RESEARCH BRIEF

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Queue-Jumping & Strategic Limit Order Routing

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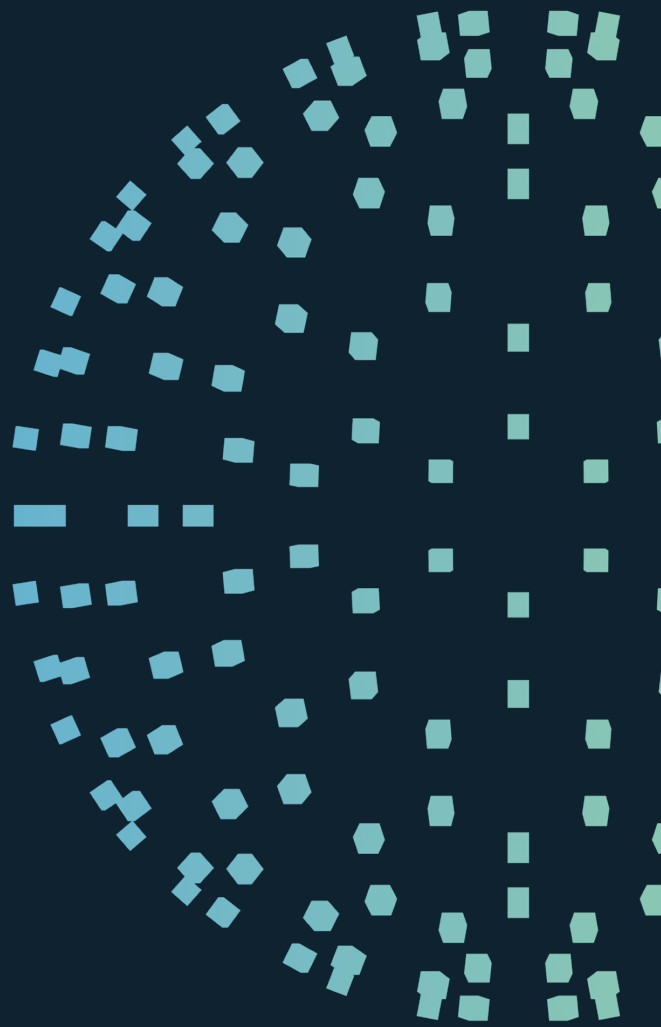
This paper is published in the December 2021 issue of the *Journal of Investing*, a special issue with a focus on trading. The full text of the original article can be accessed via the journal.

This research brief contains the original illustrations and captions.

Contact us for more information on queue-jumping and how our algorithms route limit orders strategically.

While RegNMS's Order Protection Rule protects the NBBO, queue-jumping is still possible and your limit order may not get priority

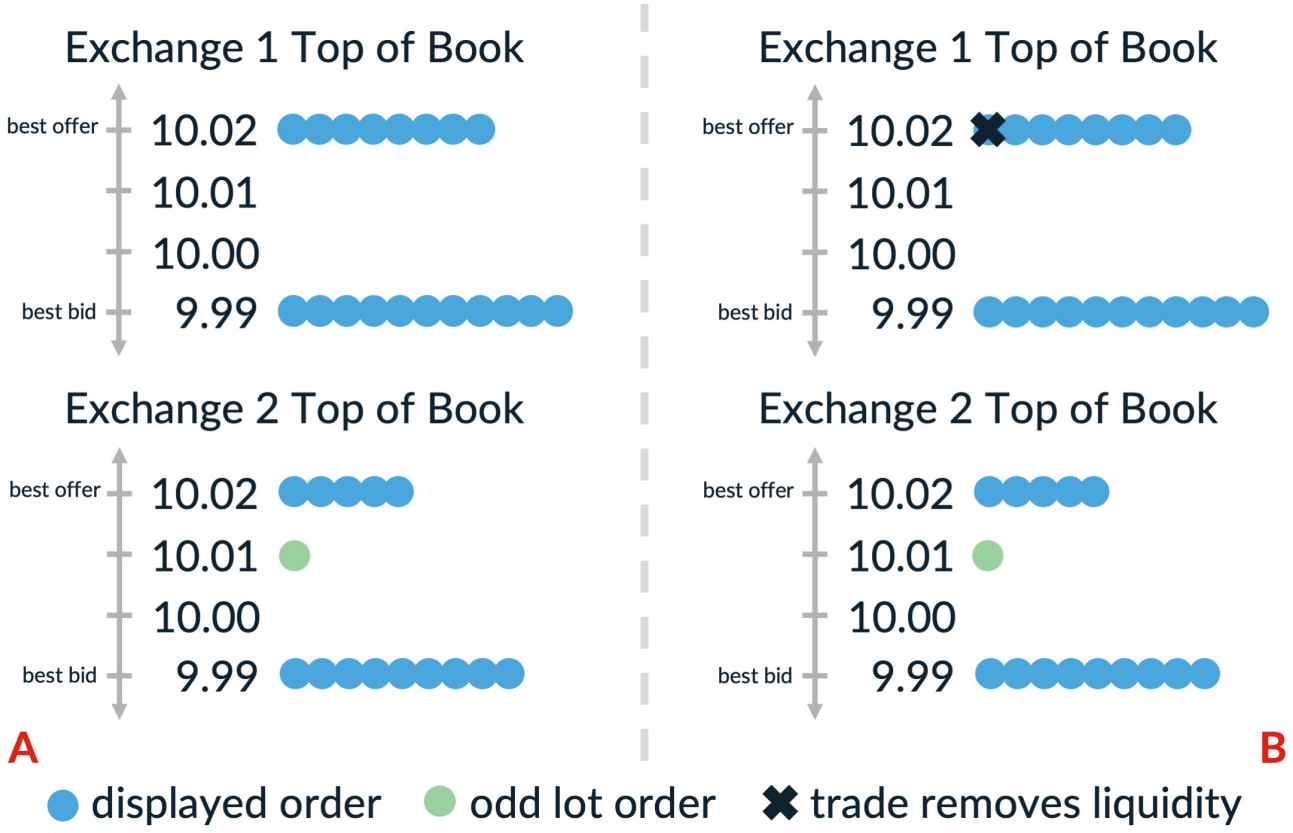


Hidden Orders Do Not Have Price Priority

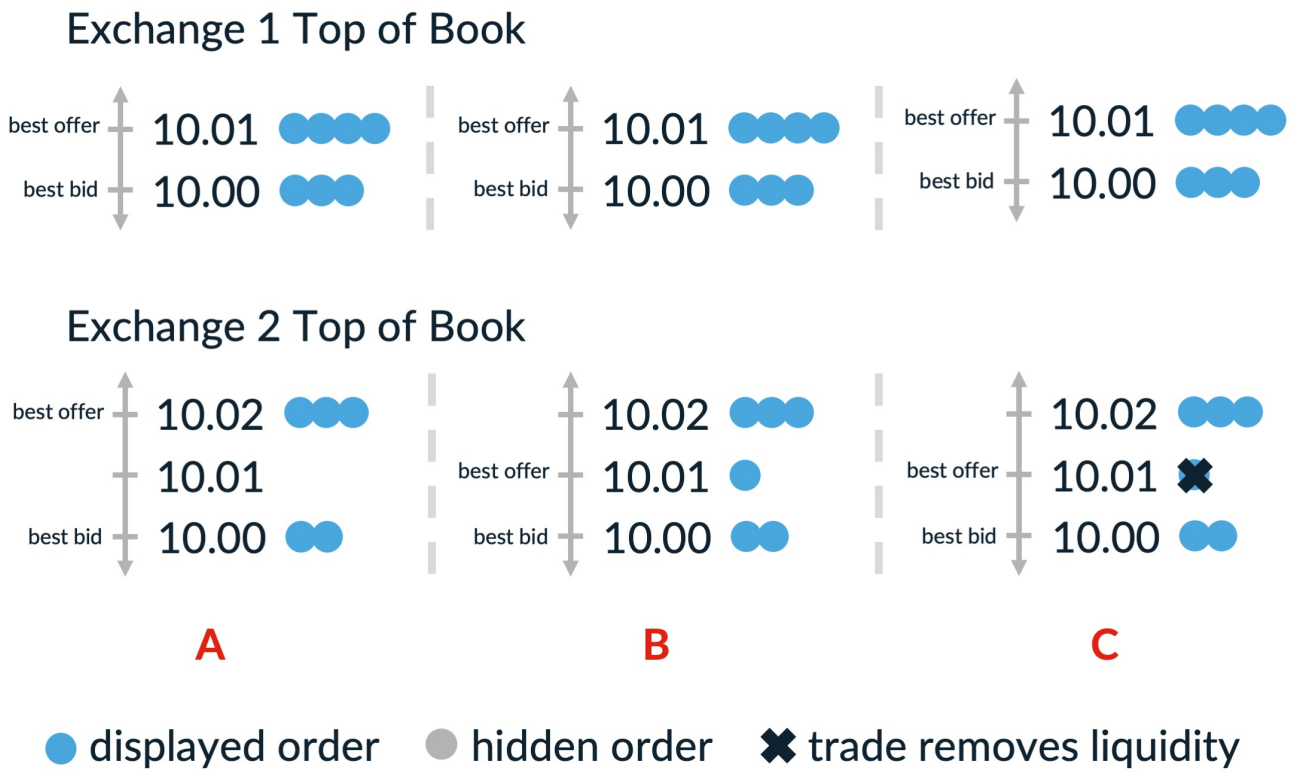
Two hidden orders on Exchange 2 offer improved pricing for the next arriving marketable order to buy (A). A market order to buy arrives at Exchange 1 (B), which has the NBBO, ignoring the hidden liquidity placed at a better price on Exchange 2.

Odd Lot Orders Do Not Have Price Priority

An odd lot order on Exchange 2 offers improved pricing for the next arriving marketable order to buy (A). A market order to buy arrives at Exchange 1 (B), which has the NBBO, ignoring the hidden liquidity placed at a better price on Exchange 2.



Later Orders May Get Priority on Another Exchange



Exchange 1 is at the NBBO while Exchange 2 is at the NBB only (A). A limit order is posted at the NBO on Exchange 2 (B). A market order to buy trades against the new limit order at the NBO on Exchange 2 (C), jumping ahead of the orders placed before it on Exchange 1.

Later Orders May Get Priority Off-Exchange

Exchange 1 is at the NBBO while Dark Pool 1 is at the NBB only (A). A limit order is posted at the NBO in the dark pool (B). A market order to buy trades against the new limit order at the NBO in the dark pool (C), jumping ahead of the orders placed before it on Exchange 1.

The US Equity Market as a “Queue of Queues”

Execution Priority Summary	
Within an exchange…	Across exchanges…
Best price always has priority, regardless of whether the order is displayed or hidden	A round lot at the NBBO can be filled before an odd lot priced more aggressively
At a given price, displayed orders are filled before hidden orders	A displayed order on one exchange can be filled before a hidden order priced more aggressively at another exchange
Among displayed orders or among hidden orders at the same price, the order that arrived first is filled first	A displayed order on one exchange can be filled before a displayed order on another exchange at the same price but out of sequence of arrival time
	A hidden order in a dark pool, exchange, or single-dealer platform can be filled before a displayed order at the same price though arriving later and is hidden

A Brief Introduction to Market Structure

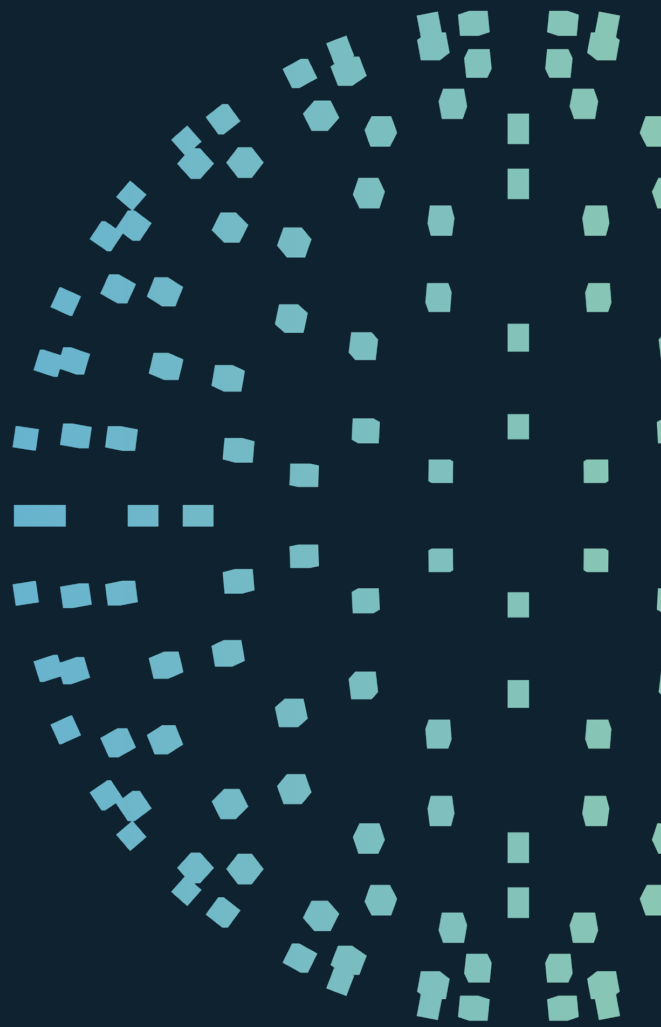
Exchanges offer three varieties of pricing:

- ***maker/taker***—providing rebate to liquidity providing orders and charging a fee to liquidity taking orders
- ***inverted***—reverse of maker/taker
- ***fee/fee***—charging a fee to both sides of each execution

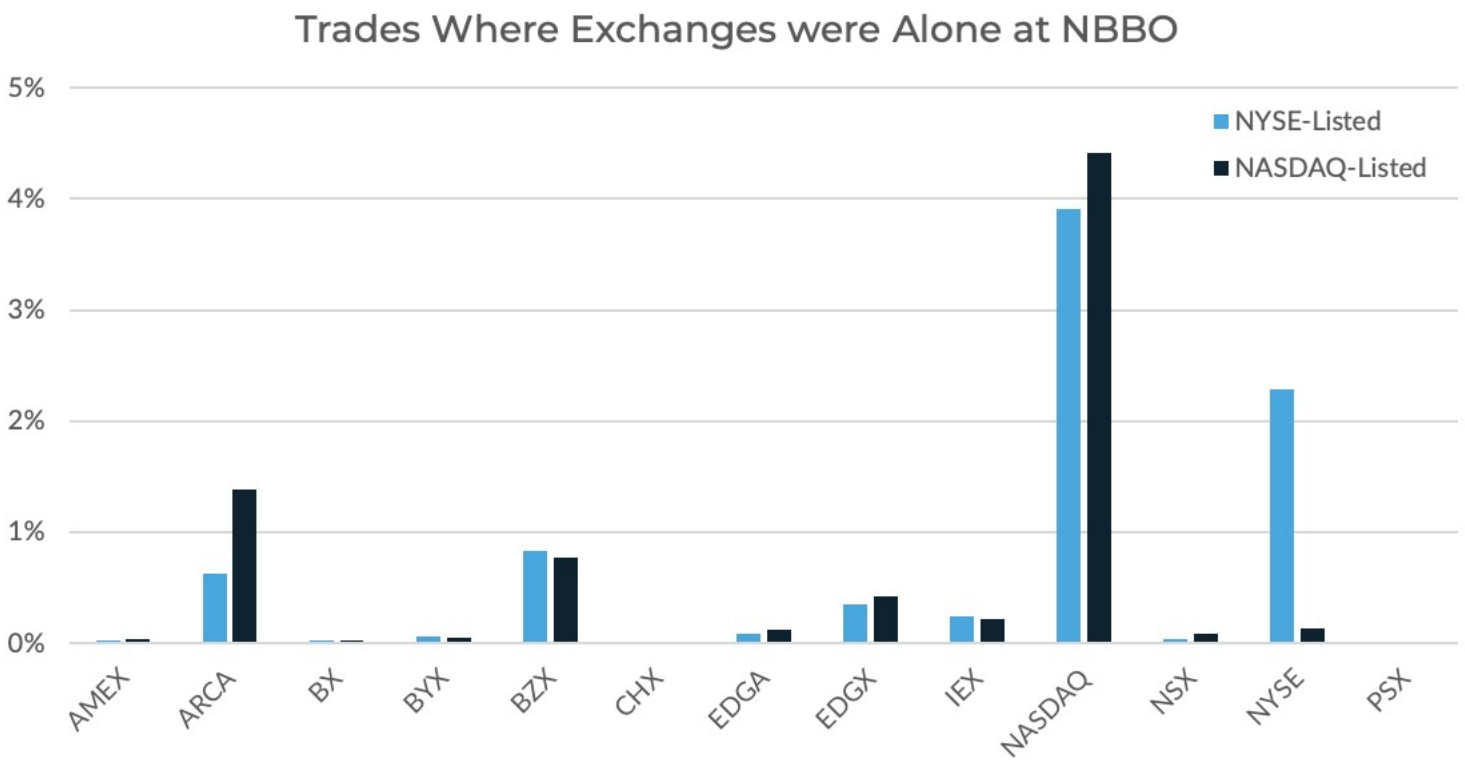
This table illustrates the market share for venues in the US equities market, conglomerate affiliation, if any, and fee structure of each. Market share varies over time.

Venue	Exchange Family	Market Share	Fee Structure
NASDAQ	NASDAQ	19.1%	Maker/Taker
NYSE	NYSE	10.0%	Maker/Taker
ARCA	NYSE	6.6%	Maker/Taker
EDGX	CBOE	6.0%	Maker/Taker
BZX	CBOE	4.9%	Maker/Taker
IEX	Independent	2.7%	Fee/Fee
EDGA	CBOE	1.7%	Inverted
NSX	NYSE	1.7%	Inverted
BYX	CBOE	1.6%	Inverted
BX	NASDAQ	0.9%	Inverted
PSX	NASDAQ	0.6%	Maker/Taker
CHX	NYSE	0.3%	Fee/Fee
AMEX	NYSE	0.3%	Maker/Taker
Dark Pools		10.0%	Varies
Other Off-Exchange		34.0%	Varies

Typical venue selection strategies are suboptimal because each time a limit order is placed, one subset of exchanges (out of more than 65,000 possible combinations) is competing for the next limit order



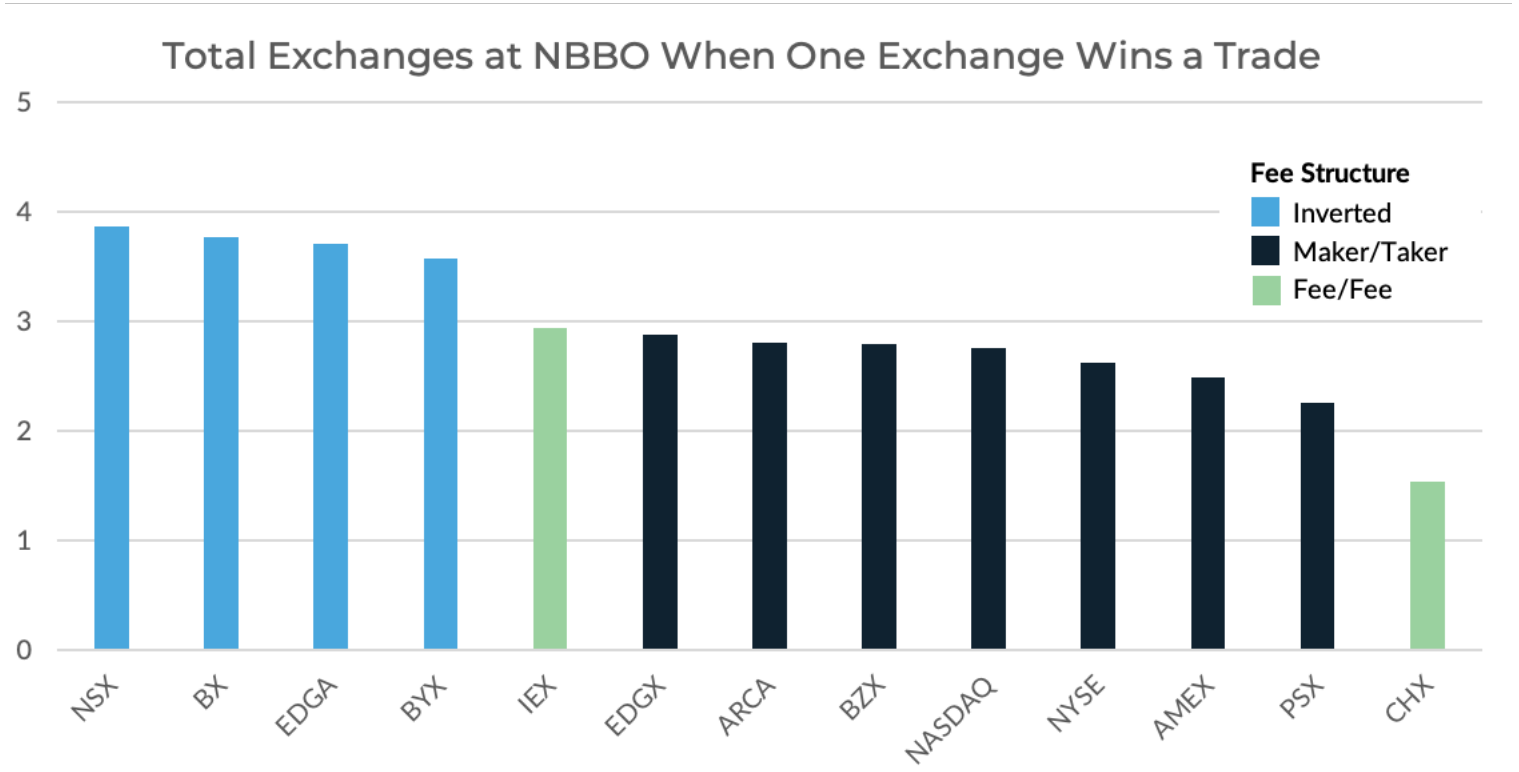
Exchanges Often Compete at the NBBO



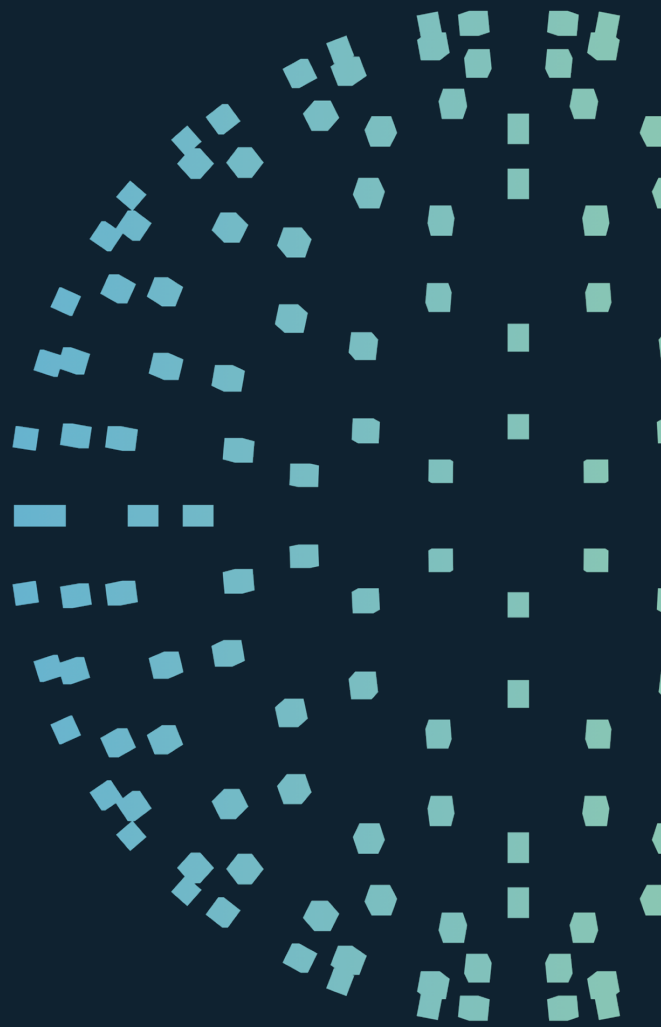
This chart illustrates the percent of trades during which there was only one exchange at the NBBO, totaling just over 7% of the time for all Russell 3000 stocks. There is some variation when stocks are arranged by primary listing exchange, as shown here. Interestingly, there is very little variation across liquidity groups, with Russell 2000 stocks having similar percentages to S&P 100 stocks, though we might expect fewer exchanges to have the NBBO in less liquid names.

Exchanges Often Compete at the NBBO

This chart illustrates the average number of exchanges competing (by having liquidity at the NBBO) whenever a particular exchange "wins" (executes) a trade. It also indicates the fee structure at each exchange. Inverted exchanges do appear to be preferred when competing, as market orders earn rebates on inverted exchanges.

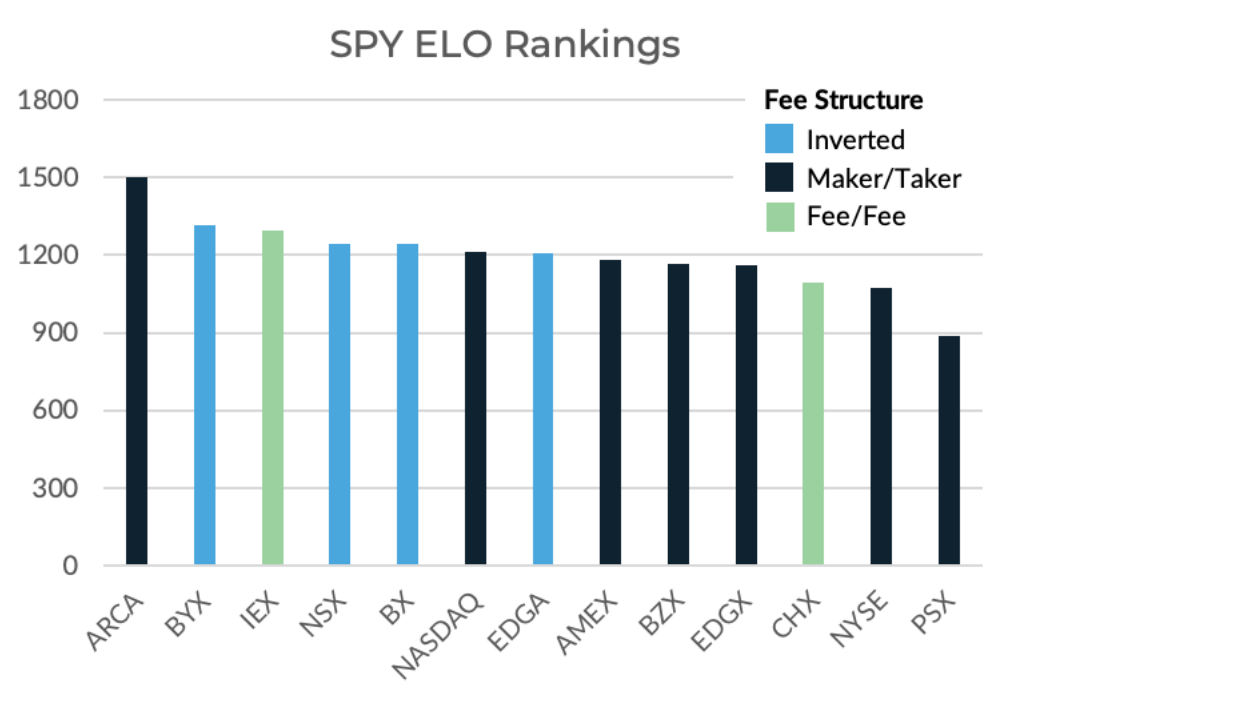


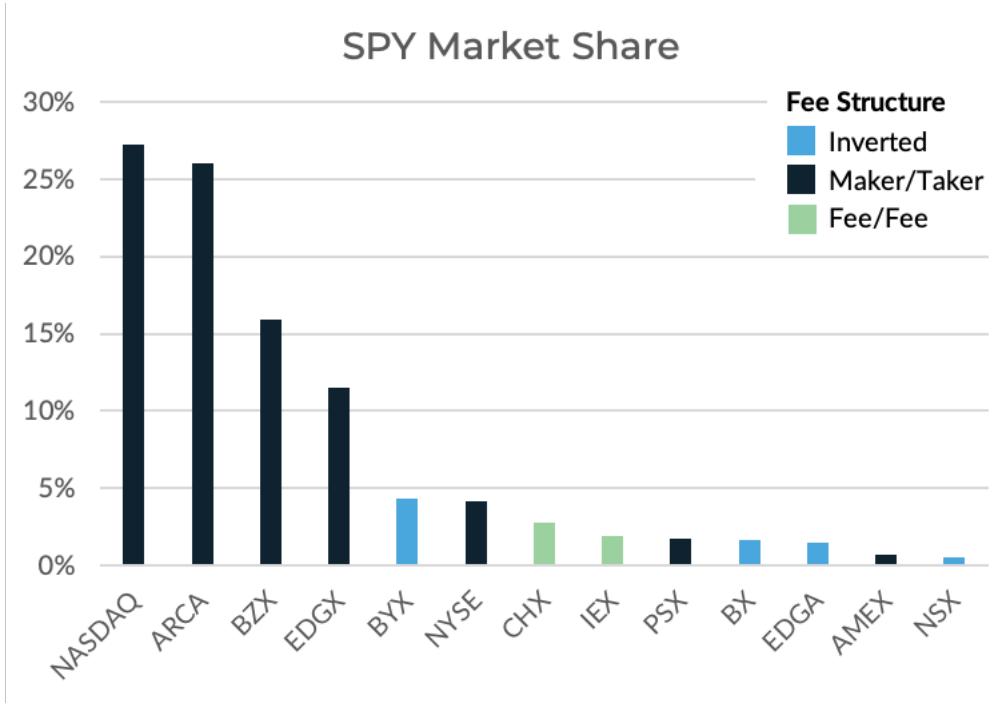
ELO rankings used for chess players can help us rank exchanges



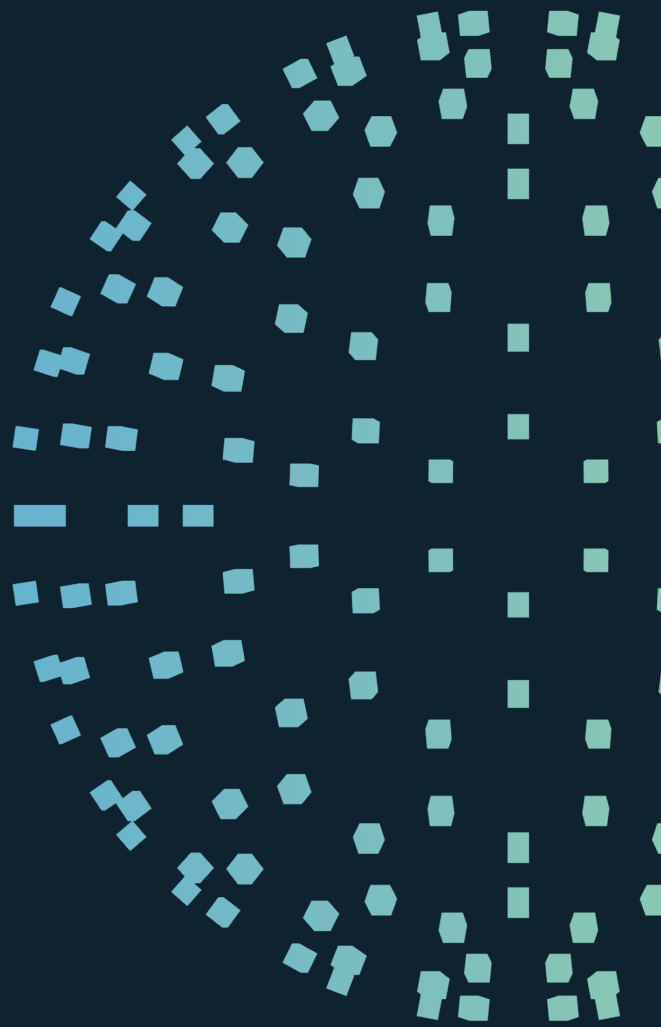
ELO example (compared to market share)

ELO rankings specific to SPY for each exchange (left) and market share specific to SPY for each exchange (right), including indication of whether each exchange is inverted, maker/taker, or fee/fee. Note that market share here excludes off-exchange volume.





BestEx Research WinMatrix technology generates exchange rankings across stocks

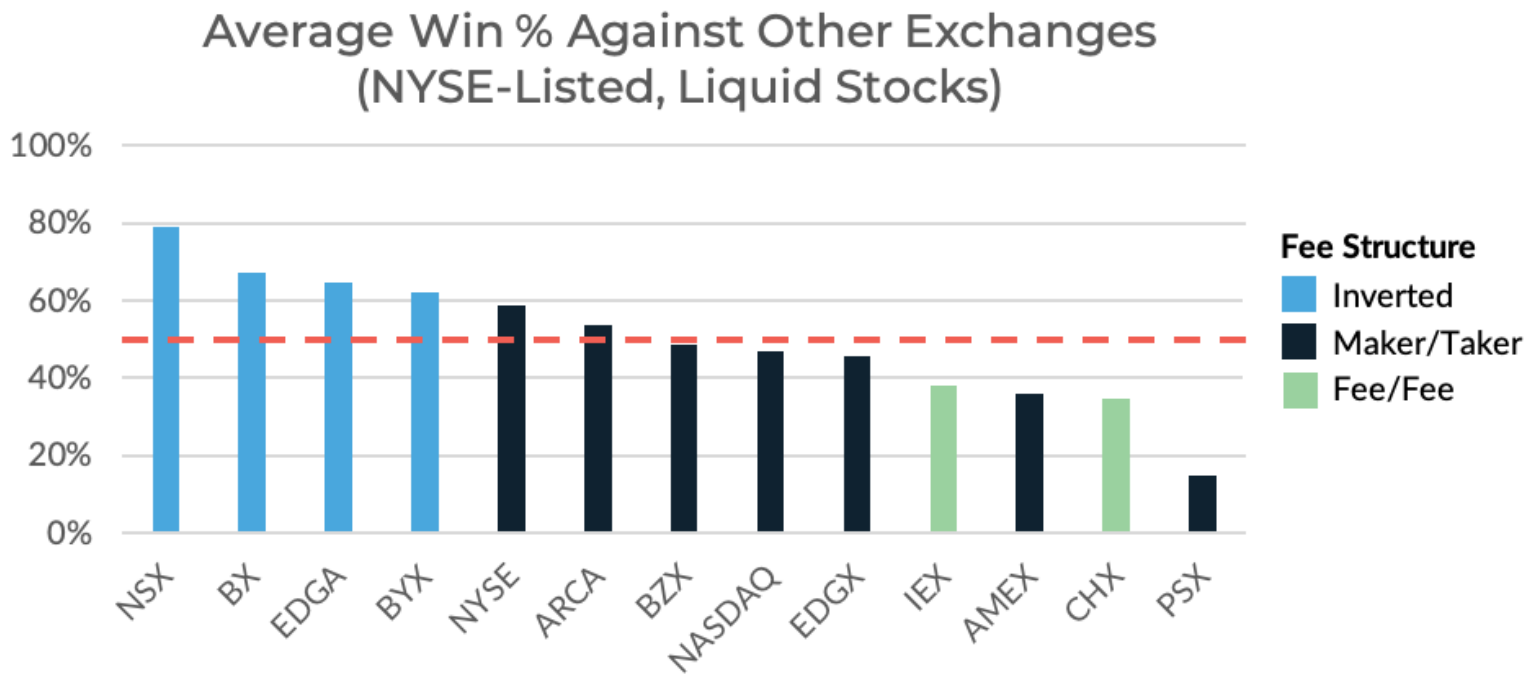


The BestEx Research WinMatrix

Each number in the matrix below represents % of games the exchange indicated by the column label is likely to win over its competitor indicated by the row label (for NYSE-listed S&P 100 stocks). For the case outlined in the navy blue box, 44% is the likelihood that when NYSE and inverted exchange BX are both at the NBO or NBB and a marketable trade (to buy or to sell, respectively) arrives at one of the two, it arrives at NYSE.

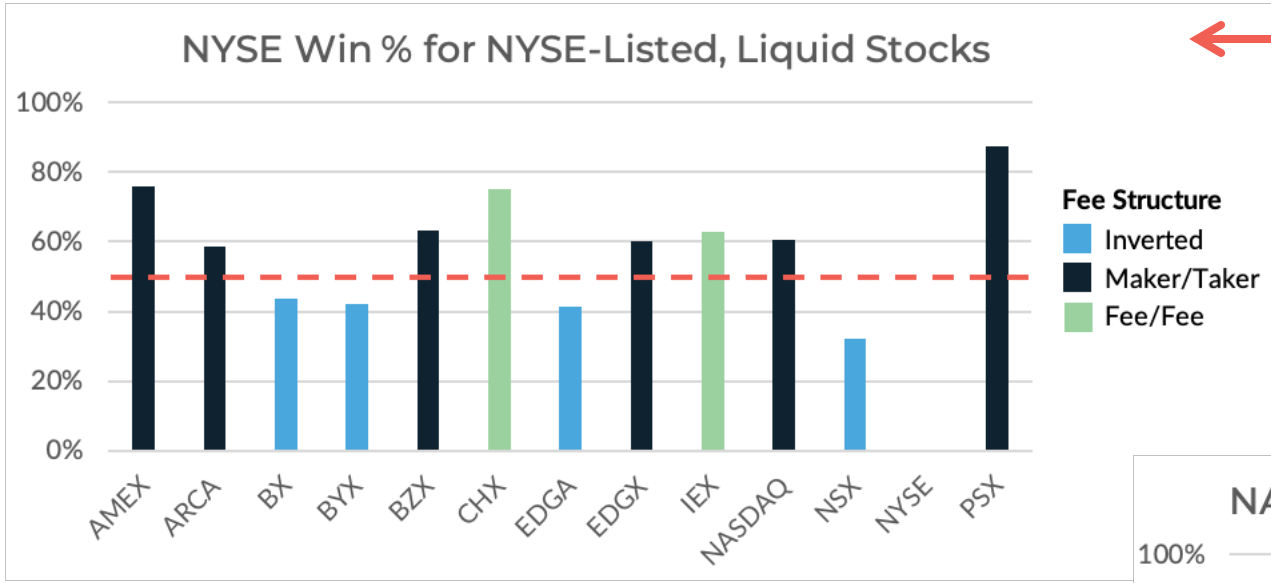
	WINNER												
	AMEX	ARCA	BX	BYX	BZX	CHX	EDGA	EDGX	IEX	NASDAQ	NSX	NYSE	PSX
AMEX		73%	79%	79%	63%	35%	78%	61%	54%	54%	95%	76%	22%
ARCA	27%		59%	60%	44%	27%	59%	46%	42%	47%	72%	59%	15%
BX	21%	41%		42%	31%	28%	50%	27%	12%	28%	62%	44%	5%
BYX	21%	40%	58%		32%	35%	64%	26%	21%	34%	74%	42%	9%
BZX	37%	56%	69%	68%		34%	64%	49%	38%	47%	77%	63%	14%
CHX	65%	73%	72%	65%	66%		70%	58%	59%	54%	94%	75%	33%
EDGA	22%	41%	50%	36%	36%	30%		30%	25%	39%	65%	41%	9%
EDGX	39%	54%	73%	74%	51%	42%	70%		44%	49%	82%	60%	14%
IEX	46%	58%	88%	79%	62%	41%	75%	56%		66%	85%	63%	26%
NASDAQ	46%	53%	72%	66%	53%	46%	61%	51%	34%		78%	61%	14%
NSX	5%	28%	38%	26%	23%	6%	35%	18%	15%	22%		32%	3%
NYSE	24%	41%	56%	58%	37%	25%	59%	40%	37%	39%	68%		12%
PSX	78%	85%	95%	91%	86%	67%	91%	86%	74%	86%	97%	88%	

The WinMatrix



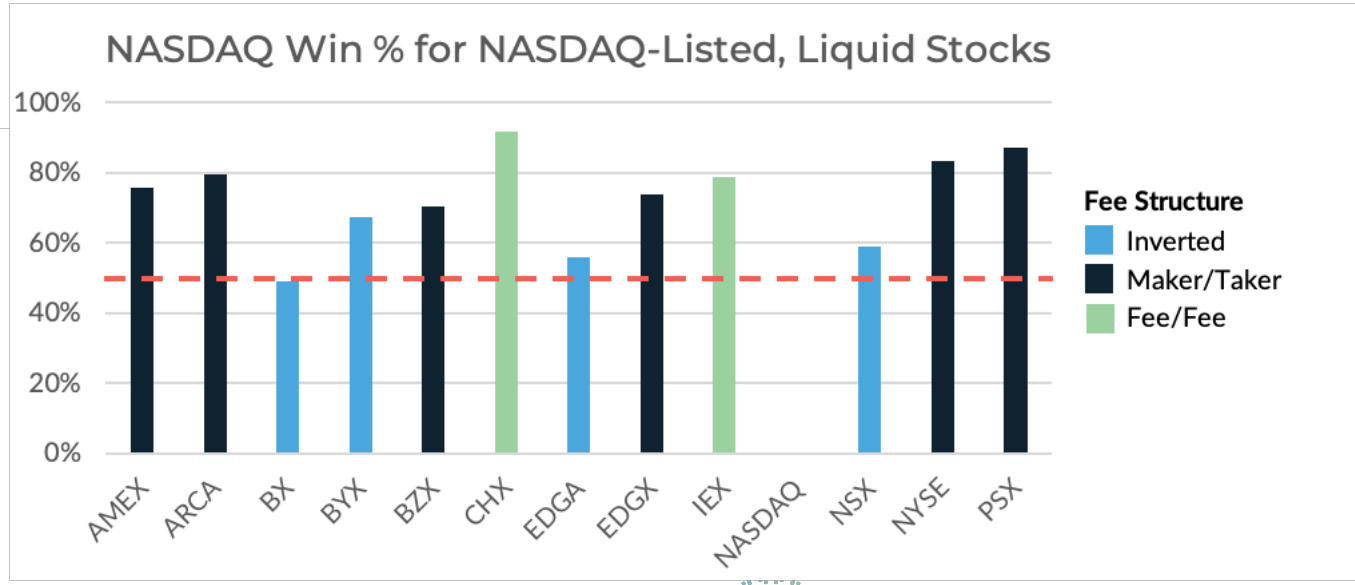
WinMatrix results for all exchanges for NYSE-listed, S&P 100 constituent stocks. The value of 79% indicated for NSX means that NSX wins a trade over other exchanges an average of 79% of the time when both are competing (present at the NBO or NBB). The orange line is a reference indicating 50%. Note that inverted exchanges have the highest win frequencies, and are arranged in order of their take rebates, with NSX rebating 30 mills per share and BYX 5 mills per share.

The WinMatrix



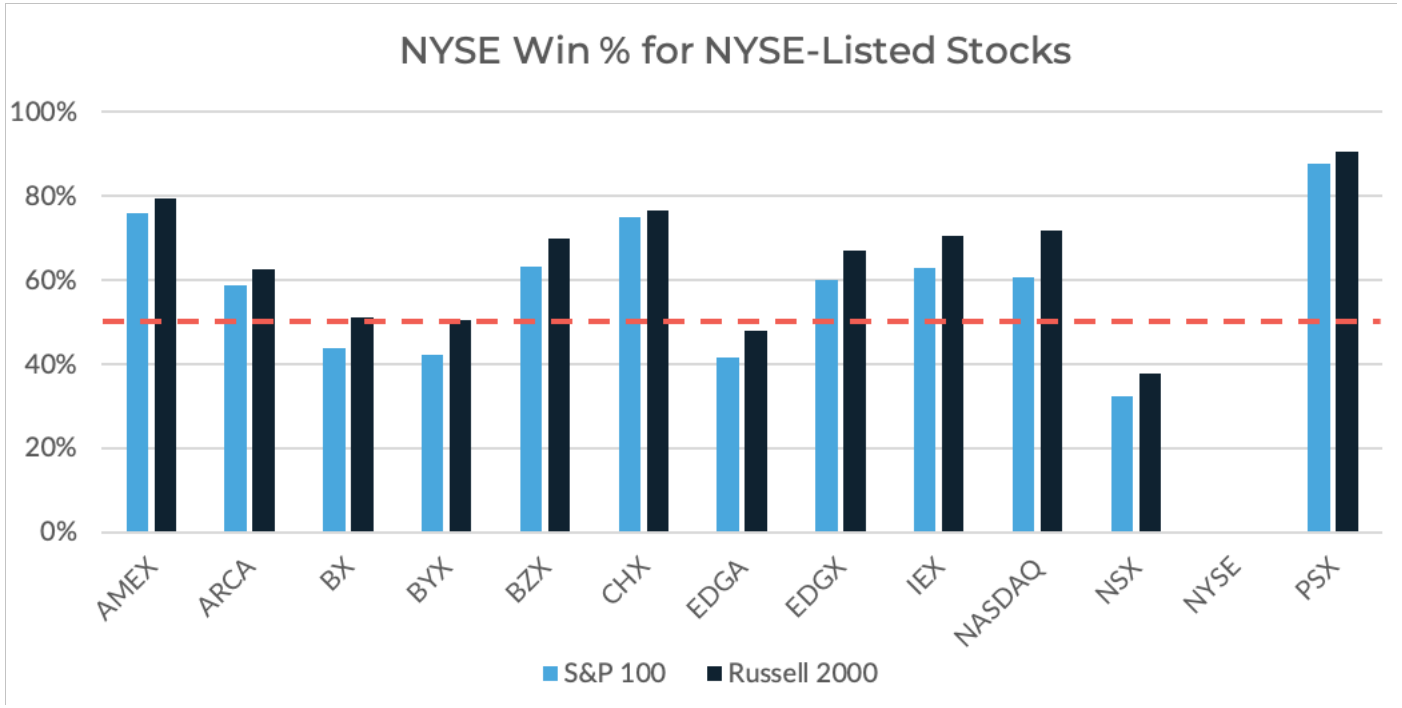
NYSE versus all other exchanges for NYSE-listed, S&P 100 constituent stocks. The 76% indicated for AMEX means that NYSE wins a trade over AMEX 76% of the time when both are competing (present at the NBO or NBB). The orange line is a reference indicating 50%. All inverted exchanges fall below the reference line, meaning that when competing with an inverted exchange, NYSE wins the trade less than 50% of the time for these stocks.

WinMatrix results including only NASDAQ versus all other exchanges for NASDAQ-listed, S&P 100 constituent stocks. Only one exchanges falls below the reference line, meaning that when competing with inverted exchange BX, NASDAQ wins the trade less than 50% of the time for these stocks.



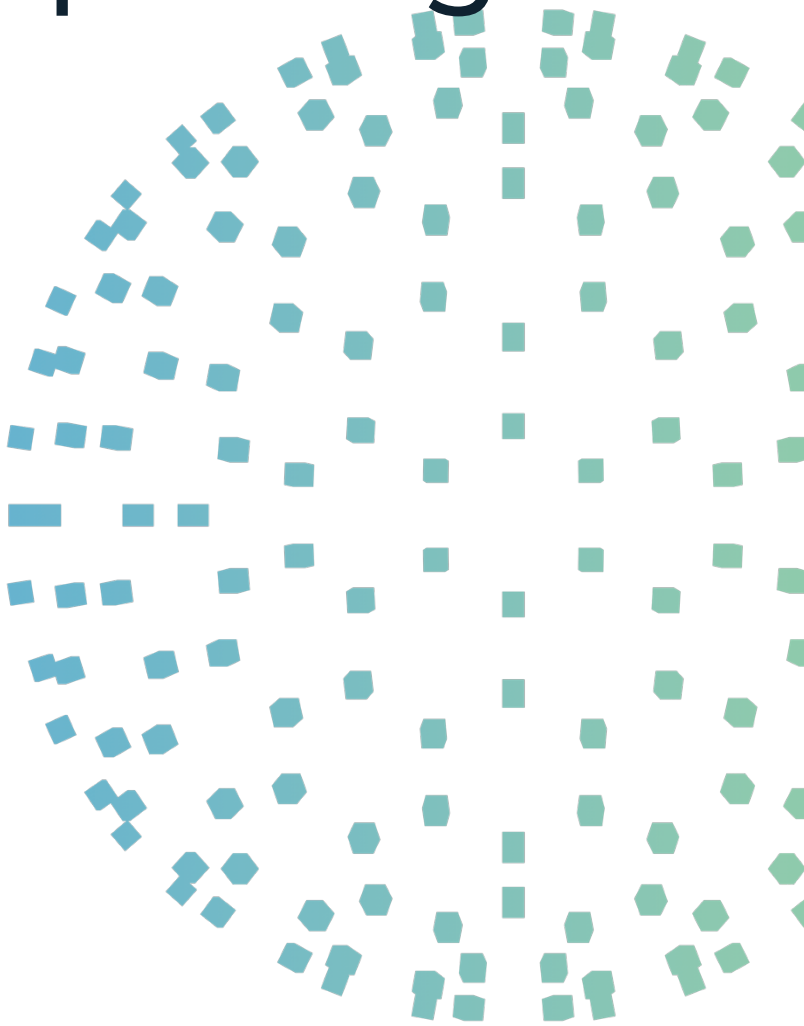
Collapsing the WinMatrix

WinMatrix results including only NYSE performance versus all other exchanges, comparing S&P 100 to Russell 2000 constituent stocks. The percentages indicated for AMEX indicate the frequency NYSE wins a trade over AMEX when both are competing (present at the NBO or NBB). The orange line is a reference indicating 50%. The results do not change much across liquidity groups.



Your trading costs keep us up at night

We know from experience that systematic, quantitative decision-making around order placement contributes to globally optimal execution and results in significantly reduced execution costs. We're constantly refining our limit order modeling, and **incorporating the WinMatrix** into our algorithms' routing technology has been the latest improvement. Contact us to learn more.



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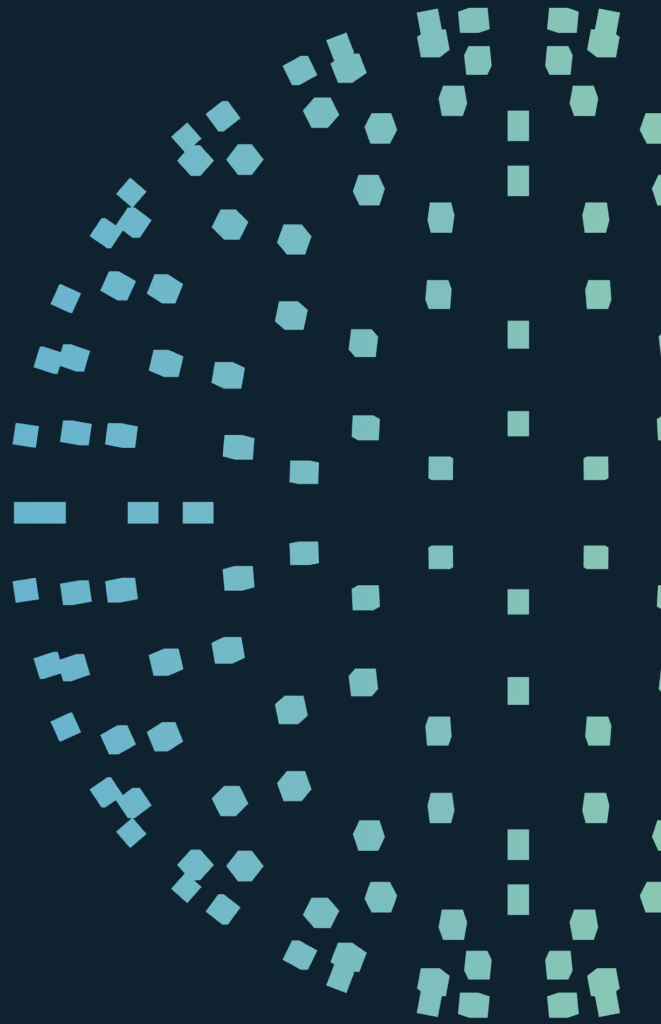

BestEx Research