

Market Microstructure

Traders@SMU

Agenda

- ❖ Brainteaser
- ❖ Core Microstructure Concepts
 - Limit Order Books
 - Liquidity
 - Information Asymmetry
 - Market Design
 - Real World Examples

Brain Teaser of the Day

Based on a sample of 100 boxes (2 packs of 50) with a total of 10 defects, what is the probability that a third randomly selected pack of 50 boxes will contain exactly 5 defects?

Binomial: $\binom{n}{k} p^k (1 - p)^{n-k}$

Poisson: $\frac{e^{-\lambda} \lambda^k}{k!}$

Geometric (Bernoulli): $(1 - k)^{k-1} p$

Negative Binomial: $\frac{k-1}{r-1} p^r (1 - p)^{k-r}$

Uniform: $\frac{1}{b-a}$

Answer

$$P(X = 5) = \frac{50!}{5! (50 - 5)!} * (.10)^5 * (1 - .10)^{50-5}$$

$$n = 50$$

$$p = .10$$

$$k = 5$$

Foundation — Order Types & Limit Order Books

Key Topics:

Types

Market, Limit, Stop, Hidden /Iceberg Orders

LOB Mechanics

Bids, asks, spread, depth

Price—Time Priority

Fairness & Speed

Limit Order Books

- An electronic list that records all outstanding limit buy and sell orders for a specific security or commodity, organized by price level.
 - It functions as a **central hub** where buyers and sellers submit orders specifying the **maximum price** they are willing to **pay** (for a buy limit order) or the **minimum price** they are willing to **accept** (for a sell limit order)

Orders

Time	Quantity	Price	Price	Quantity	Time
12:00:05	2000	99	101	1000	12:00:03
12:00:02	2500	98	102	1500	12:00:01
12:00:01	2000	97	102	3000	12:00:02
12:00:03	4000	96	103	1000	12:00:05
12:00:06	5000	95			

Bids

Asks

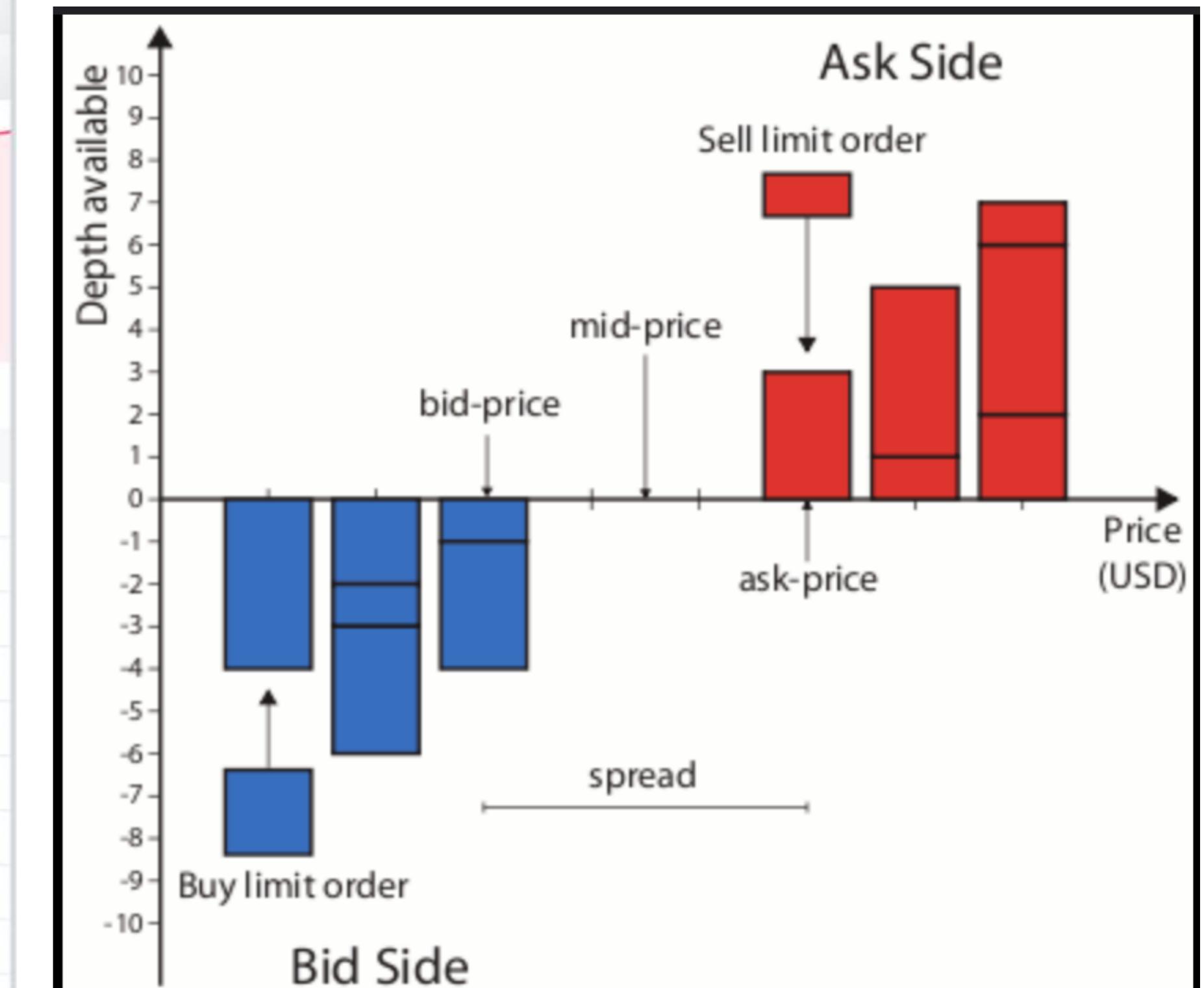
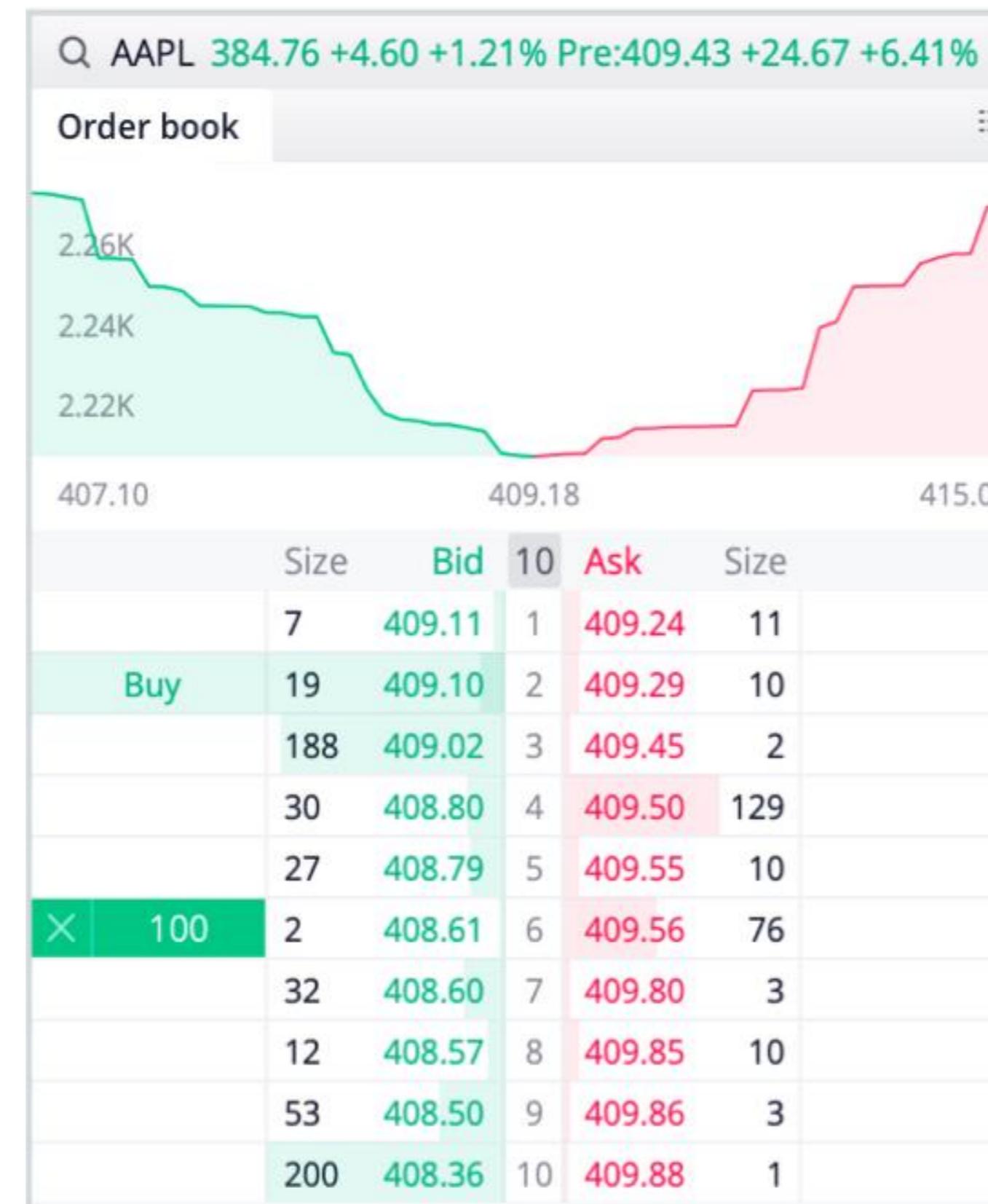
Limit Order Books

Two ways to View and Interpret LOBs

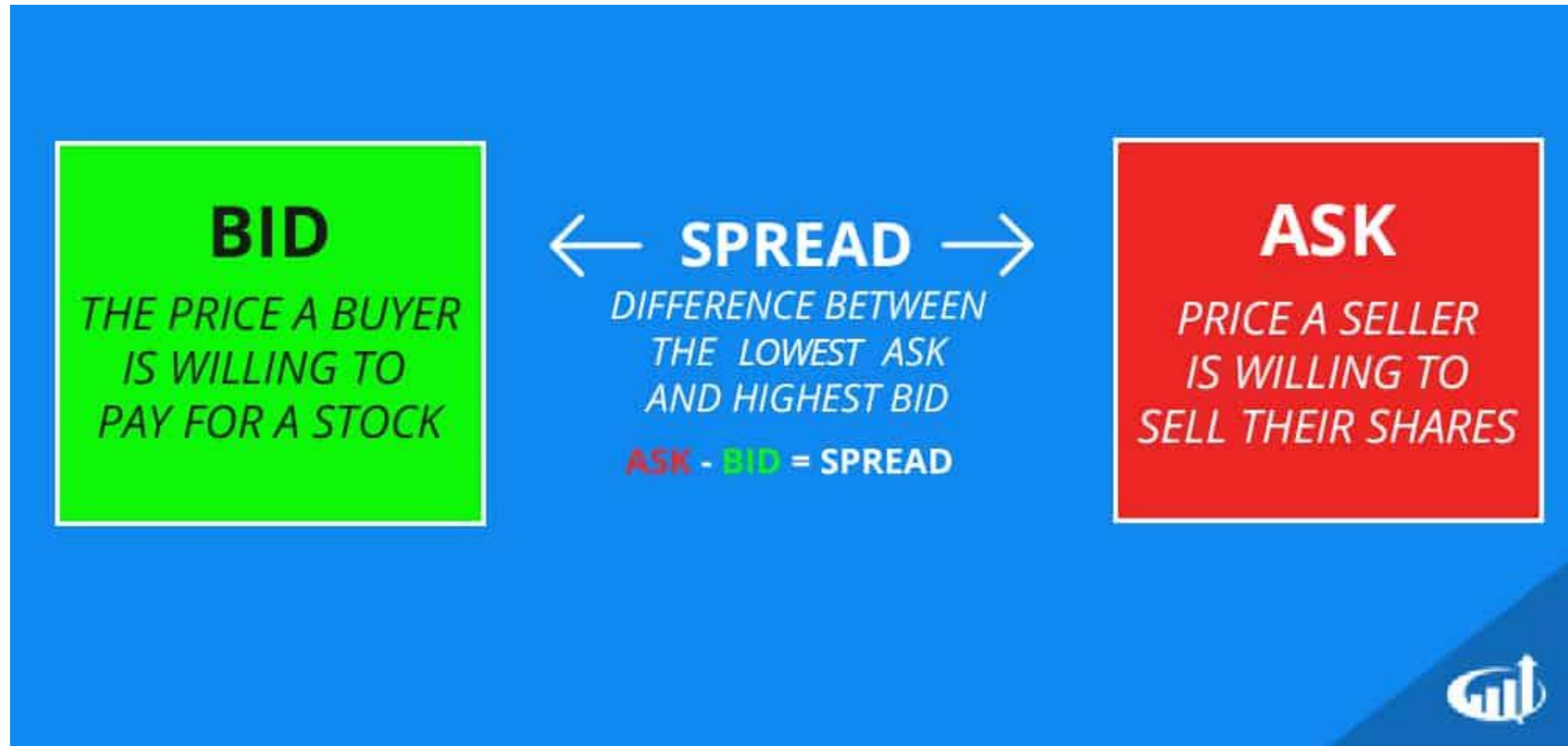
Real markets depend on this for matching flow.

Example

- SPX Options Orderbook showing iceberg orders during CPI day.
 - What happens behind the scenes?
- Notice graph to the far right, how Buy limit orders sit on the tape waiting for price to dip and take out their size



Liquidity & Transaction Costs



Liquidity & Transaction Costs

Key Topics:

What makes a market “liquid”?
(tight, deep, resilient)

Costs

bid-ask spread, market impact,
slippage, commissions

Kyle's Lambda

Quantifies how much price moves
with order flow and assess market
liquidity and transaction costs

Liquidity

The invisible cost traders always pay. Can think of it as Theta, or the cost you must
pay, to play.

Example

Liquidity and Transaction Costs differ based on these factors

Trade Size vs. Market Volume

Time of Day

Bid-Ask Spread

Order Type & Market Impact

Volatility & News Events

Market Conditions

Information Asymmetry & Adverse Selection

Key Topics:

Roles played by Informed, Noise, and Market Makers

Asymmetric Information

In case of uneven distributions, MM widen spreads to limit exposure causing reducing liquidity

Real World Triggers

Earnings, Insider Information, Rumors, Leaks, Analyst Sentiment

Empirical Patterns

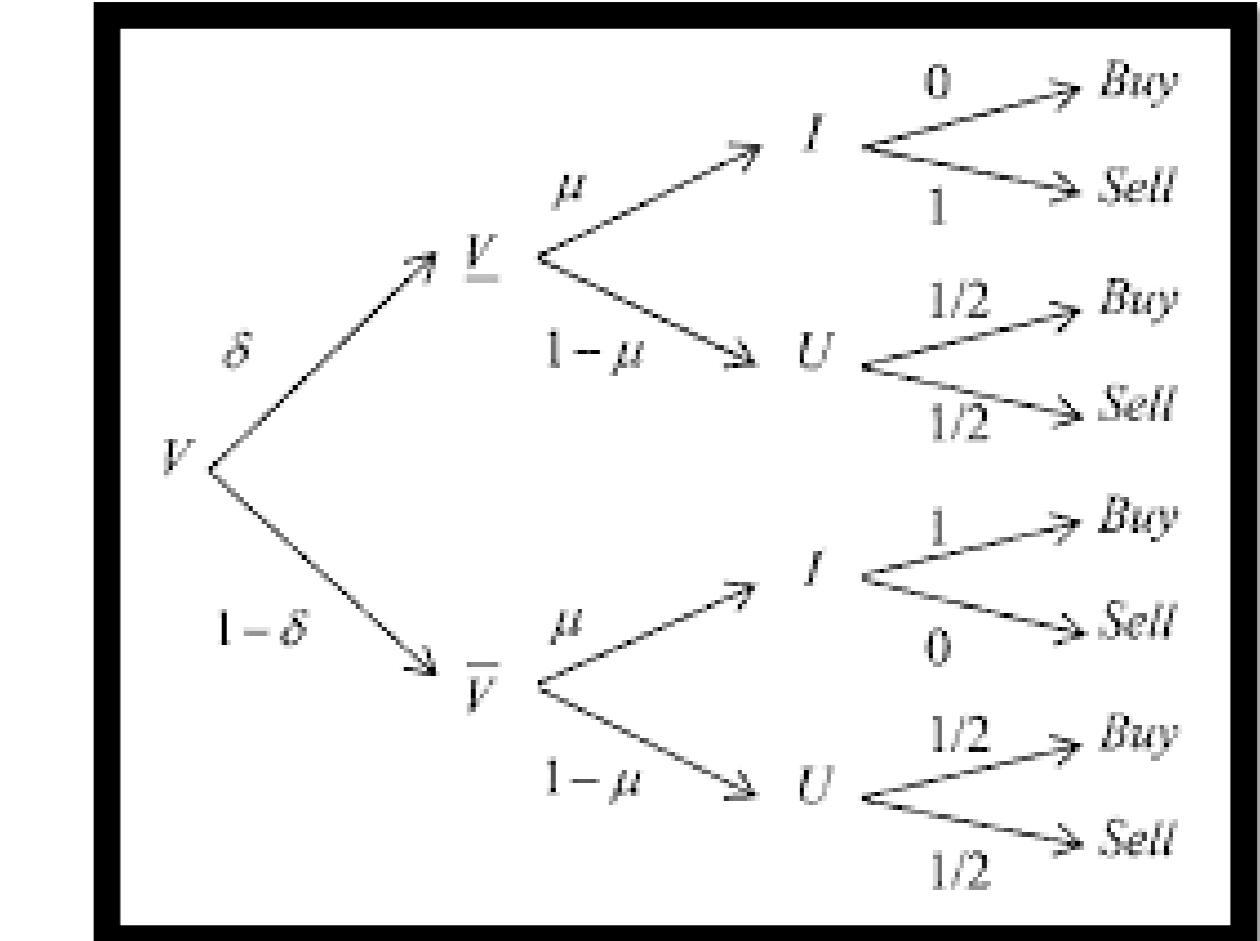
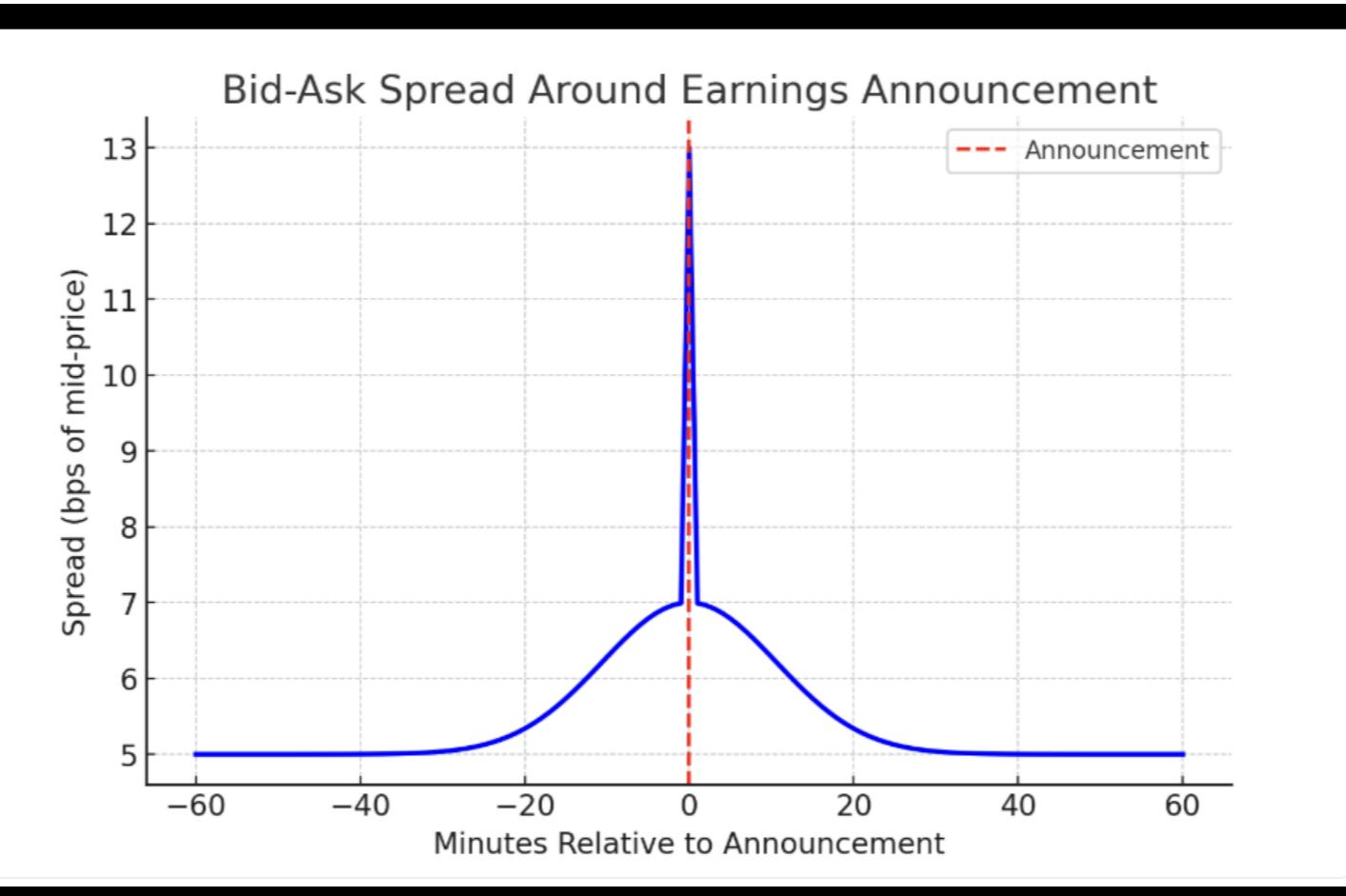
M&A Announcements, Macro Data Release, HFT's

Rules and Regulations in NYSE vs NASDAQ

Market Model, Liquidity Providers, Trading Mechanism, Order Routing, Listing Standards

Glosten-Milgrom / Kyle Models

Utilizing game trees to formalize the flow of private information in the market. Nature behind proactive spreads, liquidity effects, and adverse selection.



Market Design & Trading Mechanisms

Key Topics:

Auction v. Cont. Trading

Auctions concentrate liquidity at a single point, Cont. trading spreads it throughout the day, which impacts price discovery and vol

Dark Pools (Off Exchanges)

Quantifies the price impact of trades and assess market liquidity and transaction costs

Index Rebalancing Days

Quarterly adjustments where stocks can be added or removed from an index, and weights adjusted

NASDAQ

NASDAQ limit order book									
0.057	0.104728642	1	0.16472643	7285.86		7287.23	0.20000000	1	0.20000000
0.057	0.45288115	1	4.34614472	7281.70		7288.53	0.30000000	1	5.10000000
0.057	8.84218155	1	4.3893040	7281.68		7281.95	1.00000000	1	6.10000000
0.087	15.7058155	1	6.86290000	7279.58		7282.28	0.03858378	1	6.1388378
0.091	15.59508155	1	0.00000000	7278.55		7282.48	0.05884003	1	6.1388378
0.091	15.59508155	1	0.20000000	7278.75		7282.76	2.00000000	1	8.95884003
0.117	17.18508155	1	1.25000000	7277.34		7282.87	1.00000000	1	9.85884003
0.141	21.44074482	1	0.00000000	7275.25		7282.93	0.05884003	1	9.85884003
0.141	22.49988655	1	4.90000000	7275.47		7284.86	0.01554000	1	9.32438003
0.141	22.62124934	1	0.16166279	7275.20		7295.29	1.00000000	1	10.92438003
0.167	23.43124934	1	1.00000000	7274.35		7295.31	2.50000000	1	13.42438003
0.167	23.43124934	1	0.00000000	7274.35		7295.31	2.50000000	1	15.42438003
0.177	23.44074482	1	0.16341548	7273.47		7295.99	5.58255591	1	21.00693594
0.187	24.44074482	1	1.00000000	7272.78		7295.10	0.14941103	1	21.15834697
0.187	24.44074482	1	0.00000000	7272.78		7295.10	0.14941103	1	21.15834697
0.187	29.49074482	1	5.00000000	7272.29		7297.30	9.30000000	1	31.00634697
0.197	29.50628482	1	0.01554000	7271.91		7297.64	0.01543500	1	31.02178197
0.207	39.50628482	1	10.00000000	7271.89		7299.49	25.00000000	1	36.02178197
0.227	40.48532092	1	0.15000000	7270.70		7298.13	1.00000000	1	37.48238197
0.231	41.85392092	1	1.00000000	7270.70		7298.73	3.20820000	1	58.28238197
0.231	41.85392092	1	1.00000000	7270.30		7299.32	6.149958197	1	61.49958197
0.231	41.85392092	1	1.00000000	7270.18		7299.48	10.00000000	1	71.49958197
0.231	43.5893397	1	0.24431395	7299.51		7299.51	1.00000000	1	72.49958197
0.231	44.18415946	1	0.82523549	7269.94		7299.87	0.01636500	1	72.50694697
0.231	52.38415946	1	0.00000000	7269.94		7299.87	0.01636500	1	72.50694697
0.231	78.38415946	1	25.00000000	7269.83		7300.54	5.00000000	1	77.5494697
0.231	79.26415946	1	0.28000000	7268.93		7301.43	0.25539380	1	77.90748677
0.247	79.33162453	1	0.06746507	7268.31		7301.43	0.06000000	1	78.36748677
0.247	84.50059653	1	1.00000000	7267.33		7301.73	1.00000000	1	80.57148677
0.247	84.50059653	1	4.1689200	7267.97		7301.80	1.23650000	1	81.81398677
0.257	85.50059653	1	1.00000000	7267.80		7303.50	5.00000000	1	82.81398677
0.257	86.47757572	1	0.01527000	7267.09		7304.44	2.37600000	1	90.36489577
0.267	86.49329572	1	0.01527000	7267.06		7308.00	2.37600000	1	90.36489577
0.287	90.93239572	2	4.41000000	7265.49		7308.03	4.02000000	1	94.38489577
0.287	90.93239572	2	4.41000000	7265.49		7308.03	4.02000000	1	94.38489577
0.287	99.93239572	1	0.01000000	7265.47		7311.68	3.50298064	1	98.15569697
0.287	99.93239572	1	0.01000000	7265.47		7311.68	3.50298064	1	98.15569697
0.287	91.61149381	1	0.6881889	7265.35		7315.96	3.30000000	1	101.45569697
0.287	91.61149381	1	0.6881889	7265.35		7315.96	3.30000000	1	101.45569697
0.287	97.46291336	1	0.82501955	7264.24		7319.26	12.46180000	1	129.71689697
0.337	101.67291336	2	4.41000000	7261.76		7319.52	4.45200000	1	131.16889697
0.337	102.49900678	1	0.82659124	7261.76		7319.68	3.41210000	1	134.58998967
0.347	108.82900578	1	4.40000000	7261.20		7300.73	0.69821734	1	135.27916761

NASDAQ uses a fully electronic limit order book, which allows for rapid matching of trades

- Impacts price discovery and volatility

NYSE



Trades can be matched electronically or facilitated by human designated market makers (DMM), depending on the order type and market conditions.

What happens when all of this breaks?

Fragility in Action – The Flash Crash

Key Topics:

Timeline

May 6th, 2010 — sudden plunge & recovery

Chain Reaction

HFT withdraws, stops trigger, LOB thins out

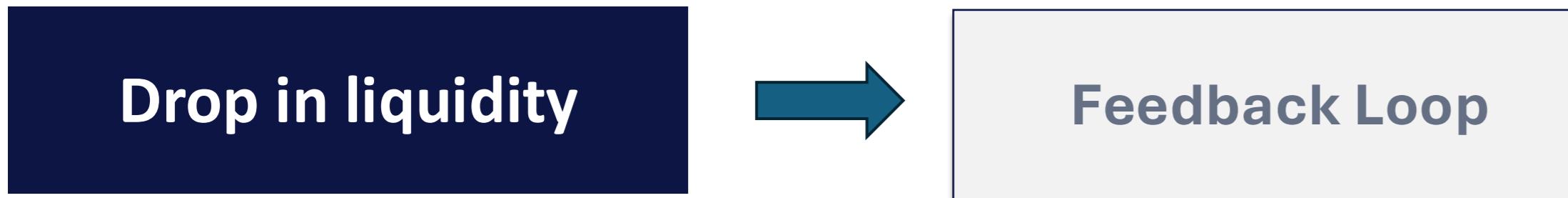
Reforms

Circuit breakers, kill switches
Trigger Threshold: **7%, 13% and 20%** of prior days closing price

The 2010 Flash Crash



Fragility in Action – The Flash Crash



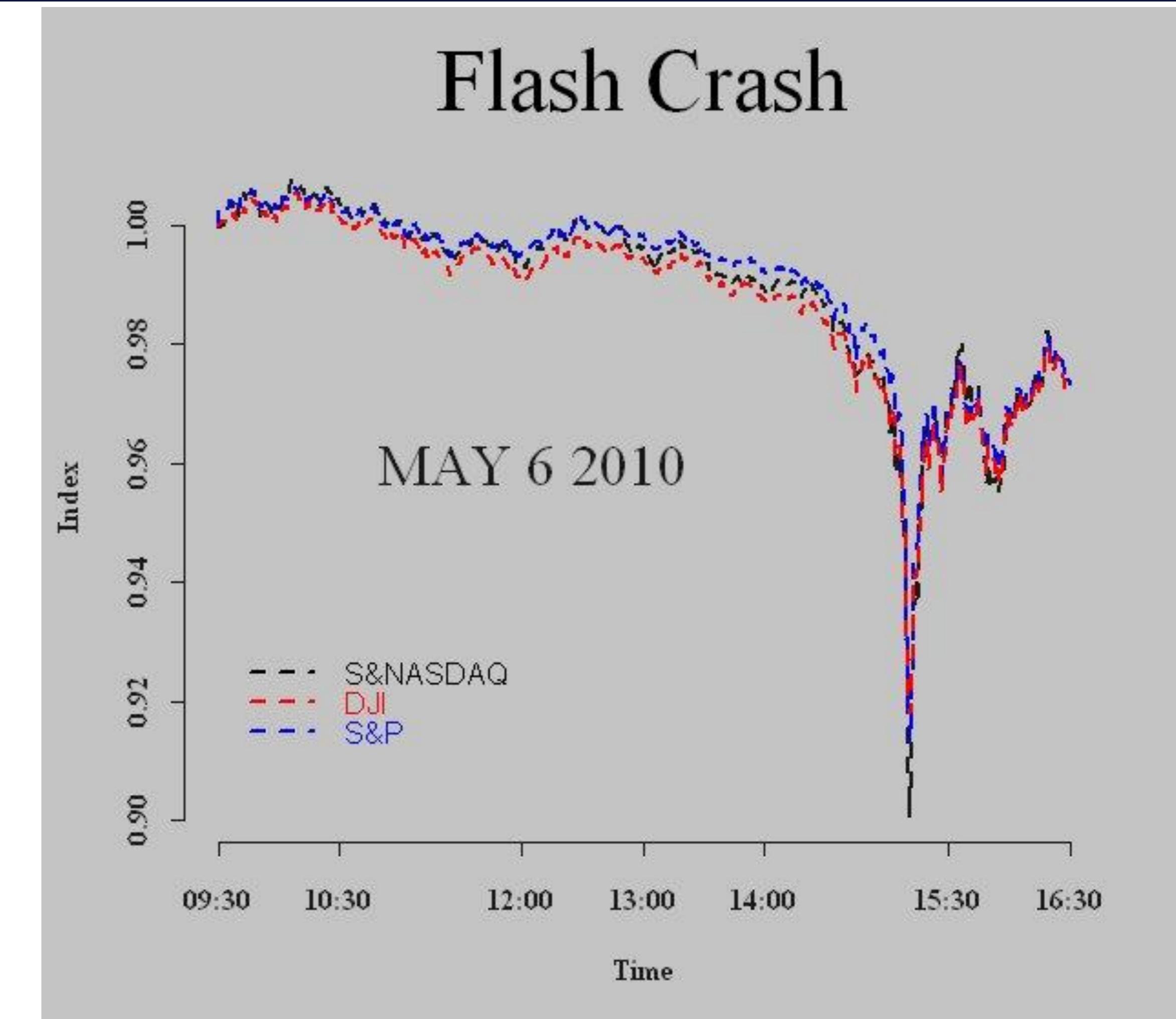
Microstructure Failures Aren't Theoretical

LOB Depth Vanished

Liquidity Dried Up

Info Asymmetry Surged

Market Design was Stress-Tested



How it all Comes Together

Order Types & LOB

- The engine — defines how orders are placed, queued, and matched
- Core mechanic that supports everything else

Liquidity

- Structure of the Order book directly affects how liquid a market is
 - Thin LOB? Slippage
 - Deep Book? Tighter Fill

Info Asymmetry

- Liquidity and Info Asymmetry are in constant tug of war
- When a party has more insight than others — MM widen spreads

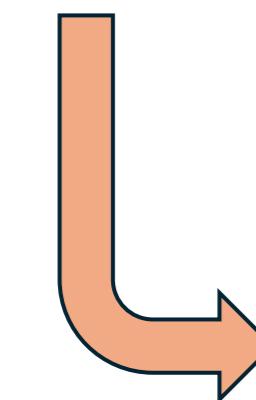
Market Design

- These rules of the NYSE and the NASDAQ govern how the LOB behaves, and how liquidity is accessed.

Order Types & LOB

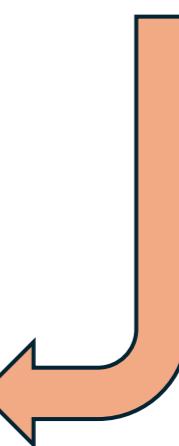
Liquidity

Info Asymmetry



Market Design

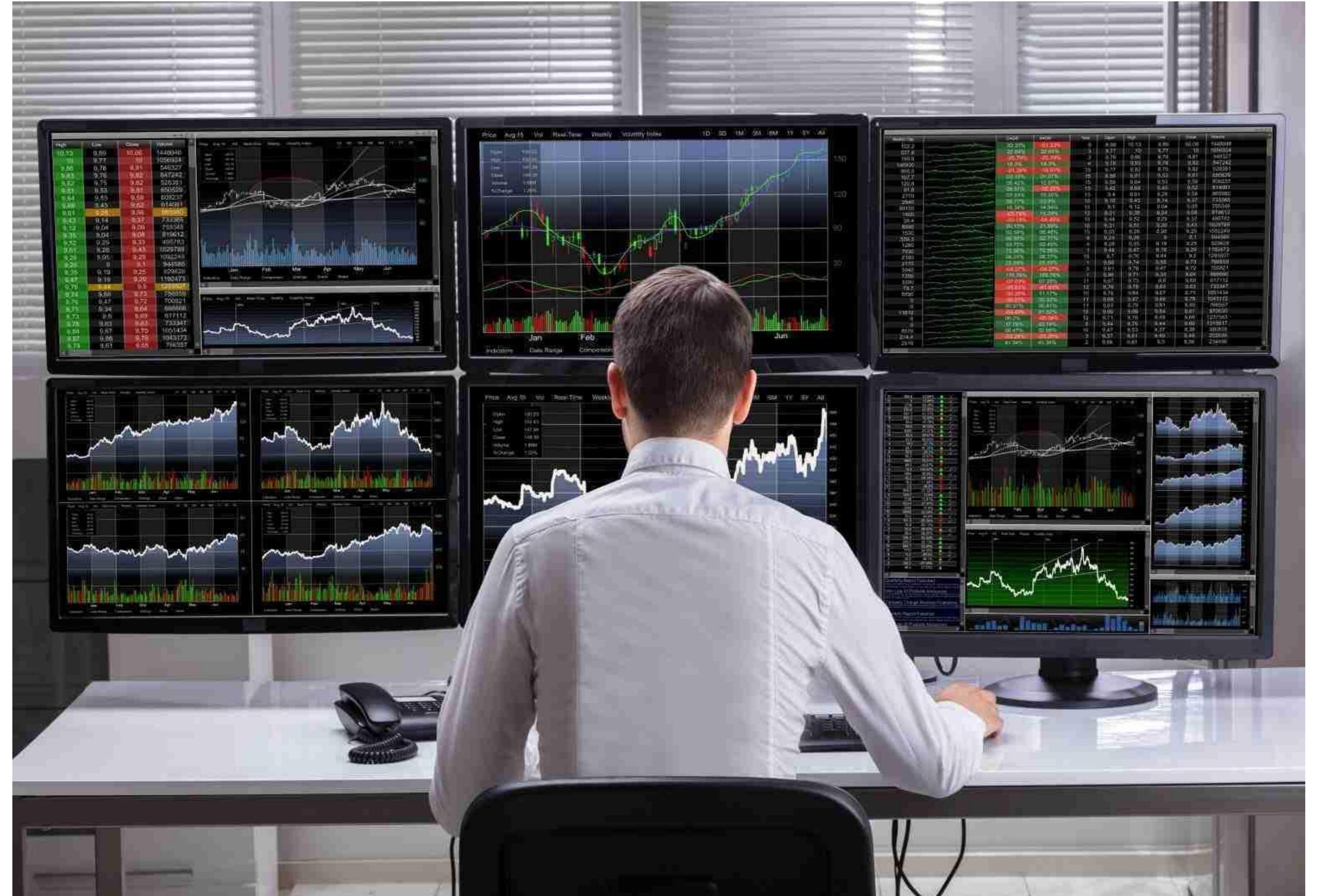
Fragility & Case Studies



Why This Matters for Traders

Real-World Relevance

- Knowing **order types** lets you control execution.
- Understanding **liquidity** helps manage slippage & fills.
- **Info asymmetry** makes you smarter about when to trade.
- Knowing **design flaws** prepares you for **vol shocks**.
- **Case studies** show where edge or danger lies.



Terminology Actively Used on the Trading Floor

Axe: A view or conviction that you have about how they market or different components of that will realize

Fill: Get entered into a position

Size: How many lots you can get filled in

Best Way: Say you have a market, 10 and 15, you know that at worst case you'll get filled at 15. You tell the broker fill me best way to get an price hopefully less than 15 if he can offer it - but you are okay paying 15

My Size is Your Size: Fill me in the total quantity you have available. Thus you are axed to get into the position quantity wise

Color: Getting the information behind the product (who's trading it, what they're axe is)

Hit the bid: As a seller, you cross the bid ask spread to the buyers price so that you get filled and the transaction takes place immediately (Selling at the bid)

- This would happen if you have a bearish view and want to either close a long position, or enter into shorts but are willing to sell at bid because you foresee the price going down

Lift the Offer: If you are very axed to get into a position, you cross the bid ask spread and pay more to buy at the offer so that you're immediately filled (buy and the offer)

- This would happen if you have a bullish view and want to either close a short position, or enter into longs and you're willing to buy at the offer because you foresee the price going up

Lifted at X: You bought the security at X price

Unwind: To close a position, or unravel the vanilla structures that make up the synthetic position



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