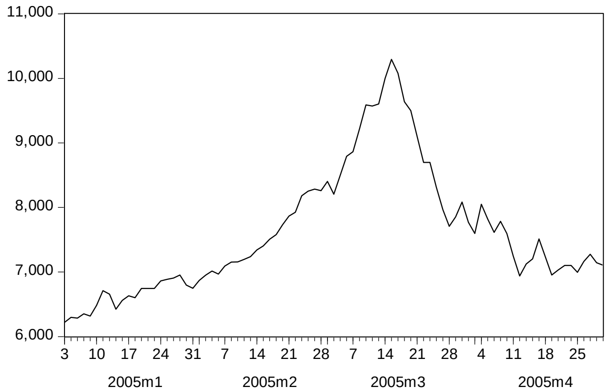
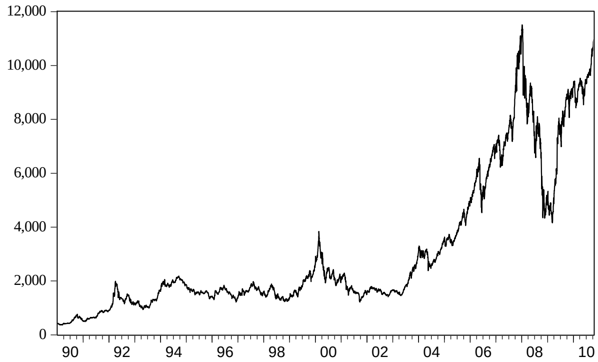


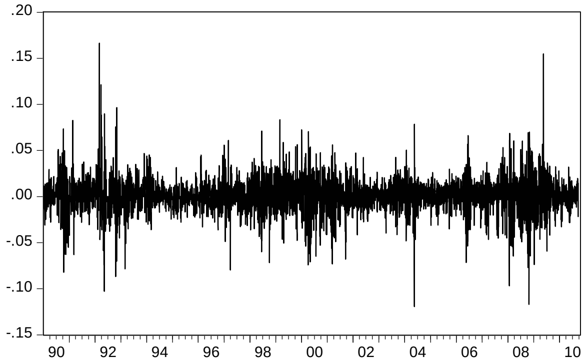
Figure 3: BSE Price-Return Index, Return Volatility, Volume and Manipulations

This figure has five panels. Panel (a) shows the BSE price index in Indian rupees. The return indices (expressed in logarithms) are shown in panel (b), and the volatility in panel (c). The BSE daily trading volume is shown in panel (d), while panel (e) shows the BSE index during the manipulation in 2001 (January–March). The sample covers the period from January 1990 to September 2010.

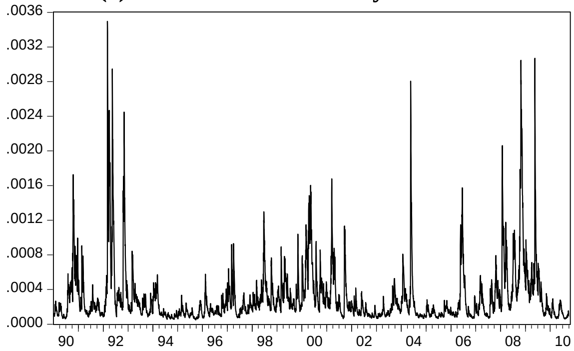
(a) BSE Price Index (in Indian Rupees)



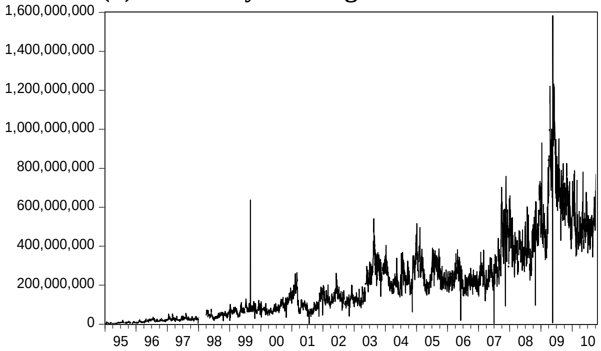
(b) BSE Return Indices (in logarithms)



(c) BSE Return Volatility



(d) BSE Daily Trading Volume



(e) BSE Index during 2001 Manipulation

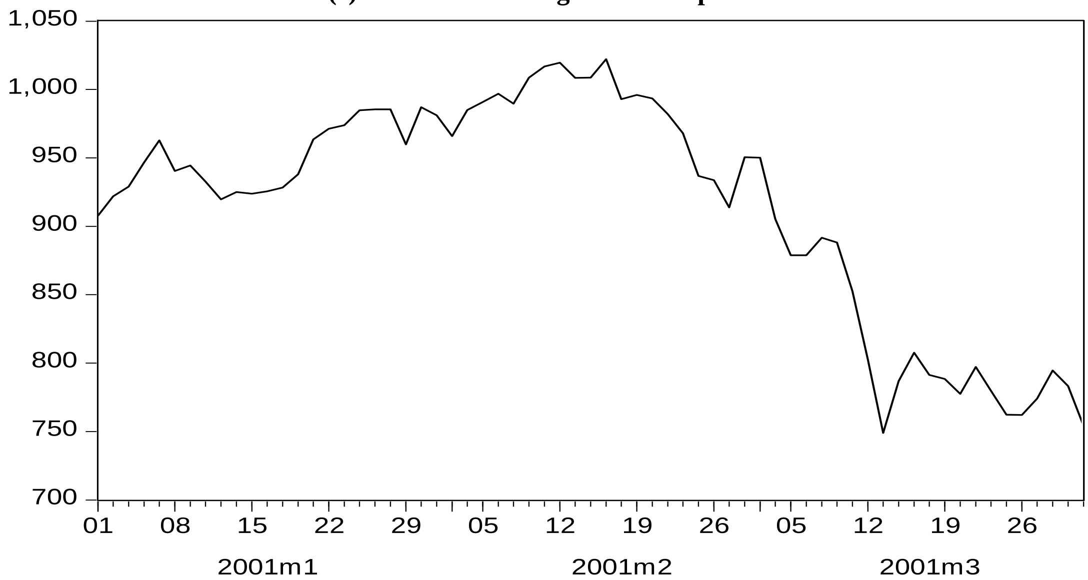


Table 1: Critical Values for Wright's (2000) *R_1*, *R_2* and *S_1* Tests

The critical values in this table are simulated with 10,000 replications in each case. For each entry, the numbers in columns 2 and 4 give the 2.5 percentiles of the distribution of the test statistics (for the specified values of *T* and *k*) and the numbers in columns 3 and 5 give the 97.5 percentiles of that distribution. Critical values for other percentiles of the distributions can be obtained from the authors on request.

k	*T* = 1500		*T* = 2500		*T* = 3000		*T* = 4000	
				R_1				
2	–2.025	1.945	–1.970	1.915	–1.973	1.964	–1.973	1.959
5	–1.970	1.933	–1.997	1.919	–1.971	1.971	–2.003	1.901
10	–1.990	1.914	–1.950	1.928	–1.948	1.957	–1.975	1.912
30	–1.957	1.805	–1.972	1.837	–1.974	1.967	–1.991	1.902
				R_2				
2	–1.997	1.917	–1.965	1.919	–1.985	1.971	–1.965	1.935
5	–1.993	1.912	–2.025	1.933	–1.933	1.973	–2.010	1.902
10	–1.997	1.911	–1.965	1.913	–1.922	1.944	–2.009	1.912
30	–1.952	1.787	–1.975	1.848	–1.968	1.972	–2.007	1.894
				S_1				
2	–2.014	1.911	–1.920	1.960	–1.920	1.960	–1.961	1.961
5	–1.914	1.933	–1.950	1.980	–1.950	1.980	–1.980	1.946
10	–1.915	1.982	–1.910	1.995	–1.910	1.995	–1.928	1.943
30	–1.843	2.049	–1.876	1.999	–1.876	1.999	–1.943	1.950

Table 2: Hypothesis Testing Under the Fractional Integration Test

This table summarizes the different constraints and their implications for our hypothesis testing under the modified GPH test.

Constraints	Hypothesis
$d = 0$	A series (Y_t) is a standard mean-reverting ARMA process.
$d = 1$	It is a non-stationary process (non-mean-reverting).
$0 < d < 1$	The series is a fractionally integrated process, known as a long memory process.
$-0.5 < d < 0.5$	The series is both mean-reverting and covariance stationary (see also Hosking (1981).
$-0.5 < d < 0$	All of the autocorrelations are negative and tend hyperbolically towards zero. As a result, the process is considered to be anti-persistent or with intermediate memory.
$0 < d < 0.5$	All the autocorrelations are positive and decline hyperbolically. In this case, the process is considered to be persistent and has a long memory.
$0.5 < d < 1$	The process is still mean reverting, but not stationary, because its variance is not finite.

Table 3: The Variance-Ratio Test Statistics for Daily Stock Returns

The study covers the daily data from January 1990 to September 2010. ** and * indicate that the rejections are significant at the 1% and 5% levels, respectively.

k	*R1*	*R2*	*S1*
2	6.20**	5.15**	6.20**
5	8.02**	7.25**	7.86**
10	8.00**	6.88 **	8.09**
30	6.44**	5.21**	7.28**
2	4.80**	3.64 **	5.56**
5	4.04**	3.07**	4.24**
10	3.12**	2.58**	3.27**

30	1.81	1.17	2.02*
2	3.05**	2.33**	3.08**
5	3.90**	3.57**	3.55**
10	4.99**	4.68**	4.48**
30	4.58**	3.82**	5.28**

Table 4: Fractional Integration Parameters (d) With AG (*r* = 0, 1, 2)

The table shows the modified GPH test statistics with regression coordinates = 43; the asymptotic standard error (ε_t) for r = 0 is 0.113; for r = 1 is 0.188, and for r = 2 is 0.256; *t*-statistics are in parentheses; and * and ** indicate significance at the 10% and 5% levels, respectively.

Markets	AG test statistics (*r* = 0)	AG test statistics (*r* = 1)	AG test statistics (*r* = 2)	Decision
BSE	–0.0146 (*–0.1289*)	0.2082 (*1.1076*)	0.0224 (*0.0875*)	Mean-reverting
DSE	–0.2345** (*–2.0751*)	–0.0984 (*–0.5235*)	0.1071 (*0.4184*)	Mean-reverting
KSE	0.1147 (*1.0152*)	0.2599 (*1.3826*)	0.4379* (*1.7105*)	Mean-reverting

Table 5: Summary of Random Walk and Mean Reversion Inferences

Note: Evidence of mean reversion ('yes' in column 6) indicates that the market does not follow a random walk.

Markets	Variance-ratio tests (H_0: series is iid/mds)	Fractional integration (H_0: series is mean reverting)	Decision: Do the markets follow RWH?
Bangladesh	No	Yes	No
India	No	Yes	No
Pakistan	No	Yes	No

Table 6: Trading-induced Manipulations in Bangladesh (1996-97)

Results from the following OLS regression model (expanded from equation 7):

$$V_t = a_0 + a_1\mathrm{JUN}_{96} + a_2\mathrm{JUL}_{96} + a_3\mathrm{AUG}_{96} + a_4\mathrm{SEP}_{96} + a_5\mathrm{OCT}_{96} + a_6\mathrm{NOV}_{96} + a_7\mathrm{DEC}_{96} + a_8\mathrm{JAN}_{97} + a_9\mathrm{FEB}_{97} + a_{10}\mathrm{MAR}_{97} + a_{11}\mathrm{POSTM}_{1997} + e_t$$

where, the dependent variable V_t is the volume on day t. Month dummies are taken to capture the manipulations. Standard errors of the estimated coefficients are corrected for autocorrelation and heteroskedasticity by using the Newey-West method (with lag truncation = 5). Sample covers the period from July 1995 to December 1997 (observations: 455).

	Variable	Coefficient	Std. Error	t-Statistic	Prob.
a_0	Constant	185657.2	14580.09	12.73361	<0.0001
a_1	JUN_96	8518.714	25231.14	0.337627	0.7358
a_2	JUL_96	252500.8	65310.2	3.866177	0.0001
a_3	AUG_96	392040.1	43913.88	8.927476	<0.0001
a_4	SEP_96	648439.9	50674.44	12.79619	<0.0001
a_5	OCT_96	576609.4	85091.77	6.776323	<0.0001
a_6	NOV_96	373966.2	131626.1	2.841126	0.0047
a_7	DEC_96	-78052.7	32312.7	-2.41554	0.0161
a_8	JAN_97	27655.51	29983.18	0.922367	0.3568
a_9	FEB_97	135151.5	32260.19	4.18942	<0.0001

a_{10}	MAR_97	138392.6	50125.34	2.76093	0.006
a_{11}	POSTM_1997	186417.3	30014.85	6.210834	<0.0001
Adjusted R^2	0.5389				
F-Stat	49.2272				<0.0001

Table 7: Manipulations and Price-Volume Relationship: Bangladesh (1996-97)

Results from the following OLS regression model (expanded from equation 8):

$$R_t = b_0 + b_1 \mathrm{V_t} + b_2 \mathrm{V_{t-1}} + b_3 \mathrm{R_{t-1}} + b_4 \mathrm{SLOPE_{AUG96}} + b_5 \mathrm{SLOPE_{SEP96}} + b_6 \mathrm{SLOPE_{OCT96}} + b_7 \mathrm{SLOPE_{NOV1_{96}}} + b_8 \mathrm{SLOPE_{NOV2_{96}}} + b_9 \mathrm{SLOPE_{DEC96}} + b_{10} \mathrm{SLOPE_{JBN97}} + b_{11} \mathrm{SLOPE_{FEB97}} + b_{12} \mathrm{SLOPE_{MAR97}} + e_t$$

where, R_t is the return on day t and V_t is the volume on day t. The lagged volume and lagged returns are included following Lee and Rui (2002). Standard errors of the estimated coefficients are corrected for autocorrelation and heteroskedasticity by using the Newey-West method (lag truncation = 6). The sample covers the period from 7/04/1995 to 12/31/1999 with 740 daily observations.

	Variables	Coefficient	Std. Error	t-Statistic	Prob.
b_0	Constant	-0.00111	0.00087	-1.27803	0.2016
b_1	Volume	9.92E-11	1.09E-10	0.910433	0.3629
b_2	Volume (-1)	-1.40E-11	6.92E-12	-2.01595	0.0442
b_3	Return (-1)	0.133361	0.048293	2.761516	0.0059
b_4	SLOPE_AUG96	7.64E-09	3.34E-09	2.285065	0.0226
b_{45}	SLOPE_SEP96	-1.06E-08	1.38E-08	-0.76506	0.4445
b_6	SLOPE_OCT96	5.61E-08	1.34E-08	4.193087	<0.0001
b_7	SLOPE_NOV1_96	1.38E-08	2.09E-09	6.613776	<0.0001
b_8	SLOPE_NOV2_96	-5.86E-08	1.34E-08	-4.38456	<0.0001
b_9	SLOPE_DEC96	-1.77E-07	6.32E-08	-2.79487	0.0053
b_{10}	SLOPE_JAN97	-5.98E-08	3.16E-08	-1.89128	0.059
b_{11}	SLOPE_FEB97	2.37E-08	9.79E-09	2.417564	0.0159
b_{12}	SLOPE_MAR97	3.29E-08	1.44E-08	2.28753	0.0225
Adjusted R^2	0.1124				
F-Stat	8.800				<0.0001

Table 8: Trading-induced Manipulations in Bangladesh (2005)

Results from the following OLS regression model (expanded from equation 7):

$$V_t = a_0 + a_1\mathrm{JUL}_{04} + a_2\mathrm{AUG}_{04} + a_3\mathrm{SEP}_{04} + a_4\mathrm{OCT}_{04} + a_5\mathrm{NOV}_{04} + a_6\mathrm{DEC}_{04} + a_7\mathrm{JAN}_{05} + a_8\mathrm{FEB}_{05} + a_9\mathrm{MAR1\&2}_{05} + a_{10}\mathrm{MAR3}_{05} + a_{11}\mathrm{MAR4}_{05} + a_{12}\mathrm{APR}_{05} + a_{13}\mathrm{MAY}_{05} + a_{14}\mathrm{JUN}_{05} + a_{15}\mathrm{POSTM}_{05} + e_t$$

where, the dependent variable V_t is the volume on day t. Month dummies are taken to capture the manipulations. Standard errors of the estimated coefficients are corrected for autocorrelation and heteroskedasticity by using the Newey-West method (lag truncation = 7). Sample covers the period from 1/01/2004 to 12/28/2006 with daily 683 observations.

	Variables	Coefficient	Std. Error	t-Statistic	Prob.
a_0	Constant	2013641.	201032.4	10.01650	<0.0001
a_1	JUL_04	-159948.0	242261.9	-0.660227	0.5095
a_2	AUG_04	1339004.	224561.4	5.962754	0.0000
a_3	SEP_04	2436881.	402651.1	6.052092	<0.0001
a_4	OCT_04	-27842.78	242505.7	-0.114813	0.9086
a_5	NOV_04	776162.0	530893.3	1.461993	0.1445
a_6	DEC_04	1839885.	444843.5	4.136029	<0.0001
a_7	JAN_05	540811.6	233097.3	2.320111	0.0208
a_8	FEB_05	1195902.	484076.4	2.470483	0.0139
a_9	MAR1&2_05	2863844.	809577.8	3.537454	0.0004
a_{10}	MAR3_05	4772608.	565093.0	8.445703	<0.0001
a_{11}	MAR4_05	2707354.	423099.2	6.398865	<0.0001
a_{12}	APR_05	2703728.	274452.7	9.851343	<0.0001
a_{13}	MAY_05	2194254.	466994.7	4.698670	<0.0001
a_{14}	JUN_05	1551721.	468384.7	3.312921	0.0010
a_{15}	POSTM_05	763963.4	297375.1	2.569023	0.0105
Adjusted R^2	0.3954				
F-stat	20.8368				<0.0001

Table 9: Manipulations and Price-Volume Relationship: Bangladesh (2005)

Results from the following OLS regression model (expanded from equation 8):

$$
\begin{aligned}
R_t = b_0 + b_1\mathrm{V_t} + b_2\mathrm{V_{t-1}} + b_3\mathrm{R_{t-1}} + b_4\mathrm{SLOPE_{AUG04}} + b_5\mathrm{SLOPE_{SEP04}} + b_6\mathrm{SLOPE_{OCT04}} + b_7\mathrm{SLOPE_{NOV04}} \\
+ b_8\mathrm{SLOPE_{DEC05}} + b_9\mathrm{SLOPE_{JAN05}} + b_{10}\mathrm{SLOPE_{FEB05}} + b_{11}\mathrm{SLOPE_{MAR1\&2\_05}} \\
+ b_{12}\mathrm{SLOPE_{MAR3\_05}} + b_{13}\mathrm{SLOPE_{MAR4\_05}} + b_{14}\mathrm{SLOPE_{APR05}} + b_{15}\mathrm{SLOPE_{MAY05}} \\
+ b_{16}\mathrm{SLOPE_{JUN05}} + e_t
\end{aligned}
$$

where, R_t is the return on day t and V_t is the volume on day t. The lagged volume and lagged returns are included following Lee and Rui (2002). Standard errors of the estimated coefficients are corrected for autocorrelation and heteroskedasticity by using the Newey-West method (lag truncation = 6). The sample covers the period from 6/01/2004 to 12/28/2006 with 740 daily observations.

	Variable	Coefficient	Std. Error	t-Statistic	Prob.
b_0	Constant	-0.0002	0.001189	-0.167937	0.8667
b_1	Volume	3.49E-10	4.75E-10	0.734845	0.4628
b_2	Volume (-1)	-6.99E-11	4.93E-10	-0.141646	0.8874
b_3	Return (-1)	-0.061	0.061824	-0.986636	0.3243
b_4	SLOPE_AUG04	1.54E-09	8.31E-10	1.84836	0.0651
b_5	SLOPE_SEP04	9.02E-10	6.82E-10	1.323824	0.1861
b_6	SLOPE_OCT04	7.54E-10	1.61E-09	0.468617	0.6395
b_7	SLOPE_NOV04	1.43E-09	1.40E-09	1.018338	0.309
b_8	SLOPE_DEC04	3.63E-10	4.35E-10	0.834932	0.4041
b_9	SLOPE_JAN05	-2.03E-09	2.27E-09	-0.89478	0.3713
b_{10}	SLOPE_FEB05	-1.41E-12	5.79E-10	-0.002434	0.9981
b_{11}	SLOPE_MAR1&2_05	1.08E-09	4.13E-10	2.60514	0.0094
b_{12}	SLOPE_MAR3_05	-5.97E-10	3.85E-10	-1.549139	0.122
b_{13}	SLOPE_MAR4_05	-1.28E-08	5.51E-09	-2.313981	0.0211
b_{14}	SLOPE_APR05	-1.97E-09	1.16E-09	-1.694713	0.0907
b_{15}	SLOPE_MAY05	1.56E-09	1.30E-09	1.194179	0.233
b_{16}	SLOPE_JUN05	8.71E-11	4.27E-10	0.203889	0.8385
Adjusted R^2	0.1157				
F-Stat	5.384501				<0.0001

Table 10: Trading-induced Manipulations in Pakistan (2000)

Results from the following OLS regression model (expanded from equation 7):

$$V_t = a_0 + a_1 \mathrm{DEC}_{1999} + a_2 \mathrm{JAN}_{2000} + a_3 \mathrm{FEB}_{2000} + a_4 \mathrm{FEB}_{2000} + a_5 \mathrm{MAR}_{2000} + a_6 \mathrm{APR}_{2000} + a_7 \mathrm{MAY}_{2000} + a_8 \mathrm{JUN}_{2000} + a_9 \mathrm{POSTM}_{2000} + e_t$$

where, the dependent variable V_t is the volume on day t. Month dummies are taken to capture the manipulations. Standard errors of the estimated coefficients are corrected for autocorrelation and heteroskedasticity by using the Newey-West method (lag truncation = 6). Sample covers the period from 1/04/1999 to 12/21/2000 with 488 daily observations.

	Variable	Coefficient	Std. Error	t-Statistic	Prob.
a_0	Constant	1.27E+08	6569081	19.26634	<0.0001
a_1	DEC_1999	8620019	10776897	0.799861	0.4242
a_2	JAN_2000	1.77E+08	41117458	4.30184	<0.0001
a_3	FEB_2000	1.36E+08	8480248	16.01246	<0.0001
a_4	MAR_2000	1.64E+08	20740068	7.911652	<0.0001
a_5	APR_2000	1.14E+08	18156548	6.297982	<0.0001
a_6	MAY_2000	1.20E+08	13355312	9.019866	<0.0001
a_7	JUN_2000	11383725	19514293	0.583353	0.5599
a_8	POSTM_2000	-488025	9207576	-0.053	0.9578
Adjusted R^2	0.5356				
F-Stat	71.211				<0.0001

Table 11: Manipulations and Price-Volume Relationship: Pakistan (2000)

Results from the following OLS regression model (expanded from equation 8):

$$R_t = b_0 + b_1 \mathrm{V_t} + b_2 \mathrm{V_{t-1}} + b_3 \mathrm{R_{t-1}} + b_4 \mathrm{SLOPE_{NOV1999}} + b_5 \mathrm{SLOPE_{DEC1999}} + b_6 \mathrm{SLOPE_{JAN2000}} + b_7 \mathrm{SLOPE_{FEB2000}} + b_8 \mathrm{SLOPE_{MAR2000}} + b_9 \mathrm{SLOPE_{JAPR2000}} + b_{10} \mathrm{SLOPE_{MAY2000}} + b_{11} \mathrm{SLOPE_{JUN2000}} + e_t$$

where, R_t is the return on day t and V_t is the volume on day t. The lagged volume and lagged returns are included following Lee and Rui (2002). Standard errors of the estimated coefficients are corrected for autocorrelation and heteroskedasticity by using the Newey-West method (lag truncation = 9). The sample covers the period from 10/23/1990 to 1/01/2002 with 2432 daily observations.

	Variable	Coefficient	Std. Error	t-Statistic	Prob.
b_0	Constant	0.000154	0.000442	0.349214	0.727
b_1	Volume	2.82E-11	1.60E-11	1.756693	0.0791
b_2	Volume (-1)	-2.64E-11	1.42E-11	-1.85581	0.0636
b_3	Return (-1)	0.09306	0.030188	3.082679	0.0021
b_4	SLOPE_NOV1999	2.74E-11	1.57E-11	1.741235	0.0818
b_5	SLOPE_DEC1999	4.77E-11	2.33E-11	2.046602	0.0408
b_6	SLOPE_JAN_2000	1.70E-11	1.64E-11	1.037421	0.2996
b_7	SLOPE_FEB_2000	8.64E-12	1.47E-11	0.587817	0.5567
b_8	SLOPE_MAR_2000	4.87E-12	8.68E-12	0.561344	0.5746
b_9	SLOPE_APR_2000	-1.13E-11	1.52E-11	-0.7418	0.4583
b_{10}	SLOPE_MAY_2000	-3.34E-11	1.51E-11	-2.2081	0.0273
b_{11}	SLOPE_JUN_2000	-2.34E-11	4.55E-11	-0.51405	0.6073
Adjusted R^2	0.0155				
F-Stat	4.4758				<0.0001

Table 12: Trading-induced Manipulations in Pakistan (2005)

Results from the following OLS regression model (expanded from equation 7):

$$V_t = a_0 + a_1 \mathrm{FEB}_{2005} + a_2 \mathrm{MAR1}_{2005} + a_3 \mathrm{MAR2}_{2005} + a_4 \mathrm{APR}_{2005} + a_5 \mathrm{POSTM}_{2005} + e_t$$

where, the dependent variable V_t is the volume on day t. Month dummies are taken to capture the manipulations. Standard errors of the estimated coefficients are corrected for autocorrelation and heteroscedasticity by using the Newey-West method (with lag truncation up to 6). Sample covers the daily data from 6/30/2004 to 10/31/2005 (included observations: 339).

	Variable	Coefficient	Std. Error	t-Statistic	Prob.
a_0	Constant	3.12E+08	33674437	9.278881	<0.0001
a_1	FEB_2005	3.86E+08	82564141	4.671387	<0.0001
a_2	MAR1_2005	4.12E+08	53244553	7.744207	<0.0001
a_3	MAR2_2005	-1.7E+07	65910626	-0.25461	0.7992
a_4	APR_2005	-7E+07	35873779	-1.94266	0.0529
a_5	POSTM_2005	-5E+07	39002061	-1.27901	0.2018
Adjusted R^2	0.3836				
F-Stat	43.0662				<0.0001

Table 13: Manipulations and Price-Volume Relationship: Pakistan (2005)

Results from the following OLS regression model (expanded from equation 8):

$$R_t = b_0 + b_1 \mathrm{V_t} + b_2 \mathrm{V_{t-1}} + b_3 \mathrm{R_{t-1}} + b_4 \mathrm{SLOPE_{FEB2005}} + b_5 \mathrm{SLOPE_{MAR1\_2005}} + b_6 \mathrm{SLOPE_{MAR2\_2005}} + b_7 \mathrm{SLOPE_{APR2005}} + e_t$$

where, R_t is the return on day t and V_t is the volume on day t. The lagged volume and lagged returns are included following Lee and Rui (2002). Standard errors of the estimated coefficients are corrected for autocorrelation and heteroskedasticity by using the Newey-West method (lag truncation = 7). The sample covers the period from 1/01/2002 to 12/30/2005 (included observations are 966 after adjustments).

	Variable	Coefficient	Std. Error	t-Statistic	Prob.
b_0	Constant	-0.00095	0.000882	-1.07366	0.2832
b_1	Volume	5.52E-11	8.21E-12	6.726449	<0.0001
b_2	Volume (-1)	-4.61E-11	7.89E-12	-5.8388	<0.0001
b_3	Return (-1)	-0.00778	0.046772	-0.16624	0.868
b_4	SLOPE_FEB2005	5.84E-12	2.40E-12	2.437274	0.015
b_5	SLOPE_MAR1_2005	1.97E-11	4.98E-12	3.948393	0.0001
b_6	SLOPE_MAR2_2005	-5.04E-11	1.47E-11	-3.43292	0.0006
b_7	SLOPE_APR2005	-4.36E-12	1.21E-11	-0.36168	0.7177
Adjusted R^2	0.1416				
F-Stat	23.7402				<0.0001

Table 14: Trading-induced Manipulations in India (2001)

Results from the following OLS regression model (expanded from equation 7):

$$V_t = a_0 + a_1\mathrm{DEC}_{2000} + a_2\mathrm{JAN}_{2001} + a_3\mathrm{FEB1}_{2001} + a_4\mathrm{FEB2}_{2001} + a_5\mathrm{FEB3}_{2001} + a_6\mathrm{MAR}_{2001} + a_7\mathrm{APR}_{2001} + a_8\mathrm{POSTM}_{2001} + e_t$$

where, the dependent variable V_t is the volume on day t. Month dummies are taken to capture the manipulations. Sample covers the periods from 8/01/1995 to 12/07/2001 with daily observations of 1459. Standard errors of the estimated coefficients are corrected for autocorrelation and heteroskedasticity by using the Newey-West method (lag truncation = 8).

	Variable	Coefficient	Std. Error	t-Statistic	Prob.
a_0	C	50375972	2483541.	20.28393	<0.0001
a_1	DEC_2000	93136288	5700410.	16.33852	<0.0001
a_2	JAN_2001	1.07E+08	7838822.	13.61125	<0.0001
a_3	FEB1_2001	1.55E+08	8960210.	17.29560	<0.0001
a_4	FEB2_2001	1.38E+08	4425420.	31.29173	<0.0001
a_5	FEB3_2001	1.54E+08	8617845.	17.86956	<0.0001
a_6	MAR_2001	62112788	24253253	2.561009	0.0105
a_7	APR_2001	40353292	10837739	3.723405	0.0002
a_8	POSTM_2001	25609162	6351034.	4.032282	0.0001
Adjusted R^2	0.3316				
F-Stat	91.4316				<0.0001

Table 15: Manipulations and Price-Volume Relationship: India (2001)

Results from the following OLS regression model (expanded from equation 8):

$$R_t = b_0 + b_1\mathrm{V_t} + b_2\mathrm{V_{t-1}} + b_3\mathrm{R_{t-1}} + b_4\mathrm{SLOPE_{DEC2000}} + b_5\mathrm{SLOPE_{JAN2001}} + b_6\mathrm{SLOPE_{FEB1\ 2001}} + b_7\mathrm{SLOPE_{FEB2\_2001}} + b_9\mathrm{SLOPE_{FEB3\_2001}} + b_9\ \mathrm{SLOPE_{MAR2001}} + b_{10}\mathrm{SLOPE_{APR2001}} + e_t$$

where, R_t is the return on day t and V_t is the volume on day t. The lagged volume and lagged returns are included following Lee and Rui (2002). Standard errors of the estimated coefficients are corrected for autocorrelation and heteroskedasticity by using the Newey-West method (lag truncation = 8). The sample covers the period from 1/09/1995 to 12/31/2004; included daily observations are 2193.

	Variable	Coefficient	Std. Error	t-Statistic	Prob.
b_0	C	-0.000683	0.000512	-1.335815	0.1817
b_1	VOL	2.87E-11	2.23E-11	1.287485	0.1981
b_2	VOL(-1)	-1.93E-11	2.26E-11	-0.854947	0.3927
b_3	LOG_RET(-1)	0.112302	0.029880	3.758459	0.0002
b_4	SLOPE_DEC00	-7.08E-12	3.77E-11	-0.187553	0.8512
b_5	SLOPE_JAN01	2.44E-11	1.36E-11	1.788591	0.0738
b_6	SLOPE_FEB1_01	1.59E-11	8.45E-12	1.884883	0.0596
b_7	SLOPE_FEB2_01	-2.66E-11	1.11E-11	-2.395518	0.0167
b_8	SLOPE_FEB3_01	-2.45E-11	2.97E-11	-0.823380	0.4104
b_9	SLOPE_MAR01	-1.18E-10	2.99E-11	-3.930792	0.0001
b_{10}	SLOPE_APR01	4.54E-12	5.63E-11	0.080701	0.9357
Adjusted R^2	0.025				
F-Stat	6.5559				<0.0001