

# Liquidity provision in a high frequency environment

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- ▶ Under such circumstances, **intermediaries** like market makers play an important role of supplying liquidity.
- ▶ In electronic limit order book markets, this role is played by **limit orders**.
- ▶ Several studies in the past that examine the order submission characteristics and liquidity supply by informed and uninformed traders.

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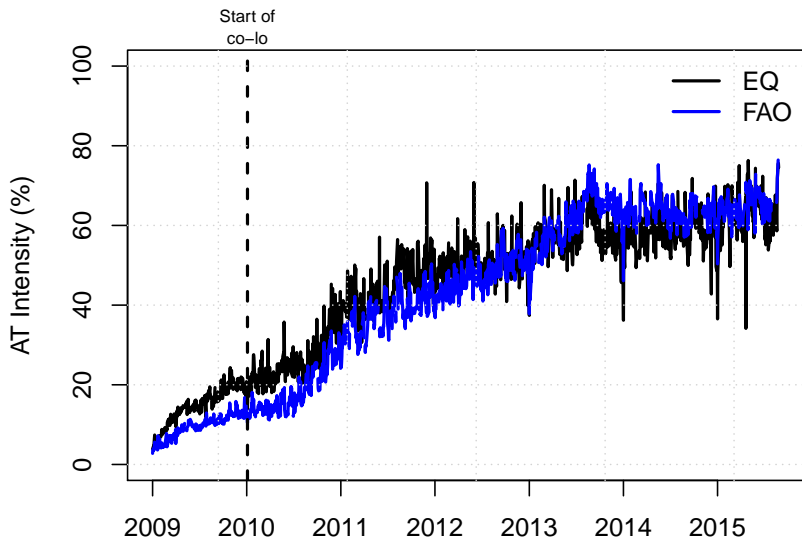
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- ▶ Hence, a **need to revisit** the question of liquidity supply with a focus on AT and non AT.

# Algorithmic trading on NSE equity markets (as % of TTV)



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  - ▶ Data: long time series of data that can be used to distinguish a *low* AT and *high* AT period, & with every order and trade tagged as AT and non AT.

# Data details

- ▶ **Raw data:** Tick by tick orders and trades data from NSE, timestamped in jiffies.



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Using this data, we recreate the full order book.
- ▶ **Segment:** NSE spot and stock futures.
- ▶ **Period:** Nov - Dec 2009 (Prior co-location) and Nov - Dec 2013 (post co-location).
- ▶ **Sample:** Top 200 firms by market cap in 2009 and 2013.
- ▶ **Final sample:** 147 stocks.

**Q.1: Are there differences in the type of orders submitted by AT and non AT?**

# Type of orders (spot)

MCAp quartiles	Q1 (Highest)		Q4 (Lowest)	
	2009	2013	2009	2013
Algo orders (%)	18.61	<b>78.95</b>	5.93	<b>41.47</b>
Fraction of <b>algo</b> orders (%)				
IOC	0.69	6.41	0.95	4.29
SL	0.32	0.02	0.57	0.10
MO	5.91	1.21	12.05	6.41
Hidden	9.65	10.83	11.38	<b>21.22</b>
Limit	83.43	<b>81.53</b>	75.05	<b>67.98</b>
Fraction of <b>non-algo</b> orders (%)				
IOC	0.07	0.32	0.21	0.34
SL	2.21	2.71	0.82	1.12
MO	7.22	7.57	5.40	4.13
Hidden	10.09	9.16	17.93	8.81
Limit	80.41	<b>80.24</b>	75.64	<b>85.60</b>
MCAp (Rs. Mn)	843,191	1,030,189	51,885	62,322
AT Intensity (%)	23.56	<b>78.40</b>	10.42	<b>39.74</b>
# of orders	63,300	112,901	10,415	19,898
# of stocks	37	37	37	37

# Type of orders (SSF)

MCap quartiles	Q1 (Highest)		Q4 (Lowest)	
	2009	2013	2009	2013
Algo orders (%)	39.82	93.42	28.45	80.62
Fraction of <b>algo</b> orders (%)				
IOC	7.16	<b>9.40</b>	4.38	<b>11.10</b>
SL	0.00	0.02	0.01	0.09
MO	0.48	0.15	0.14	0.15
Spread	6.10	8.03	4.43	<b>9.69</b>
Limit	86.26	<b>82.41</b>	91.05	<b>78.96</b>
Fraction of <b>non-algo</b> orders (%)				
IOC	4.33	1.32	2.01	0.54
SL	0.63	2.56	0.65	1.58
MO	1.80	4.07	0.66	1.86
Spread	4.85	3.26	2.80	1.71
Limit	88.39	<b>88.80</b>	93.87	<b>94.31</b>
AT Intensity (%)	22.42	73.46	11.77	47.18
# of orders	64,743	226,195	8,744	36,163
# of stocks	34	37	17	20

**Q.2 What is the pattern of activity on AT and non AT orders?**

# Order last activity by AT and non AT (Spot)

MCap quartiles	<i>As % of orders entered</i>			
	<b>Q1 (Highest)</b>		<b>Q4 (Lowest)</b>	
	2009	2013	2009	2013
<b>Algo</b>	17.96	78.41	3.81	38.66
Entered	0.15	0.03	0.17	0.10
Modified	0.02	0.02	0.01	0.04
Traded (A)	5.36	<b>14.84</b>	1.78	<b>9.52</b>
Cancelled (B)	12.43	<b>63.52</b>	1.84	<b>29.00</b>
<b>NonAlgo</b>	80.64	20.77	93.69	58.03
Entered	7.45	2.54	17.77	9.29
Modified	0.59	0.21	1.11	0.70
Traded (C)	<b>50.11</b>	<b>14.31</b>	<b>49.44</b>	<b>35.84</b>
Cancelled (D)	22.48	3.71	25.38	12.19
Cancelled (B+D)	34.92	67.23	27.23	41.19
Traded (A+C)	55.47	29.15	51.22	45.36
# of orders	59,043	102,768	9,026	16,848
# of stocks	37	37	37	37

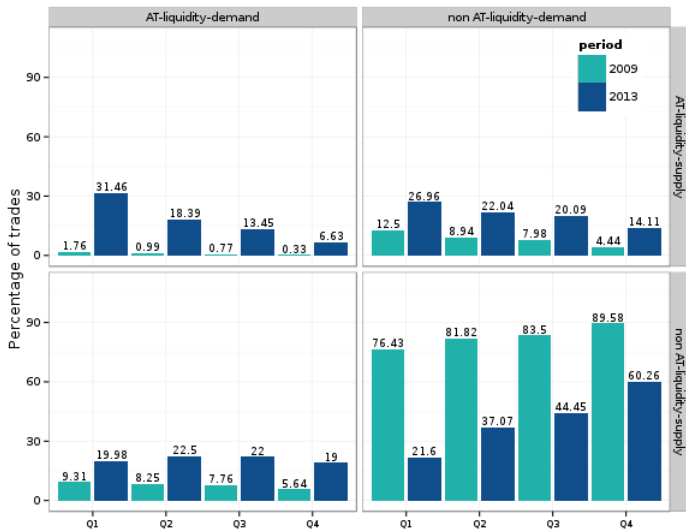
# Order last activity by AT and non AT (SSF)

MCap quartiles	<i>As % of orders entered</i>			
	<b>Q1 (Highest)</b>		<b>Q4 (Lowest)</b>	
	2009	2013	2009	2013
<b>Algo</b>	39.30	93.19	26.98	78.41
Entered	0.02	0.03	0.03	0.11
Modified	0.04	0.08	0.06	0.17
Traded (E)	1.48	<b>2.17</b>	0.90	<b>2.50</b>
Cancelled (F)	37.77	<b>90.91</b>	26.00	<b>75.63</b>
<b>NonAlgo</b>	59.90	6.40	71.29	20.86
Entered	1.30	0.46	2.66	1.63
Modified	0.33	0.10	0.74	0.32
Traded (G)	13.12	<b>2.69</b>	15.29	<b>9.43</b>
Cancelled (H)	<b>45.16</b>	3.15	<b>52.60</b>	9.49
Cancelled (F+H)	<b>82.93</b>	<b>94.06</b>	<b>78.60</b>	<b>85.12</b>
Traded (E+G)	14.59	4.85	16.19	11.93
# of orders	58,140	192,537	7,340	27,506
# of stocks	34	37	17	20

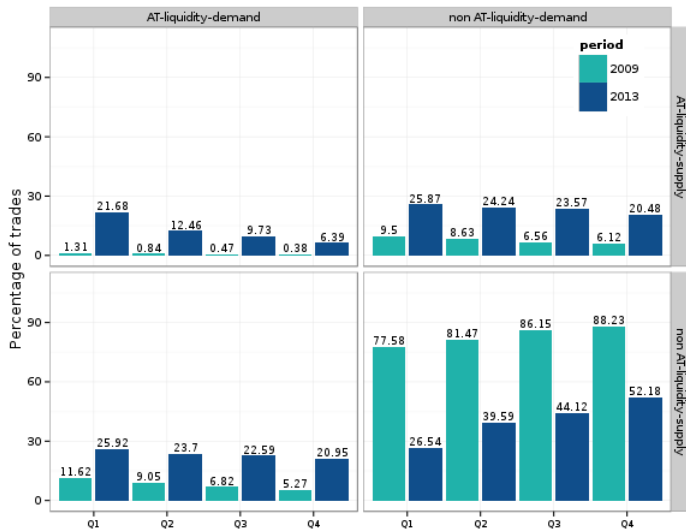


**Q.3 Within the trades, do AT supply liquidity or demand it?**

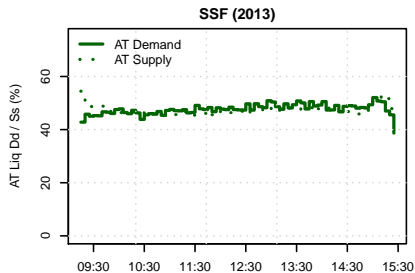
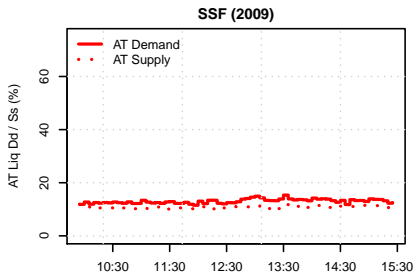
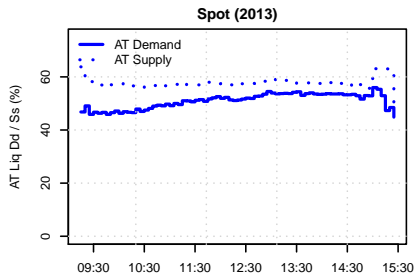
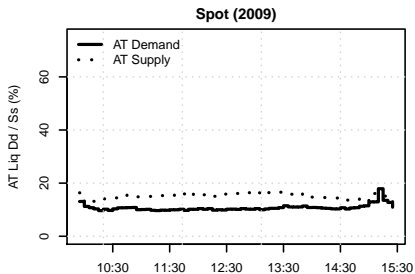
# Liquidity provisioning by AT and non AT (Spot)



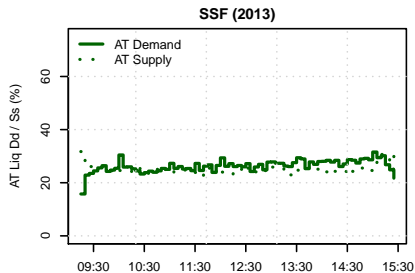
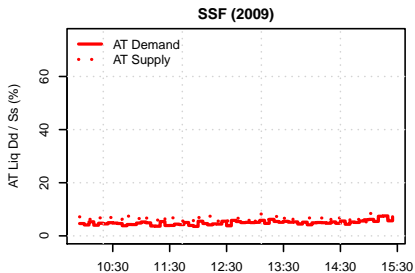
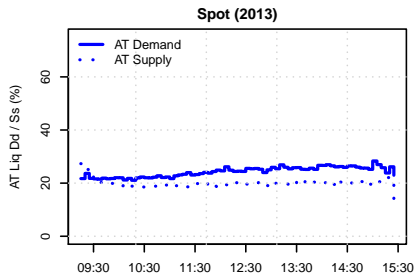
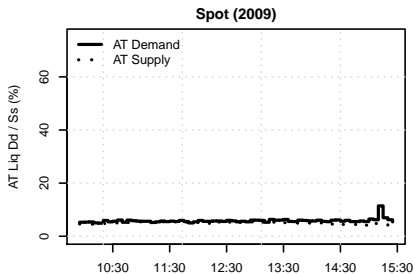
# Liquidity provisioning by AT and non AT (SSF)



# Intraday liquidity demand and supply by AT (Q1)



# Intraday liquidity demand and supply by AT (Q4)



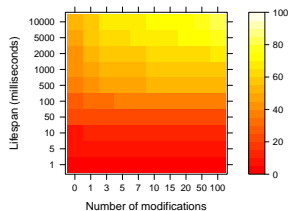
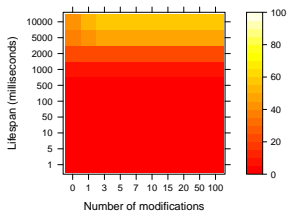
**Q4: What is the speed of order cancellations?**

# Cancelled algo orders: Spot

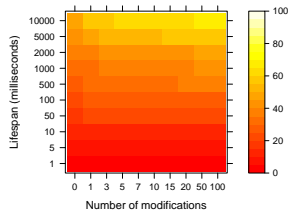
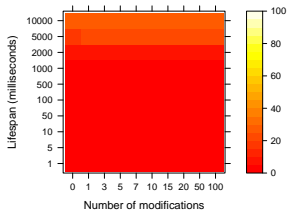
2009

2013

Q1 (Highest market cap)



Q4 (Lowest market cap)

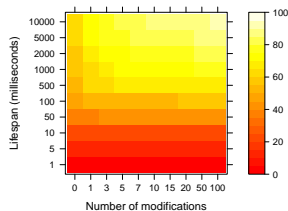
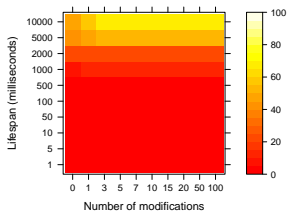


# Cancelled algo orders: SSF

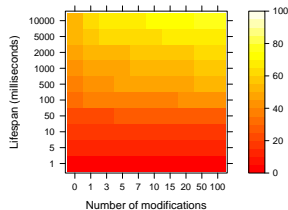
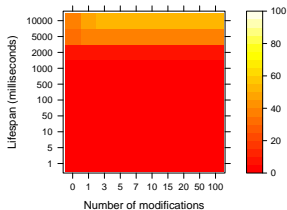
2009

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Q1 (Highest market cap)



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**Q.5: At what level of depth do cancellations occur?**

# Spot: Orders cancellations with duration less than a second

<i>As % of orders cancelled in &lt;1 second</i>				
<b>MCap quartiles</b>	<b>Q1 (Highest)</b>		<b>Q4 (Lowest)</b>	
	2009	2013	2009	2013
Order location at Entry, Exit				
<i>As % of orders cancelled in &lt;1 s</i>				
(< 1], (< 1]	13.40	<b>5.31</b>	51.97	<b>39.01</b>
(1, 3], (< 1]	0.37	0.98	0.49	1.66
(3, 5], (< 1]	0.02	0.39	0.00	0.12
(> 5], (< 1]	0.01	0.03	0.02	0.01
(< 1], (1, 3]	1.18	2.52	1.77	8.49
(1, 3], (1, 3]	7.30	10.29	13.26	20.97
(3, 5], (1, 3]	0.46	1.88	0.29	0.85
(> 5], (1, 3]	0.05	0.14	0.05	0.03
(< 1], (3, 5]	0.08	0.10	0.03	0.10
(1, 3], (3, 5]	1.07	1.34	0.37	0.90
(3, 5], (3, 5]	5.83	12.84	4.44	11.02
(> 5], (3, 5]	0.53	0.88	0.15	0.37
(< 1], (> 5]	0.02	0.03	0.00	0.03
(1, 3], (> 5]	0.12	0.11	0.01	0.22
(3, 5], (> 5]	0.94	1.79	0.18	0.85
(> 5], (> 5]	<b>68.64</b>	61.35	<b>26.95</b>	15.39
<i>As % of all cancelled orders</i>				
'Fast'	5.74	54.80	1.19	30.60
Algo 'fast'	3.63	<b>54.49</b>	0.43	<b>29.66</b>

# SSF: Orders cancellations with duration less than a second

MCap quartiles Order location at Entry, Exit	<i>As % of orders cancelled in &lt;1 second</i>			
	Q1 (Highest)		Q4 (Lowest)	
	2009	2013	2009	2013
<i>As % of orders cancelled in &lt;1 s</i>				
(< 1], (< 1]	10.63	<b>4.66</b>	32.43	<b>12.06</b>
(1, 3], (< 1]	0.94	0.57	1.03	0.84
(3, 5], (< 1]	0.11	0.10	0.09	0.12
(> 5], (< 1]	0.15	0.02	0.06	0.02
(< 1], (1, 3]	7.33	4.39	10.74	7.77
(1, 3], (1, 3]	17.86	6.38	27.95	18.93
(3, 5], (1, 3]	0.72	0.84	0.31	0.89
(> 5], (1, 3]	0.30	0.06	0.07	0.05
(< 1], (3, 5]	0.68	0.16	0.45	0.78
(1, 3], (3, 5]	3.06	5.28	1.22	11.42
(3, 5], (3, 5]	4.47	7.65	3.88	12.27
(> 5], (3, 5]	0.89	0.66	0.33	0.67
(< 1], (> 5]	7.20	5.97	6.38	6.24
(1, 3], (> 5]	7.89	4.64	4.40	7.21
(3, 5], (> 5]	4.14	4.61	1.62	5.82
(> 5], (> 5]	33.64	<b>54.02</b>	9.05	<b>14.92</b>
<i>As % of all cancelled orders</i>				
'Fast'	9.02	74.48	3.17	53.14
Algo 'fast'	4.90	<b>73.21</b>	1.19	<b>52.47</b>

**In summary,**

**A:1** Limit orders dominate the type of orders used by AT (80%) as well as non AT (85%). However,

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- A.3** AT supply almost as much liquidity as the demand.
- A.4** Significant percentage of order cancellations within one second (44% on spot and 63% on SSF).
- A.5** But most of these 'fast' cancellations away from the touch.

# Going forward

- ▶ Is there a significant intraday pattern of order activity?

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- ▶ Is there a difference in the order flow pattern during stress periods?
- ▶ How could these characteristics be explained in terms of the underlying variables of market liquidity?

Thank you

Comments / Questions?

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