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Price and trade size clustering: Evidence from the national stock exchange of India

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ABSTRACT

This paper investigates price and trade size clustering in individual trades executed in the NSE's fully computerized order-driven trading system. We also examine intraday return and liquidity patterns for the NSE traded stocks. We find a strong evidence of size and price clustering for the traded stocks. Size clustering occurs in the multiples of 500 shares. We witness a decreasing relationship between price clustering and trade price decimals for the full sample. Our results are consistent after controlling for the trade frequency and market capitalization.

1. Introduction

Standard asset pricing theory does not specify any specific value for asset prices in a scale of accounts. However, empirical literature affirms that traders prefer certain prices to organize their trade. When last digit of a price in a trade tends to occur at specific number again and again, it is termed as price clustering. Although there are many hypotheses that attempt to address price clustering, but there are no such consistent explanations. Thus, price clustering has remained an empirical question even after decades of investigation in equity markets. Most of previous studies on price and trade clustering have focused on quote-driven markets (e.g., Chung, Van Ness, & Van Ness, 2004; Ikenberry & Weston, 2008), so there is relatively less evidence on order-driven markets (Ahn, Cai, & Cheung, 2005; Ascioglu et al., 2007; Hu, Jiang, McInish, & Zhou, 2016).

In an efficient and ideal market, price clustering doesn't exist as the last digits of price should exhibit a uniform distribution (Niederhoffer & Osborne, 1966). However, empirical evidences on price clustering in stock prices are widely acknowledged (Ap Gwilym, Clare, & Thomas, 1998; Ahn et al., 2005; Ascioglu et al., 2007; Ascioglu, Comerton-Forde, & McInish, 2011; Chung et al., 2004; Hameed & Terry, 1998; Huang & Stoll, 2001; Mishra, McInish, & Tripathy, 2015; Harris, 1991; Niederhoffer & Osborne, 1966; Niederhoffer, 1965). also claims that price clustering is remarkably persistent through time and across stocks. Literature also suggests that price clustering is pervasive and observed in gold (Ball, Torous, & Tschoegl, 1985), foreign exchange (Goodhart & Curcio, 1991) and many other market segments.

Price and size clustering events are associated with information asymmetry among the market participants (Blau & Brough, 2012; Easley & O'hara, 1987). While examining the cross-sectional variation in price clustering relating its frequency to individual stock price attributes, it is observed that clustering moves directly with stock's price level and volatility, and it inversely moves with firm size and number of transactions (Harris, 1991). However, Aitken et al. (1996) do not find a consistent relationship between price clustering and stock price volatility. They observed rather that the price clustering is a direct function of price of the stock, own stock volatility, market-wide volatility, trade size and the size of the bid-ask spread. Also clustering varies inversely with greater degree of price discovery, higher trading frequency, and stocks with larger option trades and for stocks that can be sold short (Davis, Van Ness, & Van Ness, 2014). The clustering events induce price volatility as

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stocks with a greater degree of clustering will have less informative prices (Blau & Griffith, 2016).

This paper re-examine the relatively unexplored area of trade-size and price clustering in emerging market like India. The presence of business groups and cross holdings make Indian firms complex in nature.[1] Several studies examine the relationship between trade size and factors like prices, information, and liquidity, while seek to examine whether trade size and price clustering exist for the National Stock Exchange of India Ltd. (NSE) listed stocks. We find evidence for size clustering in NSE traded stocks. Size clustering is observed in multiples of 500 shares. We also analyze return and liquidity trend across the normal trading hours using intraday dataset. The NSE is an order driven market that allows electronic trading between buyers and sellers. Thus, the unique structure of the NSE provides a further motivation for this study.

Our paper makes several contributions to the literature. First, we examine price and trade clustering using the NSE listed stocks. To the best of our knowledge no study has been done in Indian context that to in a rapidly growing emerging order driven market. Our study allow a comparison of clustering phenomenon in emerging market with developed markets. Second, our study provides insights on the hourly trend of liquidity and stock return across sample period (McInish & Wood, 1992; Ohta, 2006). Third, we also examine occurrence of price and trade-size clustering across the different lot sizes. We believe that our study contributes to the growing literature in price and trade-size clustering by presenting empirical examination of emerging market like India.

This paper is organized as follows.Section 2 presents overview of selected prior studies related to price and trade clustering. Section 3 describes the dataset and distribution of order and trade size. Section 4 discusses the methodology. Section 5 presents the results and findings. Section 6 concludes the study.

2. Literature review

Every investor wish to execute desired price of trade at the desired size and at an exact time considering an ideal world (Harris, 2003). But assumption about ideal world is not practical and realistic. Considering a real and practical world conditions, Moulton (2005) observe that investors who are not able to optimize all three dimensions of liquidity (price, size and time) face a trade-offs between the setting an optimum price and an optimum trade size. The unfavorable trade conditions force investors to modify trade size and the price that establish a linkage between trade size and price clustering. Under the condition of recognizable information asymmetries, large orders by informed traders prompt greater clustering (Easley & O'hara, 1987). Informed traders prefer to trade their orders in medium lot sizes (Ascioglu et al., 2011; Chakravarty, 2001; Mishra et al., 2015) to reduce price impact and information diffusion. Hodrick and Moulton (2009) show that investors not only consider price-time substitution effect but also the optimal traded quantities. They find liquidity is a key factor for the investors which determine the trading cost. An investor needs to focus on price, trade timing and optimal quantity to reduce trade cost. Trade size and price clustering have been observed in various markets (Verousis & ap Gwilym, 2013; Alexander & Peterson, 2007; Moulton, 2005). Further, it is observe that the degree of clustering is positively related to volatility and that asymmetry in clustering depends on whether stock prices are rising or falling sell limit orders cluster more frequently as prices are rising, although buy limit orders cluster more as prices are declining (Box & Griffith, 2016; Hu et al., 2016). Moreover, Blau and Brough (2012) demonstrate that short sellers' only aim is to exploit information inefficiencies, therefore they are less concerned with the price movement and indirect negotiation. They find that short selling positions demonstrate less size clustering and price clustering than non-short selling trades, confirming that short sellers are more focused on private information than negotiation costs. Further, do not find any relationship between trade clustering and stock liquidity for the algorithmic trades.

Prior literature provides various explanations to disclose price and size clustering occurrences. While building the behavioural framework for explaining price clustering, Osborne (1962) presents the first rigorous empirical evidence on price 'congestions' in US stock prices. He observes that closing stock prices tend to cluster on whole numbers, halves, quarters, and odd one-eighths in descending preference. While, Wyckoff (1963) notes that 'we think in round numbers and try to sell at round numbers.' Niederhoffer and Osborne (1962) state that 'the tendency of traders to prefer integers seems to be a fundamental and stable principle of stock market psychology.' Niederhoffer (1965) observes price clustering across different closing price dimensions i.e. actively traded and inactively traded shares, in high and low denomination shares, and in midday and end of the day prices. Niederhoffer and Osborne (1966) also argue that price clustering in stocks is a consequence of more limit and stop orders being placed on specialists' books at even eighths. Ikenberry and Weston (2003) find that investors having a preference for even numbers or numbers ending in a zero or five argue that "price clustering may be a collective preference by investors to voluntarily trade at particular price levels in order to minimize cognitive processing costs."

Ball et al. (1985) develop the price resolution hypothesis, which states that the degree of price resolution is a function of the amount of information in the market. Goodhart and Curcio (1991) affirms that the rounding of asset prices to integers reflects the basic attraction of each round number under the attraction hypothesis. Harris (1991) under his negotiation hypothesis states that the existence of a restricted set of discrete prices known to all traders reduces negotiation time due to prevalence of limited number of bid and offer prices. He also argues that price clustering occur on round fractions and it happens so because traders use a discrete set of prices to specify the terms of their trades. Price clustering also limits the amount of information exchanged between traders and in turn bid and offer price converge quickly and thus save the significant amount of time. Christie and Schultz (1994) and Christie, Harris, & Schultz (1994) build the collusion hypothesis and conclude that Harris's negotiation hypothesis appears incapable of explaining the lack of odd-eighth quotes for the majority of sample NASDAQ stocks. They rather present evidence that NASDAQ dealers avoid odd-eighth quotes to maintain wide spreads. Booth et al. (2000) propose price manipulation hypothesis to examine the relationship between internal trading and price clustering and they observe that an internal market is more prone to price manipulation or collusion. Kahn et al. (1999) observe that retail customers tend to underestimate odd-ending prices when recalling them and suggest a limited-recall hypothesis to explain the more frequent even-ending yields in the bank deposits. argue that the price resolution, negotiation, collusion, and limited recall hypotheses all rely on the fact that market makers or sellers either negotiate or unilaterally set prices.

Individual cognitive abilities play a crucial role in disproportionately large volume of limit orders and subsequent price clustering (Kuo, Lin, & Zhao, 2014). They find a positive correlation between cognitive ability and investment performance. They observe that investors with lower cognitive abilities suffer greater losses in their round-numbered and non-round-numbered limit orders, market

[1] See for details, Khanna and Palepu (2000), "Is group affiliation profitable in emerging markets? An analysis of diversified Indian business groups", The *Journal of Finance.*

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