

Bhaumik, Sumon Kumar; Chakrabarty, Manisha; Kutan, Ali M.; Selarka, Ekta

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**How Effective are Stock Market Reforms in Emerging Market Economies?
Evidence from a Panel VAR Model of the Indian Stock Market***

Sumon Kumar Bhaumik**

Sheffield University Management School, University of Sheffield, UK
IZA – Institute of Labor Economics, Bonn, Germany
Global Labor Organization

Manisha Chakrabarty

Indian Institute of Management Calcutta, India

Ali M. Kutan

Southern Illinois University Edwardsville, USA

Ekta Selarka

Madras School of Economics, India

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** *Corresponding author.* Address: Sheffield University Management School, University of Sheffield, Conduit Road, Sheffield S10 1FL, UK. Email: s.k.bhaumik@sheffield.ac.uk.

Abstract

The paper uses a panel VAR framework to estimate the impact of a series of reforms aimed at reducing transactions cost and information cost in India's secondary market for equity, on trading cost and trading volume. In particular, we focus on the reforms that were introduced after the creation of the National Stock Exchange (NSE) and screen-based trading that have been much discussed in the literature. Our results suggest that only the creation of the clearing corporation that reduced or eliminated counterparty risk had an economically meaningful/significant impact on trading cost and volume. We also find that the impact was much greater for mid-cap firms than for large-cap and small-cap firms. In the same vein, while trading costs and trading volumes Granger cause each other for mid-cap firms, there is only one-way causality for large-cap firms – trading cost Granger causes volume but the reverse is not true, and for small-cap firms there is no causal relationship between the two. Further, the impact of a shock to the trading cost on volume dissipates within 5 periods (months), as does the impact of a shock to the volume on trading costs. The implications of these findings are discussed in the paper.

JEL codes: C58, G12, G18, O16

Keywords: Stock market reforms; Trading cost; Trading volume; Panel VAR; Emerging market

1. Introduction

A fairly large literature suggests that, by and large, capital market development, in general, and stock market development, in particular, is associated with long-term economic growth (Atje and Jovanovic, 1993; Levine and Zevros, 1996). Levine and Zevros (1996) argue that well developed stock markets facilitate economic activities in a number of ways. In particular, stock markets can (a) reduce the liquidity risk of investors and thereby facilitate long-term investment commitments of these economic agents, (b) encourage investment in potentially risky projects with higher expected returns by facilitating risk diversification, (c) create a market for information about firms that can help overcome the frictions that exist in an environment of imperfect information, and (d) create a market for corporate control that can help reduce agency costs within firms.

This positive view of stock market development in emerging market contexts have been tempered by research that have suggested that the beneficial advantages of stock market development on economic growth may be moderated by country-specific institutions (Arestis and Demeriades, 1997), and that banks may contribute more towards promoting economic growth than stock markets (Arestis et al., 2001). Singh (1997) points out, informational efficiency of stock markets, which underpins some of the benefits of stock market development highlighted above, may not be easy to replicate in emerging market contexts. Harris (1997) demonstrates that the estimated impact of stock market development on economic growth may not be robust to the choice of specification and variable measurement. Similarly, the net benefits of opening up domestic capital markets to international capital flows have been keenly debated (Henry, 2000; Stiglitz, 2000). However, the popular wisdom strongly favors development of stock markets in emerging market contexts.

Unsurprisingly, therefore, there is significant interest in the development of stock markets in emerging markets. Some scholars have attempted to trace the timeline of stock market development in emerging market economies (Bekaert et al., 2003), while others have focused on the institutional and other determinants of stock market development in emerging market contexts (Billmeier and Massa, 2009). A number of scholars have examined the impact of capital market reforms in general (Bekaert and Harvey,

1997; Bekaert et al., 2001), as well as the impact of specific types of reforms such as opening up to international capital flows (Levine and Zevros, 1998; Kim and Singhal, 2000; Henry 2000), creation of more transparent trading platforms (Corwin and Schultz, 2012), and introduction of trading in financial derivatives (Bhaumik, Karanasos and Kartsaklas, 2016), on observable market characteristics such as bid-ask spreads, volume/liquidity, returns and volatility.¹

The growing literature on stock market development in emerging market economies, however, does not adequately address two important issues. First, governments and regulators use a number of policy measures to develop the stock market. For example, in the Indian context, there is a long list of reforms that included the creation of the National Stock Exchange (NSE) with order-driven, anonymous screen-based trading, creation of settlement and trade guarantee fund and investor protection fund, gradual introduction of T+N settlement rules, and introduction of derivatives trading on market indices and individual stocks. An important empirical question is whether all these policy measures have a significant impact on stock market development or whether some policy measures are much more important than others. A related issue is whether policy measures should be introduced in a specific sequence, with certain policies introduced early to speed up the process of equity market development (Bekaert, Harvey and Lundblad, 2003; Karacadag, Sundararajan and Elliott, 2003).

Second, in order for stock market development to have an economically meaningful impact on the real economy, the benefits of stock market development have to be reaped not just by large blue-chip companies but by a much wider range of companies, especially medium and smaller companies that have a track record of financial viability and those that require growth capital from the stock (and bond) market(s) (Berger and Udell, 1998, 2006). Specifically, the measures should reduce the trading cost and increase the trading volume – with attendant implications for information content – of not just stocks of large firms that anyhow find it relatively easy to access external capital but also those of smaller firms that generally find it more difficult to access external finance. Whether or not policy measures aimed at stock market

¹ In addition, there is a fairly large literature on informational efficiency of emerging equity markets (e.g., Kawakatsu and Morey, 1999; Lagoarde-Segot and Lucey, 2008)

development in emerging market contexts have this desired impact on stocks of smaller (or non-blue-chip) firms remains an empirical question that has not been adequately examined in the literature.

In this paper, we address the aforementioned lacunae in the literature. We model trading cost and trading volumes of a panel of individual stocks as vector auto-regressive (VAR) processes that are influenced by each other and also by policy measures aimed at stock market development. In effect, therefore, we have a panel VAR model, which we estimate using a system GMM approach. We estimate the model in the context of India, an emerging market economy that has adopted a number of measures aimed at stock market development since the early 1990s (Bajpai, 2006; Bhaumik et al., 2016). In particular, we focus on the reforms that were introduced after the creation of the NSE and screen-based trading that have been much discussed in the literature. Our results suggest that only the creation of the clearing corporation that reduced or eliminated counterparty risk had an economically meaningful/significant impact on trading cost and volume. We also find that the impact was much greater for mid-cap firms than for large-cap and small-cap firms. In the same vein, while trading costs and trading volumes Granger cause each other for mid-cap firms, there is only one-way causality for large-cap firms – trading cost Granger causes volume but the reverse is not true, and for small-cap firms there is no causal relationship between the two. Further, the impact of a shock to the trading cost on volume dissipates within 5 periods (months), as does the impact of a shock to the volume on trading costs. The implications of these findings are discussed later in the paper.

Our paper makes a number of contributions to the literature. First, while there is a large literature on the impact of capital account liberalization (Henry, 2000b) and factors such as political risk (e.g., Perotti and Van Oijen, 2001) on equity market development in emerging market context, there is very little evidence about the impact of policies and reforms aimed at equity market development on market characteristics such as the trading cost. In this paper, following in the footsteps of Barclays et al. (1999), Weston (2000) and Chelley-Steeley (2008), we contribute to the evidence base on emerging markets. Second, from a conceptual standpoint, we report evidence that suggest that not all policies or reforms have equal impact on equity markets. Specifically, we identify the policies that have the greatest impact, with

attendant implications for the sequencing of these policies. Finally, we provide evidence about the heterogeneity in the impact of these policies on trading costs and trading volumes of firms, by market capitalization, which highlights both the likely role of these policies on the width of emerging equity markets and the possible limits to the impact of these policies.

The rest of the paper is structured as follows: In Section 2, we describe the context of analysis, namely, the Indian equity market. In Section 3, we discuss our empirical strategy, and the variables used for the analysis. In Section 4, we discuss the data. The empirical results are reported and discussed in Section 5. Section 6 concludes.

2. Context of analysis

As documented in Shah and Thomas (2000), in the early 1990s, the Indian equity market was dominated by the Bombay Stock Exchange (BSE) which accounted for over 75 percent of the trading volume in the country. Even though the capital market regulator, the Securities and Exchange Board of India (1988), was officially created in 1988, it “acquired legal standing” (pp. 15) only in 1993, such that, until then, the BSE was de facto an unregulated securities market. Shah and Thomas (2000) note that, perhaps as a consequence, the BSE was able to create entry barriers on new members, thereby raising trading costs. The costs were even higher for investors who were located outside Mumbai, where the BSE was located, on account of inadequate telecommunication infrastructure. At the same time, the floor-based trading at the BSE contributed to non-transparency of prices, and market manipulation was arguably common. One of the factors that contributed to non-transparency of prices was the settlement at the BSE which was based on an account period in which “trades made in a single account during each two-week trading period were netted” (Shah and Thomas, 2000: pp. 17).² Shah and Thomas (2000) estimate that during that period trades in almost 6,900 of the 7,000 listed shares were settled bilaterally among the BSE members.

² This practice, which was known as *badla* trading, is much discussed in the literature and in policy circles. See, for example, Shah (1995) and Berkman and Eleswarapu (1998).

The reform of the Indian equity market began in earnest with the creation of the NSE in 1994. The market design at the NSE, which launched screen-based trading from inception and where “trading was based on order matching in an open limit order book market” (Shah and Thomas, 2000: pp. 17), arguably led to price transparency. It has also been argued that the creation of the NSE was a key reason for decline in trading costs in the Indian equity markets (OECD, 2007), with the market impact cost declining from 3.00 percent in 1993 to 0.50 percent in 1997 (Table 5.2, pp. 153). Over the same time period, the brokerage declined from 0.75 percent to 0.15 percent. Between 1994 and 2001, the NSE led the way in introducing several other reforms, such as the creation of a clearing corporation that reduced (or eliminated) counterparty risk associated with transactions “through ‘novation’ at the clearing corporation” (Shah and Thomas, 2001: pp. 7), dematerialization of shares, and replacement of *badla* trading with separate spot and futures (more generally, derivatives) markets. As discussed in Shah and Thomas (2001), many of these reforms were subsequently adopted by the BSE and other major exchanges.

The end to *badla* trading coincided with gradual introduction of T+N rolling settlement. At its inception, NSE reduced this netting period to one week, from the Wednesday of one week to the Tuesday of the following week. Rolling settlements were introduced gradually but, until June 2001, trading in only shares of only a few small and mid-cap companies had been shifted to Compulsory Rolling Settlement (CRS). However, with effect from July 2, 2001, SEBI mandated CRS in all large cap companies (mostly forming part of BSE- 200 Index and the shares having a facility of deferral of the trading positions) on T+5 basis. Further, with effect from, December 31, 2001, trading and settlement in all listed securities was mandated under CRS on T+5 basis and weekly or account period settlement was discontinued. Finally, with effect from April 1, 2002, trades are settled on T+3 basis.

In the post-2001 period, the two equity market reforms that stand out are the introduction of the Real Time Gross Settlement (RTGS) system and the introduction of pre-open call options. RTGS was first implemented in India in March 2004 as a major technology based electronic funds transfer system across the country. The system facilitated customer, inter-bank payment on a ‘real’ time and on gross basis. The system also facilitated settlement of Multilateral Net Settlement Batch (MNSB) files emanating from other

ancillary payment systems. The RTGS infrastructure is critical in facilitating the orderly settlement of payment obligations. This policy change is important in our research context as introduction of a critical financial market infrastructure operated by central bank that in turn ensures “safety net” attributes by providing final settlement in central bank money.

Pre-open call auctions, on the other hand, has implications for market transactions cost which can be conjectured as a spillover effect of improved transparency and price discovery. For example, Gerace et al. (2015) find that the dissemination of indicative trade information during the pre-open call auction session in China leads to an overall improvement in stock liquidity in the continuous trading session.³ Bid-ask spreads narrow in the first trading hour because adverse selection risk fell significantly and there is less price volatility in the continuous market. This effect is greater for actively traded securities than illiquid securities. On the other hand, as the limit order book is opaque during the auction period it may lead to reduction of liquidity especially for small companies which are facing thin market.

The post-NSE set of reforms have also led to decline in transactions cost in the Indian equity market. The counterparty risk associated with trading, for example, was completely eliminated by 2004 (OECD, 2007: Table 5.2). Similarly, between 1993 and 2004, settlement cost declined from 1.25 percent to 0.03 percent. However, estimates suggest that over the same time period, the decline in market impact cost and brokerage accounted for 73 percent of the decline in overall transactions cost. Further, the impact of some of the reforms such as introduction of RTGS have not been estimated at all. A priori, therefore, the impact of all equity market reforms on trading cost and market development is not similar and, at the same time, the Indian context is suitable for empirically examining this proposition.

³ In related research, Chelley-Steeley (2008) demonstrates that opening and closing market quality of participating stocks was improved by introduction of closing call auction at the London Stock Exchange. There is, in other words, prima facie evidence to suggest that the beneficial impact of such auctions may be generalizable across countries and across the specific nature of the auctions.

3. Empirical strategy and variable measurement

3.1 Empirical strategy

The literature on the economic implications of stock market development suggest that much of the benefits of stock market development results from greater investor participation in the secondary market. Greater investor participation has implications for information flow about the listed companies and, by extension, about the efficiency with which capital is allocated through the stock market. If greater investor participation improves liquidity of stocks in the secondary market, it can also reduce the cost of equity capital for firms (Butler et al., 2005). Arguably, therefore, a test of whether policy measures aimed at stock market development are successful should examine the impact of these policies on trading (or transactions) costs in the secondary market. This forms the basis of our empirical strategy.

Specifically, we use panel VAR to examine the implications of such stock market developments on the trading cost in the secondary market. In our VAR framework we also posit that if a change in trading costs has an impact on the trading volume in the secondary market, the resultant change in liquidity may, in turn, affect the trading cost by changing the price impact of trades. We, therefore, consider bivariate panel VAR model using trading costs and trading volumes. We use the panel VAR approach because the interactions between trading volume and transaction cost have not been strongly theoretically grounded, and hence a VAR-based a-theoretic set-up would be most applicable. Thus, in our model, we first examine the evolution of trading cost and trading volume following capital market reforms. Next, we explore in VAR framework how the changes in trading cost lead to changes in trading volume, thus affecting market liquidity and, in turn, trading cost.

Our regression model, therefore, is given by

$$\begin{pmatrix} y_{1it} \\ y_{2it} \end{pmatrix} = \begin{pmatrix} \sum_{j=1}^l \gamma_{1j} y_{1it-j} + \sum_{j=1}^l \delta_{1j} y_{2it-j} + \sum_{k=1}^5 \beta_{1k} D_k + (\text{control variables})_t + u_{1i} + \varepsilon_{1it} \\ \sum_{j=1}^l \gamma_{2j} y_{1it-j} + \sum_{j=1}^l \delta_{2j} y_{2it-j} + \sum_{k=1}^5 \beta_{2k} D_k + (\text{control variables})_t + u_{2i} + \varepsilon_{2it} \end{pmatrix} \quad [1]$$

where y_1 is trading cost, y_2 is trading volume, D_k are dummies for k stock market development policy initiatives, and ε are iid error terms. Since trading cost is a meaningful characteristic of individual stocks but not of a market index, we estimate this model using a panel of i firms listed at the NSE,⁴ such that u_i are firm-specific fixed effects accounting for heterogeneity at firm level. Further, since our interest does not lie in the market microstructure but in the impact of policy initiatives on trading costs (and trading volume) in the secondary market, we use monthly measures of trading costs and trading volume, such that the time indicator t indicates the number of months in the January 1995-November 2014 sample period. Specifically, for our sample, we have $i = 1, 2, \dots, 851$, and $t = 1, 2, \dots, 239$. The rationale for the sample size and the length of the time dimension is discussed in the next section.

The choice of the estimation method for the system characterized by (1) depends on the order of integration of the variables. If the system is cointegrated $CI(d, b)$ system, for which linear combinations of $I(d)$ variables are $I(0)$, there are four different representations of this cointegrated system (Watson, 1994), one of which is the VECM (vector error correction model) that is extensively used in the literature (e.g., Kurov and Lasser, 2004; Forte and Pena, 2009). However, where the variables are individually $I(0)$, they can be estimated using the basic VAR model (Lutkepohl, 2004). Given that equation (1) includes strictly exogenous variables, we will, in effect, estimate a VAR-X model (Breitung et al., 2004). As discussed later in the paper, the null hypothesis of (panel) unit root is rejected for our data, and hence we estimate a panel VAR model,⁵ using the system GMM approach following Holtz-Eakin et al. (1988) and Love and Zicchino (2006).⁶ The equations described in (1) are jointly estimated to ensure efficiency gains. We also allow for cross-sectional heterogeneity in the variance of error terms using sandwich variance estimator.

⁴ For a rationale for the choice of NSE as the context of analysis, see Bhaumik et al. (2016).

⁵ The model structure is, of course, compatible with a VAR as well as a VEC model. As we discuss later in the paper, we use appropriate tests to ascertain that variables are $I(0)$.

⁶ It is generally argued in the literature that since time-invariant individual-specific intercepts are correlated with the error term in dynamic panels (Nickell, 1981), it is prudent to estimate panel VAR models using GMM (e.g., Goes, 2016; Liu and Zhang, 2016; Ouyang and Li, 2018). While the magnitude of this bias is inversely related to T (Abrigo and Love, 2015), it is unclear as to whether it is sufficiently small to warrant OLS estimation for our sample period, especially because in our unbalanced panel T may not be large for a number of stocks/companies included in our sample.

3.2 Variable measurement

The key measurement issue in the context of our empirical model involves a decision about the proxy for trading costs; trading volume is easily measured (Bhaumik et al., 2016). Based on the discussion in Aiyagari and Gertler (1991) and Keim and Madhavan (1997), we argue that the bid-ask (or buy-sell) spread is perhaps the single most important component of trading costs. This is consistent with the discussion in the literature which suggests that the bid-ask spread is significantly made up of order processing costs and inventory holding costs of the investors (Stoll, 1989; Huang and Stoll, 1997).⁷ It is also consistent with the argument that non-trivial bid-ask spreads exist in the presence of (and hence is at least correlated with) transactions cost (Cohen et al., 1981). In other words, while the bid-ask spread may not be the perfect measure of trading (or transactions) cost (Lesmond et al., 1999), it can be a fairly good proxy for trading costs, especially when the analysis is restricted to a single exchange, thereby bypassing the problem of differences in brokerage costs across exchanges.

There is a large literature on estimation of bid-ask spreads, which can be traced back to Roll (1984). We estimate the spread using the approach of Corwin and Schultz [CS] (2012). The CS approach assumes that the actual value of a stock price follows a diffusion process, and that the daily high and the daily low prices are buyer-initiated and seller-initiated respectively. Thereafter, the CS approach involves the use of a closed-form solution, rather than the iterative and maximum likelihood estimation approaches that are computationally intensive. Most importantly, for our purposes, the CS estimator “is derived under very general conditions. It is not ad hoc and can be applied to a variety of different market structures” (Corwin and Schutlz, 2012: pp. 720). CS demonstrate that the spread estimated using their approach outperforms those estimated using the popular Roll (1994) and Lesmond et al. (1999) approaches.

The CS approach also enables us to compute bid-ask spreads for time periods such as a month. CS note that “[b]ecause the variance and the spread are nonlinear functions of the high-low price ratio, an

⁷ As demonstrated by George et al. (1991), the adverse selection component of the bid-ask spread, while significant, accounts for only 8-13 percent of the quoted spread.

average of spread estimates is not an unbiased estimate of the spread. *However, our simulation results and empirical analysis both suggest that this is not a problem in practice* (pp. 725; emphasis added).” They estimate monthly spreads as the average of all 2-day spread estimates within a calendar month; all negative spreads are set to zero and a minimum of 12 daily price ranges are required to calculate a monthly spread. Additionally, in the seminal paper, the CS estimator has been used to estimate monthly high-low spreads for stocks listed on (NYSE/Amex and) the Bombay Stock Exchange (BSE), i.e., for the Indian context, as a potential application on non-US markets.⁸

Next, we identify the specific policy measures that we include in our empirical model. In the Indian context, starting with the establishment of the National Stock Exchange (NSE) and screen-based order-driven trades, a number of policy measures have been introduced over time to facilitate stock market development (Bajpai, 2006: Appendix IV). To begin with, by way of restricting our sample period to the post-1994 period and considering securities which are listed on NSE, we leave out the creation of NSE and related trading policies from our set of policies, largely because the statistically and economically significant impact of the creation of NSE on bid-ask spread (and transactions cost) are well-documented (e.g., Corwin and Schultz, 2012). Of the others, we choose the following five policies which, in our judgement, constitute the most important post-NSE policy initiatives aimed at stock market development in India: [*d1*] the creation of National Securities Clearing Corporation Limited (NSCCL) in April 1996, which removed counterparty risk (and its cascading consequences) by guaranteeing each trade; [*d2*] the creation of National Securities Depository Limited (NSDL) in November 1996, which facilitated conversion of stocks from paper/physical to electronic form which, in turn, significantly reduced both trading costs and delays with share transfers; [*d3*] the introduction of derivatives trading and rolling settlement in July 2001;⁹ [*d4*] the introduction of real time gross settlement (RTGS) in October 2004; and [*d5*] the (re-)introduction of the call auction for Nifty, NSE’s flagship index, in October 2010.

⁸ More recent use of the CS spread can be found in Liu et al. (2016) and Rosati et al. (2017).

⁹ Even though compulsory rolling settlement (CRS) was introduced in a phased manner, we choose July 2001 as this was the first large scale implementation of CRS, with clear expectations about wider roll out of CRS over the foreseeable future.

Finally, we control for three exogenous factors that may have affected the Indian stock market. First, we control for the US interest rate which can affect cross-border capital flows. Second, we control for the market risk in developed markets using the VIX index of the Chicago Board Options Exchange (CBOE), which measures the near-term volatility conveyed by S&P 500 stock index option prices. Third, we control for the impact of the financial crisis, using September 2008 as the starting point for the crisis.¹⁰

4. Data

Recall that, for the panel VAR framework, we need, to begin with, measures of trading cost and trading volume. We compute these using data from the NSE, which is India's largest stock exchange by market capitalization. It is demutualized and, as mentioned above, has used a screen-based limit order matching system since its inception. It is argued that the NSE, therefore, provides a better-quality market than the BSE (Krishnamurti et al., 2003), and it is also the largest stock exchange in India by market capitalisation. Hence, while the older literature on the Indian stock market used data from the BSE (Berkman and Elewarapu, 1998), more recent literature has used data from the NSE as well (Bhaumik et al., 2016).

To begin with, for each month in our sample period, and for each stock in our sample, we measure volume using the daily average (Indian rupee) turnover of the stocks. Next, we follow the methodology of Corwin and Schultz (2012), discussed earlier in the paper, to calculate monthly spread for each stock, for each month in the sample period. The widely used panel unit root tests of Im, Pesaran and Shin [IPS] (2003) require that there be no gap in the data and given that trading gaps do exist for shares of mid-cap and small-cap companies. Also, for the asymptotic assumption of the IPS test to hold for an unbalanced panel, each

¹⁰ The exact timing of the start of the financial crisis is not easy to determine; see <https://www.stlouisfed.org/financial-crisis/full-timeline>. However, based on the movement of the S&P 500 index, we chose to view September 2008 as the start of the financial crisis. This is also consistent with the first substantive government intervention in the form of the decision by the Federal Housing Finance Agency (FHFA) to put Fannie Mae and Freddie Mac under conservatorship, on September 7, significant regulatory intervention by the regulators in Washington Mutual Fund and Wachovia Corporation, and the now infamous decision by Lehman Brothers Holdings to file for Chapter 11 bankruptcy on September 15.

stock included in our sample must have data for more than 9 time periods (i.e., months). Hence, we retain in our sample, only those stocks for which at least 12 months, i.e., 1 year of data are available. Overall, our final sample includes data on 849 firms for which continuous trading data is available, and our sample period extends from January 1995¹¹ to November 2014, such that we have 239 (monthly) data points in our sample.

INSERT Table 1 about here.

In Table 1, we report the average market capitalization, CS spread, and trading volume for our sample of firms. Unsurprisingly, the large-cap firms in the sample have much higher market capitalization, on average, than the mid-cap and small-cap firms.¹² Average trading volume too drops sharply as we move from the large-cap sub-sample to the mid-cap and small-cap sub-samples. Importantly, from the point of view of our analysis, the (average) spread too increases monotonically as one moves from the large-cap sub-sample to the small-cap sub-sample. This provides us with *prima facie* evidence that trading costs are higher for mid-cap and small-cap firms, thereby making it important to understand whether equity market reforms significantly reduce trading cost for these firms.

INSERT Figure 1 about here.

In Figure 1, we report the trends in the two endogenous variables in equation (1), namely, the CS spread and trading volume. The data suggests that over much of the sample period, there was both a difference between spreads of large-cap, mid-cap and small-cap firms, as well as considerable co-movements among these spreads. There was considerable convergence in the spreads of these three types of firms in the immediate aftermath of the financial crisis, but the spread for large-cap firms and others

¹¹ The NSE was opened in November 1994, providing Indian investors with an order-driven electronic limit order book, reduced tick sizes, satellite technology with links to sites all over India, and improved settlement and clearing standards (see Shah and Thomas (2000)). By October 1995, NSE had surpassed the BSE, becoming the dominant equities market in India.

¹² Our large-cap sub-sample includes 81 firms that were part of the CNX100 index for the duration of the sample period. Our mid-cap sub-sample includes firms whose average market capitalization over the sample period remained between the 25th and 75th percentiles of the distribution of market capitalization of the 851 firms in the full sample. Finally, our sub-sample of small-cap firms includes 85 firms whose average market capitalization over the sample period was in the bottom decile of the aforementioned distribution. While these classifications are admittedly *ad hoc*, we feel that they serve the purpose of examining how the impact of the equity market reforms vary across large-cap, mid-cap and small-cap firms.

diverged once again from 2010. The volume data confirms that trading volume is much higher for large-cap firms than for mid-cap and small-cap firms. This data also suggests that while trading volume of large-cap firms have increased sharply since 2004, there is a strong persistence in the trading volumes of mid-cap and small-cap firms. This raises the question as to whether any reduction in trading costs (as measured by the spread) on account of equity market reforms has a significant impact on trading volumes, and the efficacy of reforms that aim to increase depth and width of secondary equity markets by reducing the trading cost. We shall examine this issue more rigorously later in this section.

INSERT Table 2 about here.

In Table 2, we report the estimates of the panel unit root tests proposed by IPS (2003), and Maddala and Wu (1999) and Choi (2001) [MWC]. The null hypothesis of both the IPS and MWC tests is that all firms in the panel follow a unit root, and the alternative hypothesis is that some (but not all) of the firms have unit roots. The standardized test statistic follows a standard normal distribution. The non-parametric Fisher-type tests on which MWC is based uses p -values from unit root test for each firm, and the test statistic $P = -2 \sum_{i=1}^N \ln p_i$ asymptotically follows a chi-square distribution with $2N$ degrees of freedom. The p -values for the test are obtained using Monte Carlo simulations, and Fisher-type tests are suitable for unbalanced panels. They also allow lag lengths of the (augmented) Dickey-Fuller tests for the individual firms to differ. The test statistics reported in Table 2 and their significance levels suggest that the null hypothesis of unit roots for all firms in the sample (or respective sub-samples) is rejected by both the IPS and the MWC tests, for both the spread and the trading volume. As mentioned above, we therefore proceed with the estimation of the bivariate VAR model highlighted in equation (1). The results of the VAR model are reported and discussed in the next section.

5. Regression results

The estimates of the VAR model (equation (1)) is reported in Table 3. We report the estimates for the full sample, and the large-cap, mid-cap and small-cap sub-samples. The lag lengths for the spread and volume equations were determined using the moment-based AIC criterion developed by Andrews and Lu (2001)

for over-identified system. Further, as mentioned earlier in the paper, following Holtz-Eakin et al. (1988), the model has been estimated using system GMM. The Hansen's over identification J statistics (1982) reported in the table suggest that the choice of instruments has been appropriate.

5.1 Policy reforms, trading costs and volume

Recapitulate that the focus of this paper is on the impact of equity market reforms on trading costs, and its implications for depth and width of the equity market. Hence, as the first step of our analysis, we focus on the impact of (the post-1994) equity market reforms on trading cost, our proxy for which is the CS spread. Our coefficient estimates suggest the following: (a) the five reforms that we have chosen for our model have reduced the spread (i.e., the trading cost), (b) the impact of the introduction of the clearing house that reduces (or eliminate) counterpart risk has had a much greater *economic* impact on the spread than the other reforms (e.g., the coefficient for NSCCL is -0.03 for the full sample while the coefficients of the other reforms are smaller), and (c) the impact of the reforms on the spread is much greater for the mid-cap and small-cap sub-samples than for the large-cap sub-sample.

INSERT Table 3 about here.

In other words, the impact of the early reforms, the establishment of the NSE and the subsequent move towards screen-based trading (which has been discussed in the earlier literature), and the establishment of the clearing house (which we discuss in this paper) have contributed to disproportionately greater reduction in the spread (or trading cost) relative to other reforms in the context of India's equity market. Further, as highlighted by the *dynamic multiplier* graphs in Figure 2, which capture the impact of changes to exogenous variables on spread and volume,¹³ the equity market reforms (variables *d1* through *d5* in the graphs) had an immediate impact on the spreads of mid-cap and small-cap firms but incremental impact of these reforms on these spreads was negligible after the fifth period, where each time period is a

¹³ The confidence intervals shown on Figure 2 are constructed using 100 Monte Carlo simulations.

month. Hence, it may be important to focus on reforms that reduce information cost and the costs associated with contract enforcement, and to introduce them early to have an early and meaningful impact on equity market development.

INSERT Figure 2 about here.

As in the case of the spread/trading cost, while policy measures such as the creation of NSDL [d2] have had statistically significant impact on trading volumes at the NSE, the economic significance of these policies fade in comparison to the impact of the creation of NSCCL [d1]. Interestingly, however, once we control for other factors, the creation of NSCCL evidently reduced trading volume during the sample period. By contrast, the creation of NSDL increased trading volumes, as expected. Further, while the creation of NSCCL and NSDL had impact on trading volumes for large cap firms and, to a lesser extent, for mid-cap firms, none of the policies had any impact on the trading volumes of small-cap firms. Finally, the dynamic multiplier graphs in Figure 2 indicate that, as in the case of the trading cost, the marginal impact of the policies on trading volume, where significant, dissipates within five periods.

Regarding control variables, an increase in both the US interest rate and VIX (i.e., higher uncertainty) are associated with lower spread, as well as with lower trading volume. However, the relationships between VIX and both spread and volume are much less significant, from an economic point of view, than the relationships between (the change in) the US interest rate and spread and volume. Finally, both trading costs and trading volumes were higher during the period of financial crisis. The impact of VIX, change in the interest rate and financial crisis are not statistically significant for small-cap firms, particularly for volume of small-cap firms.

This is also corroborated with Figure 2. The financial crisis has a positive impact on volume and spread (as evidenced from 1st and 3rd graphs in the first row of Figure 2) and take approximately 5-6 months to come back to its origin (shown by 0 line). Similarly, the positive shock of other 2 variables such as VIX and Change in US interest rate lead to decreased transaction cost and volume of trade (more so for change in US interest rate), but these are also short-lived (as evidenced by 1st and 3rd graphs in 2nd and 3rd rows

respectively). The magnitude and time duration of these impacts decreases with the decrease in market capitalization.

5.2 VAR structure and impulse responses

Next, we examine the VAR structure of the model, i.e., we examine whether changes to the spread had any impact on trading volume and whether the changes to volume (and consequently to the liquidity of the secondary market) had any feedback effect on the spread. To begin with, we note that while spread and volume Granger cause each other in the full sample, the results are much more mixed for the three sub-samples. For the mid-cap firms spread and volume Granger cause each other, but for large-cap firms there is only one-way causality – spread Granger causes volume but the reverse is not true, and for small-cap firms there is no causal relationship between spread and volume.

INSERT Figure 3 about here.

Next, we examine the impulse response functions reported in Figure 3, and we are particularly interested in the impact of spread shocks on volume, and vice versa. The impulse response functions indicate the following: (a) The shock on the spread/transactions cost decreases the trading volume and its impact gradually diminishes over time. The impact is greatest for the mid-cap firms but even for these firms the impact dies out within five periods. (b) By contrast, a shock on volume increases the spread, once again much more for mid-cap firms than for the others. (The initial impact of a volume shock on spread is uneven for large-cap firms.) However, this shock too dies out within five periods. In other words, while we observe feedback from changes in spread/trading costs to trading volume, and vice versa, this feedback is most pronounced for the mid-cap firms, and negligible for small-cap firms.

5.3 Discussion

Emerging market regulators and policy makers pursue a number of different policies and reforms packages aimed at improving the quality of their equity markets, as part of a wider portfolio of reforms aimed at financial development. Indeed, these countries have the option to “liberalize in many ways and many countries have taken different routes” (Bekaert, Harvey and Lundblad, 2003; pp. 275). Not surprisingly perhaps, there is considerable heterogeneity among informational efficiency, transactions cost etc of emerging equity markets (Lagoarde-Segot, 2009). This, in turn, raises the question of whether all policies/reforms have an equal impact on market microstructure, which has implications for whether the portfolio of policies and reforms can be streamline and also for sequencing of these policies. In this paper, we abstract from issues of capital account liberalization (Henry, 2000b) and political risk (e.g., Perotti and Van Oijen, 2001) in emerging market economies, and focus on policies aimed at addressing microstructure issues, in the tradition of Barclay et al. (1999), Weston (2000) and Chelley-Steeley (2008). Specifically, we focus on the impact of policies and reforms on trading cost and trading volume.

Our results suggest that not all policies/reforms have an equal impact on the equity market. Specifically, in the Indian context, the creation of NSCCL, which minimized or eliminated counterparty risk, with attendant implications for transactions cost, had a much greater impact on both trading costs and trading volume than other policies such as the introduction of T+N rolling settlement and introduction of equity derivatives. Recapitulate that our sample period deliberately excludes the creation of the NSE and the associated move to screen-based trading which had significant impact on transactions cost at the Indian stock exchanges (Corwin and Schultz, 2012; OECD, 2007). Taken together, these results suggest that major changes such as transparency in pricing which reduces information cost and policies that reduce counterparty risk are perhaps much more relevant and important for the development of secondary equity markets than other reforms that may improve informational efficiency of the market and reduce volatility (e.g., Bhaumik et al., 2016), but which has limited impact on trading cost and trading volume.

We also find that the impact of policies and reforms vary by market capitalization of the firms. They have little impact on the trading costs and volumes of large-cap firms for which information costs and

transactions costs are perhaps low to begin with, and whose trading may be dominated by large informed traders who also have greater ability to enforce contracts. More importantly, these policies have nearly no impact on the trading cost and volume of small-cap firms, indicating that the policies may have limited success in increasing the width of the secondary market by reducing liquidity risks associated with equity of smaller firms which, in turn, has implications for the ability of these policies to improve capital access of smaller firms through the equity market. Taken together with the analysis of Berger and Udell (1998, 2006), this suggests that smaller emerging market firms may remain dependent on non-equity sources of capital. However, the policies have economically meaningful impact on the trading costs and volumes of mid-cap firms, suggesting that there is reason to be optimistic about the role of these policies to benefit a wider set of firms beyond the large-cap. Given that it is desirable from the policymakers' perspective to design reforms that increase trading of shares of small-cap firms which may make it easier for these firms to raise equity capital, our results suggest that policymakers may have to think beyond equity market reforms to help these companies.

Finally, we find that the impact of the exogenous policies on trading costs and volumes of firms dissipate within five periods which, in our empirical set up, corresponds to five months. This finding implies that the exogenous policies did not have a permanent impact on trading costs and volumes of firms. An important consideration, therefore, is whether trading cost and volume have a lasting impact each other, to ensure that the initial impact of the policies is sustained. Our results suggest that trading cost and volume Granger cause each other only for mid-cap firms. For large-cap firms, trading cost Granger causes volume but not the other way around, and these variables do not Granger cause each other for small-cap firms. Further, the impact of a shock to either of these variables on the other dissipates within five periods. These results add further credence to the argument that, on the one hand, policies aimed at equity market development may help increase the width of this market by reducing trading costs of mid-cap firms and, on the other hand, they may fail to benefit smaller firms with smaller market capitalization.

6. Conclusion

The debate about the exact impact of equity market development on the real sector (and, correspondingly, economic growth) notwithstanding, there is general agreement about the proposition that development of equity markets in emerging market economies, generally as a part of overall financial development, is a worthwhile endeavor. However, with the literature focusing largely on factors such as capital account liberalization and integration of emerging equity markets with global capital markets, there is little evidence about which policies or reforms aimed at equity market development have an economically meaningful impact, and whether these policies have equally beneficial reforms for all firms, irrespective of their market capitalization. In this paper, using a panel VAR structure, and data from 849 listed firms in India, for the January 1995-November 2014 period, we examine these issues. We deliberately leave out the creation of the NSE and the adoption of screen-based trading, whose benefits have been widely discussed, from our sample period. As such, our results suggest that only one of the subsequent policies have had economically meaningful impact on trading costs and volumes, and that the observed impact varies by market capitalization. Specifically, the impact is largely visible for mid-cap firms, limited for large-cap firms, and negligible for small-cap firms.

We have already discussed the implications of these findings in the previous section. However, it may be important to consider what the results and their implications mean for the broader issue of financial development, even if we restrict ourselves to the relatively narrow issue facilitating access to external capital for firms, especially small and medium enterprises, which has significant implications for economic growth. Our empirical analysis suggests that, in emerging market economies, while stock market development should undoubtedly be one of the pillars of financial development, the focus of policymakers may have to remain significantly on more traditional segments of the financial sector, such as the banking sector, especially if growth of smaller firms is a key policy consideration.¹⁴ Further, there is scope to reflect

¹⁴ That is not to say that smaller firms may not find it difficult to access bank credit – see the literature summarised in Fraser, Bhaumik and Wright (2015) – but that would be a separate discussion.

on whether attempts to facilitate access to long term capital should disproportionately focus on the stock market or whether the dividends are likely to be greater for reform (and development) of the market for fixed-income securities. But a discussion of these wider issues lies outside the scope of this paper.

References

- Abrigo, M.R.M., Love, I. (2015). Estimation of vector autoregression in Stata: A package of programs, Mimeo, Downloadable from <http://paneldataconference2015.ceu.hu/Program/Michael-Abrigo.pdf>.
- Andrews, D.W.K., Lu, B. (2001). Consistent model and moment selection procedures for GMM estimation with application to dynamic panel data models, *Journal of Econometrics*, 101(1):123-164.
- Arestis, P., Demetriades, P. (1997). Financial development and economic growth: Assessing the evidence, *Economic Journal*, 107(442): 783-799.
- Arestis, P., Demetriades, P.O, Luintel, K.B. (2001). Financial development and economic growth, *Journal of Money, Credit and Banking*, 33(1): 16-41.
- Atje, R., Jovanovic, B. (1993). Stock markets and development, *European Economic Review*, 37(2-3): 632-640.
- Ayigari, S.R., Gertler, M. (1991). Asset returns with transactions costs and uninsured individual risk, *Journal of Monetary Economics*, 27(3): 311-331.
- Bajpai, G.N. (2006). Development of the securities market in India, In: Aziz, J., Dunaway, S., Prasad, E. (eds.) *China and India: Learning from Each Other – Reforms and Policies for Sustained Growth*, Washington, DC: International Monetary Fund.
- Barclay, M.J. et al. (1999). Effects of market reform on the trading costs and depths of Nasdaq stocks, *Journal of Finance*, 54(1): 1-34.
- Bekaert, G., Harvey, C.R. (1997). Emerging equity market volatility, *Journal of Financial Economics*, 43(1): 29-77.
- Bekaert, G., Harvey, C.R., Lundblad, C.T. (2001) Emerging equity markets and economic development, *Journal of Development Economics*, 66(2): 465-504.
- Bekaert, G., Harvey, C.R., Lundblad, C.T. (2003). Equity market liberalization in emerging markets, *Journal of Financial Research*, 26(3): 275-299.
- Berger, A.N., Udell, G.F. (1998). The economics of small business finance: The roles of private equity and debt markets in the financial growth cycle, *Journal of Banking and Finance*, 22: 613-673.

- Berger, A.N., Udell, G.F. (2006). A more complete conceptual framework for SME finance, *Journal of Banking and Finance*, 30: 2945-2966.
- Berkman, H., Eleswarapu, V.R. (1998). Short-term traders and liquidity: A test using Bombay Stock Exchange data, *Journal of Financial Economics*, 47(3): 339-355.
- Bhaumik, S.K., Kartsaklas, A., Karanasos, M. (2016). The informative role of trading volume in an expanding spot and futures market, *Journal of Multinational Financial Management*, 35: 24-40.
- Billmeier, S., Massa, I. (2009). What drives stock market development in emerging markets – institutions, remittances, or natural resources? *Emerging Markets Review*, 10(1): 23-35.
- Breitung, J., Bruggemann, R., Lutkepohl, H. (2004). Structure vector autoregressive modeling and impulse responses, In: Lutkepohl, H., Kratzig, M. (eds.) *Applied Time Series Econometrics*, Cambridge: Cambridge University Press.
- Butler, A.W., Grullon, G., Weston, J.P. (2005). Stock market liquidity and the cost of issuing equity, *Journal of Financial and Quantitative Analysis*, 40(2): 331-348.
- Chelley-Steeley, P.L. (2008). Market quality changes in the London Stock Market, *Journal of Banking and Finance*, 32(10): 2248-2253.
- Choi, I. (2001). Unit root tests for panel data, *Journal of International Money and Finance*, 20(2): 249-272.
- Cohen, K.J., Maier, S.F., Schwartz, R.A., Whitcomb, D.K. (1981). Transactions costs, order placement strategy, and existence of the bid-ask spread, *Journal of Political Economy*, 89(2): 287-305.
- Corwin, S.A., Schultz, P. (2012). A simple way to estimate bid-ask spreads from daily high and low prices, *Journal of Finance*, 67(2): 719-760.
- Forte, S., Pena, J.I. (2009). Credit spreads: An empirical analysis on the informational content of stocks, bonds, and CDS, *Journal of Banking & Finance*, 33(11): 2013-2025.
- Fraser, S., Bhaumik, S.K., Wright, M. (2015). What do we know about entrepreneurial finance and its relationship with growth? *International Small Business Journal*, 33(1): 70-88.
- George, T.J., Kaul, G., Nimalendran, M. (1991). Estimation of the bid-ask spread and its components: A new approach, *Review of Financial Studies*, 4(4): 623-656.

- Gerace, D., Liu, Q., Tian, G.G., Zheng, W. (2015). Call auction transparency and market liquidity: Evidence from China, *International Review of Finance*, 15(2): 223-255.
- Goes, C. (2016). Institutions and growth: A GMM/IV panel VAR approach, *Economics Letters*, 138: 85-91.
- Hansen, L.P. (1982). Large sample properties of generalized method of moments estimators, *Econometrica*, 50(4): 1029-1054.
- Harris, R.D.F. (1997). Stock markets and development: A re-assessment, *European Economic Review*, 41(1): 139-146.
- Henry, P.B. (2000a). Do stock market liberalizations cause investment booms? *Journal of Financial Economics*, 58(1-2): 301-334.
- Henry, P.B. (2000b). Stock market liberalization, economic reform, and emerging market equity prices, *Journal of Finance*, 55(2): 529-564.
- Holtz-Eakin, D., Newey, W., Rosen, H.S. (1988). Estimating vector autoregressions with panel data, *Econometrica*, 56(6): 1371-1395.
- Huang, R.D., Stoll, H.R. (1997). The components of the bid-ask spread: A general approach, *Review of Financial Studies*, 10(4): 995-1034.
- Im, K.S., Pesaran, M.H., Shin, Y. (2003). Testing for unit roots in heterogeneous panels, *Journal of Econometrics*, 115(1): 53-74.
- Karacadag, C., Sundararajan, V., Elliott, J.E. (2003). Managing risks in financial market development: The role of sequencing, Working paper no. WP/03/116, International Monetary Fund, Washington, D.C.
- Karmakar, M. (2010). Information transmission between small and large stocks in the National Stock Exchange in India: An empirical study, *Quarterly Review of Economics and Finance*, 50(1): 110-120.
- Kawakatsu, H., Morey, M.R. (1999). Financial liberalization and stock market efficiency: An empirical examination of nine emerging market countries, *Journal of Multinational Financial Management*, 9(3-4): 353-371.

- Keim, D.B., Madhavan, A. (1997). Transactions cost and investment style: An inter-exchange analysis of institutional equity trades, *Journal of Financial Economics*, 46: 265-292.
- Kim, E.H., Singhal, V. (2000). Stock market openings: Experience of emerging economies, *Journal of Business*, 73(1): 25-66.
- Krishnamurti, C., Sequeira, J.M., Fangjian, F. (2003). Stock exchange governance and market quality, *Journal of Banking & Finance*, 27(9): 1859-1878.
- Kurov, A., Lasser, D.J. (2004). Price dynamics in the regular and E-Mini futures, *Journal of Financial and Quantitative Analysis*, 39(2): 365-384.
- Lagoarde-Segot, T. (2009). Financial reforms and time-varying microstructures in emerging equity markets, *Journal of Banking and Finance*, 33(10): 1755-1769.
- Lagoarde-Segot, T., Lucey, B.M. (2008). Efficiency in emerging markets – evidence from the MENA region, *Journal of International Financial Markets, Institutions and Money*, 18(1): 94-105.
- Lesmond, D.A., Ogden, J.P., Trzeinka, C.A. (1999). A new estimate of transactions costs, *Review of Financial Studies*, 12(5): 1113-1141.
- Levine, R., Zevros, S. (1996). Stock market development and long-run growth, *World Bank Economic Review*, 10(2): 323-339.
- Levine, R., Zevros, S. (1998). Capital control liberalization and stock market development, *World Development*, 26(7): 1169-1183.
- Liu, W., Luo, D., Zhao, H. (2016). Transactions costs, liquidity risk, and the CCAPM, *Journal of Banking & Finance*, 63: 126-145.
- Liu, G., Zhang, C. (2016). The dynamic linkage between insurance activities and banking credit: Some evidence from global countries, *International Review of Economics & Finance*, 44: 40-53.
- Love, I., Zicchino, L. (2006). Financial development and dynamic investment behavior: Evidence from panel VAR. *Quarterly Review of Economics and Finance*, 46(2): 190-210.
- Lutkepohl, H. (2004). Vector autoregressive and vector error correction models, In: Lutkepohl, H., Kratzig, M. (eds.) *Applied Time Series Econometrics*, Cambridge: Cambridge University Press.

- Maddala, G.S., Wu, S. (1999). A comparative study of unit root tests with panel data and a new simple test, *Oxford Bulletin of Economics and Statistics*, 61(51): 631-652.
- Nickell, S. (1981). Biases in dynamic model with fixed effects, *Econometrica*, 49(6): 1417-1426.
- OECD (2007). OECD Economic Surveys: India, Volume 2007/14.
- Ouyang, Y., Li, P. (2018). On the nexus of financial development, economic growth, and energy consumption in China: New perspective from a GMM panel VAR approach, *Energy Economics*, 71: 238-252.
- Perotti, E.C., Van Oijen, P. (2001). Privatization, political risk and stock market development in emerging economies, *Journal of International Money and Finance*, 20(1): 43-69.
- Roll, R. (1984). A simple implicit measure of the effective bid-ask spread in an efficient market, *Journal of Finance*, 39(4): 1127-1139.
- Rosati, P. et al. (2017). The effect of data breach announcements beyond the stock price: Empirical evidence on market activity, *International Review of Financial Analysis*, 49: 146-154.
- Shah, A. (1995). The impact of speculation upon volatility and market efficiency: The *badla* experience on the BSE, Mimeo, Centre for Monitoring Indian Economy, Mumbai. Downloadable from https://www.researchgate.net/profile/Ajay_Shah6/publication/2349922_The_impact_of_speculation_on_volatility_and_market_efficiency_The_badla_experience_on_the_BSE/links/54c1bcf80cf2dd3cb958e58d.pdf.
- Shah, A., Thomas, S. (2000). David and Goliath: Displacing a primary market, *Global Financial Markets*, Spring: 14-23.
- Shah, A., Thomas, S. (2001). The evolution of the securities markets in India in the 1990s, Mimeo, Indira Gandhi Institute of Development Research, Mumbai. Downloadable from <https://pdfs.semanticscholar.org/f5e5/1f168f5d641d95e095ce919bca9bdca4dacc.pdf>.
- Sharma, J.L., Kennedy, R.E. (1977). A comparative analysis of stock price behavior on the Bombay, London, and New York stock exchanges, *Journal of Financial and Quantitative Analysis*, 12(3): 391-413.

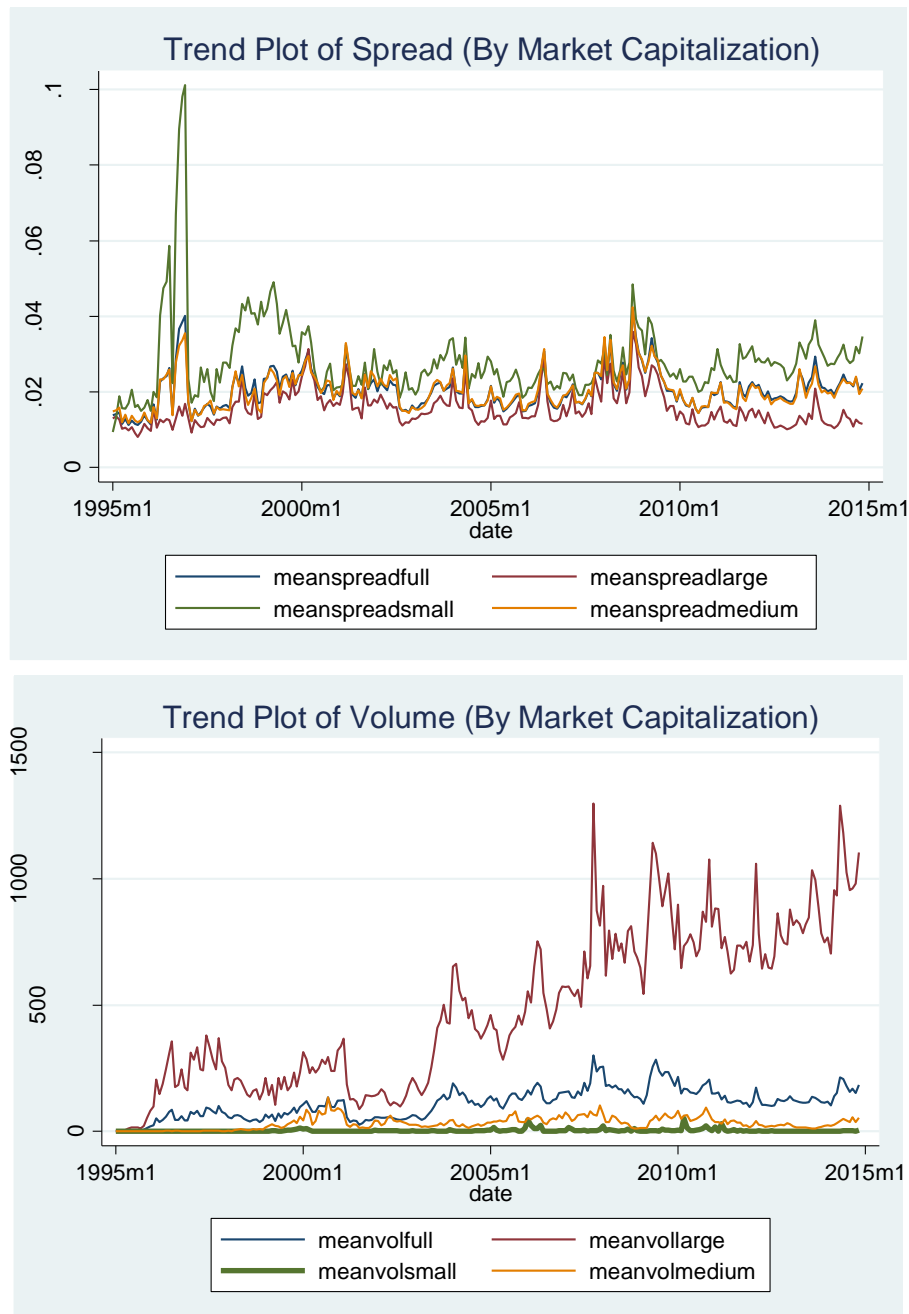
- Singh, A. (1997). Financial liberalisation, stock markets and economic development, *Economic Journal*, 107(442): 771-782.
- Stiglitz, J.E. (2000). Capital market liberalization, economic growth and instability, *World Development*, 28(6): 1075-1086.
- Stoll, H.R. (1989) Inferring the components of the bid-ask spread: Theory and empirical tests, *Journal of Finance*, 44(1): 115-134.
- Weston, J.P. (2000). Competition on the Nasdaq and the impact of recent market reforms, *Journal of Finance*, 55(6): 2565-2598.

Table 1. Descriptive statistics

	No. of firms/stocks (No. of firm-months)	Market capitalization	CS Spread	Volume
Full sample	849 (99,327)	53,376.05 (211,387.60)	0.021 (0.016)	131.84 (483.28)
Large-cap firms	81 (14,694)	270,942.80 (486,127.80)	0.016 (0.008)	544.19 (1,008.28)
Mid-cap firms	425 (49,126)	7,987.52 (10,063.50)	0.021 (0.013)	36.03 (149.90)
Small-cap firms	85 (7,005)	529.39 (472.70)	0.028 (0.023)	3.69 (35.74)

Note: Our data involves a sample of 849 firms listed at the National Stock Exchange of India (NSE), for a period of 239 months. In the course of the analysis, we distinguish between large-cap firms, those that were consistently part of the CNX100 market index for the sample period, mid-cap firms that lay between the 25th and 75th percentiles of the distribution of market capitalization for the sample period, and small-cap firms that were consistently in the bottom decile of the distribution over the sample period. The figures reported in Table 1 suggest that there was a steep decline in both the market capitalization and trading volume of the average firm as one moves from the large-cap sub-sample to the small-cap sub-sample. Correspondingly, there is a noticeable increase in the CS spread, which is our proxy for trading costs. (The values within parentheses are standard deviations.)

Figure 1. Trends in CS spread and volume over the sample period



Note: The plots reported in Figure 1 suggest that while there is a clear difference in the spread for *large*-, *medium*- and *small*-cap firms, these trends tend to move together. By contrast, there is a clear divergence between the trading volumes of *large*- and *medium*- and *small*-cap firms since 2005. While the trading volume of *large*-cap firms has risen sharply, trading volumes of the *medium*- and *small*-cap firms remain steady at much lower levels.

Table 2. Panel unit root

Sample	Im, Pesaran and Shin		Maddala and Wu/Choi	
	Spread	Volume	Spread	Volume
Full sample (n = 849 & nT = 99,327)	- 100.00 *** (0.00)	- 280.00 *** (0.00)	16,100.00 *** (0.00)	15,100.00 *** (0.00)
Large-cap firms (n = 81 & nT = 14,694)	- 35.05*** (0.00)	- 16.49*** (0.00)	1377.50*** (0.00)	469.24*** (0.00)
Mid-cap firms (n = 425 & nT = 49,126)	- 69.87*** (0.00)	-100.00*** (0.00)	5640.22*** (0.00)	5267.36*** (0.00)
Small-cap firms (n = 85 & nT = 7,005)	- 29.52*** (0.00)	-290.00*** (0.00)	818.86*** (0.00)	1187.35*** (0.00)

Note: The results reported in the table use the panel unit root tests proposed by Im, Pesaran and Shin (2003), and Maddala and Wu (1999) and Choi (2001). The null hypotheses for both these tests is that all panels have unit roots. The reported test statistics were generated using ADF test; the lag length was chosen on the basis of AIC. The values within parentheses are p-values and *** indicate significance at the 1 percent level. The Choi Test Statistic is Chi-Square and IPS test follows asymptotically normal distribution.

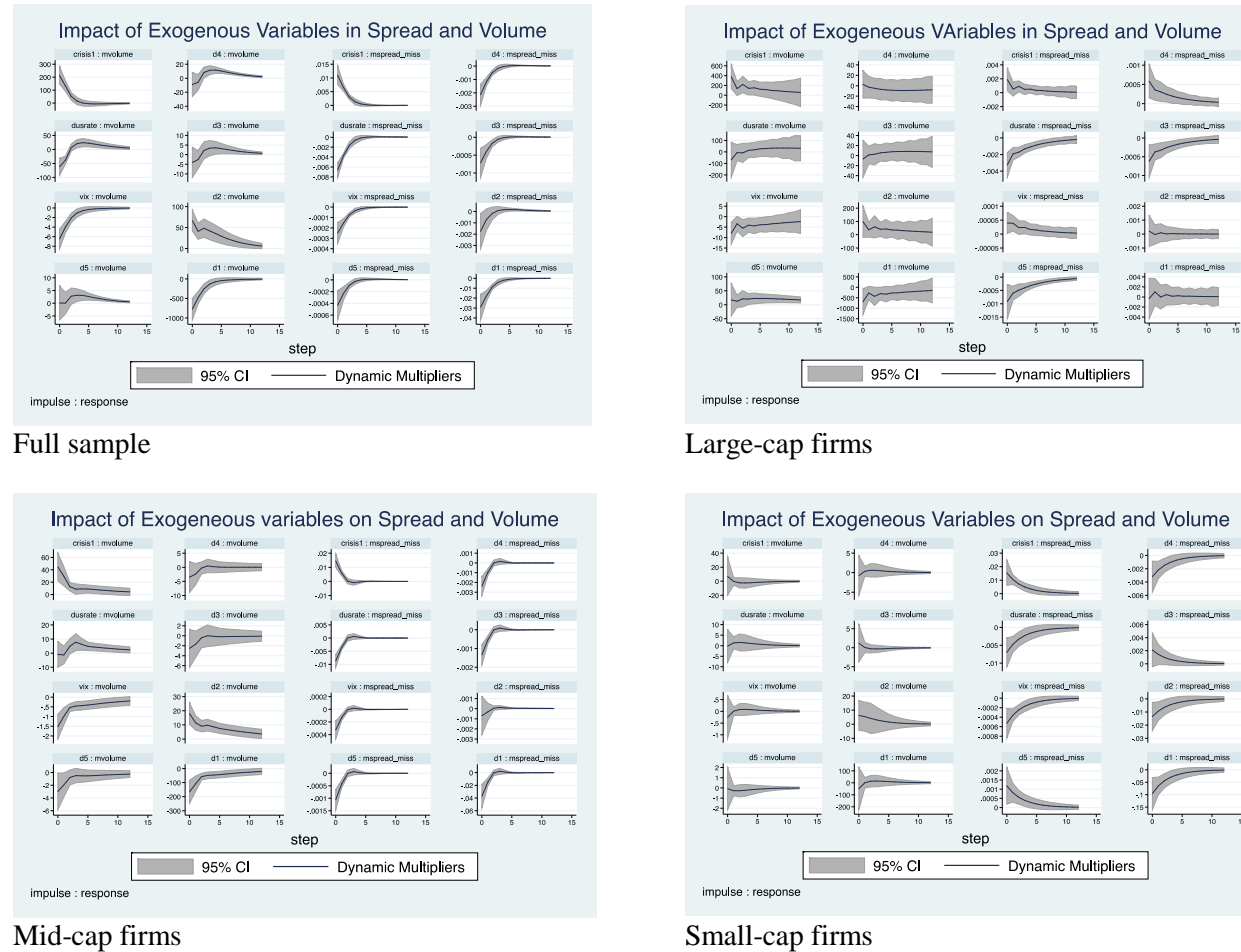
Table 3. VAR estimates

	Full sample		Large-cap firms		Mid-cap firms		Small-cap firms	
	Spread Eq.	Volume Eq.	Spread Eq.	Volume Eq.	Spread Eq.	Volume Eq.	Spread Eq.	Volume Eq.
<i>Autoregressive elements</i>								
Spread (L1)	0.53 *** (0.00)	55.00 (0.97)	0.62 *** (0.00)	- 63.81 (0.65)	0.41 *** (0.00)	76.83 (0.56)	0.68 *** (0.00)	- 207.16 (0.53)
Spread (L2)	- 0.07 * (0.09)	- 6311.78 *** (0.00)	- 0.13 *** (0.00)	- 454.70 * (0.06)	- 0.17 *** (0.00)	- 690.95 * (0.08)		
Spread (L3)					- 0.01 (0.88)	- 287.67 *** (0.02)		
Volume (L1)	3.11E-06 ** (0.01)	0.62 *** (0.00)	- 1.73E-06 (0.15)	0.39 * (0.08)	- 1.41E-06 (0.35)	0.64 *** (0.00)	- 0.00001 (0.40)	0.41 *** (0.00)
Volume (L2)	- 4.82E-07 (0.65)	0.18 *** (0.00)	- 1.54E-06 (0.14)	0.47 ** (0.02)	4.40E-06 *** (0.01)	0.08 (0.11)		
Volume (L3)					4.52E-07 (0.65)	0.15 *** (0.01)		
<i>Equity market reforms</i>								
NSCCL	- 0.03 *** (0.00)	- 772.99 *** (0.00)	- 0.0003 (0.89)	- 688.52 ** (0.02)	- 0.04 *** (0.00)	- 165.55 *** (0.00)	- 0.10 *** (0.01)	- 48.75 (0.60)
NSDL	- 0.002 ** (0.03)	66.58 *** (0.00)	- 0.0002 (0.70)	96.99 * (0.10)	- 0.001 (0.46)	17.96 *** (0.00)	- 0.01 ** (0.02)	6.25 (0.23)
CRS	- 0.001 *** (0.00)	- 4.03 (0.33)	- 0.001 *** (0.01)	- 6.61 (0.69)	- 0.001 *** (0.00)	- 2.52 (0.20)	0.002 (0.11)	1.19 (0.64)
RTGS	- 0.002 *** (0.00)	- 9.13 (0.31)	0.001 ** (0.01)	2.37 (0.88)	- 0.002 *** (0.00)	- 3.49 (0.21)	- 0.003 *** (0.01)	- 0.76 (0.77)
Call auction	- 0.0004 *** (0.00)	0.12 (0.97)	- 0.001 ** (0.01)	17.25 (0.56)	- 0.001 *** (0.00)	2.97 (0.13)	0.01 ** (0.02)	- 0.08 (0.94)
<i>Control variables</i>								
VIX	- 0.0003 *** (0.00)	- 6.47 *** (0.00)	0.00004 ** (0.03)	- 7.96 *** (0.01)	- 0.0003 *** (0.03)	- 1.52 *** (0.00)	- 0.01 *** (0.00)	- 0.25 (0.60)
Change in US interest rate	- 0.01 *** (0.00)	- 61.70 (0.00)	- 0.003 *** (0.00)	- 68.58 (0.36)	- 0.01 *** (0.00)	- 0.92 (0.83)	- 0.01 *** (0.01)	- 0.23 (0.96)
Financial crisis dummy	0.01 *** (0.00)	212.98 *** (0.00)	0.002 ** (0.03)	375.53 *** (0.01)	0.02 *** (0.00)	44.54 *** (0.00)	0.03 *** (0.00)	7.04 (0.62)

Granger test								
Spread → Vol	23.07 ***		9.69 ***		7.86 ***		0.40	
Vol → Spread	16.81 ***		2.18		11.80 ***		0.72	
Hansen J statistic	9.01 (0.27)		6.78 (0.87)		3.05 (0.99)		10.52 (0.57)	
No. of obs.	96,780		14,451		47,425		6,835	

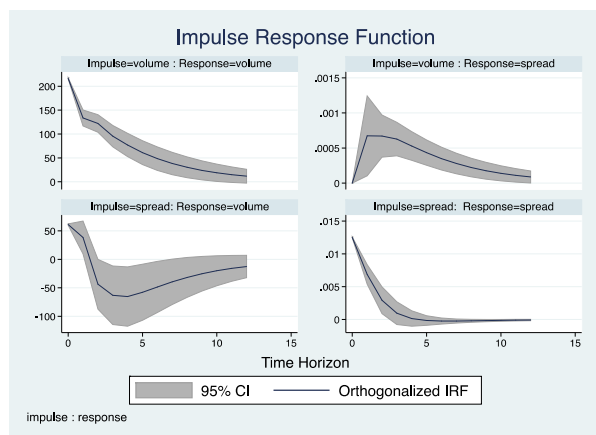
Note: The table reports the estimates of the VAR model highlighted in equation (1). The lag lengths were chosen on the basis of the moment-based AIC criterion developed by Andrews and Lu (2001). Following Holtz-Eakin et al. (1988), the model is estimated using GMM. The non-significance of the Hansen J statistic suggests that the choice of instruments is appropriate. The figures within parentheses are p-values and ***, ** and * indicate significance at the 1 percent, 5 percent and 10 percent levels, respectively. The regression estimates suggest that while many of the five reforms chosen for the model had statistically significant impact on the spread, our proxy for trading cost, the impact was economically meaningful only for the first post-NSE reform, namely, the creation of NSCL. Further, the impact is much greater for small-cap and, to a lesser extent, mid-cap companies than for large-cap companies. The number of observations indicate nT after adjusting for lag-lengths used in the VAR models.

Figure 2. Impact of equity market reforms on spread

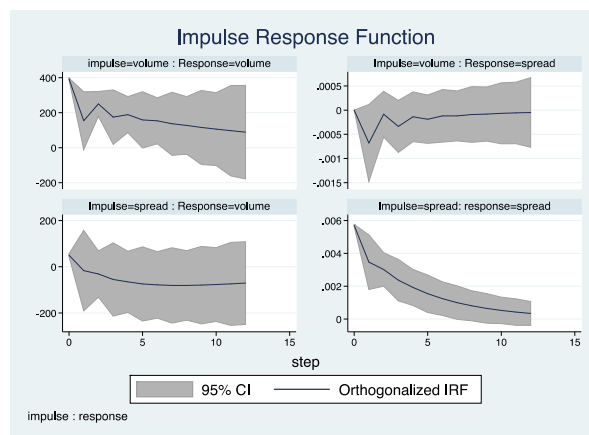


Note: In this figure we report the impact of changes to the exogenous variables on spread and volume, for the full sample as well as for the large-cap, mid-cap and small-cap sub-samples. The graphs suggest that the five equity market policies/reforms (*d1* through *d5*) used in our model reduced the spread for the mid-cap and small-cap firms immediately after their introduction but there was no incremental impact on the spread beyond the 5th period (month, in our case). The impact of these reforms on the spread for the large-cap firms was much less significant from an economic viewpoint.

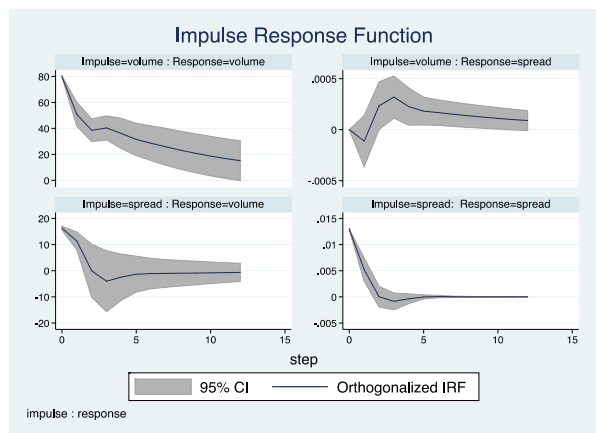
Figure 3. Impulse response functions (spread and volume)



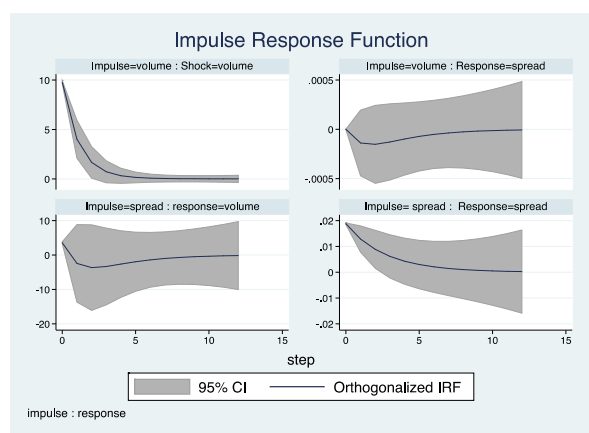
Full sample



Large-cap firms



Mid-cap firms



Small-cap firms

Note: A shock on spread reduces volume, albeit much more for mid-cap firms than for large-cap or small-cap firms. Even for mid-cap firms, this shock dies out within five periods, i.e., five months. By contrast, a shock on volume increases the spread, once again much more for mid-cap firms than for the others. (The initial impact of a volume shock on spread is uneven for large-cap firms.) However, this shock too dies out within five periods.