Order placement behavior in a high frequency environment

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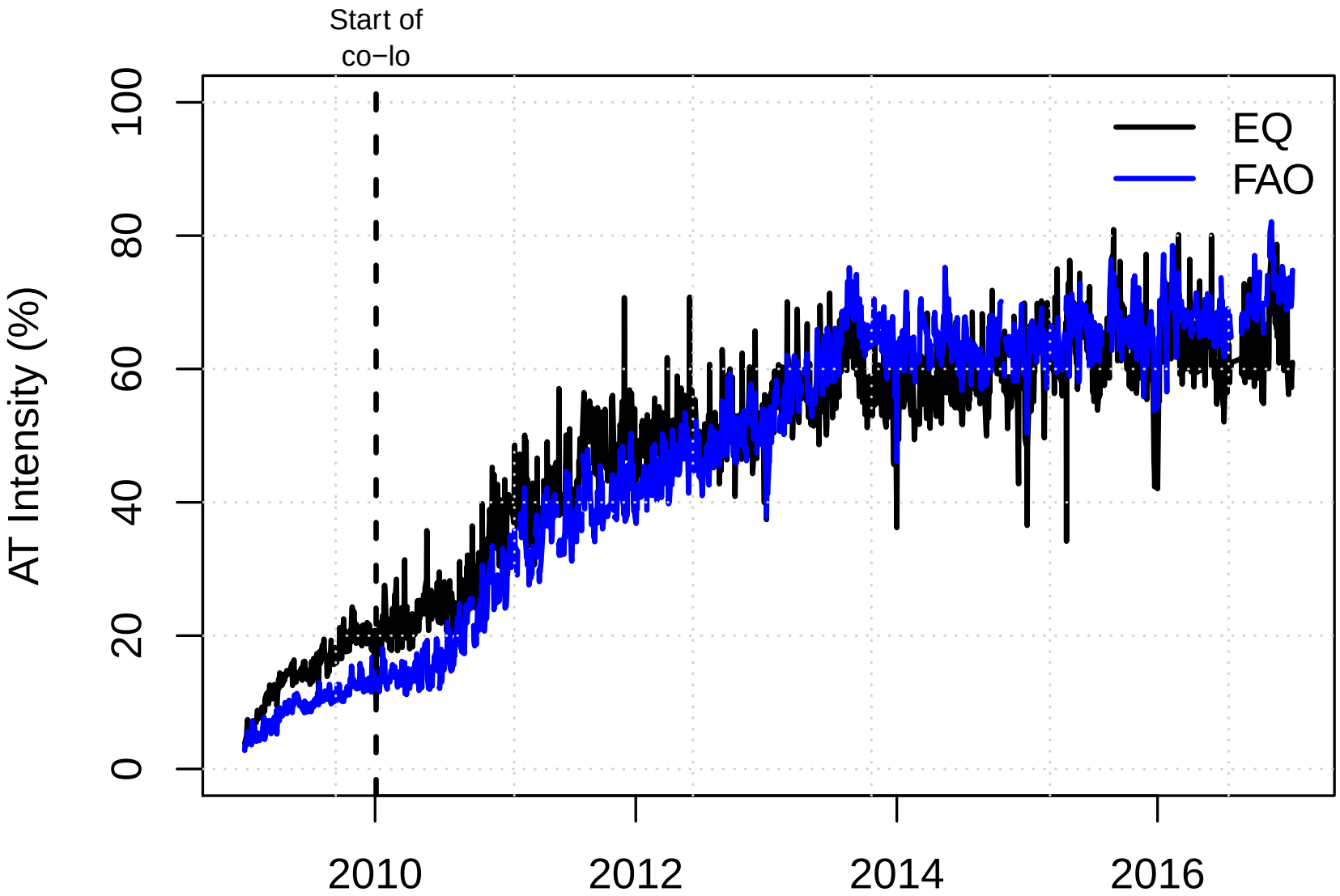
The rise of algorithmic trading on Indian equity markets



What we know about AT

- Studies in the context of NSE equity markets:
  1. Boehmer and Shankar (2013) find that increase in AT does not result in high levels of systemic risk.
  2. Aggarwal and Thomas (2014) find that
     1. higher AT improves market liquidity, reduces volatility and increase price efficiency.

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  2. Aggarwal and Thomas (2014) find that
     1. higher AT improves market liquidity, reduces volatility and increase price efficiency.
     2. does not increase the incidence of extreme price movements.
     3. key: improvement in market quality of *small market cap* stocks.
  3. Aggarwal et al (2017) examine the impact of a regulatory fee (to curb high orders to trades ratio) on market quality.
     1. Find that when the fee was imposed by the exchange, it had its intended consequence of bringing down the OTR, and improve market quality.
     2. Not so when the fee was imposed by the regulator.

This work

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  - **Q.5** If yes, do these cancellation occur from inside the touch?

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- A couple of other studies: Jarnecic and Snape (2014), Subrahmanyam and Zheng (2015).
- NSE equity markets, an interesting case:
  - U.S: a fragmented market structure.
  - 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	**78.95**	5.93	**41.47**
Fraction of **algo** 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	**21.22**
Limit	83.43	**81.53**	75.05	**67.98**
Fraction of **non-algo** 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	**80.24**	75.64	**85.60**
MCap (Rs. Mn)	843,191	1,030,189	51,885	62,322
AT Intensity (%)	23.56	**78.40**	10.42	**39.74**
# 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 **algo** orders (%)				
IOC	7.16	**9.40**	4.38	**11.10**
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	**9.69**
Limit	86.26	**82.41**	91.05	**78.96**
Fraction of **non-algo** 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	**88.80**	93.87	**94.31**
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)

As % of orders entered

MCap quartiles	**Q1** (Highest)		**Q4** (Lowest)	
	2009	2013	2009	2013
Algo	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	**14.84**	1.78	**9.52**
Cancelled (B)	12.43	**63.52**	1.84	**29.00**
NonAlgo	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)	**50.11**	**14.31**	**49.44**	**35.84**
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

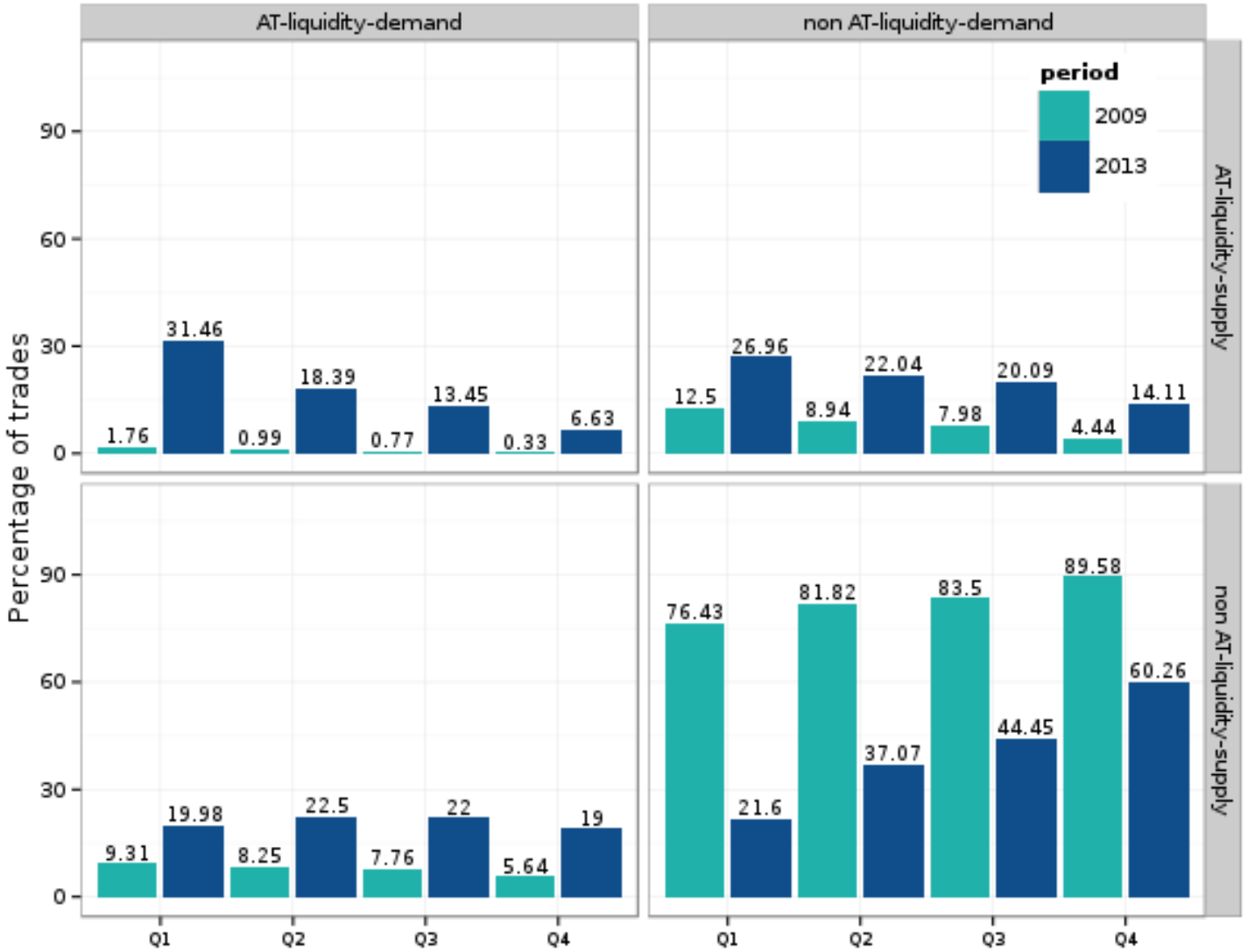
Order last activity by AT and non AT (SSF)

As % of orders entered

MCap quartiles	**Q1** (Highest)		**Q4** (Lowest)	
	2009	2013	2009	2013
Algo	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	**2.17**	0.90	**2.50**
Cancelled (F)	37.77	**90.91**	26.00	**75.63**
NonAlgo	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	**2.69**	15.29	**9.43**
Cancelled (H)	**45.16**	3.15	**52.60**	9.49
Cancelled (F+H)	**82.93**	**94.06**	**78.60**	**85.12**
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)



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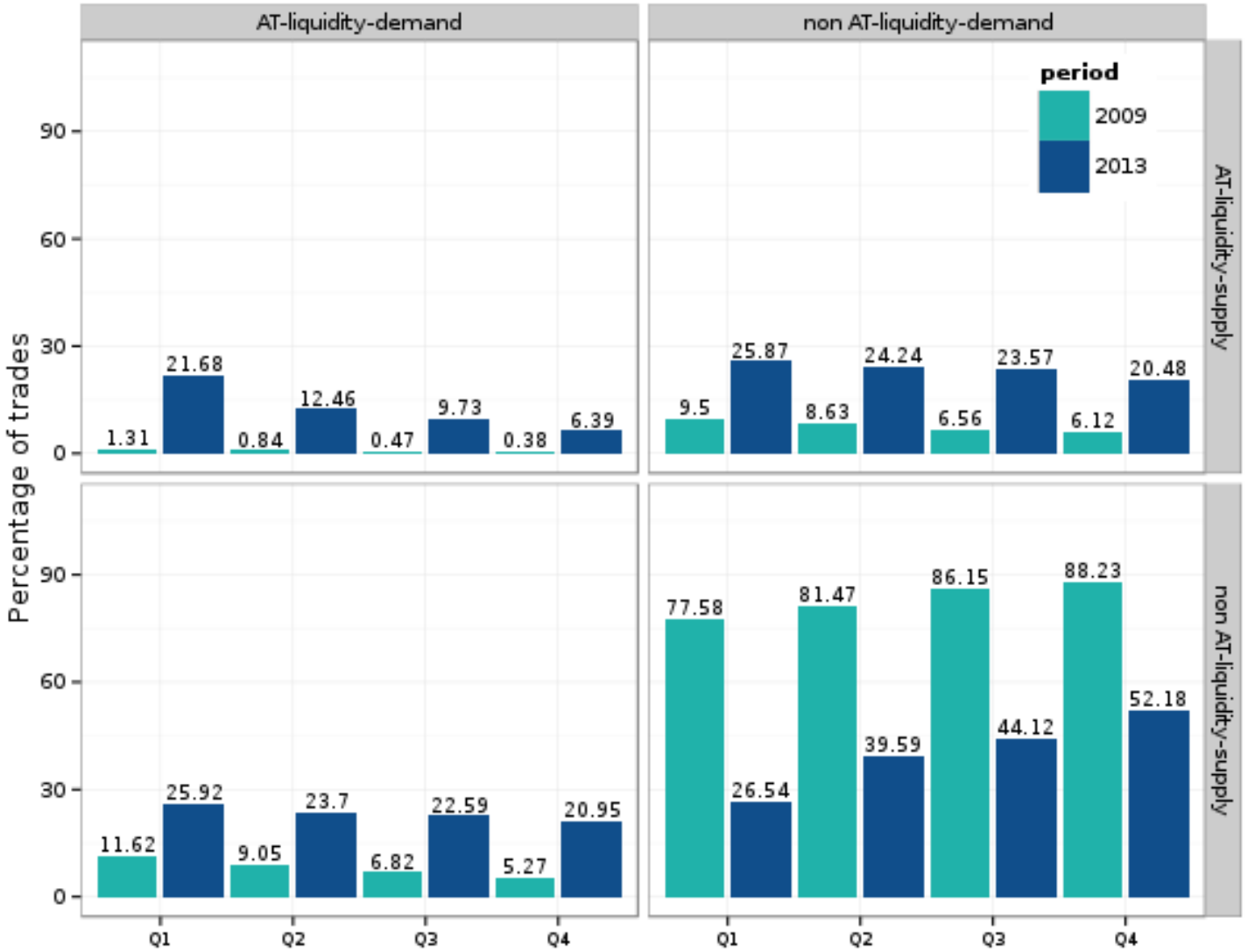
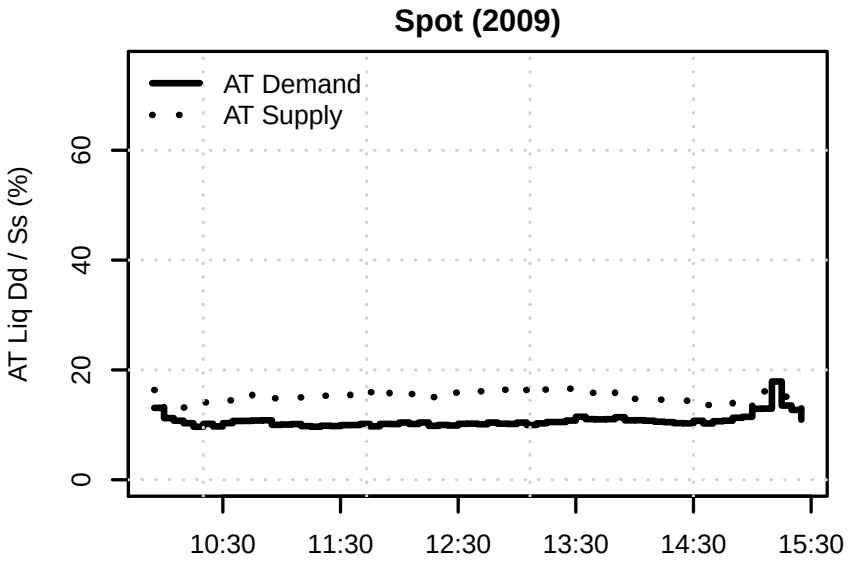
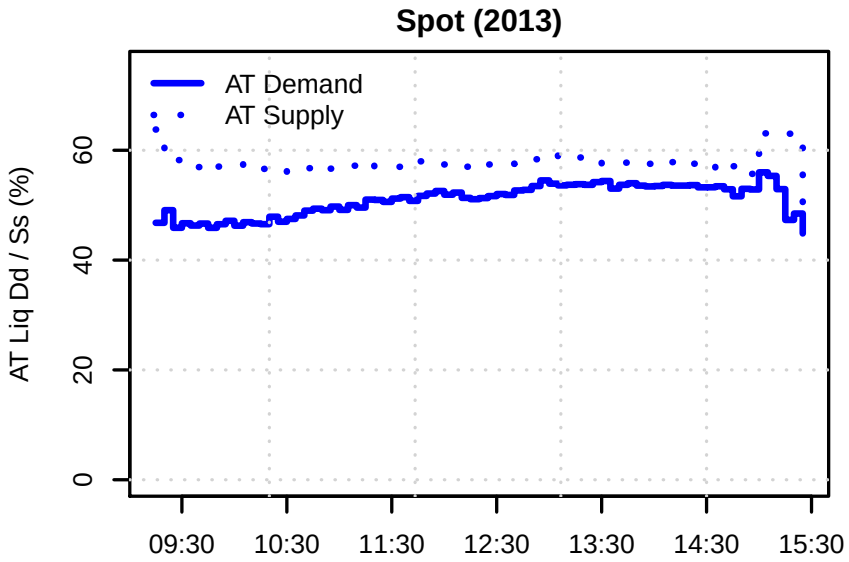
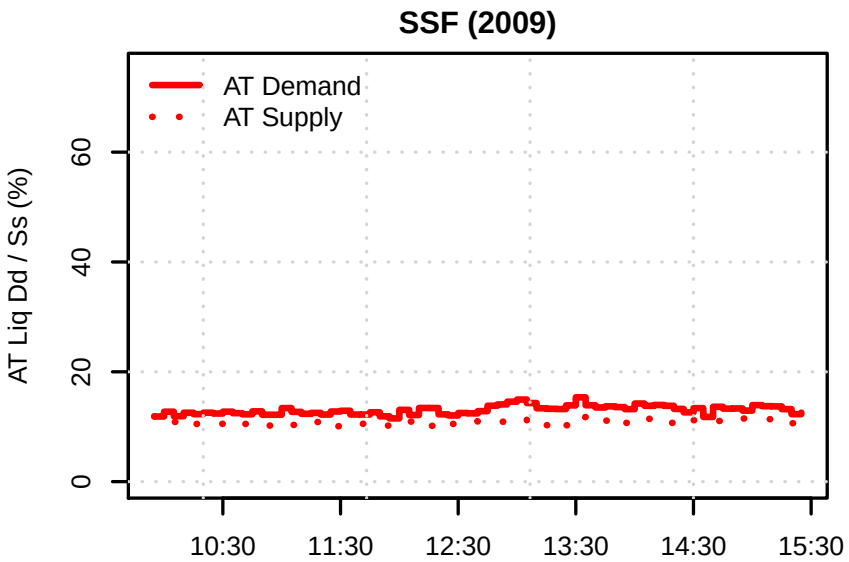
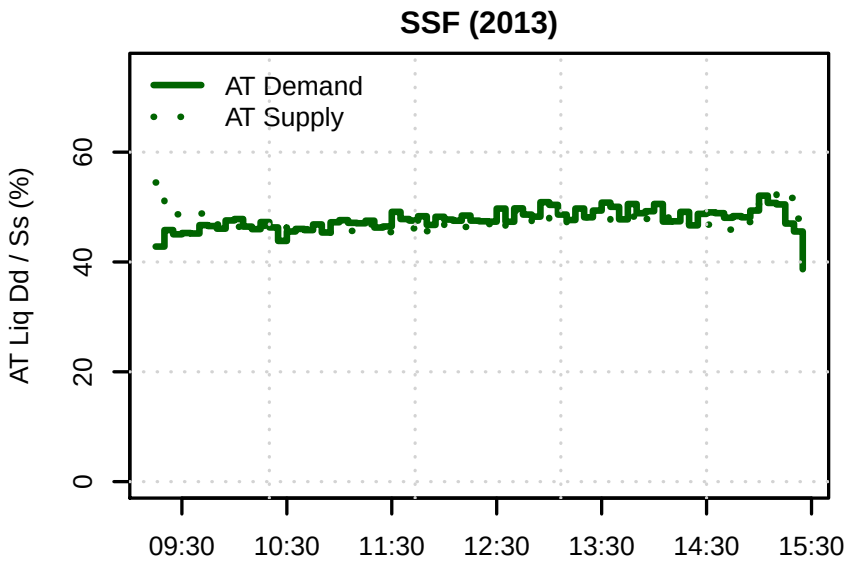


Intraday liquidity demand and supply by AT (Q1)

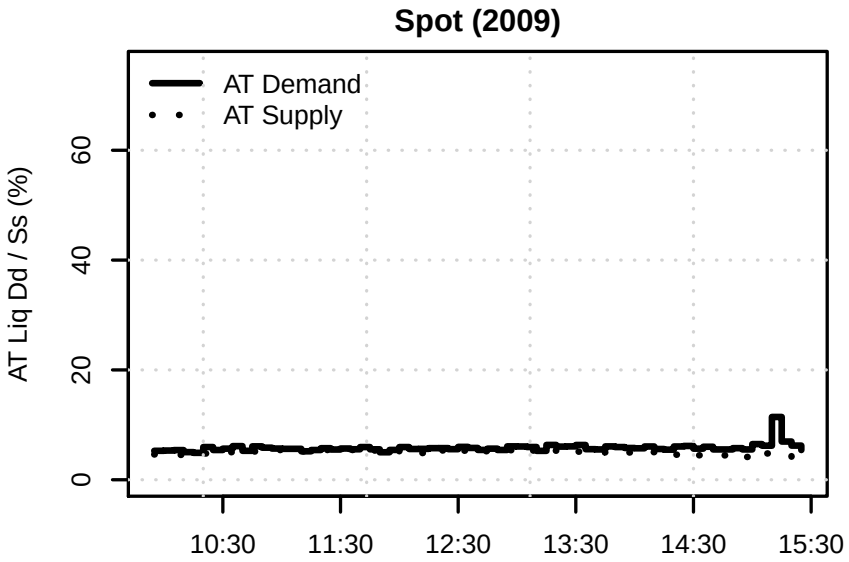


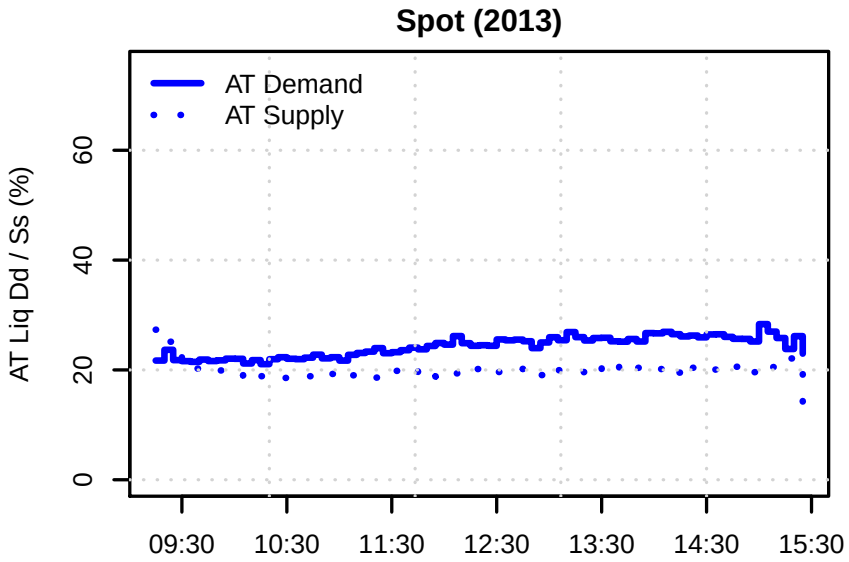


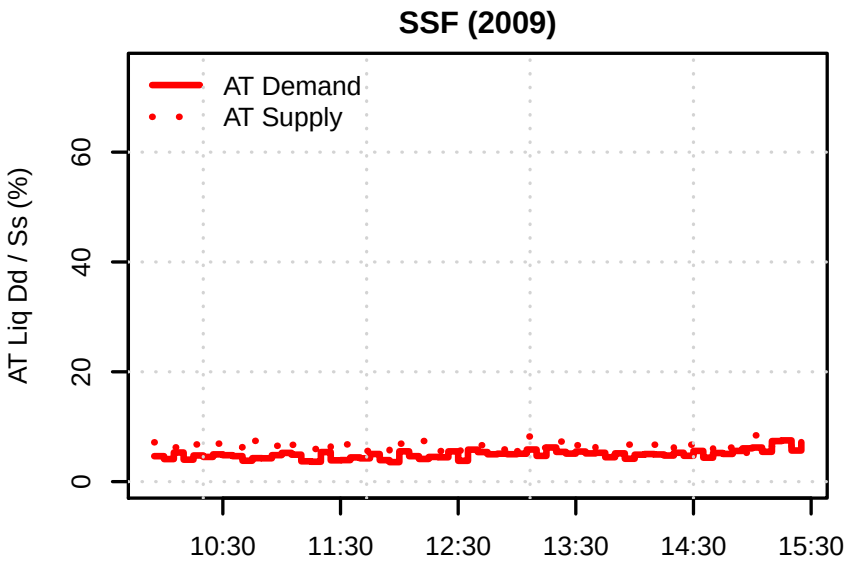


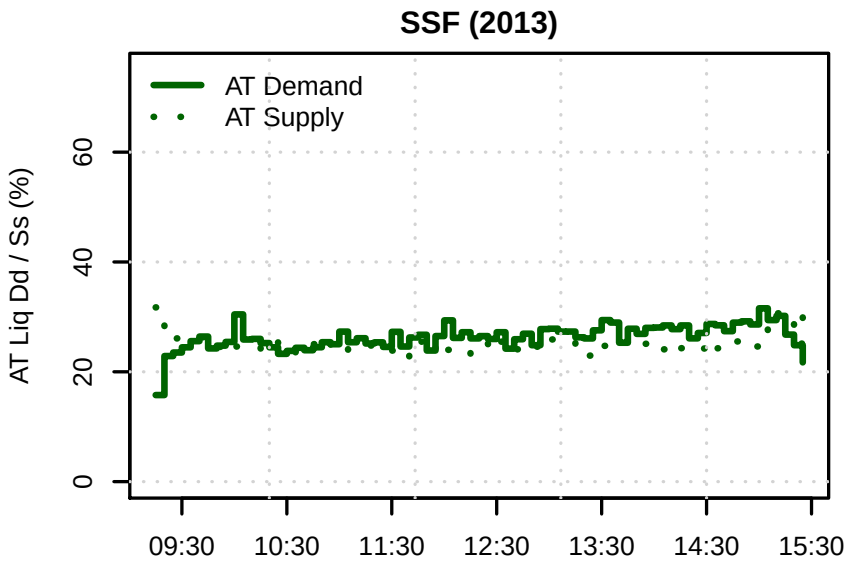


Intraday liquidity demand and supply by AT (Q4)







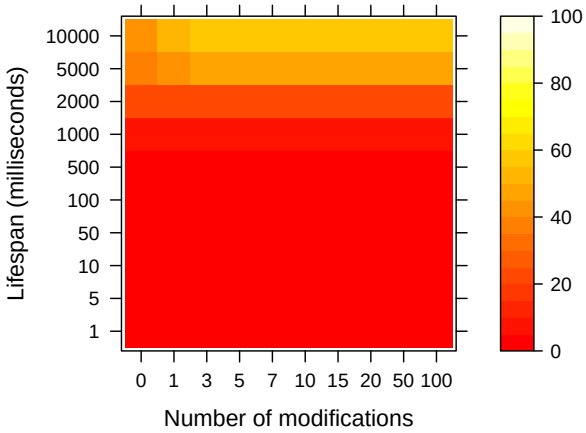


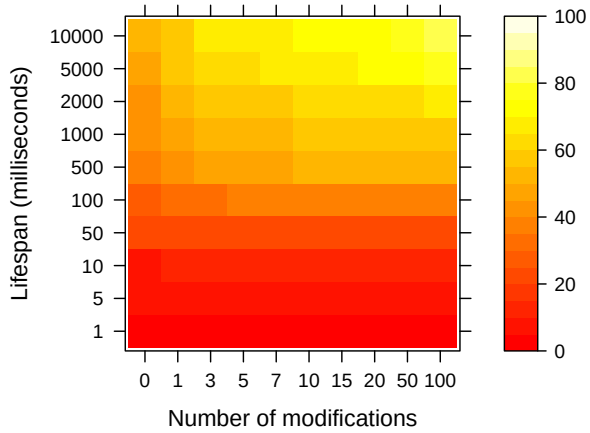
Q4: What is the speed of order cancellations?

Cancelled algo orders: Spot

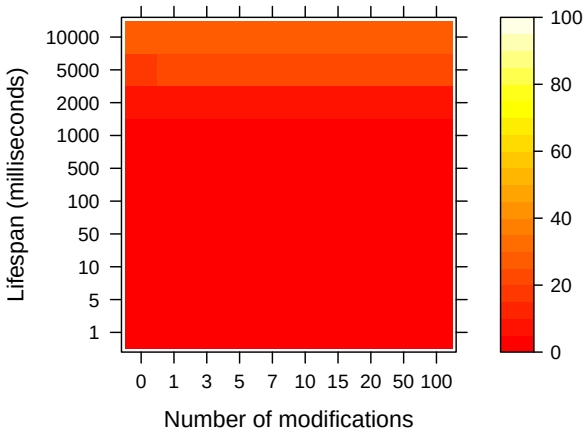
2009 2013

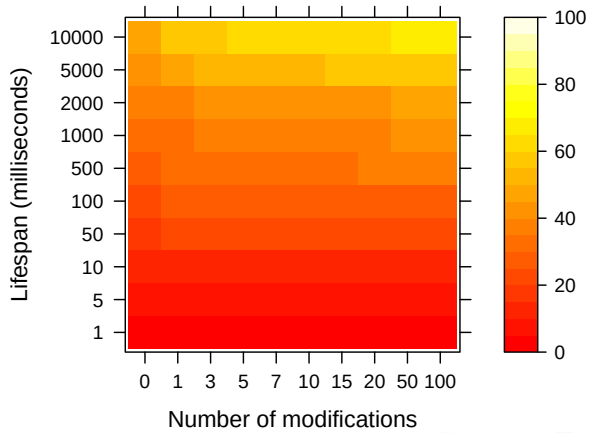
Q1 (Highest market cap)





Q4 (Lowest market cap

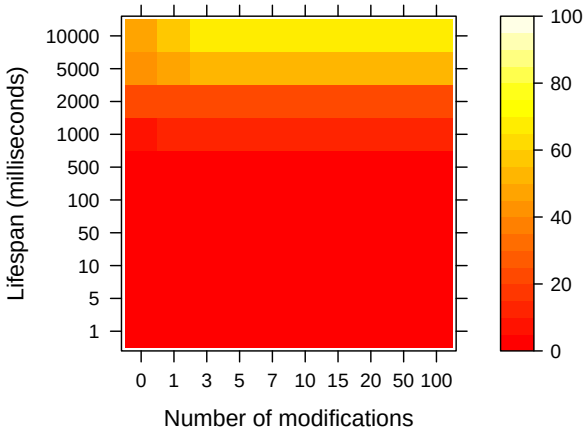


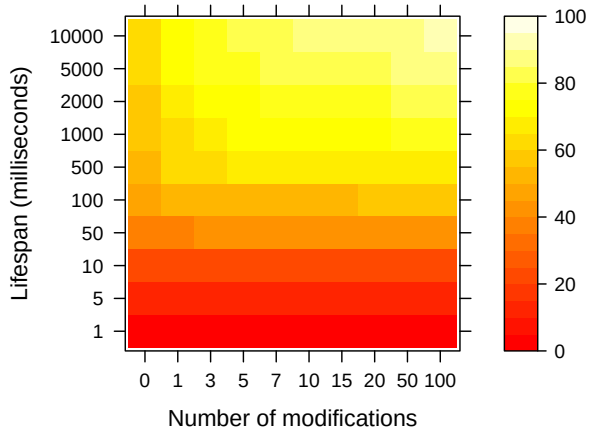


Cancelled algo orders: SSF

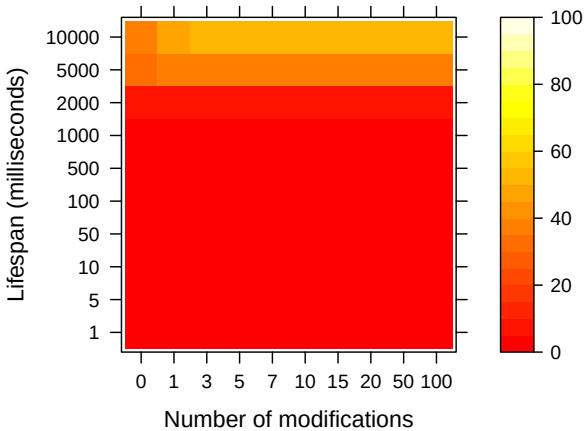
2009 2013

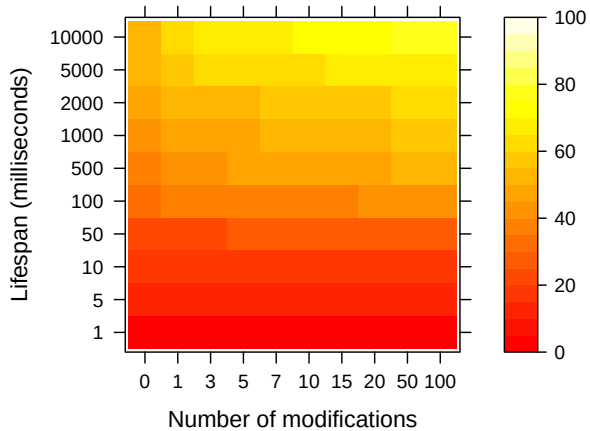
Q1 (Highest market cap)





Q4 (Lowest market cap





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

Spot: Orders cancellations with duration less than a second

	As % of orders cancelled in <1 second			
MCap quartiles	**Q1** (Highest)		**Q4** (Lowest)	
Order location at Entry, Exit	2009	2013	2009	2013
	As % of orders cancelled in <1 s			
$(<1],(<1]$	13.40	**5.31**	51.97	**39.01**
$(1,3],(<1]$	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
$(>5],(>5]$	**68.64**	61.35	**26.95**	15.39
	As % of all cancelled orders			
'Fast'	5.74	54.80	1.19	30.60
Algo 'fast'	3.63	**54.49**	0.43	**29.66**

SSF: Orders cancellations with duration less than a second

	As % of orders cancelled in <1 second			
MCap quartiles	**Q1** (Highest)		**Q4** (Lowest)	
Order location at Entry, Exit	2009	2013	2009	2013
	As % of orders cancelled in <1 s			
$(<1],(<1]$	10.63	**4.66**	32.43	**12.06**
$(1,3],(<1]$	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	**54.02**	9.05	**14.92**
	As % of all cancelled orders			
'Fast'	9.02	74.48	3.17	53.14
Algo 'fast'	4.90	**73.21**	1.19	**52.47**

In summary,

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A.4 Significant percentage of order cancellations within one second (44% on spot and 63% on SSF).

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Going forward

- What explains high rate of order cancellations?
- Do we see higher cancellations during stress periods

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- Do we see higher cancellations 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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