Final report

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Evidence from the National Stock Exchange in India

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February 2017

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Forgery, market liquidity, and demat trading: Evidence from the National Stock Exchange in India*

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Abstract

We analyse the impact of the establishment of a new technology on the National Stock Exchange in India that allowed trading of stocks without the need to transfer paper share certificates (demat trading). We find that there was a sharp increase in market liquidity following its introduction and this was greatest for those stocks that were previously illiquid. We present evidence that suggests that the primary channel for the increase in liquidity was the elimination of the risk of being sold forged securities as the clearing system took on the risk of reimbursing buyers of forged shares at the establishment of demat trading.

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1 Introduction

In early 1990s, the Government of India initiated a series of reforms in the financial markets. The reforms were triggered by a host of factors, including stock price manipulations leading a very big scandal leading to a stock market meltdown, shattering investors' confidence. A key component of the reforms was creation of a new stock market, the National stock exchange (NSE) which resulted from stiff opposition of the brokers to reforming the Bombay Stock Exchange (BSE). The reforms covered a wide range areas including methods of trading, payment and settlement. Moreover, the governance structure of the new stock exchange was very different from that of the BSE. While the BSE was owned by the brokers, the new NSE was set up by large financial institutions backed by the government. A series of studies have examined these reforms.[1]

Important and cutting edge changes were to both technological and organisational design of the stock market. The table 1 below summarises the timeline of key reforms undertaken in the period.[2] As a part of the reform, on 26 December 96, the NSE introduced an innovation called de-materialised (demat) trading. This eliminated the need to transfer paper share certificates from seller to the buyer. Instead buyers and sellers hold an account in a centralised depository, much like a bank account, which contains a record of their portfolio. At the conclusion of a transaction the security is simply debited from the sellers account and credited to the buyers account.

We find that the adoption of demat trading had a large effect on the liquidity of securities as measured by the bid ask spread. In particular we find that on average the bid ask spread dropped by around 22%. Moreover we find that the drop was greater for those firms that had the higher bid ask spread before the adoption of demat trading. These results are estimated using a short time window of 20 trading days, and are robust to varying the time window and inclusion of other controls such as the trading volume. We also find that the trading volume and the number of transactions increased by about 15% at the NSE relative to the Bombay stock Exchange for the same period.

One of the main reasons for the adoption of demat trading was the circulation of forged

[1] See **krishnamurti03 gupta92 rajan05 shah99 thomas06** among others.

[2] Table 2 gives a more comprehensive treatment of the financial markets reforms.

paper share certificates. It was hoped that a shift to the electronic demat form would eliminate the effect of their existence on trading. Prior to the adoption of demat trading, buyers were wary of receiving forged shared certificates, and this naturally dampened trading. After the adoption of demat, the clearing system (NSCCL) had a mechanism to implement its mandate of guaranteeing trades when one of the parties to the transaction could not deliver. This meant that buyers were now fully insured against the possibility of receiving forged share certificates, as the clearing system would step in to ensure they were delivered authentic shares in demat form.

We construct a simple model based on this idea. In addition to the average drop in the bid ask spread, and in line with this model, we find that there is a larger drop in the bid ask spread for the firms with an initially high spread. Moreover there is a disproportionate increase in the volume and the number of transactions for these firms, which is also consistent with our model.

Table 1: Historical Background

12 April 1992	The Securities and Exchange Bureau of India is created by an act of parliament. This body regulates the capital markets in India.
11 November 1994	NSE begins to function. The NSE is established as an online trading platform.
14 March 1995	Online trading introduced at the BSE. For a transaction to be completed the seller must physically deliver the share certificates to the buyer.
April 96	National Securities Clearing Corporation Ltd. (NSCCL) is established. It has the mandate to act as a market participant who takes on the risk of the counterparty default and ensures that the payments are performed even in case of default.
October 1995	NSE overtakes the BSE and becomes the largest stock exchange in India.
26 December 1996	Demat trading begins on the NSE. This gives the NSCCL a mechanism to make good on its mandate to compensate buyers for delivery of fake shares by exchanging these for authentic shares in a demat form.
29 December 1997	Demat trading begins on the BSE

2 Model

In this section we construct a simple model based on the lemons model (**akerlof**) to derive testable implications that we take to the data in section 3. We model a perfectly competitive market with dealers (market makers) who quote a price for buying and selling any stock, and there is a measure 1 of traders (sellers) each holding one security, who decide whether to sell the security at a price quoted by the dealers. Although we use the dealer market to ease the analysis, we should note that the NSE is an auction market.[3]

The value of an authentic security of firm i is commonly known to be $v_i > 0$. There is a fraction γ_i of forged securities for firm i with 0 value. Whether a security is forged or authentic is only privately observable to the seller.

The sellers with forged securities are willing to sell for any price $p_i \geq 0$. Among the traders with the authentic securities, there a fraction $s(p_i, v_i)$ are willing to sell the security of firm i when the price is p_i and the value of the firm is v_i. We assume that $s(p_i, vi)$ is continuous, increasing in p_i and $s(p_i, vi) = 1$ if $p_i \geq v_i$. Since there are liquidity sellers, $s(p_i, vi) > 0$ is possible even when $p_i < v_i$. The fact that $s(p_i, vi)$ is increasing in p_i captures the idea that the need for liquidity may be heterogeneous and hence number of sellers is increasing in p_i.

Normalizing the total number of shares for all firms to 1 the total supply of securities for firm i is

$$1 \text{ if } p_i \geq v_i$$

$$\gamma_i + (1 - \gamma_i)s(p_i, v_i) \text{ if } v_i > p_i \geq 0$$

Let $\hat{v}_i(p_i)$ be the average value of a security as a function of its price. Using the supply above we find

$$\hat{v}_i(p_i) = \begin{cases} (1 - \gamma_i)v_i & \text{if } p_i \geq v_i \\ \frac{(1-\gamma_i)s(p_i,v_i)v_i}{\gamma_i + (1-\gamma_i)s(p_i,v_i)} & \text{if } v_i > p_i \geq 0 \end{cases} \tag{1}$$

The dealers only buy securities of firm i as long as $\hat{v}_i(p_i) \geq p_i$. Perfect competition among dealers drives the profits down to 0. Hence dealers are willing to sell[4] for price $p_i^S = v_i$, and

[3] We expect our results to go through without this simplification. For a deeper discussion of dealer vs. auction market see **huang96**

[4] We assume that the dealers, being market makers, do not knowingly sell fake securities.

buy at a price $p_i^B = \hat{v}_i(p_i^B) = (1-\gamma_i)s(p_i^B, v_i)v_i$. Using this we can compute S_i, the bid ask spread for firm i, which will be our outcome variable of interest.

$$S_i = \frac{p_i^S - p_i^B}{v_i} = \frac{\gamma_i}{\gamma_i + (1-\gamma_i)s(p_i^B, v_i)} \tag{2}$$

Note that the bid-ask spread is increasing the fraction of shares that are forged.

$$\frac{\partial S_i}{\partial \gamma_i} = \frac{s(p_i^B, v_i)}{(\gamma_i + (1-\gamma_i)s(p_i^B, v_i))^2} - (1-\gamma_i)\frac{\partial s(p_i^B, v_i)}{\partial p_i^B}\frac{\partial p_i^B}{\partial \gamma_i} > 0, \tag{3}$$

as $\frac{\partial p_i^B}{\partial \gamma_i} < 0$.

Once demat trading was adopted NSCCL, the clearing system established earlier in the year, could ensure that buyers are compensated with authentic shares in demat form in case they are sold forged ones. Hence we treat the introduction of demat as an innovation that eliminates the existence of forged share certificates. Hence post demat we have $\gamma_i = 0$ for all i. Consequently post demat we have $S_i = 0$ for all firms. This simple model gives us some testable implications that we take to the data.

Testable Implication 1. *There is a drop in the bid ask spread after the introduction of demat trading. The magnitude of the drop is increasing in γ_i, the fraction of shares of firm i that are forged.*

Testable Implication 2. *There is an increase in the number of transactions after the introduction of demat trading. The magnitude of the increase is increasing in γ_i, the fraction of shares of firm i that are forged.*

3 Empirics

In this section we present our empirical results. Section 3.1 describes the data we use. In section 3.2 we take the testable implication from section 2 to the data. Finally, in section 3.3 we discuss alternative explanations of the results.

3.1 Data

The bulk of our data comes from the Prowess dataset compiled by the Centre for Monitoring Indian Economy. Our sample comprises of the 1038 firms that were listed on both the BSE and the NSE from 1 January 1995 to 31 December 1998.

We construct the bid-ask spread, our main dependent variable, using a measure proposed in **corwin12** This measure uses the daily high and low prices to compute the bid-ask spread based on the idea that the high price is almost always a buy trade and the low price is almost always a sell trade. **corwin12** show that this estimator generally outperforms other low-frequency estimators.[5]

3.2 Results

We start with figure 1, which shows the average liquidity at the NSE over a period of 30 trading days before and after the establishment of demat trading. The vertical red line denotes the day on which demat trading began. Consistent with our hypothesis, we find that there is indeed a decline in the average bid-ask spread.

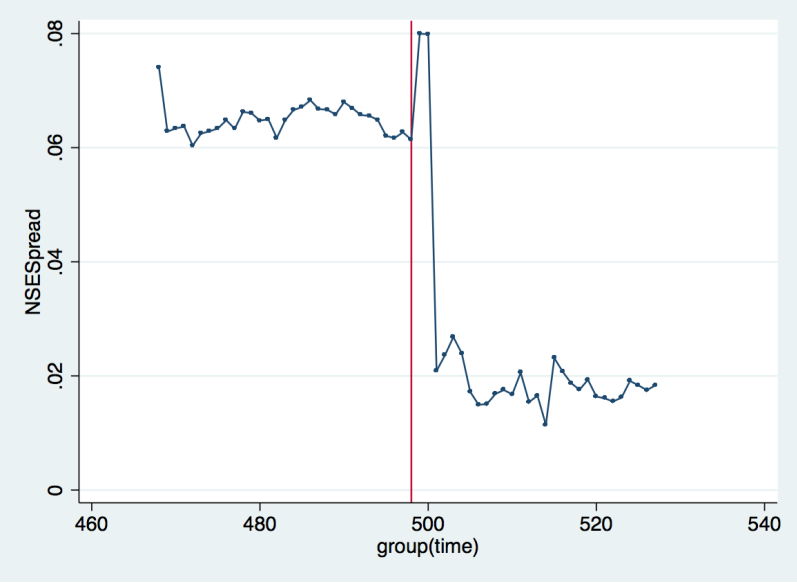

Figure 1: Liquidity before and after the establishment of demat trading on the NSE

[5]Our data only reports the daily high-low and opening-closing prices. The intra-day data on ticks is not available for the time period we analyze and consequently we cannot use high-frequency estimators.

To test this formally, we run the following regression

$$y_{it} = \alpha_i + \gamma \text{Demat NSE}_t + X'_{it}\delta + \epsilon_{it}, \tag{4}$$

where α_i are the firm fixed effects, X_{it} is the trading volume and 'g is the coefficient of interest. The results are reported in column 1 in table 3. We find that there is a 3.83 percentage point drop in the bid-ask spread. Since the average spread is 6.54 percent, the creation of demat leads to a 58% drop, which is substantial. For the regression we have used a window of 20 trading days before and after the adoption of demat trading. To ensure that our results are robust, we run this regression while varying the window of time from ± 30 to ± 5 trading days. In these regressions we also control for the trading volume, and the day dummies (five dummies – one for each working day of the week). The results are reported in table 4. Although the magnitude of the effect increases with the length of the window, we find that the results are statistically significant even when we use 5 days before and after demat adoption for our estimation.

Our model predicts that there is not only an average decline in the bid-ask spread, but that the effects are stronger for stocks that are less liquid. To test this hypothesis we begin in figure 2. In this figure we plot the bid-ask spread by quintiles based on how liquid the stock was two months prior to the establishment of demat trading. We note that the decline in the bid-ask spread is greatest for the least liquid firms.

To test this formally we run the following regreassion

$$y_{it} = \alpha_i + \beta_t + \lambda(\text{Demat NSE}_t \times \text{Pre Demat Mean Spread}_i) + X'_{it}\delta + \epsilon_{it}, \tag{5}$$

where y_{it} is the bid-ask spread of firm i on day t measured using the **corwin12** estimator. Pre Demat Mean Spread measures the average spread for the firm from $T - 50$ to $T - 20$ where T is 26 Dec 1996, the day on which demat trading began. The results are reported in columns 2-5 in table 3. In columns 2 and 3 we note that the coefficient on the interaction term is negative and significant indicating that the decline in the bid-ask spread is greater for the firms with a larger bid-ask spread prior to adoption of demat trading. Note that the positive and significant estimate on Demat NSE is misleading since it applies only to firms

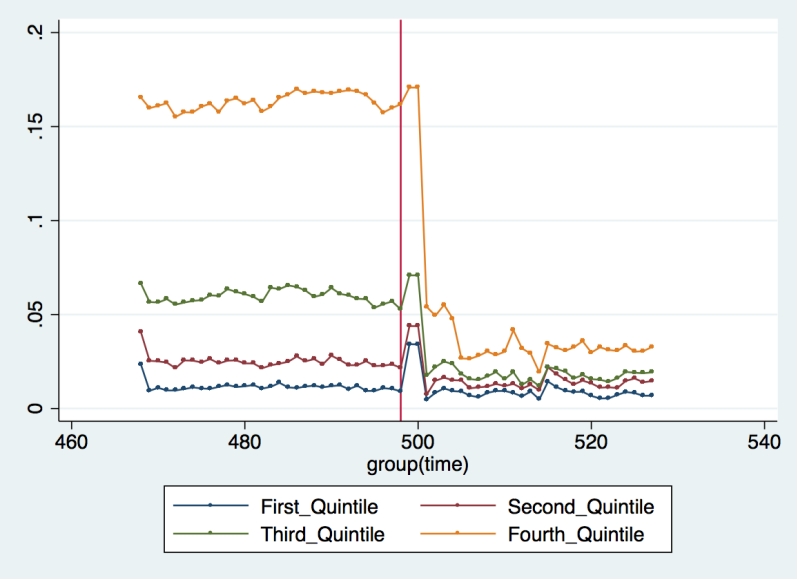

Figure 2: Liquidity before and after by quintile

with a 0 Pre Demat Mean Spread, which is outside the range of our sample.

The advantage of the specification in equation (5) is that we can control for day fixed effects. In columns 4 we include these in the regression and find that the estimate for λ is unchanged. In column 5 we include firm specific linear time trends and find that the results are unaffected. In addition to these we also control for the firm specific volume of trade on the NSE and BSE separately in the results reported in columns 4 and 5.

In the regressions reported in table 3 we use a window of 20 trading days before and after the adoption of demat. To ensure that our results are robust to varying the time frame of analysis, we take the specification from column 4 and vary the window of time from ± 30 days to ± 5 days. The results, reported in table 5, confirm that the analysis is robust to varying the number of days included in the sample.

Next, we examine the effect of demat on the log shares traded. We should expect that this should increase with the adoption of demat, and the increase should be larger for firms that were less liquid at the start. The results, reported in table 6, confirm this hypothesis. Similarly, we examine the effect of demat on the log number of transactions to examine whether there is an effect of demat and whether this effect is heterogeneous. The results, reported in table 7, confirm that the effect is indeed greater for firms that are less liquid at the start.

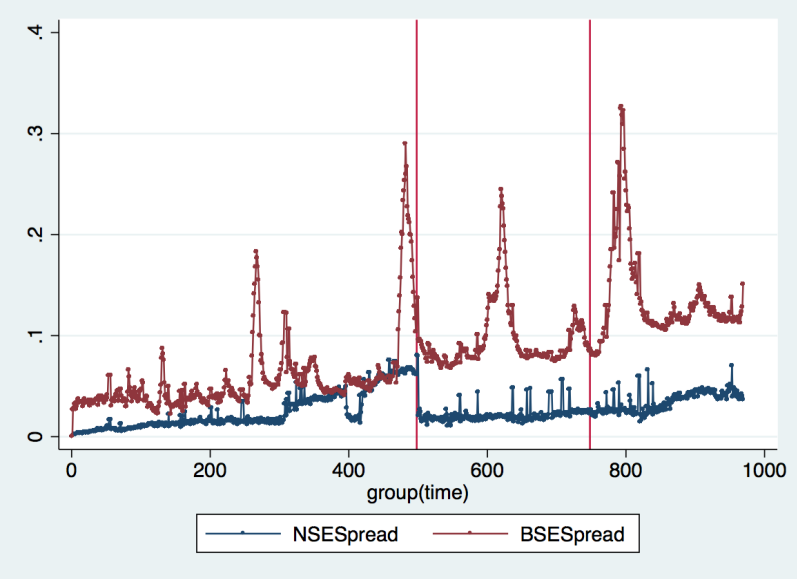

Figure 3: Liquidity before and after by quintile

It took the BSE one whole year to adopt demat trading after it was introduced at the NSE. This allows us to examine the adoption of demat trading affected outcomes on the NSE relative to the BSE. To start with, we present figure 3 that shows the average bid-ask spread over all firms in our sample over from January 1995 to November 1998. The first vertical red line corresponds to the date of introduction of demat at the NSE and the next one corresponds to the date of introduction at the BSE. We notice that there is a clear drop in the bid-ask spread at the NSE relative to the BSE after demat trading is introduced. This gap persists over time and does not appear to be narrowed by the introduction of demat trading at the BSE a year later. It is interesting to note that unlike the NSCCL, the clearing house of the BSE had no mandate to insure buyers against the risk of being sold fake securities. Consequently, the introduction of the same technology had no immediate effect on the liquidity on the BSE.

A natural specification that we could have tried in this setting is

$$Y_{it}^{NSE} - Y_{it}^{BSE} = \alpha_i + \gamma \text{Demat NSE}_t + X_{it}'\delta + \epsilon_{it}. \tag{6}$$

However, as we see in figure 3, the volatility of the bid-ask spread at the BSE is high and one such episode of volatility corresponds to the date of adoption of demat trading at the NSE. Consequently such results are likely to be unreliable. Instead we do this exercise with log number of shares traded and the log number of transactions. The results are reported

in columns 3 and 6 of tables 8 and 9. The results indicate that in the days following the adoption of demat, the number of shares traded on the NSE relative to the BSE increased by between 11-15%. Similarly, the number of transaction increased by just over 15% at the NSE relative to BSE. These effects are economically significant.

Interestingly, in columns 2 and 5 in tables 8 and 9, we note that there seems to be an increase in the number of shares traded, and transactions at the BSE after the introduction of demat at the BSE. One possible explanation of this could be that the volume of trade increases as investor confidence responds to the introduction of demat trading. The results suggest that this increased market activity somehow spilled over into the BSE. Nonetheless, the increase on these variables at the NSE was greater than on the BSE.

3.3 Alternative mechanisms

There are several channel through which demat may have affected liquidity (**raju01**). Our explanation is based on a change in expectations of the buyers – the adoption of demat trading leads to the buyers expecting that they would be compensated in case they were sold fake securities. This channel particularly affects securities of firms that had a larger fraction of forged share certificates in the market, and were consequently less liquid. In this section we present alternative explanations of our results and argue that given the pattern of evidence we have presented, these are unlikely to explain the short run effects we have documented.

Endorsement and delivery The Registrar of Companies, a centralised government authority, had to endorse a certificate as being genuine for every transaction. The process known as endorsement and delivery usually took at least 2 months. A period of 3-6 months was not uncommon. For demat transactions however, the endorsement was instantaneous as there was no need for verifying securities. It is reasonable to believe that this would have attracted traders who were previously repelled by the need to wait for a few months before selling securites they had bought. Consequently, it is possible that the elimination of the need for this process lead to a drop in the bid ask spread.

It is unlikely that this is the channel that is driving our results. **raju01** note that even at the end of 1997, one year after the adoption of demat, demat market capitalization as a

percentage of total market capitalization was just 0.11%.[6] As such, almost all securities were still transacted through paper share certificates. It is therefore unlikely, that the drop in the bid ask spread was caused by the elimination of endorsement and delivery.

Indivisibility Before the adoption of demat there was a lower bound to the number of shares that could be traded since only share certificates for multiples of a certain amount existed. This would have excluded small investors interested buyers securities in smaller denominations. It is therefore possible that liquidity increased as more of such buyers participated in the NSE after the adoption of demat trading. Although this may have happened over the long run, we believe that this is unlikely to be driving our short run results.

First, as noted earlier, demat over this period accounted for a tiny proportion of transactions (around .11% at the end of 1997). Second, if this effect was large we should notice that the size of the average transaction at the NSE drops relative to the BSE as the smaller transactions migrate to the NSE. We test this prediction in table 10 and we find that there is no such effect on the average trade.

Costs of transacting with paper Prior to demat, securities had to be physically transported to the location of trade. Moreover, there was the possibility of loss or theft of share certificates. This would lead to reduced liquidity of the securities which, the adoption of demat would have increased. As noted earlier, by the end of 1997, an year after demat trading was introduced, the demat market capitalization as a percentage of total market capitalization was only 0.11%. This indicates that there was only a tiny volume of trade that took place through the new technology. It is therefore unlikely that the drop in liquidity was a result of a drop in actual transaction costs. Moreover, the cost of handling physical securities should apply to all firms, and this is inconsistent with the differential drop that we observe for the less liquid securities.

Differential stamp duty To incentivize trade in demat securities the Indian capital market regulator SEBI slashed the stamp duty of 0.5% charged for transfer of physical shares to zero for demat transactions. This may have increased the volume of trade and lead to a

[6]This percentage was 3.85 by the end of 1998, 20.96 by the end of 1999, and 50.55 by the end of 2000.

decline in the bid ask spread. However, once again this explanation appears to be inconsistent with the fact that demat market capitalization remained very small even one year after the adoption of demat trading.

4 Conclusion

In December 1996 the NSE adopted the technological innovation of demat trading that allowed the trading of securities without the transfer of paper certificates. This enabled the clearing system to credibly insure buyers against the possibility of being sold fake securities. Using a simple model based on asymmetry of information about the authenticity of the paper certificates between the sellers and buyers, we show that the adoption of demat trading will have strong effects on liquidity of securities, particularly for firms that have a greater fraction of forged certificates in the market.

Our empirical results are consistent with the prediction of the model. We find large effects that adoption of demat trading increased liquidity, the number of transations, and the volume. We find that these large effects arose in a short period of time as these are significant even when examining a brief period of time of 20 days before and after the adoption of demat trading.

The NSE was created by the Indian government as a competitor to the BSE, which was believed to be captured by insiders. As such its creation is an example of an aggressive government intervention in the financial markets. In the years that followed, the NSE lead in adopting several technological and institutional innovations that were subsequently adopted by the BSE. By focusing on one such innovation, namely the adoption of demat trading, we have attempted to document a notable success story of government intervention in financial markets.

5 To do

1. send Sanjay da a summary of results in a slide
2. Limit order book model

3. Fraud – govt vs non government

Appendix

Table 2: Timeline of events

Date	Event
02/02/21	Clearing House started by Bank of India. This was used for BSE
10/07/87	BSE sets up investor protection fund
12/04/92	SEBI was enacted.
03/11/94	NSE starts to function
14/03/95	BSE On-Line Trading (BOLT) system introduced – Before this information of prices were not available real time. This allowed brokers to extract rents by skimming off the difference between the price at which they actually sold a security and the price they quoted as being the "market price" to their client.
June 95	Introduction of centralised insurance cover for all trading members (NSE)
July 95	Establishment of Investor Protection Fund (NSE)
Oct 95	NSE becomes the largest stock exchange in India
Dec 95	NSDL is incorporated.
April 96	Commencement of clearing and settlement by NSCCL (NSE) – In order to avoid counterparty risk of default a central counterparty (clearing house) is used which acts as a market participant who is taking the risk of the counterparty default and ensures that the payments are performed even in case of default. The NSCCL aggregates trades over a trading period, nets the positions to determine the liabilities of members and ensures movement of funds and securities to meet respective liabilities.
June 96	Establishment of Settlement Guarantee Fund at NSE (Equivalent to TGF in BSE next yr)
Nov 96	NSDL is inaugurated
26th Dec 96	Commencement of Demat trading at the NSE
Feb 1997	Regional clearing facility goes live – NSE
12/05/97	Trade Guarantee Fund (TGF) introduced in BSE
21/07/97	Broker's Contingency Fund (BCF) introduced (BSE)

1997	BSE On-Line Trading (BOLT) system expanded nation-wide within
29th Dec 97	Commencement of Demat trading at the BSE
Feb 1999	Launch of Automated Lending and Borrowing Mechanism (NSE)
01/06/99	Interest Rate Swaps (IRS) / Forward Rate Agreements (FRA) allowed (BSE)
15/07/99	CDSL commences work (BSE)
February 2000	Commencement of Internet Trading – NSE
June 2000	Commencement of Derivatives Trading (Index Futures)– NSE
16/05/07	Corporatisaton and Demutualisation of BSE

Table 3: Effect of establishment of demat at NSE on liquidity

	(1)	(2)	(3)	(4)	(5)
Demat NSE	-0.0383^{***}	-0.0383^{***}	-0.0383^{***}		
	(0.00197)	(0.000899)	(0.000899)		
Demat NSE $\times$		-0.812^{***}	-0.812^{***}	-0.812^{***}	-0.954^{***}
Pre Demat Mean Spread		(0.0255)	(0.0255)	(0.0256)	(0.0253)
NSE Volume			$-1.53e-09^{+}$	$1.22e-10$	$7.39e-11$
			$(8.13e-10)$	$(7.94e-10)$	$(6.37e-10)$
BSE Volume			$-8.88e-10$	$1.24e-09$	$-6.51e-10$
			$(1.41e-09)$	$(1.42e-09)$	$(1.26e-09)$
Constant	0.0654^{***}	0.0654^{***}	0.0654^{***}	0.0187^{***}	0.0245^{***}
	(0.000985)	(0.000449)	(0.000451)	(0.00110)	(0.000797)
Day fixed effect	No	No	No	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
Firm linear trend	No	No	No	No	Yes
N	41518	41518	41518	41518	30025

Notes:

- The sample consists of $\pm$ 20 days from the establishment of demat trading at NSE.
- Standard errors clustered at the firm level are shown in parentheses.
- $^{+}$ $p < 0.10$, * $p < 0.05$,** $p < 0.01$, *** $p < 0.001$

Table 4: Spread before and after establishment of demat at NSE

	(1) ± 30 Days	(2) ± 25 Days	(3) ± 20 Days	(4) ± 15 Days	(5) ± 10 Days	(6) ± 5 Days
Demat NSE	-0.0411^{***}	-0.0399^{***}	-0.0383^{***}	-0.0357^{***}	-0.0288^{***}	-0.00895^{***}
	(0.00206)	(0.00202)	(0.00197)	(0.00186)	(0.00169)	(0.00113)
Constant	0.0625^{***}	0.0621^{***}	0.0618^{***}	0.0625^{***}	0.0616^{***}	0.0618^{***}
	(0.000944)	(0.000908)	(0.000858)	(0.000836)	(0.000781)	(0.000929)
Day dummy	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
N	62278	51898	41518	31138	20758	10378

Notes:

- Dependent variable is the bid-ask spread at the NSE.
- The regression in each column is run on a sample with successively fewer days, with the number of days indicated in the column header.
- Standard errors clustered at the firm level are shown in parentheses.
- All specifications include day of week, firm fixed effects, and the trading volume on the NSE and BSE.
- $^{+}$ $p < 0.10$, * $p < 0.05$,** $p < 0.01$, *** $p < 0.001$

Table 5: Interaction of pre demat spread with demat

	(1) ± 30 Days	(2) ± 25 Days	(3) ± 20 Days	(4) ± 15 Days	(5) ± 10 Days	(6) ± 5 Days
Demat NSE ×	-0.851^{***}	-0.833^{***}	-0.812^{***}	-0.757^{***}	-0.660^{***}	-0.358^{***}
Pre Demat Mean Spread	(0.0275)	(0.0269)	(0.0256)	(0.0246)	(0.0260)	(0.0245)
Constant	0.0183^{***}	0.0155^{***}	0.0187^{***}	0.0154^{***}	0.0151^{***}	0.0236^{***}
	(0.000967)	(0.00106)	(0.00110)	(0.00148)	(0.00121)	(0.00164)
Day fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
N	62278	51898	41518	31138	20758	10378

Notes:

- Dependent variable is the bid-ask spread at the NSE.
- The regression in each column is run on a sample with successively fewer days, with the number of days indicated in the column header.
- Standard errors clustered at the firm level are shown in parentheses.
- All specifications include day of week, firm fixed effects, and the trading volume on the NSE and BSE.
- $^{+}$ $p < 0.10$, * $p < 0.05$,** $p < 0.01$, *** $p < 0.001$

Table 6: Effect of demat on log shares traded

	(1)	(2)	(3)	(4)	(5)
Demat NSE	0.756***	0.761***	0.761***		
	(0.0228)	(0.0218)	(0.0218)		
Demat NSE ×		2.934***	2.934***	2.956***	2.956***
Pre Demat Mean Spread		(0.340)	(0.340)	(0.342)	(0.342)
Constant	7.244***	7.241***	7.241***	7.539***	7.496***
	(0.0113)	(0.0108)	(0.0108)	(0.0307)	(0.0309)
Day fixed effect	*No*	*No*	*No*	*Yes*	*Yes*
Firm fixed effects	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Firm linear trend	*No*	*No*	*No*	*No*	*Yes*
N	34642	34642	34642	34642	34642

Notes:

- The sample consists of ± 20 days from the establishment of demat trading at NSE.
- Standard errors clustered at the firm level are shown in parentheses.
- All specifications include firm fixed effects.
- $^{+}$ $p < 0.10$, * $p < 0.05$,** $p < 0.01$, *** $p < 0.001$

Table 7: Effect of demat on log number of transactions

	(1)	(2)	(3)	(4)	(5)
Demat NSE	0.693***	0.701***	0.701***		
	(0.0182)	(0.0173)	(0.0173)		
Demat NSE ×		2.594***	2.594***	2.614***	2.614***
Pre Demat Mean Spread		(0.284)	(0.284)	(0.285)	(0.285)
Constant	2.216***	2.215***	2.215***	2.517***	2.478***
	(0.00901)	(0.00852)	(0.00852)	(0.0224)	(0.0228)
Day fixed effect	*No*	*No*	*No*	*Yes*	*Yes*
Firm fixed effects	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Firm linear trend	*No*	*No*	*No*	*No*	*Yes*
N	33858	33858	33858	33858	33858

Notes:

- The sample consists of ± 20 days from the establishment of demat trading at NSE.
- Standard errors clustered at the firm level are shown in parentheses.
- All specifications firm fixed effects.
- $^{+}$ $p < 0.10$, * $p < 0.05$,** $p < 0.01$, *** $p < 0.001$

Table 8: Using shares traded at the BSE as a placebo

	(1) NSE	(2) BSE	(3) Difference	(4) NSE	(5) BSE	(6) Difference
Demat NSE	0.773***	0.634***	0.145***	0.666***	0.566***	0.114***
	(0.0228)	(0.0248)	(0.0243)	(0.0234)	(0.0261)	(0.0269)
Constant	7.078***	6.771***	0.381***	7.142***	6.841***	0.367***
	(0.0141)	(0.0158)	(0.0187)	(0.0181)	(0.0206)	(0.0239)
N	34642	32720	30025	25961	24612	22840

Notes:

- Dependent variable in column (1) and (4) is the log number of shares traded on the NSE
- Dependent variable in column (2) and (5) is the log number of shares traded on the BSE
- Dependent variable in column (3) and (6) is the difference between log number of shares traded on the NSE and log the number of shares traded on the BSE
- The dependent variable varies by firm and day. The regressions reported in the first three column use the sample restricted to ± 20 days from the establishment of demat and the last three columns use a sample restricted to ± 10 days.
- Standard errors clustered at the firm level are shown in parentheses.
- All specifications include day of week and firm fixed effects.
- $^{+}$ $p < 0.10$, * $p < 0.05$,** $p < 0.01$, *** $p < 0.001$

Table 9: Using the number of transactions at the BSE as a placebo

	(1) NSE	(2) BSE	(3) Difference	(4) NSE	(5) BSE	(6) Difference
Demat NSE	0.710***	0.553***	0.157***	0.609***	0.524***	0.153***
	(0.0183)	(0.0177)	(0.0183)	(0.0217)	(0.0193)	(0.0186)
Constant	2.076***	1.759***	0.394***	2.120***	1.861***	0.503***
	(0.0109)	(0.0106)	(0.0127)	(0.0137)	(0.0132)	(0.0180)
N	33858	32034	29416	16071	15289	344581

Notes:

- Dependent variable in column (1) is the log number of transactions on the NSE
- Dependent variable in column (2) is the log number of transactions on the BSE
- Dependent variable in column (3) is the difference between the log number of transactions on the NSE and the log number of transactions on the BSE
- The dependent variable varies by firm and day. The regressions reported in the first three column use the sample restricted to ± 20 days from the establishment of demat and the last three columns use a sample restricted to ± 10 days.
- Standard errors clustered at the firm level are shown in parentheses.
- All specifications include day of week and firm fixed effects.
- $^{+}$ $p < 0.10$, * $p < 0.05$,** $p < 0.01$, *** $p < 0.001$

Table 10: The effect of demat on the size of the average trade

	(1) NSE	(2) BSE	(3) Difference	(4) NSE	(5) BSE	(6) Difference
Demat NSE	-52.31^{*}	-123.8^{*}	93.98	-65.06^{*}	-126.4^{+}	112.1
	(20.59)	(54.12)	(61.80)	(25.49)	(73.04)	(79.87)
Constant	276.3^{***}	574.0^{***}	-333.5^{***}	304.1^{***}	599.3^{***}	-354.5^{***}
	(13.35)	(68.81)	(77.39)	(21.17)	(79.71)	(88.86)
N	33858	32034	29416	25364	24081	22354

Notes:

- Dependent variable in column (1) is the number of transactions on the NSE
- Dependent variable in column (2) is the number of transactions on the BSE
- Dependent variable in column (3) is the difference between number of transactions on the NSE and the number of transactions on the BSE
- The dependent variable varies by firm and day. The regressions reported in the first three column use the sample restricted to $\pm$ 20 days from the establishment of demat and the last three columns use a sample restricted to $\pm$ 10 days.
- Standard errors clustered at the firm level are shown in parentheses.
- All specifications include day of week and firm fixed effects.
- $^{+}$ $p < 0.10$, * $p < 0.05$,** $p < 0.01$, *** $p < 0.001$

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