Effect of insider trading on stock characteristics

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Abstract

Purpose – This paper investigates if investors consider legal insider trading data while making investment decisions. If any investment decision is based on insider transactions, then it will result in abnormal stock characteristics. The purpose of this paper is to investigate if insider trading affects stock characteristics like price, return and volume. The paper further investigates the effect on stock characteristics after the trade of different types of insiders and the relationship between abnormal return and abnormal volume.

Design/methodology/approach – The study uses the event study method to measure the abnormal price, return and volume. Two-stage least square regression is used to investigate the relationship between abnormal return and abnormal volume.

Findings – The insider trades affect price, return and volume. The results are identical for both buy and sell transactions. The trades of different types of insiders have diverse effects on stock characteristics. The trades of substantial shareholders give rise to the highest abnormal price and return, whereas the promoters' trades result in the highest abnormal volume. No relationship is detected between abnormal return and volume.

Originality/value – A novel method to calculate the abnormal price is proposed. The effect of trading of all types of insiders on stock characteristics is analyzed. The relationship between abnormal return and abnormal volume, after an insider trade, is investigated.

Keywords Insider trading, Event study method, Stock characteristics, Two-stage least square regression

Paper type Research paper

1. Introduction

The legality of an insider trade depends on the information it is based. It is legal if it is based on public information. The uncertainty about insiders' information has spawned academic literature on whether to prohibit insider trading (Prentice and Donelson, 2010). One strand of studies has argued against insider trading (Schotland, 1967; Cho and Shaub, 1991; Werhane, 1991.) while the other has supported it (Manne, 1966; Leland, 1992; Meulbroek, 1992; Chakravarty and McConnell, 1999). However, most investors believe that insiders' transactions are based on non-public information, and mimicking these transactions can help them earn a better return (Tavakoli *et al.*, 2012; Lei *et al.*, 2014). Largescale mimicking of these transactions should result in a deviation of the actual values of stock characteristics (price, return and volume) from their expected values. If such a deviation is detected, then it can be inferred that investors are mimicking insiders and that they believe insiders' transactions are based on non-public information.

To investigate the effect of insider trade on price, studies like Tavakoli *et al.* (2012) and Chang and Suk (1998) have used abnormal return, whereas Aktas *et al.* (2008) have used daily average transaction price. However, there is no study that uses daily closing stock price and event study method to analyze the effect of insider trading on price. It is essential to study the

impact of insider trading on the daily stock price as daily stock price data is devoid of intraday data issues like intraday volatility movements (for example, the volatility is high at the opening and closing of the trading day) and microstructure noise. Therefore, the daily closing stock price data are used to study the effect of insider trade on the stock price. Some studies connect market efficiency with abnormal values of stock characteristics (Aktas *et al.*, 2008; Bajo, 2010). According to such studies, the abnormal value of stock characteristics proves that the market is not efficient.

The event study method is undertaken to calculate the abnormal value of stock price, return and volume. The mean model is used to calculate abnormal price, and the market model is used to calculate abnormal return. The method proposed by Ajinkya and Jain (1989) is used to calculate the abnormal volume. The paper also studies the effect on stock characteristics after insider purchases and insider sales. The data for the study include 200 most liquid Indian firms listed on the Bombay Stock Exchange. Tavakoli *et al.* (2012) and Morris and Boubacar (2013) suggest that transactions of all insiders do not have the same effect on the stock return. Following such studies, the paper examines the effect of transactions of different types of insiders on the stock characteristics. The study also analyses the relationship between abnormal return and abnormal volume.

The findings indicate that insider trades significantly affect the stock characteristics (price, return and volume). This finding is true for both buy and sell transactions. The results also indicate that insider trades of directors and executives, promoters [1] and majority shareholders affect the stock price and volume. However, the transactions of most of these insiders are found to have no effect on return. The results also indicate that there is no relationship between abnormal return and abnormal volume.

This study contributes to the current literature in the following ways. The study suggests a method to calculate the abnormal price. This helps to understand how price reacts after an insider trade and also contributes toward the market efficiency literature. The study investigates the relationship between abnormal return and abnormal volume, after an insider trade. The study is also the first to investigate the effect of insider trades of different category of insiders on price, return and volume. This will help to detect trade of which category of insiders is mostly mimicked by outside investors and whose trade is generating higher abnormal return and price. This insight can be used by investors. The study also investigates the effect of buy and sell transactions of different category of insiders. This will further help in investment decisions as sell transactions are known to be based on liquidity concerns.

The paper is organized as follows. The next section presents an overview of the literature. Section 3 discusses the method, and Section 4 the data and results. The conclusion is provided in Section 5.

2. Review of literature
This study investigates the effect of insider trading on the stock markets by assessing its impact on stock characteristics like price, return and volume. The findings from extant literature corresponding to each stock characteristic are reviewed below.

2.1 Price
Most of the studies use the abnormal return to study the effect of insider trading on price (Chakravarty and McConnell, 1999; Inci *et al.*, 2010; Dardas, 2012; Tavakoli *et al.*, 2012; Kim *et al.*, 2019). There has been scant focus on the price effect of insider trading. Very few studies use daily price data to examine the effect of legal insider trading on stock price. Leland (1992) suggests that when insider trading is permitted, stock price is higher on an average.

Aktas *et al.* (2008) report that stock price on insider net purchase (sale) days tend to be smaller (larger) than on other days.

2.2 Return

Many studies suggest that return is affected by insider trades (Pettit and Venkatesh, 1995; Chang and Suk, 1998; Gurgul and Majdosz, 2007; Degryse *et al.*, 2014). Most studies indicate that insider trades result in higher abnormal return for the insiders (Jeng *et al.*, 2003; Wisniewski and Bohl, 2005; Cheuk *et al.*, 2006; Gurgul and Majdosz, 2007; Firth *et al.*, 2011; Gregory *et al.*, 2013; Foley *et al.*, 2016). Although certain studies indicate that abnormal return depends on the type of trade (buy/sell) carried out by the insider (Lakonishok and Lee, 2001; Jeng *et al.*, 2003), past literature is not able to indicate whether insider purchases or insider sales result in higher abnormal return. Studies like Jeng *et al.* (2003), Gurgul and Majdosz (2007), Tardivo *et al.* (2011) and Morris and Boubacar (2018) have reported that insider purchases result in higher abnormal return rather than insider sales. However, studies like Cheuk *et al.* (2006) and Firth *et al.* (2011) report that insider sales result in higher abnormal return.

As insider trades lead to positive abnormal return and have predictive powers, it is expected that these trades act as a signal to uninformed investors. Wisniewski and Bohl (2005), Gurgul and Majdosz (2007), Firth *et al.* (2011) and De La Bruniere *et al.* (2020) indicate that uninformed investors can earn a higher abnormal return by mimicking insiders.

Thus, most studies assert that insider trades result in abnormal return for insiders and can be mimicked by outsiders to earn abnormal return.

2.3 Volume

Various studies have reported that insider trading results in an increase in the volume of the market (Buffa, 2004; Chang and Suk, 1998; Bruce *et al.*, 2011). To explain the effect of insider trading on volume, Givoly and Palmon (1985) propose the "leading indicator hypothesis," suggesting that insider trades act as a leading indicator or signal for future events and investors believe that insiders have a better assessment of the firm's activities. As a result, they try to mimic the insiders' trades. Numerous studies have confirmed the hypothesis and have suggested that outsiders attempt to mimic insider trades, thereby increasing trading volume (Firth *et al.*, 2011; McMillan *et al.*, 2014; Seyhun, 1988; Chang and Suk, 1998; Wang and Wang, 2017). However, Aktas *et al.* (2008) and Gurgul and Majdosz (2007) do not agree with the above studies. Aktas *et al.* (2008) report higher volume in days of insider purchases but lower volume in insider sales days. Gurgul and Majdosz (2007) suggest that only insider purchases affect the volume, and this effect can be seen three days prior to the announcement.

Most of the literature mentioned above are not studied in India or countries with similar institutional setting. The institutional setting in India differs a lot from the US or any other developed nation. The significant differences are – concentrated ownership, lax implementation of regulations and slow information dissemination. The distinct institutional setting in India does present an opportunity to investigate if insiders benefit abnormally from their trades.

Studies suggest that insider trading affects either price, return or volume, but no study examines the effect of insider trading on all the three stock characteristics. Keeping in view the above mentioned research gap, the following hypothesis is proposed:

H1. Insider trading affects stock characteristics – price, return and volume.

Most of the studies analyze the impact of trading of only one type of insider on one of the stock characteristics (Degryse *et al.*, 2014; Firth *et al.*, 2011; Tavakoli, 2012; Gregory *et al.*, 2013; McMillan *et al.*, 2014). For example, Pettit and Venkatesh (1995) and Degryse *et al.* (2014) study different types of insiders and indicate that the effect of transactions of managers and

top executives on return is higher than that of other insiders. None of the studies analyze the impact of trades of all types of insiders on all the stock characteristics. The following hypothesis is proposed to address the research gap:

H2. Insider trades of different types of insiders affect the stock characteristics.

A number of studies (Hiemstra and Jones, 1994; Chen *et al.*, 2001; Lee and Rui, 2002) document the relationship between trading volume and stock returns, but there is no relevant study that explores the relationship between abnormal return and abnormal volume. Bajo (2010) has studied, in a minimal way, the relationship between abnormal volume and abnormal return by finding out the amount of abnormal return in three different abnormal volume cut-offs. To address this research gap, the following hypothesis is proposed:

H3. Abnormal return affects abnormal volume and vice-versa.

3. Methodology
The short-run event study method (Brown and Warner, 1985) and its variants are adopted for addressing the hypotheses. The method used for each stock characteristic is explained below.

3.1 Effect of insider trading on stock characteristics
The event study method requires the determination of two periods – an estimation window $[t_1, t_2]$ and an event window $[T_1, T_2]$. The estimation period $[t_1, t_2]$ used for this study is from the $t-90$th to the $t-10$th day. ($t-0$th day being the day of announcement of the insider trade) The event period $[T_1, T_2]$ considered for this study is from $t-0$th day to $t+20$th day. We have studied only those trades where both the estimation and event periods do not have any other insider trade except for the trade being announced on $t-0$th day. In most of the studies related to investigating the effects of insider trading on return (for example, Wisniewski and Bohl, 2005; Cheuk *et al.*, 2006; Firth *et al.*, 2011; Gregory *et al.*, 2013) it is found that the estimation period is more than 200 days. However, in studies like Eyssell and Arshadi (1993) and Bajo (2010), which study the effects of insider trading on volume, it is observed that the estimation period is much shorter (Eyssell and Arshadi, 1993–100 days and Bajo, 2010–66 days). As the study involves investigating the effects of insider trading on return, volume and price, the estimation period is kept short, i.e. from $t-90$th to $t-10$th day. The event period is starting on the $t-0$th day as before the $t-0$th day the insider trade occurrence is not known to the market. The event period ends on the $t+20$th day to capture the full effect of the trade on the stock characteristics. The 20 days after $t-0$th day is based on the finding of Marisetty (2003), who show that full adjustment of any information in the Indian stock exchanges takes place on 19th day after the disclosure of the information (see Figure 1).

3.2 Price and insider trading
Most of the studies have tried to study the impact of insider trading on stock price by using abnormal return (like Dardas, 2012; Inci *et al.*, 2010; Tavakoli *et al.*, 2012; Chang and Suk, 1998). In this study, a distinct method is used to estimate the impact of insider trading on the
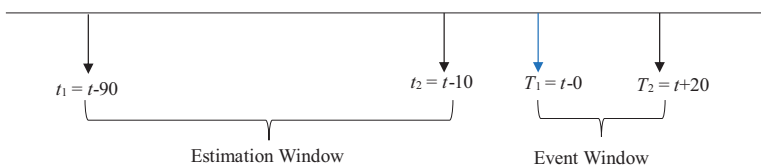

$t_1 = t$-90 $t_2 = t$-10 $T_1 = t$-0 $T_2 = t$+20

Estimation Window Event Window

Figure 1.
Event study method

stock price. Ajinkya and Jain (1989) suggest two models to calculate the abnormal volume using the event study method – the mean and market models. In this paper, the mean model is adopted to calculate the expected price (estimated price):

$$P_{j,m} = \frac{\sum_{i=-90}^{-10} P_{j,i}}{N} \qquad (1)$$

where,

$P_{j,m}$ the mean price between $t-90$ to $t-10$ (estimation period), $t-0$ is the day of the announcement of the insider trade.

$P_{j,i}$ is the closing price on ith day of jth stock.

N is the no of days in the estimation period.

The difference between the actual stock price and the expected stock price gives the abnormal stock price, i.e. the impact of insider trading on the stock price. The abnormal price $(AP_{j,i})$ of security j at time i is calculated as:

$$AP_{j,i} = P'_{j,t} - P_{j,m} \qquad (2)$$

where,

$i = [t-0, t+20]$

$P'_{j,t}$ the actual price of jth stock on ith day.

The standard event study method, as suggested by Brown and Warner (1985), is used to calculate the cumulative average abnormal price between $t-0$ and $t+20$ ($CAAP_{t-0, t+20}$).

$$CAAP_{t-0,t+20} = \sum_{i=t-0}^{t+20} AAP_i \qquad (3)$$

where,

AAP_i average abnormal price at time i.

$$AAP_i = \frac{1}{N_i} \sum_j AP_{j,i}$$

where N_i is the number of events on

i^{th} day and i varies from $t-0$ to $t+20$.

The result's statistical significance is validated using the t-statistic which is calculated by using the crude dependence test [2] proposed by Brown and Warner (1980).

$$t_{CAAP_{t-0,t+20}} = \frac{CAAP_{t-0,t+20}}{\sigma_{AAP_{t-0,t+20}} \times \sqrt{L}} \qquad (4)$$

where,

$\sigma_{AAP_{t-0,t+20}}$ SD of average abnormal price between $t-0$ and $t+20$

L the number of days in the event period given by $L = (T_2 - T_1 + 1)$.

Here $L = ((t+20) - (t-0)) + 1 = 21$

3.3 Return and insider trading

Most of the studies use the event study method proposed by Brown and Warner (1985) to investigate if insiders earn an abnormal return (Pettit and Venkatesh, 1995; Chang and Suk, 1998; Gurgul and Majdosz, 2007; Degryse *et al.*, 2014; Jeng *et al.*, 2003; Wisniewski and Bohl, 2005; Cheuk *et al.*, 2006; Firth *et al.*, 2011; Gregory *et al.*, 2013). While some studies like Eckbo and Smith (1998) and Jeng *et al.* (2003) use technique of performance measurement or performance evaluation to find out if insiders can earn abnormal return from their

transactions. The market model of event study method is used to calculate abnormal return as follows:

$$R_{j,i} = \alpha_j + \beta_j R_{m,i} + u_{j,i} \tag{5}$$

where,

$i = [t-90, t-10]$, $t-0$ is date of the announcement of the insider trade.

$R_{j,i}$ the excess return (risk-free rate of return deducted from return [3] on security j at time i) on security j at time i, $j = 1, 2 \ldots, N$

$R_{m,i}$ the excess return on the market portfolio at time i, α_j and β_j the parameters of the market model,

$u_{j,i}$ the zero-mean disturbance term

N the no. of events.

The values of $R_{j,i}$ and $R_{m,i}$ during the estimation period are calculated. The parameters (α_j and β_j) are estimated by applying the values of $R_{j,i}$ and $R_{m,i}$ in the market model. These parameters are applied to get the expected return values during the event period. The abnormal return of security j at time t is calculated as:

$$AR_{j,i} = \text{Actual Return} - \text{Expected Return} \tag{6}$$

$$AR_{j,i} = \left\{ R'_{j,i} - \left(\alpha_j + \beta_j R'_{m,i} \right) \right\} \delta \tag{7}$$

where,

$R'_{j,i}$ the actual excess return of security j at time i

$R'_{m,i}$ the actual excess return on the market portfolio at time i α_j and β_j the parameters calculated from the estimation period $i = [t-0, t+20]$

$\delta = 1$ if insider buys first or $\delta = -1$ if insider sells first [4].

Similar to calculations in price, the cumulative average abnormal return between $t-0$ and $t+20$ (CAAR $_{t-0, t+20}$) and the t-statistic are calculated. (for detail calculation refer to Appendix 1)

3.4 Volume and insider trading

Studies like Chang and Suk (1998) have used the model suggested by Ajinkya and Jain (1989) to calculate the abnormal volume. However, studies like Bajo (2010) have used the model suggested by Jarrell and Poulsen (1989) to calculate the normalized abnormal volume. One of the differences between Jarrell and Poulsen (1989) and Ajinkya and Jain (1989) model is that Ajinkya and Jain (1989) model uses the market volume to calculate the abnormal return. In this study, the market model suggested by Ajinkya and Jain (1989) is implemented as the market volume is an essential factor in the study, and it should be taken into consideration while estimating the abnormal volume. Following is the model which is applied to calculate the abnormal volume:

As raw volume is not normally distributed, the log-transformed volume is used for the event study.

$$n_{j,i} = \ln(1 + V_{j,i}) \tag{8}$$

where,

$V_{j,i}$ the raw volume of firm j in time i

$n_{j,i}$ the log transformed volume.

$$n_{j,i} = a_j + b_j n_{m,i} + e_{j,i} \tag{9}$$

where,

a_j and b_j are the intercept and the slope coefficient, respectively,

$n_{m,i}$ sum of shares traded of all the firms in the market index on day, i.

$$n_{m,i} = \sum_{k=1}^{M} n_{k,i}$$

where M = no. of firms in the market index, $i = [t-90, t-10]$, $t-0$ is the day of announcement of insider trade.

Ajinkya and Jain (1989) suggest that volume and residuals of the market model for volume are significantly auto-correlated. To remove the autocorrelation and estimate the intercept and slope coefficient correctly, Ajinkya and Jain (1989) suggest using estimated generalized least squares (EGLS) model to estimate Eqn (11) while imposing AR (1) structure on the residuals. The abnormal volume of security j at time i is calculated as:

$$AV_{j,i} = \text{Actual Volume} - \text{Expected Volume} \tag{10}$$

$$AV_{j,i} = n'_{j,i} - \left(a_j + b_j n'_{m,i} \right) \tag{11}$$

where,

$n'_{j,i}$ is the actual volume of security j on day i.

$n'_{m,i}$ is the actual volume of shares traded of all the firms in the market index on day I, a_j and b_j the parameters calculated from the estimation period,

$i = [t-0, t+20]$, $t-0$ is the day of announcement of the insider trade.

Similar to calculations in price, the cumulative average abnormal volume between $t-0$ and $t+20$ (CAAV $_{t-0, t+20}$) and the t-statistic are calculated. (for detail calculation refer to Appendix 2)

3.5 Simultaneous equation modeling

A simultaneous equation modeling between abnormal return and abnormal volume is used to study if either of them affects the other. Abnormal price is not used as there is no literature support for variables that might affect abnormal price. Cumulative abnormal return (CAR) is proxied for abnormal return, and cumulative abnormal volume (CAV) is proxied for abnormal volume. CAR and CAV for each event are calculated as follows:

$$CAR_j = \sum_{i=t-0}^{t+20} AR_{j,i} \tag{12}$$

$$CAV_j = \sum_{i=t-0}^{t+20} AV_{j,i} \tag{13}$$

To conduct simultaneous equation modeling with cross-sectional data, Brooks (2008) and Hill *et al.* (2011) have suggested two-step least square (TSLS) regression. So, two TSLS regressions are carried out, where CAR is the dependent variable for one TSLS and CAV is the dependent variable for another.

Wisniewshki and Bohl (2005), Cheuk *et al.* (2006), Firth *et al.* (2011), Gregory *et al.* (2013) and Bajo (2010) have all used the market capitalization and book-to-market ratio as independent variables against abnormal return. Gurgul and Majdosz (2007) and Wisniewshki and Bohl (2005) have used the type of insider transaction (buy or sell) as an independent variable. Similarly, CAV, the natural logarithm of market capitalization, price-to-book ratio (inverse of book-to-market ratio) and a dummy for buy/sell insider transaction are used as the independent variables in the TSLS regression where CAR is the dependent variable. Natural logarithm of the volume of shares transacted, dummy for promoter's trade and dummy for director and executive's trade are used as the instrumental variables. Core *et al.* (2006) have

used volume of insider transactions as an independent variable against CAV. Park *et al.* (1995) have used the type of insider to study abnormal volume. Similarly, Dardas (2012) has used the type of insider as an independent variable against CAV. The natural logarithm of volume of insiders' transactions, dummy for promoters' trade and dummy for director and executive trade are used as the independent variables in the TSLS regression where CAV is the dependent variable. The natural logarithm of market capitalization and price-to-book ratio are the instrumental variables in this regression.

For each of the TSLS regressions, the Stock and Yogo (2004) test is used to confirm if the instrumental variables are strong. The Hansen–Sargan overidentification test examines the validity of the instrumental variables. The equations for the model are as follows:

TSLS 1:

$$CAV_j = \alpha_0 + \alpha_1 VOL_j + \alpha_2 DP_j + \alpha_3 DDE_j + \alpha_4 MCAP_j + \alpha_5 PBR_j + \alpha_6 BS_j + \epsilon_{1j} \qquad (14)$$

$$CAR_j = \beta_0 + \beta_1 \widehat{CAV}_j + \beta_2 MCAP_j + \beta_3 PBR_j + \beta_4 BS_j + \epsilon_{2j} \qquad (15)$$

TSLS 2:

$$CAR_j = \gamma_0 + \gamma_2 MCAP_j + \gamma_3 PBR_j + \gamma_4 VOL_j + \gamma_5 DP_j + \gamma_6 DDE_j + \epsilon_{3j} \qquad (16)$$

$$CAV_j = \delta_0 + \delta_1 \widehat{CAR}_j + \delta_2 VOL_j + \delta_3 DP_j + \delta_4 DDE_j + \epsilon_{4j} \qquad (17)$$

where CAR_j is the cumulative abnormal return for event j, CAV_j is the cumulative abnormal volume, $MCAP_j$ is the natural logarithm of market capitalization of the respective firm during the announcement day, PBR_j is the price/book ratio of the firm, BS_j is the dummy for buy/sell transaction where 1 represents a buy and 0 represents a sell, DP_j is the dummy for promoters' transaction where 1 represents promoters' trade and 0 represents the trade by substantial shareholder, DDE_j is the dummy for directors' and executives' transaction where 1 represents director and executive trade and 0 represents the trade by substantial shareholder, VOL_j is the natural logarithm of the volume of insider transaction, $\widehat{CAR}_j$ and $\widehat{CAV}_j$ are the residuals, $\alpha_1, \alpha_2, \ldots, \beta_1, \beta_2, \ldots, \gamma_1, \gamma_2, \ldots \delta_1, \delta_2, \ldots$ are the coefficients of the variables and $\epsilon_{1j}, \epsilon_{2j}, \ldots$ are the error terms.

4. Data and results

This study's time period is April, 2007 to March, 2015, mainly because of the availability of insider trading data in India. Insider trading data beyond April, 2015 has not been used in this study as there was a significant change in insider trading regulations in April, 2015. We consider only market transactions by insiders for the study. Insider trading data is collected from BSE [5] Website. BSE publishes all insider trade information like date and nature of insider trade, name of the insider, number of shares transacted, regulation followed for the transaction, mode of insider trade, number of shares held by the insider and the day the trade is reported to the exchange. To ensure availability of data related to stock price and volume, only those firms included in BSE 200 [6] (as on 5th June, 2015) are considered. The stock price and volume data are collected from the Bloomberg Terminal. Market Capitalization and price-to-book ratio data are collected from the ProwessIQ database of the Center for Monitoring Indian Economy (CMIE).

Table 1 provides a summary of the data being used for the analysis. With respect to various insiders, the volume of shares transacted by promoters is about 20 times the volume of shares transacted by directors and executives but less than one-fifth of the volume of shares transacted by substantial shareholders. However, the number of events when promoters transact is half of that of directors and executives and much lesser than that of substantial shareholders. Thus, the promoters transact the least number of times. Morris and

Insider and transaction types	No. of events	No. of firms	Volume of shares transacted (millions)	Volume of shares transacted per event (millions)
All Insider transactions	429	160	4004	9.33
Insider purchases	212	121	955	4.50
Insider sales	217	116	3049	14.05
All Director and executives	79	52	32	0.41
Director and executives purchases	33	27	11	0.33
Director and executives sales	45	30	21	0.47
All promoters	31	28	624	20.13
Promoters purchases	12	12	01	0.08
Promoters sales	19	17	623	32.79
Substantial shareholders	320	139	3348	10.46
Substantial shareholders purchases	167	101	943	5.65
Substantial shareholders sales	153	91	2405	15.72

Table 1.
Summary of event study data

Note(s): This table presents an overview about the data that has been used for event study method. The volume of share transacted per event is calculated by dividing the volume of shares transacted to the number of events

Boubacar (2013) and Lakonishok and Lee (2001) also report that the number of transactions of directors and executives is more than that of the major shareholders (U.S. does not have a concept of promoters, so the transactions of major shareholders who have more than 10% shareholding are taken into account). The volume of shares transacted per event is more in promoters than in directors and executives and substantial shareholders. It is also observed that the volume of shares transacted per sell transaction is higher than the volume of shares per buy transactions in all insiders, especially in promoters, which is believed to be carried out for liquidity purposes. (Kolasinski and Li, 2010; Inci *et al.*, 2010)

H1. Insider trading affects stock characteristics – price, return and volume.

Cumulative average abnormal price (CAAP), cumulative average abnormal return (CAAR) and cumulative average abnormal volume (CAAV) are used to study if insider trading affects any of these stock characteristics (see Table 2).

An abnormal stock price movement is identified around all insider transactions. The same is observed in purchase or sale transactions of insiders. The values of CAAP for all insider transactions, only purchase transactions and only sell transactions are positive. This means that the actual price is more than the expected price after any type of insider transaction. When only insider sell transactions are considered, the results match Aktas *et al.* (2008) as it reports an increase in price after insider sell transactions.

According to Copeland's (1976) sequential information arrival model, investors are initially in a state of equilibrium in which all possess an identical set of information. When a single piece of information arrives, each investor reacts by shifting his/her demand curve. Based on the investor's perception regarding the information, an investor shifts his/her demand curve up (optimist) or down (pessimist). This results in an increase or decrease in price.

When an investor receives information of an insider purchase and shifts his/her demand curve up, thereby increasing the price (and the abnormal price), he/she mimics the insider.

Panel A: Price	CAAP	t-value
All insider transactions	622.0781	46.4840
Only insider purchases	368.7078	12.5829
Only insider sales	869.6103	174.6497
Panel B: Return	CAAR	t-value
All insider transactions	0.0227	5.2249
Only insider purchases	0.0229	3.6288
Only insider sales	0.0225	3.1933
Panel C: Volume	CAAV	t-value
All insider transactions	1.6860	8.8490
Only insider purchases	1.2595	4.2168
Only insider sales	2.1027	7.8825

Note(s): This table shows whether insider trading affects stock characteristics (price, return and volume). The CAAP, CAAR, CAAV are calculated using Eqs (3), (18) and (20) and the t statistic is calculated using Eqs (4), (19) and (21), respectively

Table 2.
Does insider trading
affect Stock
Characteristics

On the contrary, when an investor reacts to an insider purchase by shifting his/her demand curve down, he/she does not mimic the insider. Similarly, when an investor receives an insider sale information and shifts his/her demand curve down (thereby decreasing the price), he/she is said to be mimicking the insider. When an investor shifts his/her demand curve up after an insider sale, he/she does not mimic the insider. If the above theory is complemented with the results, then it is observed that CAAP is positive after insider purchase and insider sale transactions. The outside investors are mimicking the insider purchases but are carrying opposite transactions after insider sales. In other words, outsiders are always buying, irrespective of whether insiders are buying or selling. This reiterates Table 1's findings that outside investors believe that mimicking sell transactions are futile as they are motivated by liquidity concerns.

Cumulative average abnormal return is positive for all insider transactions as well as for only buy and only sell transactions. It indicates that all types of insider trades generate positive abnormal return and an outside investor can earn positive abnormal return by mimicking these insider trades. Wisniewski and Bohl (2005) and Cheuk et al. (2006) report similar results. Gurgul and Majdosz (2007) partially agree with the results when they report that insiders earn positive abnormal return from their buy transactions but not from their sales transactions.

According to the results, volume gets affected whenever there is an insider trade. The cumulative average abnormal volume is positive for all transactions as well as for insider buy and sell transactions. Thus, the volume is higher than expected whenever there is an insider trade. Buffa (2004), Chang and Suk (1998), Bruce et al. (2011), Firth et al. (2011) and McMillan et al. (2014) report similar results. However, Aktas et al. (2008) and Gurgul and Majdosz (2007) do not agree with the results.

From the above findings, it can be summarized that hypothesis 1 holds and insider trades (whether they are buy or sell) affect price, return and volume. The findings also indicate that when outsiders come to know about insider trades, they rush to buy, thereby increasing volume and price. In the process, insiders and outsiders (who mimic insider trades) earn an abnormal return.

H2. Insider trades of different types of insiders affect the stock characteristics.

The cumulative average abnormal values of different insiders and the t-value are calculated to address the above hypothesis (see Table 3).

| | All transactions | | Purchases | | Sales | |
Panel A: Price	CAAP	t-value	CAAP	t-value	CAAP	t-value
Director and Executives transactions	570.8610	55.8418	214.9028	6.5026	831.8969	77.6157
Promoter transactions	268.6641	27.6770	592.6721	18.0300	64.0274	3.7946
Substantial Shareholders	668.7992	43.5789	383.0072	13.1620	980.7421	224.8313

| | All transactions | | Purchases | | Sales | |
Panel B: Return	CAAR	t-value	CAAR	t-value	CAAR	t-value
Director and executives transactions	0.0189	1.8631	0.0386	2.6035	0.0045	0.2826
Promoter transactions	−0.0067	−0.4593	−0.0040	−0.1826	−0.0083	−0.3524
Substantial shareholders	0.0264	5.5344	0.0217	2.8274	0.0316	3.4829

| | All transactions | | Purchases | | Sales | |
Panel C : Volume	CAAV	t-value	CAAV	t-value	CAAV	t-value
Director and executives transactions	2.3195	6.9699	2.4410	4.6580	2.2303	4.6018
Promoter transactions	7.6931	9.5232	3.2383	2.3696	10.5067	11.0282
Substantial shareholders	0.9496	3.9130	0.8838	2.6826	1.0215	3.1180

Note(s): This table shows if the effect of insider trading on market characteristics differs with type of insider. It also contains the effect of buy and sell transactions by different type of insiders on each of the stock characteristics. The abnormal values are estimated using CAAP, CAAR and CAAV and their statistical significance is found using the *t*-value

Table 3.
Does the type of insider affect the abnormal values

Abnormal price, return and volume for different types of insiders are calculated to study if each stock characteristic reacts differently to the trade of each type of insider. The abnormal values of stock characteristics for buy and sell transactions of each type of insider are also calculated. This helps to understand if stock characteristics react differently to sell and buy transactions of each type of insider.

In panel A, if all the transactions are considered, then it is observed that the cumulative average abnormal price (CAAP) is positive for the transactions of directors and executives, promoters and substantial shareholders. Individually, CAAP due to promoters' purchases (sales) is the highest (lowest) compared to the CAAP of any other type of insider. Following the sequential information arrival model, it can be inferred that promoter purchases (sales) are most (least) mimicked by outsiders. Inci *et al.* (2010) point out that the market's initial reaction to purchases by top executives is strongest, followed by officers and large shareholders. Dardas (2012) reports that there are no significant price reactions to trades of top-level, middle-level and low-level insiders in Germany and the UK, except for the sell transaction of middle-level insiders of Germany. In this study, it is observed that the market mimics promoters' purchases most.

In panel B, directors and executives' purchases and substantial shareholders' purchases and sales result in positive CAAR. So, outside investors can earn a higher abnormal return by mimicking such transactions. The results are similar to the results of Morris and Boubacar (2013) and Tavakoli *et al.* (2012), who report that directors and senior officers' trades generate a more abnormal return. The results also match Chauhan *et al.* (2016), who say that abnormal return from trades of insiders holding higher ownership is lower than the abnormal return from trades of insiders holding lesser ownership. However, Firth *et al.* (2011) report inconclusive results when they study the relationship between ownership percentage and abnormal return. Betzer and Theissen (2009) report that the insider's position in the firm has no impact on the abnormal return earned by the insider. This study's results also provide evidence contrary to the information hierarchy hypothesis since promoters, who in India

possess most information about their company, earn the lowest return while substantial shareholders who possess the least information earn the highest return.

Finally, from panel C, cumulative average abnormal volume calculated above indicates that insider trades affect volume. Specifically, CAAV for promoters is largest, while that of substantial shareholders is least. This agrees with the findings from abnormal prices that promoters' trades are most mimicked, causing the largest unexpected transactions.

Most of the studies on abnormal volume, cited above, have not analyzed the effect of trade of different categories of insiders on volume. However, Dardas (2012) studies the effect on intraday volume by trades of insiders belonging to different levels of management. He indicates that in Germany and United Kingdom, trading volume is higher after announcements of CEOs' transactions than by other insiders. Given that promoters mostly occupy CEO and managing director positions in Indian companies, the results conform to Dardas (2012) as they indicate that the trading volume is higher after the announcement of promoters' transactions.

From the results, it is evident that hypothesis 2 holds. CAAP and CAAV indicate that promoters are mostly mimicked in India, although their returns are not significant. On the other hand, substantial shareholders and, to a lesser degree, directors and executives earn abnormal profits, although they are not imitated much.

H3. Abnormal return affects abnormal volume and vice-versa.

To understand whether abnormal return affects abnormal volume or vice-versa, cumulative abnormal return (CAR) and cumulative abnormal volume (CAV) are used. Two TSLS regressions are carried out, with CAR being the dependent variable in the first and CAV in the second. The independent variable in the first TSLS is CAV and the control variables are natural logarithm of market capitalization, price-to-book ratio and dummy for buy/sell transaction. The instrumental variables are natural logarithm of volume of shares traded, dummy for promoter's trade and dummy for director's and executive's trade. The independent variable in the second TSLS is CAR, and the control variables are natural logarithm of volume of shares traded, dummy for promoter's trade and dummy for director's and executive's trade. The instrumental variables are the natural logarithm of market capitalization and the price-to-book ratio. Table 4 presents the descriptive statistics of these

	Min	Max	Mean	Median	SD
CAR	−0.2433	0.2544	0.0043	−0.0002	0.0899
CAV	−35.3683	36.9862	1.1293	−0.3491	12.0731
MCAP	8.3578	13.1347	11.4394	11.4357	0.9294
PBR	0.17	9.33	3.0071	2.5200	2.0521
VOL	5.1120	18.8174	12.4337	12.7367	3.2175

Note(s): This table presents the descriptive statistics of the variables used for regression. The dependent variables are cumulative abnormal return (CAR) and cumulative abnormal volume (CAV). CAR is the sum of all abnormal returns over corresponding event window days of each insider transaction, calculated using Eqn (12). CAV is the sum of all abnormal volume over corresponding event window days of each insider transaction, calculated using Eqn (13). The independent variables include natural logarithm of market capitalization (MCAP), price-to-book ratio (PBS), natural logarithm of volume of shares traded (VOL), dummy for buy/sell (BS), dummy for promoter's trade (DP) and dummy for director and executive's trade (DDE). The market capitalization and the price-to-book ratio is of the respective firm used and is for the day of announcement of the insider trade. Price-to-book ratio is the ratio between the market price of the stock and the book price of the stock. Volume of share traded represents the number of shares that were traded in that particular insider trade. Minimum value (Min), maximum value (Max), mean, Median and standard deviation (SD) of the variables are shown in the table.

Table 4.
Summary statistics

variables. The result of the first TSLS is shown in panel A of Table 5, and the result of the second TSLS is shown in panel B. HAC (heteroskedasticity and autocorrelation consistent) standard errors were used in both TSLS.

The instrumental variables in the first TSLS are natural logarithm of the volume of shares traded, dummy for promoter's trade and dummy for director's and executive's trade. The instrumental variables in the second TSLS are the natural logarithm of the market capitalization and price-to-book ratio. The Stock and Yogo test and Hansen–Sargan test suggest that the instrumental variables are valid and strong in both TSLS (see Table 6). This suggests that the instrumental variables selected by us can be used in the TSLS regressions.

Adjusted R^2 shows that the independent variables can explain variance in CAR by 7.15% and CAV by 3.62%. Model fit using F-statistic was found to be adequate in panel A and panel B. CAR is positively related to dummy for buy/sell, which means that insider purchases result in higher CAR. The finding is similar to Fidrmuc *et al.* (2006), who report that the market reaction to insider purchases is much higher than insider sales. P/B ratio is negatively related to CAR. This implies that insider trading in firms with a lower P/B ratio results in higher CAR

Panel A	Coefficient	Prob
CAV	0.0006	0.7762
MCAP	−0.0062	0.2466
PBR	−0.0057	0.0203**
BS	0.0325	0.0031***
Adjusted R^2	0.0715	
F-stat	6.25	0.0000
Panel B		
CAR	23.1133	0.5059
VOL	−0.1341	0.5521
DP	7.4526	0.0035***
DDE	−2.7793	0.1630
Adjusted R^2	0.0362	
F-stat	3.209	0.0132

Note(s): This table shows the TSLS regression result between CAR, CAV and other variables like natural logarithm of market capitalization (MCAP), price-to-book ratio (PBR), natural logarithm of volume of shares traded (VOL), dummy for buy/sell (BS), dummy for promoter's trade (DP) and dummy for director and executive's trade (DDE). Panel A shows the TSLS where CAR is the dependent variable. Panel B shows the TSLS for CAV. Both the panels show the coefficients attached to each variable and the statistical probability that such relationship does not exist. The table also shows the adjusted R^2 and the F-statistic. The instrumental variables for panel A are natural logarithm of volume of shares traded (VOL), dummy for promoter's trade (DP) and dummy for director and executive's trade (DDE). The instrumental variables for panel B are natural logarithm of the market capitalization and price-to-book ratio

Table 5.
TSLS regression between CAR and CAV

	p-values	
	TSLS 1	TSLS 2
Stock and Yogo	0.0065	0.0007
Hansen–Sargan	0.6769	0.4863

Note(s): Stock and Yogo (2004) test for weak instruments evaluates the strength of the first stage regression. Low p-values suggest strong instruments. Hansen–Sargan is a test for overidentifying restrictions, testing the joint significance of the set of endogenous variables in the system of equations. It has a chi-square distribution. High p-values suggest that instruments are valid.

Table 6.
Instrumental variables test for strength and validity

and vise-versa. However, there is no significant impact on CAR due to market capitalization. This does not match with the findings of Wisniewski (2004), who corroborates that the size effect impacts CAR. CAV is positively related to dummy of promoters' trade. This indicates an increase in abnormal volume after a promoter's trade than after the trade of a substantial shareholder. It is also observed that the natural logarithm of volume of insider trade does not impact CAV. It is crucial to note that hypothesis 3 does not stand, and both CAV and CAR do not affect each other. The results differ from Bajo (2010), who report that higher volume shows higher return around the event date.

5. Conclusion
It can be inferred from the results that insider trades affect stock characteristics like price, return and volume. It can also be inferred that buy and sell transactions both affect the stock characteristics. While the transactions of directors and executives, substantial shareholders and promoters affect the price and volume, the same cannot be said for return.

The results indicate that when outside investors find out about insider trades, they carry out purchase transactions, thereby increasing volume and price. Through these transactions, insiders as well as the mimicking outside investors earn abnormal return. According to this study, Indian investors do not adhere to the information hierarchy hypothesis. Mostly promoters are mimicked in India, although their trades do not generate significant returns. The trades of directors and executives and substantial shareholders are not mimicked much, but they generate abnormal returns. The fact that there is abnormal movement in price, return and volume after an insider trade indicates that the market is not strong-form efficient. The results also indicate that abnormal return and abnormal volume do not affect each other.

The study contributes to the literature by proposing a robust method to calculate the abnormal price. The study indicates that an outside investor can earn abnormal return by mimicking the purchase transactions of insiders. The study reiterates the finding of previous research that insider-sell transactions are based on liquidity concern (Kolasinski and Li, 2010; Inci *et al.*, 2010). Specifically, an outside investor can earn abnormal return by mimicking any transaction of the substantial shareholder or purchase transactions of directors and executives. Promoters' trade should not be mimicked as they do not generate abnormal return. As most Indian firms are family-owned firms, promoters give more importance to their fiduciary responsibility toward the firm, and their trades are based on this objective.

This study is based on insider trades from April, 2007 to March, 2015, which were regulated by the Securities and Exchange Board of India ([Prohibition of] Insider Trading) Regulations, 1992. It will be interesting to observe the outcome with data after April, 2015, when the Securities and Exchange Board of India ([Prohibition of] Insider Trading) Regulations, 2015 came into force. This study is also limited to stock characteristics like price, return and volume. Stock characteristics like bid-ask spread and volatility can also be included in similar studies.

Notes
1. According to the Companies Act, 2013, a promoter is someone who is named in the prospectus of the company or has direct or indirect control over the affairs of the company or under whose instructions the Board of Directors are accustomed to act. In other words, they are the founder-owners.

2. The Crude Dependence test is used as it uses the entire sample for variance estimation and does not consider unequal variances across observations.

3. Return on security j at time t is calculated as $(P_1 - P_0)/P_0$, where P_0 is the price of the security at time t_0 and P_1 is the price of the security at time t_1.

4. By convention, return is indicated as (Cash Inflow – Cash Outflow) / (Cash Outflow). In case of buying, return formula becomes $(P_1 - P_0)/P_0$ where P_0 is the price at time T_0 and P_1 is the price at time T_1. But, if insider is selling first then return should be calculated as $(P_1 - P_0)/P_0$. Since return is calculated as $(P_1 - P_0)/P_0$, return from sales is multiplied by $\delta = -1$ (Betzer and Theissen, 2009), ignoring the effect of the denominator.

5. BSE (Bombay Stock Exchange Ltd.) is one of the national stock exchanges of India and is the oldest stock exchange in Asia.

6. S&P BSE 200 index is designed to measure the performance of the top 200 companies listed at BSE Ltd., based on size and liquidity across sectors.

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Appendix 1

The standard event study method, as suggested by Brown and Warner (1985), is used to calculate the cumulative average abnormal return between $t - 0$ and $t + 20$ ($CAAR_{t-0,\,t+20}$).

$$CAAR_{t-0,\,t+20} = \sum_{i=t-0}^{t+20} AAR_i \tag{18}$$

where, AAR_i average abnormal return at time i

The statistical significance of the result is validated using the t-statistic which is calculated by using the crude dependence test proposed by Brown and Warner (1980).

$$t_{CAAR_{t-0,\,t+20}} = \frac{CAAR_{t-0,\,t+20}}{\sigma_{AAR_{t-0,\,t+20}} \times \sqrt{L}} \tag{19}$$

where, $\sigma_{AAR_{t-0,\,t+20}}$ SD of average abnormal return between $t - 0$ and $t + 20$ L the number of days in the event period given by $L = (T_2 - T_1 + 1)$.

Here $L = ((t + 20)-(t-0)) + 1 = 21$

Appendix 2

The standard event study method, as suggested by Brown and Warner (1985), is used to calculate the cumulative average abnormal return between $t - 0$ and $t + 20$ ($CAAV_{t-0,\,t+20}$).

$$CAAV_{t-0,\,t+20} = \sum_{i=t-0}^{t+20} AAV_i \tag{20}$$

where, AAV_i average abnormal volume at time i

The statistical significance of the result is validated using the t-statistic which is calculated by using the crude dependence test proposed by Brown and Warner (1980).

$$t_{CAAV_{t-0,\,t+20}} = \frac{CAAV_{t-0,\,t+20}}{\sigma_{AAV_{t-0,\,t+20}} \times \sqrt{L}} \tag{21}$$

where, $\sigma_{AAV_{t-0,\,t+20}}$ SD of average abnormal volume between $t - 0$ and $t + 20$ L the number of days in the event period given by $L = (T_2 - T_1 + 1)$.

Here $L = ((t + 20)-(t-0)) + 1 = 21$

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