

FINA 4103
Class Note 4: US Trading Rules

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Review: Multiple Exchanges

- ▶ Stocks can be “cross-listed (dual-listed)” at multiple exchanges
 - ▶ Liquidity, information, wide range of investors
 - ▶ E.g., Walgreen, Microsoft, Intel,..., listed on NYSE and NASDAQ
- ▶ Moreover, the US rules allow single-listed stocks to be traded in multi exchanges
- ▶ How to trade these stocks? Where? At what price?

Regulation on Multiple Exchanges

Securities Exchange Act

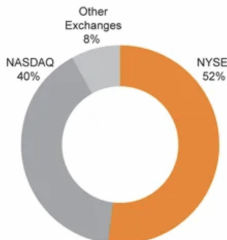
and

National Market System

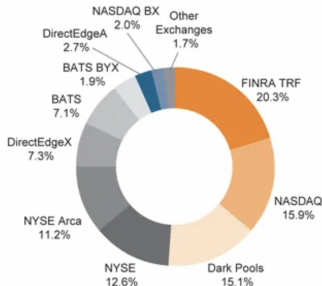
Market Fragmentation

- ▶ **Fragmented** markets: multiple platforms operate side by side
 - ▶ US (16 exchanges), Canada, China, India, etc
 - ▶ International fragmentation is also possible (e.g., Euro)

1998 U.S. Equity Market Share



2015 U.S. Equity Market Share



Source: Credit Suisse Trading Strategy

Note: "Other TRF" includes broker capital commitments and internalizations. "Other Exchanges" includes NYSE Amex, CBSX, Chicago, National and PSX.

Market Fragmentation

- ▶ The US SEC sets (very complex) trading rules
- ▶ Two major regulation frameworks:
 - ▶ Securities Exchange Act
 - ▶ National Market System (NMS)
- ▶ Each has several important rules
 - ▶ We take the user's perspective
- ▶ **Goal** = ensure the same-quality trade services among all ex.
 - ▶ Available stocks, prices, etc
 - ▶ Fragmented venues operate as a single **consolidated** venue

Securities Exchange Act & Unlisted Trading Privileges

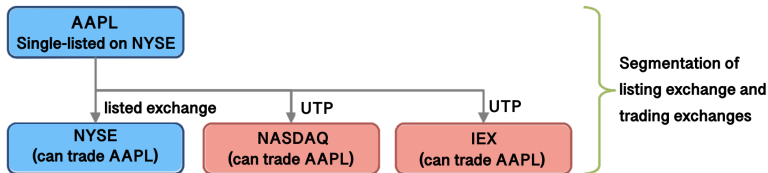
The Securities Exchange Act (1934):

- ▶ Rule 12(f) stipulates the **Unlisted Trading Privileges**

Unlisted Trading Privileges (UTP)

Stocks of a company listed on an exchange can be traded on other exchanges.

- ▶ Even if AAPL is listed on NASDAQ, it can be traded on NYSE (and other exchanges)



The Impact of Unlisted Trading Privileges

1. Limits the benefit of cross-listing
 - ▶ In fact, cross-listing is not that popular in the US
2. What factors matter in deciding on listing exchange?
 - ▶ Brand, IPO costs, etc
3. UTP obscures exchange-specific characteristic
4. Rise of exchanges without listing services (BATS, Direct Edge)

The Impact of Unlisted Trading Privileges

Practical implications?

► Data on listed exchanges and aggregate data

2016 Monthly Trading (shares)		Stock A (listed on NYSE)	Stock B (listed on NYSE Arca)	Stock C (listed on NASDAQ)	Total
	NYSE	14,912,855,914	0	0	14,912,855,914
	NYSE Arca	4,975,004,832	3,498,952,382	3,428,196,091	11,902,153,305
	NYSE MKT	0	412,389,574	142,888,212	555,277,846
	NASDAQ	7,386,584,488	1,942,555,064	10,981,664,745	20,310,804,297
	NASDAQ OMX BX	1,494,049,002	507,233,815	892,298,238	2,893,581,055
	NASDAQ OMX PSX	194,443,391	137,526,114	136,091,928	468,061,433
	BATS BZX	3,932,602,812	1,813,700,923	2,681,196,076	8,427,499,811
	BATS BYX	2,030,547,580	667,503,924	1,247,960,469	3,946,011,973
	Direct Edge EDGX	3,613,357,678	1,225,692,410	3,039,249,200	7,878,299,288
	Direct Edge EDGA	1,501,833,535	588,298,220	930,164,212	3,020,296,027
	CHX	331,583,340	224,721,165	108,338,364	664,642,869
	TRF & ADF	23,105,465,569	6,771,742,571	16,688,471,430	46,565,679,570
	Total	63,478,328,141	17,790,316,162	40,276,519,085	121,545,163,388

If no UTP, looking at this section is enough

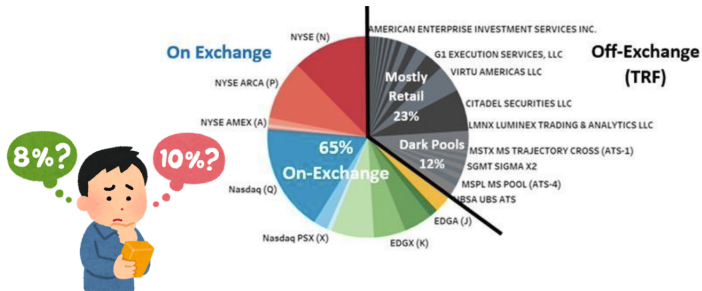
By trading exchanges

By listing exchanges

Source: BATS

National Market System

- ▶ UTP: exchanges are fungible in terms of available stock types
- ▶ Users: Which price should we refer?



National Market System

- ▶ **National Market System (NMS)** (mid-1970-2007)
 - ▶ Connect all 16 exchanges in terms of order execution
 - ▶ Execution services at NYSE are the same as those at NASDAQ
 - ▶ All exchanges can be used as one big consolidated exchange
- ▶ But how? Must be connected in a couple of dimensions
 - ▶ Information;
 - ▶ Price tick; and
 - ▶ Execution price

National Market System Plan (mid-1970s)

Provide wholistic view of the market

- ▶ **Securities Information Processors (SIP):**
 - ▶ Collect LOB information from all exchanges, aggregate it, and publish it to users
- ▶ SIP information consists of
 - ▶ **Consolidated Quotation:** LOB data (what orders/quotes are available)
 - ▶ **Consolidated Tape:** data on executed trade (price, quantity)



Issues in National Market System Plan

- ▶ Innovations in IT and communication tech
⇒ SIP becomes relatively slow in processing/providing data
- ▶ Each exchange starts providing its raw LOB data to customers
 - ▶ Called **Direct Data Feeds**
 - ▶ Much faster than SIP, but super expensive
 - ▶ (Exchanges' incentive of DDF provision?)
- ▶ Uneven playing field
 - ▶ SIP information becomes meaningless if all traders use DDF

Regulation National Market System

To provide consolidated execution services

- ▶ **Reg NMS** (June, 2005): one of the most important rules
- ▶ Mostly related to the trade execution (i.e., at which price, how fast)
- ▶ Consists of four important rules

	Rule #	Contents
Order Protection Rule	Rule 611	No trade-through
Access Rule	Rule 610	No Locked Mrkt
Sub-Penny Rule	Rule 612	Minimum tick size
Market Data Rule	Rule 601,603	Direct feed

“Trade Through” and Order Protection Rule

Rule 611

Trade Through

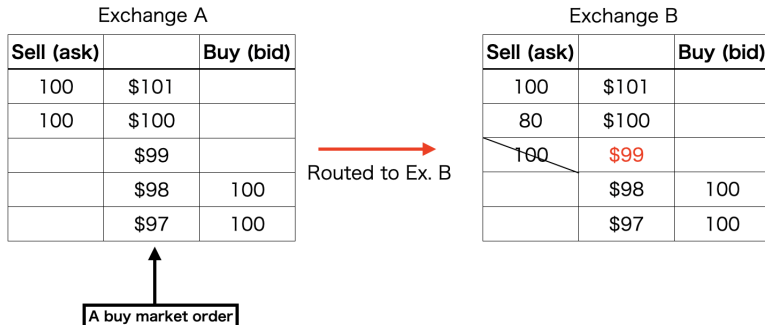
A marketable order is executed on one exchange while a better quote is available on other exchanges.

- ▶ “No Trade Through”: a marketable order must be routed to an exchange that offers the best price
- ▶ Rule 611 of RegNMS “Order Protection Rule” prohibits trade through
- ▶ You are guaranteed to trade at the best price among exchanges, no matter where you place an order

Trade Through and Order Protection Rule

Rule 611

- ▶ Exchange A cannot execute buy orders at \$100



- ▶ The exchange who receives an order is responsible to check prices in other ex. and route the order
 - ▶ Smart Order Router (SOR)

No Locked Market

Rule 610

- ▶ “Locked market” among exchanges is prohibited

Exchange A

Sell (ask)		Buy (bid)
100	\$101	
100	\$100	
90	\$99	
	\$98	100
	\$97	100

Exchange B

Sell (ask)		Buy (bid)
100	\$101	
80	\$100	
	\$99	
	\$98	100
	\$97	100



- ▶ Exchange B must route it to A
 - ▶ Does not apply to hidden quotes
- ▶ Rule 611 is for marketable (executable) orders on local LOB
- ▶ Rule 610 is for liquidity-provision orders on local LOB

Sub-Penny Rule

Rule 612

- ▶ What is the domain of the price?
 - ▶ In theory, price takes continuum values $p \in \mathbb{R}_+$
 - ▶ But algorithm must have discretized price domain
- ▶ Price ticks = discrete numbers that the price can take
 - ▶ $p \in \{p_0, p_1, p_2, \dots, p_n\}$
- ▶ Rule 612: the (minimum) tick size must be \$0.01
 - ▶ $p_0 = \$0.00, p_1 = \$0.01, p_2 = \$0.02, \dots$
- ▶ Limit orders cannot quote sub-penny prices, e.g., $p \neq \$101.255$
- ▶ Why do we need this rule?

Exceptions to Rules 610 and 611

Conditions and Order Types

Flickering Quotes

- ▶ Modern market updates quotes very quickly
- ▶ “Flickering quotes” are exempted (up to 1sec)¹
 - ▶ Exchange *A* executed order at 10:00:0000, as it offered the best price on data
 - ▶ But in reality, exchange *B* had a better price, while the data reflects it at 10:00:0050
 - ▶ This does not violate the rule

¹Flickering quotes (orders): quotes submitted and cancelled repeatedly in a very short time interval

Intermarket Sweep Orders

Intermarket Sweep Orders

An order placed to multiple exchanges at the same time. It must consume the best quote but exempted from the order protection rule.

- ▶ Typically ISO is used with IOC instruction (“Day” ISO also exists)
- ▶ Sophisticated order type to better execute large orders in multiple-market environment
- ▶ Or is it? Why do we need this when Rule 611 guarantees execution at the best price?

Intermarket Sweep Orders

- ▶ You want to buy 1000 units when the LOBs are like below
- ▶ What if you use plain market order and place it to exchange A?

Exchange A

Sell (ask)		Buy (bid)
300	\$101	
100	\$100	
100	\$99	
	\$98	
	\$97	200
	\$96	300

Exchange B

Sell (ask)		Buy (bid)
200	\$101	
300	\$100	
500	\$99	
	\$98	
	\$97	100
	\$96	400

Exchange C

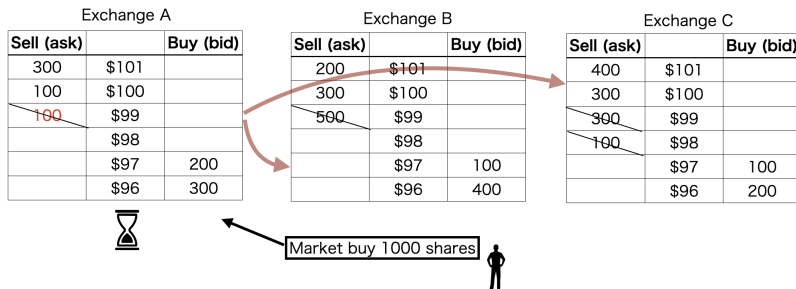
Sell (ask)		Buy (bid)
400	\$101	
300	\$100	
300	\$99	
100	\$98	
	\$97	100
	\$96	200

Market buy 1000 shares



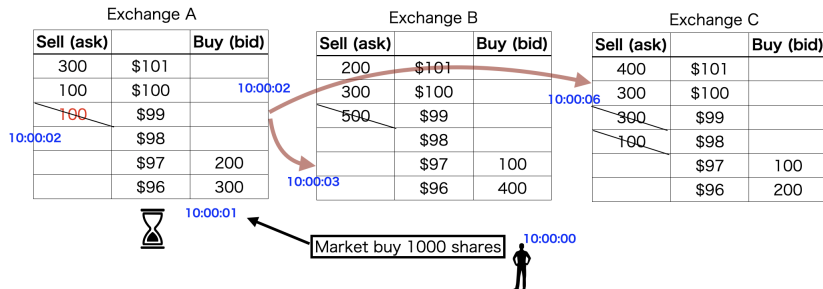
Intermarket Sweep Orders

- ▶ Exchange A must route your order to B and C
 - ▶ Several patterns in order-routing algorithm
 - ▶ Pro-rata allocation (most popular)
 - ▶ Time priority rule
 - ▶ Round robin
- ▶ Large orders cannot be executed in one venue



Intermarket Sweep Orders

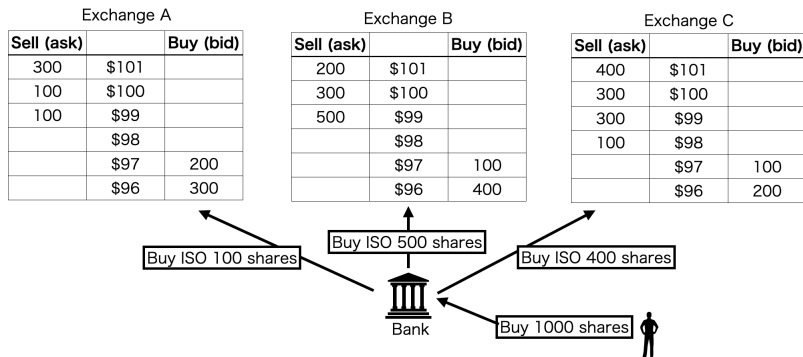
- ▶ Exchanges' SOR can be slower than your broker's in-house information and communication tech
- ▶ Observing the pattern of order execution, other traders may realize your trading intensity and "front run"
 - ▶ Executions at A (10:00:02) and B (10:00:03)
 - ▶ Rivals anticipate underlying large order & incoming one at C
 - ▶ Front-run to C before 10:00:06



Intermarket Sweep Orders

- ▶ If you place ISO to exchange A , your broker checks the best prices among exchanges and split your orders
- ▶ Now it's broker's responsibility to follow the rule
 - ▶ i.e., ISO must consume the best price (at the time of order placement)
- ▶ Exchanges: no need to route received ISOs

Intermarket Sweep Orders



- ▶ Typically, broker-dealer has discretion on how to split (but try to minimize the trading cost and delay)
- ▶ ISO is mostly sent with IOC instruction

“Do-not-Ship”

- ▶ Delays due to order routing are a primary concern
- ▶ Insert “Do-not-Ship (DNS)” instruction in your orders



“Do-not-Ship”

Do-not-Ship

Orders with “Do-not-Ship (DNS)” instruction are not routed to other exchanges (even if other exchanges offer better prices) and is cancelled.

- ▶ DNS limit:
 - ▶ if it does not lock or cross the market, it stays on local LOB
 - ▶ if it crosses or locks other LOBs, then cancelled (avoid being routed out by Rule 610)
- ▶ DNS IOC (with or without limit price):
 - ▶ if there is liquidity on the other side (at the limit price or better), executed locally
 - ▶ otherwise, cancelled (avoid being routed out by Rule 611)
 - ▶ RegNMS-Compliance IOC (called NMS IOC on NYSE)
- ▶ To avoid routing latency and stale limit prices on other exchanges

In the Actual Market

Who Uses Which Order Types and Why?

- ▶ Li, Ye, and Zheng (2022, JFE) analyzed which order types the traders actually use
 - ▶ Proprietary data on NYSE with trade-by-trade order types
- ▶ All orders are classified by three factors
 1. Price qualifier: limit price, stop price, no price condition
 2. Time in force: IOC, DAY, GTC
 3. Routing decisions: DNS, ISO, no routing instruction
 4. Display decisions: hidden (%), no instruction

Who Uses Which Order Types and Why?

Observation

57% of orders in the sample refused order routing stipulated by RegNMS.

- ▶ More than half of trading orders are refusing the best price
- ▶ Why?—The paper proposes two possible factors

Summary Stats: What Do We Observe?

Table 2
Summary statistics for order types

Classification	Order Type	Trades	Executed Volume	Average Order Size	Market Share (Executed Volume)	Fill Rate	Take Local Liquidity	Route	Make Liquidity
Liquidity-taking	Plain market	6,364,008	1,775,278,400	278.96	4.48%	100.00%	66.34%	33.64%	0.00%
	Plain IOC	4,196,808	1,127,373,900	268.63	2.84%	19.48%	98.07%	1.93%	0.00%
	ISO	25,410,600	6,207,890,700	244.30	15.66%	22.48%	100.00%	0.00%	0.00%
	DNS IOC	14,652,500	4,499,703,400	307.09	11.35%	31.86%	100.00%	0.00%	0.00%
Liquidity-making	DAY limit	43,360,100	9,560,971,500	220.50	24.12%	2.71%	29.78%	14.28%	55.94%
	DNS limit	44,243,300	8,069,151,300	182.38	20.36%	3.72%	11.43%	0.00%	88.57%
	Reserve	6,660,529	1,917,804,300	287.94	4.84%	2.09%	31.09%	16.30%	52.62%
	DNS Reserve	4,077,848	732,919,700	179.73	1.85%	1.56%	5.00%	0.00%	95.00%
Trailing Price	Peg	1,256,004	237,375,000	188.99	0.60%	78.12%	0.71%	0.01%	99.28%
	Buy Minus Zero Plus	13,263	2,330,600	175.72	0.01%	45.88%	7.71%	12.91%	79.38%
Auction	Market-on-close	897,083	3,890,610,000	4336.96	9.82%	100.00%			
	Market-on-open	346,417	798,674,000	2305.53	2.02%	100.00%			
	Limit-on-open	373,525	289,195,000	774.23	0.73%	1.96%			
	Limit-on-close	212,533	448,966,000	2112.45	1.13%	15.30%			
No Expiry Time	STOP	150,566	50,090,400	332.68	0.13%	-	68.28%	31.65%	0.07%
	Good-Till-Cancel (Plain Limit)	36,612	20,495,800	559.81	0.05%	-	11.30%	4.28%	84.42%
	Do Not Reduce	6,297	6,119,500	971.81	0.02%	-	12.57%	5.30%	82.13%

Fees and Routing

Exchanges charge several types of fees

- ▶ Make/take fees (rebates):
 - ▶ Liquidity-taking orders pay take fee f_{take}
 - ▶ Liquidity-making orders earn rebate $f_{make} (< f_{take})$
 - ▶ Exchange earns $f_{take} - f_{make}$ as its profits
 - ▶ Ex. NYSE charges $f_{take} = \text{¢}0.21$ and $f_{make} = \text{¢}0.13$
- ▶ Order-routing fees:
 - ▶ Exchange that routes order to other exchanges charges f_{route}
 - ▶ Rule 610 caps $f_{route} \leq \text{¢}0.3$ per share
- ▶ NYSE sets $f_{route} = \text{¢}0.3$; even if it routes out orders, it does not lose money

Fees and Routing: Rule 610

- ▶ RegNMS does not incorporate fees into account

Exchange A

Sell (ask)		Buy (bid)
100	\$10.01	
100	\$10.00	
	\$9.99	
	\$9.98	ⓧ
	\$9.97	100
	\$9.96	120
	\$9.95	110

Exchange B

Sell (ask)		Buy (bid)
100	\$10.01	
100	\$10.00	
40	\$9.99	
20	\$9.98	
	\$9.97	100
	\$9.96	120
	\$9.95	110

Limit buy of 10 shares at \$9.98

- ▶ Is order routing (due to Rule 610) profitable or costly?
- ▶ Rule 610 blurs making liquidity and taking liquidity
 - ▶ Make order at NYSE is routed to NASDAQ and takes liquidity

Fees and Routing: Rule 610

- "Make" orders earn no price improvement from routing

Table 4
Order types and limit order book dynamics

Panel A: Price improvements for routed out orders				
Improvement	Plain Market	Plain IOC	DAY Limit	Reserve
0	26.99%	0.00%	77.49%	79.51%
0.01	48.58%	70.49%	12.93%	9.43%
0.02	13.87%	12.00%	2.74%	3.52%
0.03	5.11%	4.52%	1.35%	1.68%
0.04	2.09%	2.46%	0.96%	1.32%
0.05	0.98%	1.59%	0.95%	1.33%
0.06	0.52%	1.00%	0.34%	0.63%
0.07	0.32%	0.81%	0.26%	0.36%
0.08	0.22%	0.69%	0.21%	0.21%
0.09	0.15%	1.13%	0.16%	0.15%
0.1	0.04%	0.66%	0.07%	0.05%
0.10+	1.12%	4.65%	2.56%	1.82%

Fees and Routing: Rule 611

- ▶ Exchanges impose different fee levels
 - ▶ Also different structures, e.g., maker-taker fees, inverted maker-taker fees
- ▶ Following the Rule 611, exchanges often route marketable orders to worse prices after fees
- ▶ Is order routing due to Rule 611 profitable or not (see Table 4)?
- ▶ If profitable, then why take orders also refuse routing?

Intermarket Sweep Orders

- ▶ ISO is to help execution of a large block at multiple exchanges to avoid information leakage or staleness
 - ▶ ...at least according to SEC
- ▶ Data shows that ISO orders' size is not that large
 - ▶ Average size of ISO is 244 shares
 - ▶ IOC market (268 shares), market (278 shares)
- ▶ The main reasons for using ISOs might differ from the SEC's original intentions

Race to Take Standing Limit Orders (“Sniping”)

- ▶ The share of ISO in sniping races is significant (about 77%)
 - ▶ Plain IOC counts only $13.42+17.37-5.96 = 24.83$
- ▶ Non-routable orders have high winning rate

Table 6
Speed races to snipe stale quotes

Winner \ Loser	Plain IOC	ISO	DNS IOC	Total winning races	Winning rate
Plain IOC	5.96	4.47	2.99	13.42	5.46%
ISO	7.03	86.35	47.33	140.71	57.26%
DNS IOC	4.38	43.69	43.56	91.63	37.28%
Total Losing races	17.37	134.51	93.88	244.76	

In this table, we report the pairwise speed race counts among three types of IOC orders, where we define the speed races in Section IV.A. The order types in the rows are race winners and the order types in the columns are race losers. If $q > 1$ orders win (lose) the race, each order is counted as winning (losing) $1/q$ of the race. All numbers are averaged at the stock-day level.

Race in Making Liquidity

- ▶ Two dimensions of race:
 1. How quickly you cancel standing limit orders with stale prices
 2. Races to establish front queue positions on LOB
- ▶ In both races non-routable limit orders win the races to routable orders
 - ▶ E.x., DNS limit orders successfully cancel 42% of the time in sniping events
 - ▶ Routable limit orders rarely escape

Speed: Time Priority

Table 9
Speed races to establish front queue positions

	Average trades per day	First responder count per day		
		Total	DAY limit	DNS limit
Full Sample	1652	495	121	374
Breakdown			24.4%	75.6%
Large	3118	1108	258	850
Breakdown			23.3%	76.7%
Medium	1065	263	75	188
Breakdown			28.5%	71.5%
Small	680	124	36	88
Breakdown			29.0%	71.0%

In this table, we count the first responders to liquidity-taking orders. The first responders are non-marketable limit orders that refill liquidity at the same price where the liquidity is consumed. To ensure that the responding limit order is triggered by the liquidity-taking order, we require that the refill order be submitted within 0.1 seconds. The average number of first responders per day is reported in the second column, and the following columns report the average numbers of first responders per day by order types. The market shares of responding orders are reported under the counts.

Who Uses Non-routable Orders

- ▶ Clientele matters:
 - ▶ DNS orders are not faster than plain orders *per se*
 - ▶ Who are using these orders? Perhaps HFTs?
- ▶ Difference in compliance rules
 - ▶ Users of ISO are required to have fast connections to all exchanges

Who Uses Non-routable Orders

- ▶ Orders refusing best price contribute more to price efficiency
 - ▶ They successfully trade on new information
 - ▶ WPC: weighted price contribution
- ▶ High-speed informed traders tend to use these order types

Table 7
Weighted price contribution by order types

Order Type	Observation	Total shares (Taking)	Mean size (Taking)	Share of taking volume	WPC
Plain market	3,801,767	1,177,671,600	309.77	6.77%	-4.56%
Plain IOC	4,065,849	1,105,589,800	271.92	6.36%	3.86%
ISO	25,410,520	6,207,867,200	244.30	35.69%	90.32%
DNS IOC	14,652,458	4,499,691,500	307.09	25.87%	27.10%
DAY limit	11,366,776	2,846,871,200	250.46	16.37%	-13.78%
DNS limit	4,448,268	922,261,400	207.33	5.30%	-2.34%
Reserve limit	945,753	596,177,100	630.37	3.43%	-0.95%
Reserve DNS limit	148,111	36,655,900	247.49	0.21%	0.35%

Is Exchange Competition Beneficial?

- ▶ Overall, SEC encourages exchange competition:
 - ▶ Competition is good for users
- ▶ Budish, Lee, and Shims (2023, JPE):
 - ▶ Trading fees should decline and become negligible
 - ▶ We actually observe very low trade-execution fees
- ▶ It's like Bertrand competition
 - ▶ All exchanges provide same trade-execution services
 - ▶ UTP and RegNMS
- ▶ Is it good?... how exchanges make money if $\text{fee} = 0$?

► What's going on?

DOW JONES, A NEWS CORP COMPANY

DJIA **25448.48** 0.27% ▲

Nasdaq **7452.13** -0.44% ▼

U.S. 10 Yr -3/32 Yield **3.194%** ▼

Crude Oil **69.08** 0.63% ▲

Euro **1.1511** 0.52% ▲

THE WALL STREET JOURNAL.

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<https://www.wsj.com/articles/sec-to-rule-nyse-nasdaq-didnt-justify-market-data-fee-increases-1539721232>

MARKETS

SEC Ruling Takes Aim at Stock-Exchange Profits

The Securities and Exchange Commission decision blocking higher fees for certain stock-market data casts doubt on a crucial and growing source of revenue that has helped exchanges make up for the declining income from trading

By Alexander Osipovich, Dave Michaels and Gretchen Morgenson

Updated Oct. 16, 2018 5:42 p.m. ET