



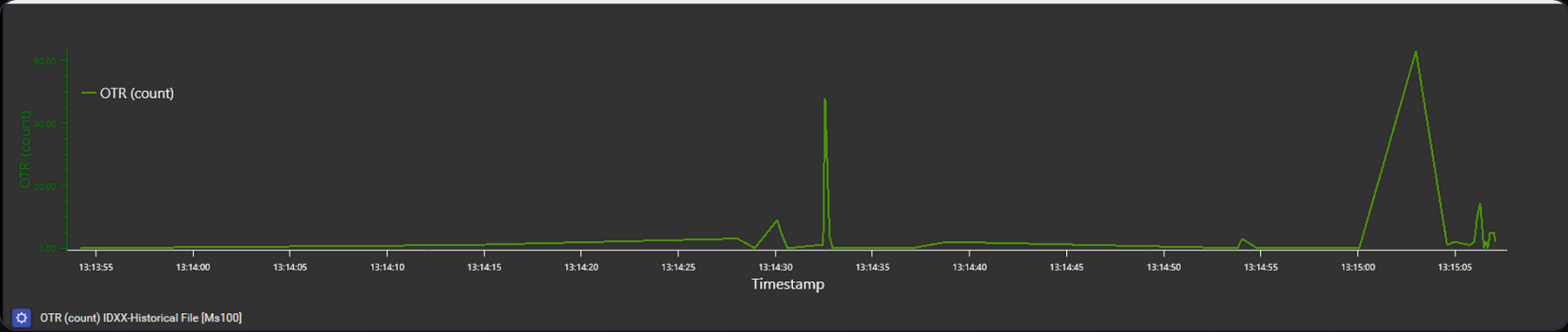
The desk behind every capture · real product pixels · Mechanism, not a trade

01

One NASDAQ day. Six tiles.

A full trading session replayed through the VisualHFT study plugins. **Seven recorded moments** where a study tile did what its research says it should, and a count of how often that picture appears.

62 is what the OTR (order-to-trade ratio) tile read on IDXX: more than 60 book changes inside one 100 millisecond window, and no trade on the tape.



OTR (count) chart · IDXX · 13:13 to 13:15 ET · 22 August 2023 · A recorded instance of the mechanism, not a trade

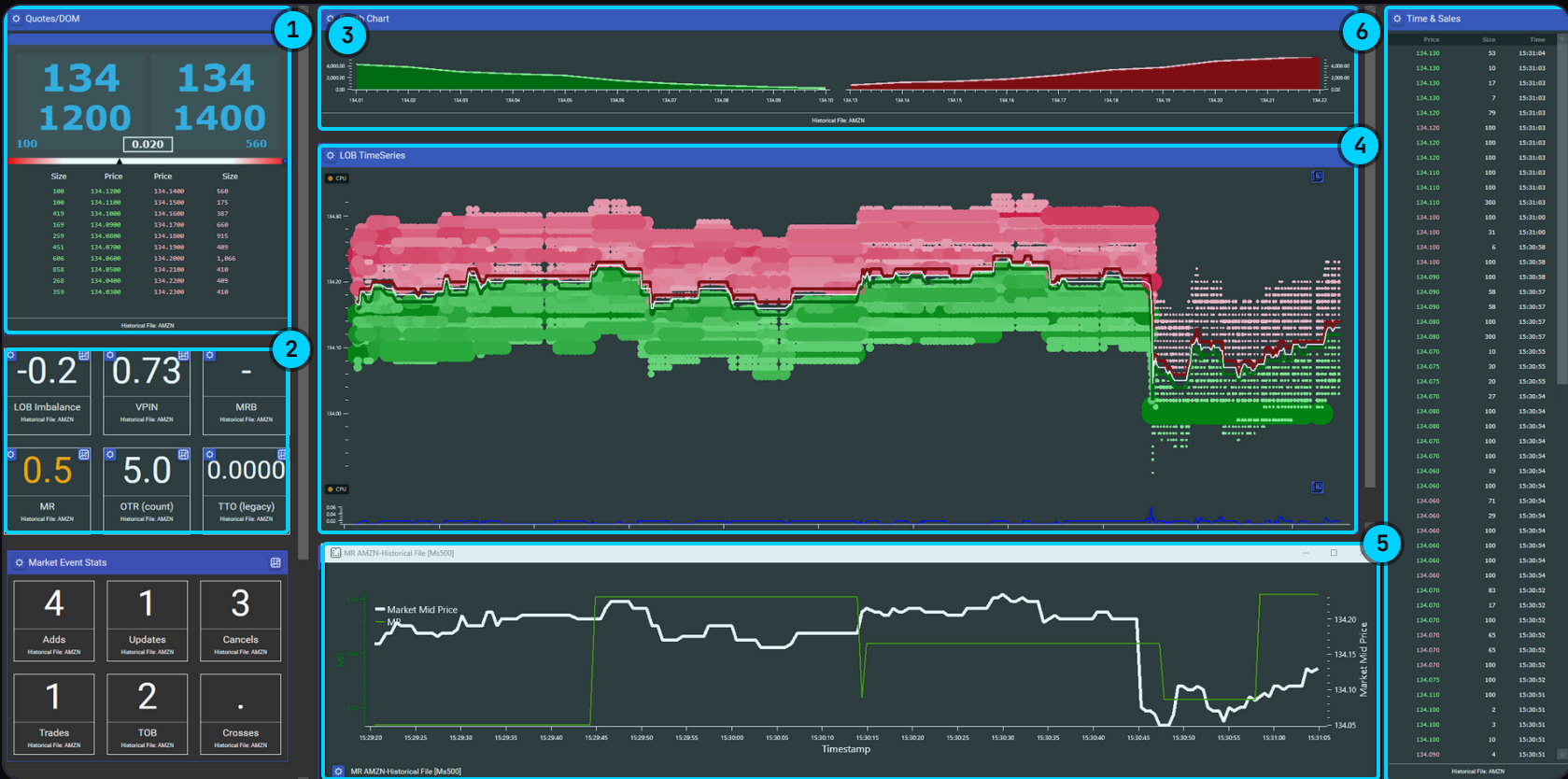
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BEFORE YOU START

How to read the captures



THE DESK AT 15:31:05 ON AMZN · MECHANISM, NOT A TRADE

- 1

Quotes and ladder
Bids and offers, price and size, 10 levels per side.
- 2

Study tiles
Each tile is one study, read at its own aggregation level.
- 3

Depth chart
Resting size by price on both sides of the book.
- 4

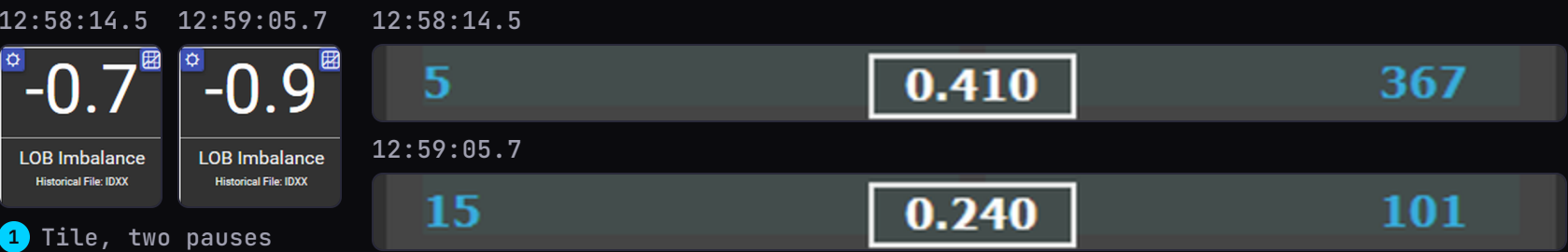
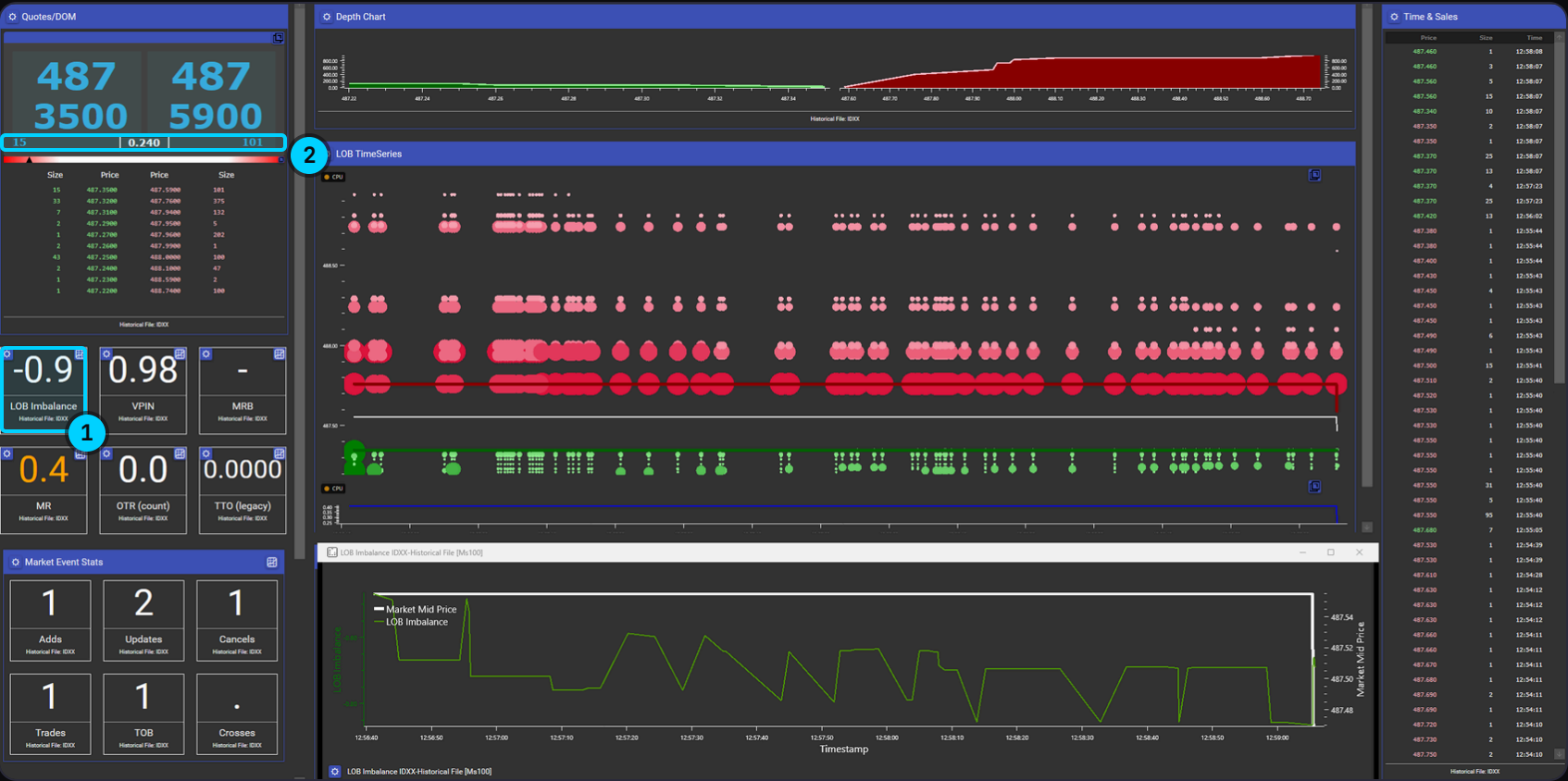
Order book chart
Every price level over time, with the best bid and offer.
- 5

Study chart
The green line is the study's value and, on most captures, the white line is the mid price.
- 6

Time and Sales
Green when the feed marks a print as a buy, red as a sell.

Every capture shows this desk and pauses at the key frames. This issue shows two or three pauses per tile with the numbers on screen, and numbered boxes tie each magnified detail to the place it comes from. All times are US Eastern. All captures are from 22 August 2023, replayed near real time. The Market Event Stats panel at the bottom left counts events over its own interval; Time and Sales is the tape.

● LOB Imbalance, Touch Weighted IDXX · 12:58 to 12:59 ET Mechanism, not a trade



1 Tile, two pauses

2 Touch sizes: 5 bid against 367 offered, then 15 against 101. The boxed figure is the spread.

Shares at the touch

5 : 367

Bid against offer at 12:58:14, tile reading -0.7 .

Mid price step

8.5¢

487.555 to 487.470 at 12:59:05, through a new offer.

Between the pauses

51 s

No trade on the tape. The last print stayed 12:58:08.

THE LEAN

01 The book leans, holds, and the mid follows

On IDXX at 12:58:14 the touch held **5 shares** bid at 487.35 against **367** offered at 487.76. The LOB Imbalance tile, Touch Weighted, read -0.7 : the book leans to the sell side. The mid price was flat and the last trade had printed at 12:58:08.

For about **50 seconds** the best bid and offer prices held at 487.35 and 487.76 and nothing traded. At 12:59:05 a seller improved the offer to 487.59, 101 shares, and the mid stepped down **8.5 cents**, from 487.555 to 487.470. It moved the way the book leaned, through a new quote.

THE DAY, COUNTED

The setup in the capture, the mid flat while the tile holds 0.6 or more in one direction for three seconds or longer, appeared **588 times** across the day with Touch Weighted, almost only on thinner and mid-liquidity names. The IDXX capture is one real instance, not a typical one.

588

setups across the day



Watch the capture

Scan or click. Replayed near real time; fast-forwarded stretches are marked on screen.

visualhft.com/images/blog/visualhft-idxx-lob-touch.mp4

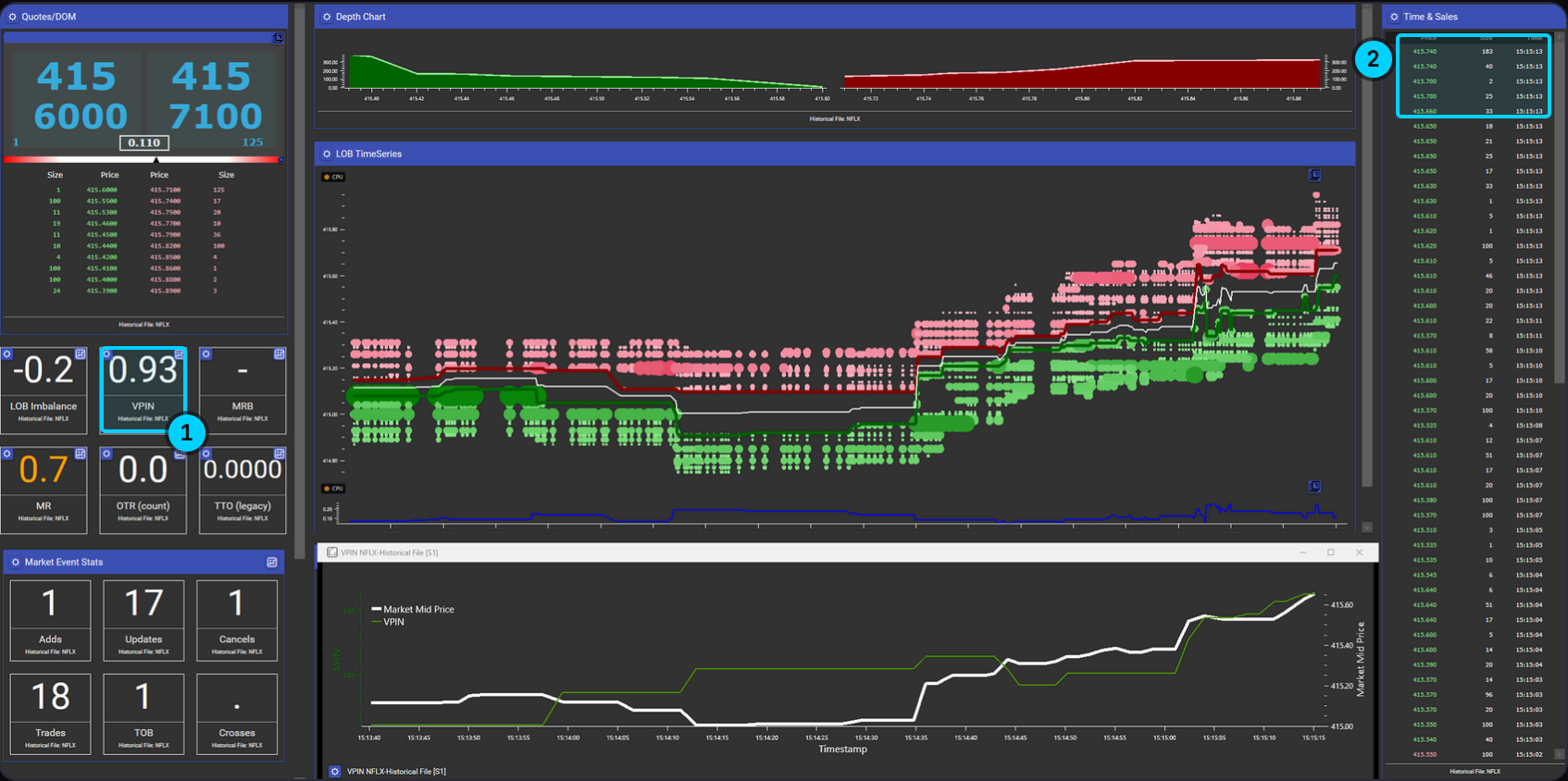
A lopsided touch leaned, held, and the mid followed through a new quote.

Research: Gould and Bonart (2016) · Cont, Kukanov and Stoikov (2014)

● VPIN

NFLX · 15:14 to 15:15 ET

Mechanism, not a trade



15:14:56.0 15:15:15.6 15:15:15.6

Price	Size	Time
415.740	183	15:15:13
415.740	40	15:15:13
415.700	2	15:15:13
415.700	25	15:15:13
415.660	33	15:15:13

1 VPIN tile, two pauses

2 Newest prints on the tape; green marks a buy

VPIN in nineteen seconds

0.80 to 0.93

15:14:56 to 15:15:15.

Prints marked as buys

39 to 47

Of the 48 prints on screen.

Quotes moved up by about

30¢

Best bid 415.32 to 415.60, offer 415.41 to 415.71.

02

THE FLOW

Order flow turns one-sided

VPIN runs on a volume clock. Trades fill buckets of equal size and the tile averages the imbalance of the last 50. On NFLX at 15:14:56 it read 0.80, and 39 of the 48 prints on screen were marked as buys.

Nineteen seconds later it read 0.93 and 47 of 48 prints were marked as buys. Four of them were half-penny prints from hidden orders, which the NASDAQ feed flags as buys. The best bid had moved from 415.32 to 415.60. VPIN names no side. The tape shows which side was buying.

THE DAY, COUNTED

The setup in the capture, VPIN rising at least 0.10 within 60 seconds to its own top-decile level while at least 60% of the volume is one-sided, appeared 35 times across the day.

35

setups across the day



Watch the capture

Scan or click. Replayed near real time; fast-forwarded stretches are marked on screen.

visualhft.com/images/blog/visualhft-nflx-vpin.mp4

VPIN says how one-sided the volume is. The tape says which side.

Research: Easley, López de Prado and O'Hara (2012) · critique: Andersen and Bondarenko (2014)

● Market Resilience

AMZN · 15:30 to 15:31 ET

Mechanism, not a trade



15:30:45.2 15:30:48.7 15:31:05.0 15:30:45.2

0.4 0.3 0.5

MR MR MR

Historical File: AMZN Historical File: AMZN Historical File: AMZN

1 Tile: 0.4, then 0.3, then 0.5

2 Touch sizes either side of the spread box, at the hit and at 15:31:05

100 0.040 100

15:31:05.0

100 0.020 560

Best bid in under a second

15¢

134.19 to 134.04, no bids between 134.19 and 134.05.

Market Resilience tile

0.4 to 0.3 to 0.5

Down after the hit, then up to 0.5 by 15:31:05.

Between the last two pauses

16 s

By 15:31:05, 134.12 down to 134.03 held 100 to 858 shares.

03

THE REFILL

The book takes a hit and refills

At 15:30:45 a burst of sells took the AMZN best bid from **134.19** to **134.04** in under a second, with prints as low as 134.03. No bids were left between 134.19 and 134.05. By 15:30:48.7 Market Resilience had dropped from 0.4 to **0.3**.

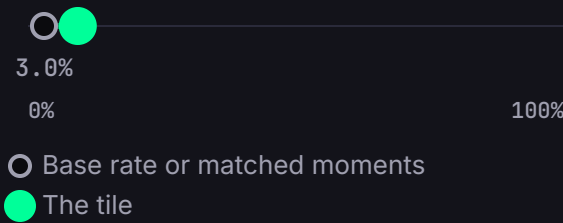
Sixteen seconds after that, at 15:31:05, every price from 134.12 down to 134.03 held between 100 and 858 shares again. The best bid was back at **134.12** and the score read **0.5**. About half of the drop in price had come back.

THE DAY, COUNTED

79 of the day's 845 depletions (**9.3%**) showed the full cycle: depth hit, score dips, depth refills, score recovers. At matched moments with no depletion the same score pattern appeared **3.0%** of the time.

Full dip and recover

9.3%



Watch the capture

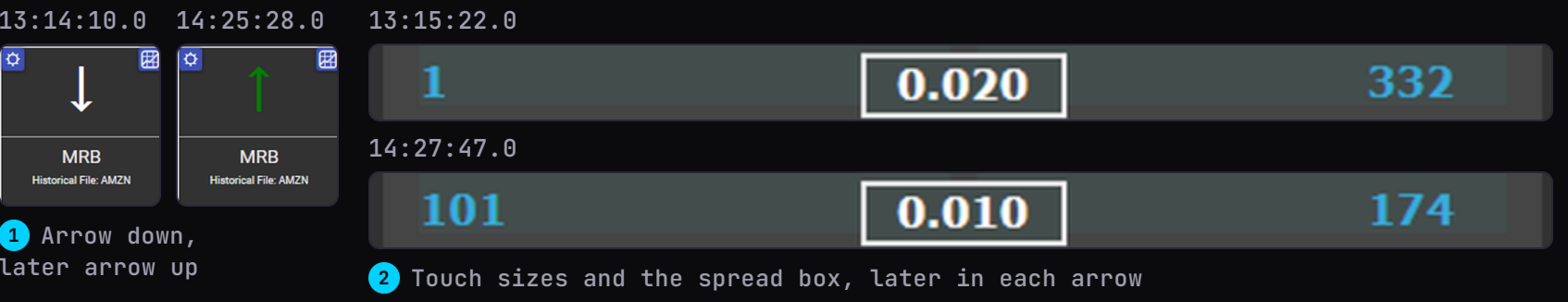
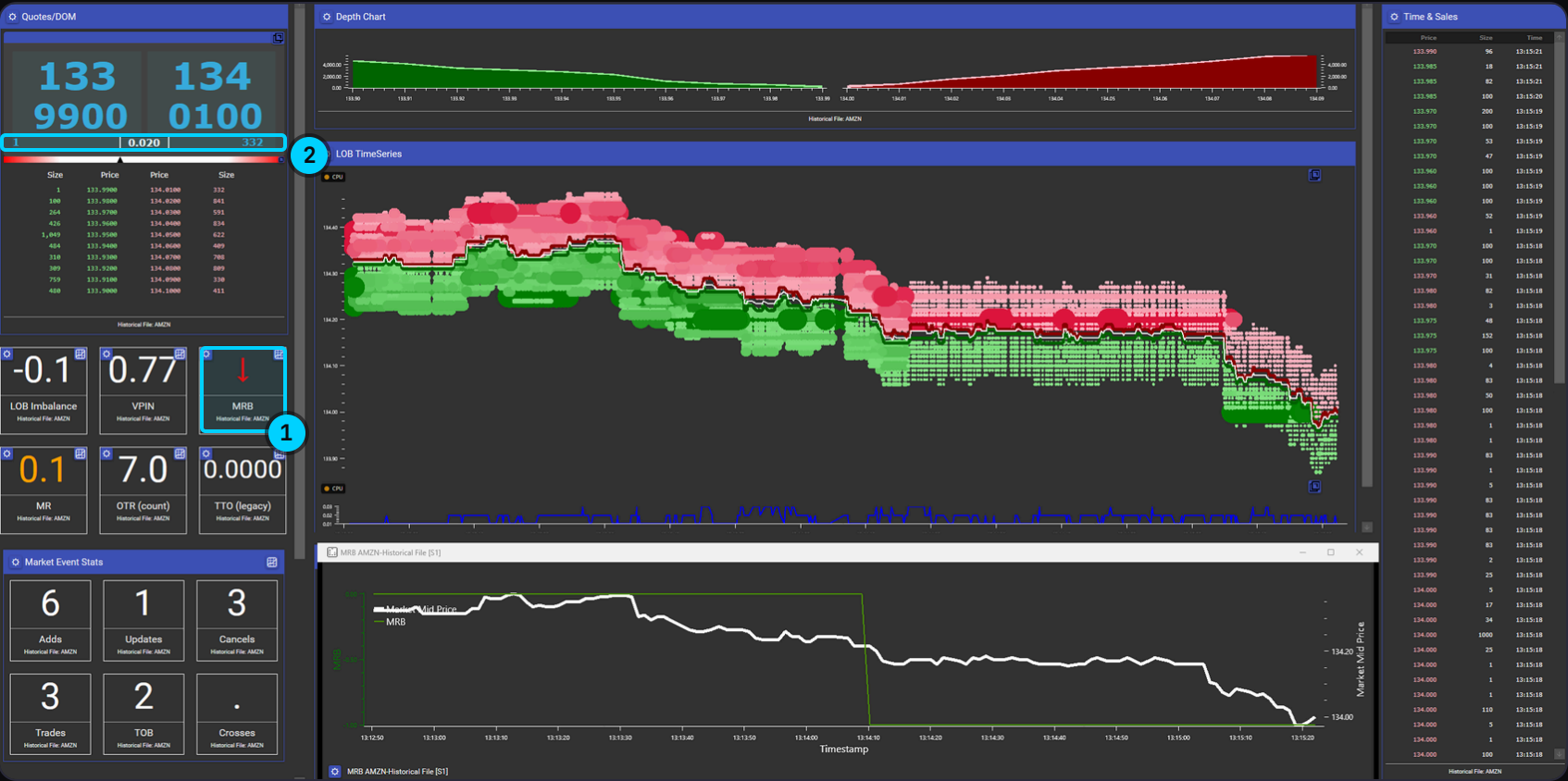
Scan or click. Replayed near real time; fast-forwarded stretches are marked on screen.

visualhft.com/images/blog/visualhft-amzn-mr.mp4

The book took a hit, the bids refilled, and by 15:31:05 the score was up to 0.5.

Research: Kyle (1985) · Obizhaeva and Wang (2013) · Large (2007)

● Market Resilience Bias AMZN · 13:14 and 14:25 ET Mechanism, not a trade



Prints that hit the bid

28 of 31

13:14:06, 134.24 down to 134.19.
The arrow turned down.

Down arrow held

72 s

Best bid 134.21 at the arrow,
133.99 at 13:15:22.

Up arrow, later

2 min+

Best bid 133.86 at 14:25:28,
134.10 at 14:27:47.

THE SIDE

04 The arrow points at the side that failed to refill

At 13:14:06, **28 of 31** prints hit the AMZN bid. The Market Resilience Bias tile switched to a **down arrow**: the tile read the bid side as failing to refill. It held for **72 seconds**, and the best bid went from 134.21 to 133.99.

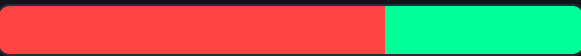
More than an hour later, at 14:25, sells hit the bid again and the arrow pointed **up**: the tile judged the offers as the side that did not come back. It held for more than two minutes while the best bid rose from 133.86 to 134.10. We chose both moments because the price followed. The counts below show how often the arrow appears, not how often price followed.

THE DAY, COUNTED

Across the day the tile fired **127 times**, **84** down and **43** up, on 7 of 14 symbols. Each arrow stayed on screen for a median of 30 seconds.

127

arrows across the day, on 7 of 14 symbols



84 down arrows

43 up arrows



Watch both captures

Scan or click. Replayed near real time; fast-forwarded stretches are marked on screen.

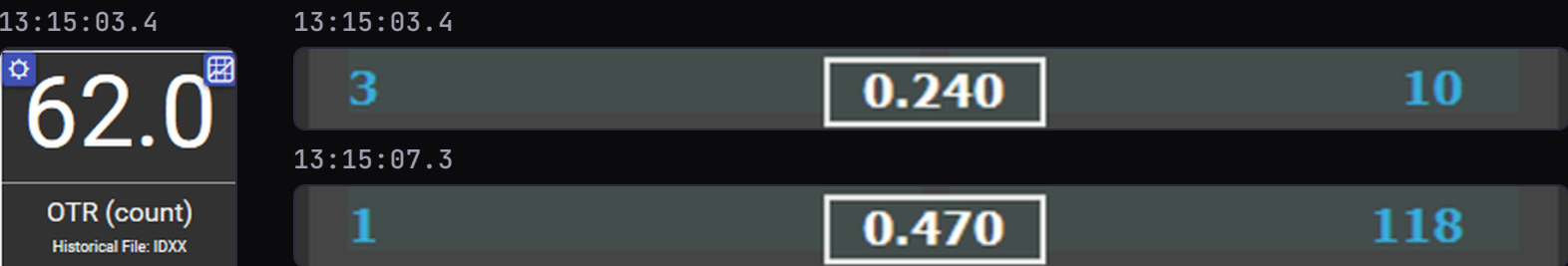
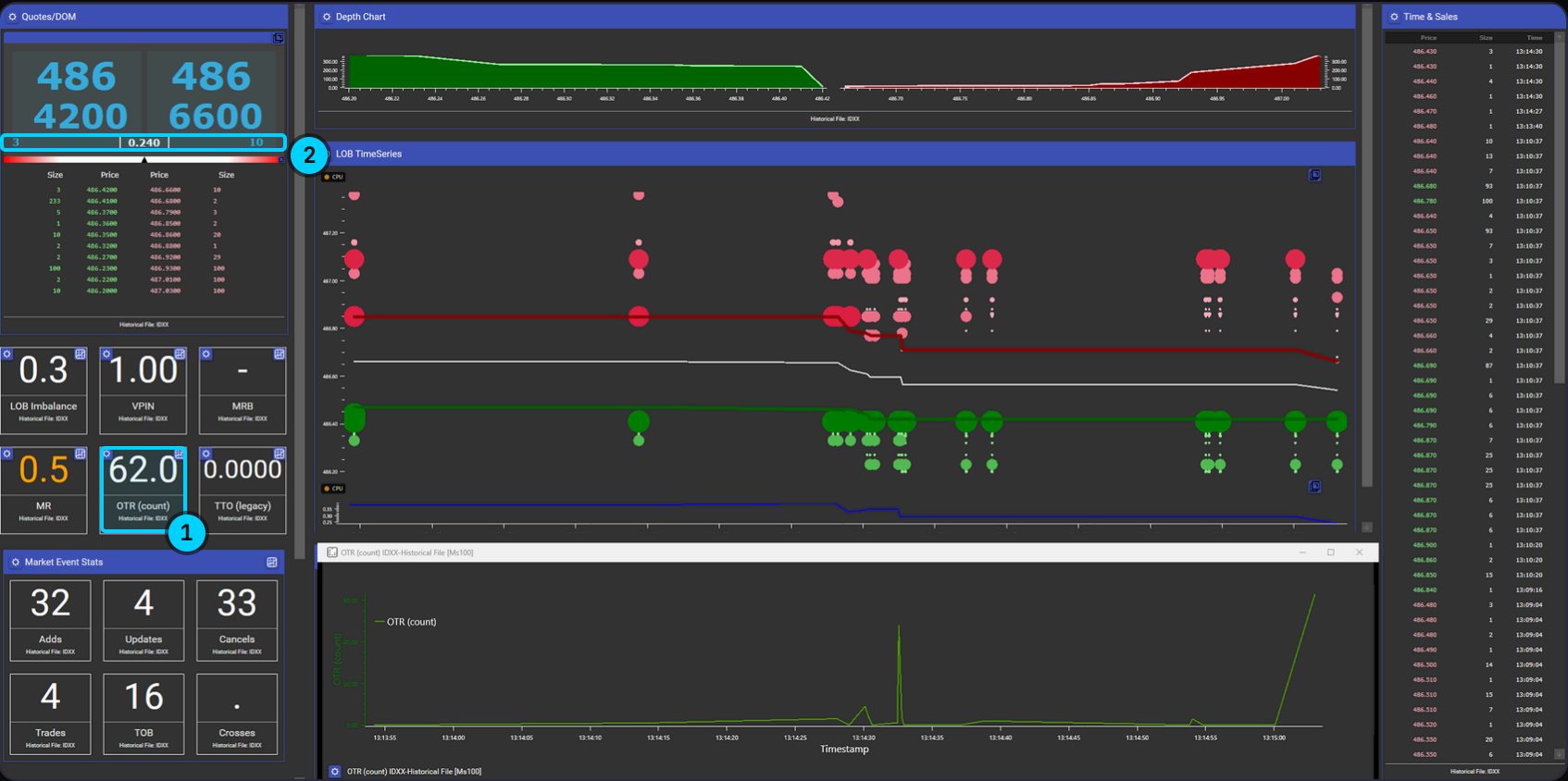
visualhft.com/images/blog/visualhft-amzn-mrb-down.mp4

visualhft.com/images/blog/visualhft-amzn-mrb-up.mp4

The arrow marks where liquidity is missing. It is not a direction call.

Research: Large (2007) · the arrow mapping is VisualHFT's own construction

OTR (count) IDXX · 13:14 to 13:15 ET Mechanism, not a trade



1 Tile reads 62 2 The boxed spread: 0.240, then 0.470

OTR (count) reading

62

More than 60 book changes in 100 ms. No trade since 13:14:30.

Best bid, about five seconds on

44¢

486.42 to 485.98.

Spread

0.24 to 0.47

13:15:03 to 13:15:07.

THE CHURN

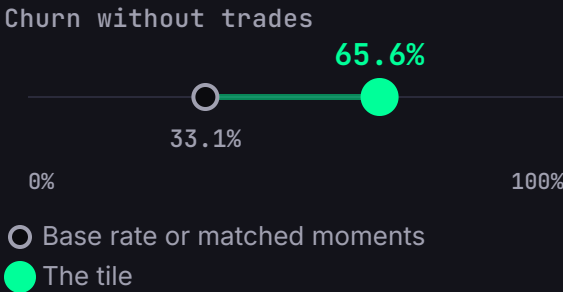
05 The book churns while nothing trades

At 13:15:00 the OTR (count) tile on IDXX jumped to 62: more than 60 book changes inside one 100 millisecond window, and no trade on the tape. The last print was 13:14:30. The best offer stepped down from 486.71 to 486.66 and the spread narrowed from 0.29 to 0.24.

In this capture the quotes moved about five seconds later. The best bid fell from 486.42 to 485.98, the offer to 486.45, and the spread widened to 0.47. The mid dropped 32.5 cents, from 486.54 to 486.215. The widening is real for this moment. Across the day it was not reliable. That is context, not a direction.

THE DAY, COUNTED

The picture in the capture, OTR in its own top 1% for at least half a second: in 40 of 61 such readings (65.6%) the tape showed two prints or fewer and the book changed at least four times within a second either side, against 33.1% at matched moments. Part of this is built into the ratio.



Watch the capture

Scan or click. Replayed near real time; fast-forwarded stretches are marked on screen.

visualhft.com/images/blog/visualhft-idxx-otr.mp4

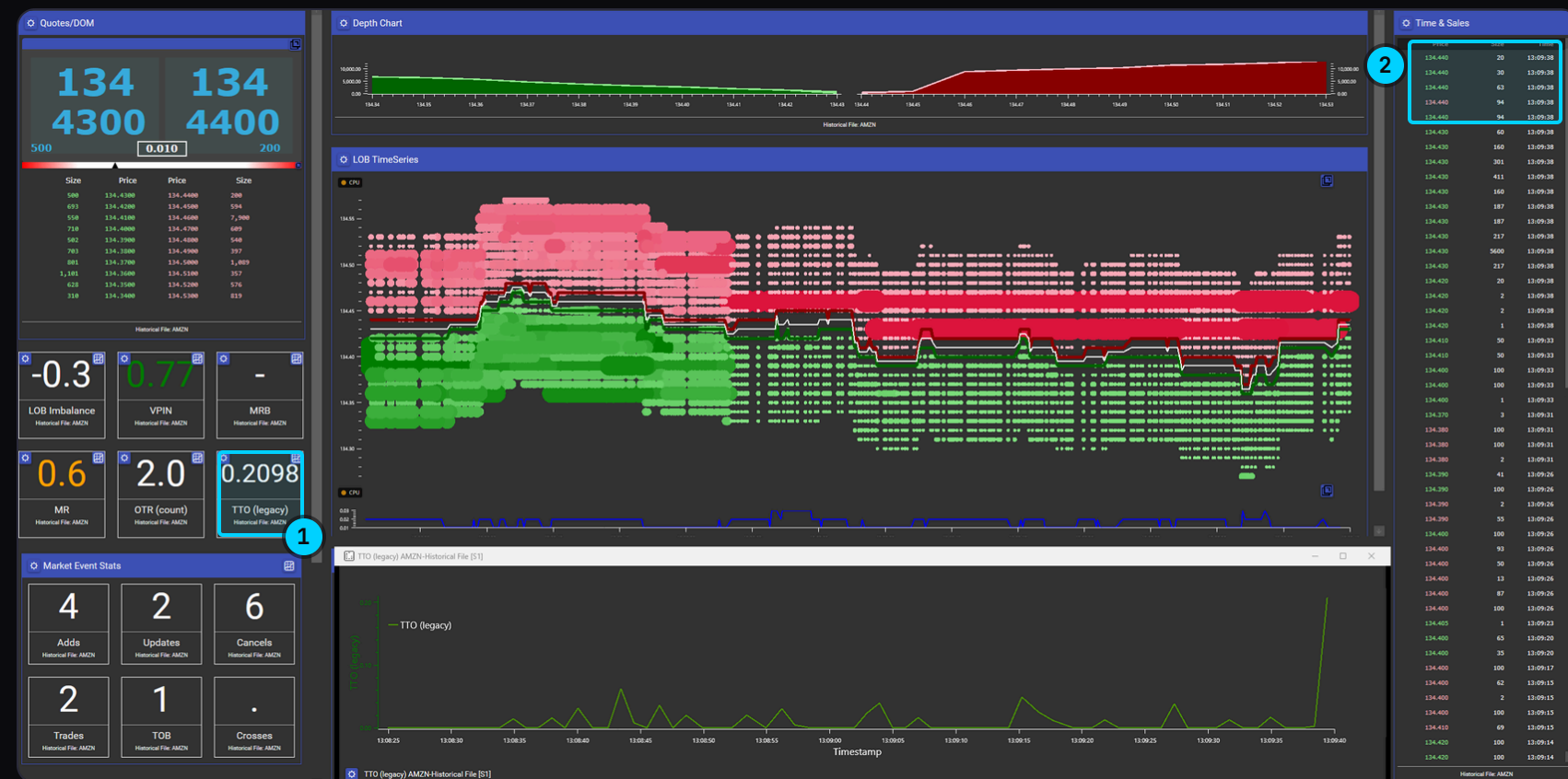
While nothing traded on the tape, the book was rewritten dozens of times in 100 milliseconds.

Research: Hasbrouck and Saar (2009) · Friederich and Payne (2015)

- TT0 (legacy)

AMZN · 13:09 ET

Mechanism, not a trade



13:09:38.4 13:09:39.5 13:09:39.5

Figure 1 displays two screenshots of the TTO (legacy) interface for AMZN. The left screenshot shows a value of 0.0000, and the right screenshot shows a value of 0.2098. Both screenshots include a gear icon for settings and a grid icon for data visualization.

1 Tile, about one second apart

13:09:39.5

Price	Size	Time
134,440	20	13:09:38
134,440	30	13:09:38
134,440	63	13:09:38
134,440	94	13:09:38
134,440	94	13:09:38

2 Newest prints of the sweep; green marks a buy

TT0, about one second apart

0.0000 to 0.2098

13:09:38 to 13:09:39.5.

Prints marked as buys

18 of 19

Ten at 134.43, one of 5,600 shares.

Shares offered at 134.43

7,800

Gone after the sweep. Best offer now 134.44.

06

THE SWEEP

Tradition

Trading overwhelms the book

On AMZN at 13:09:38 the offer side held **99 shares** at 134.42 and **7,800** at 134.43. TTO read 0.0000. At 13:09:39.5, **19 prints** had crossed, 18 of them marked as buys, ten at 134.43 and one of 5,600 shares. Both offers were gone.

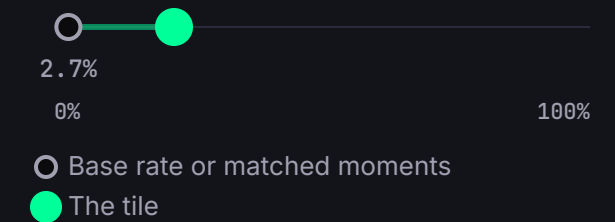
TTO read **0.2098** and spiked far above every earlier bump on its chart. Traded volume had jumped to about a fifth of the book activity in that second.

THE DAY, COUNTED

A sweep is five or more same-side prints within 250 milliseconds that move the mid. TTO reached its own top 10% for at least half a second in **1,988 of 8,887** sweeps (**22.4%**), against **2.7%** at quiet moments. A jump during a sweep is largely built into the ratio.

Top 10% reading in a sweep

22.4%



Watch the capture

Scan or click. Replayed near real time; fast-forwarded stretches are marked on screen.

visualhft.com/images/blog/visualhft-amzn-tto.mp4

TTO lights up the moment trading overwhelms the book.

Research: SEC MIDAS trade-to-order ratio, a different statistic



Touch Weighted, next mid tick

73.9%

Against 51.7%. Strongest fifth, 100 ms, held-out liquid symbols.

After an OTR spike, next ten seconds

69.8%

Against 49.9% at random moments. Held-out, 100 ms, exploratory.

Market Resilience cycle

9.3%

Of depletions, against 3.0% at matched moments. 500 ms.

THE TEST

07 What we counted, and how we tested it

We fixed the split before any result existed and locked each test's rules before its held-out symbols were scored, with two exceptions: the OTR scan is exploratory and was written after earlier results, and the rules for choosing capture moments were written after those results too. The held-out symbols are other symbols on the same day, re-scored across several rounds of this research.

DISCOVERY: WHERE RULES WERE CHOSEN

QQQ AMD INTC MSFT SBUX VRTX POOL

HELD OUT: SCORED ONCE RULES WERE LOCKED

AAPL AMZN CSCO GILD NFLX IDXX

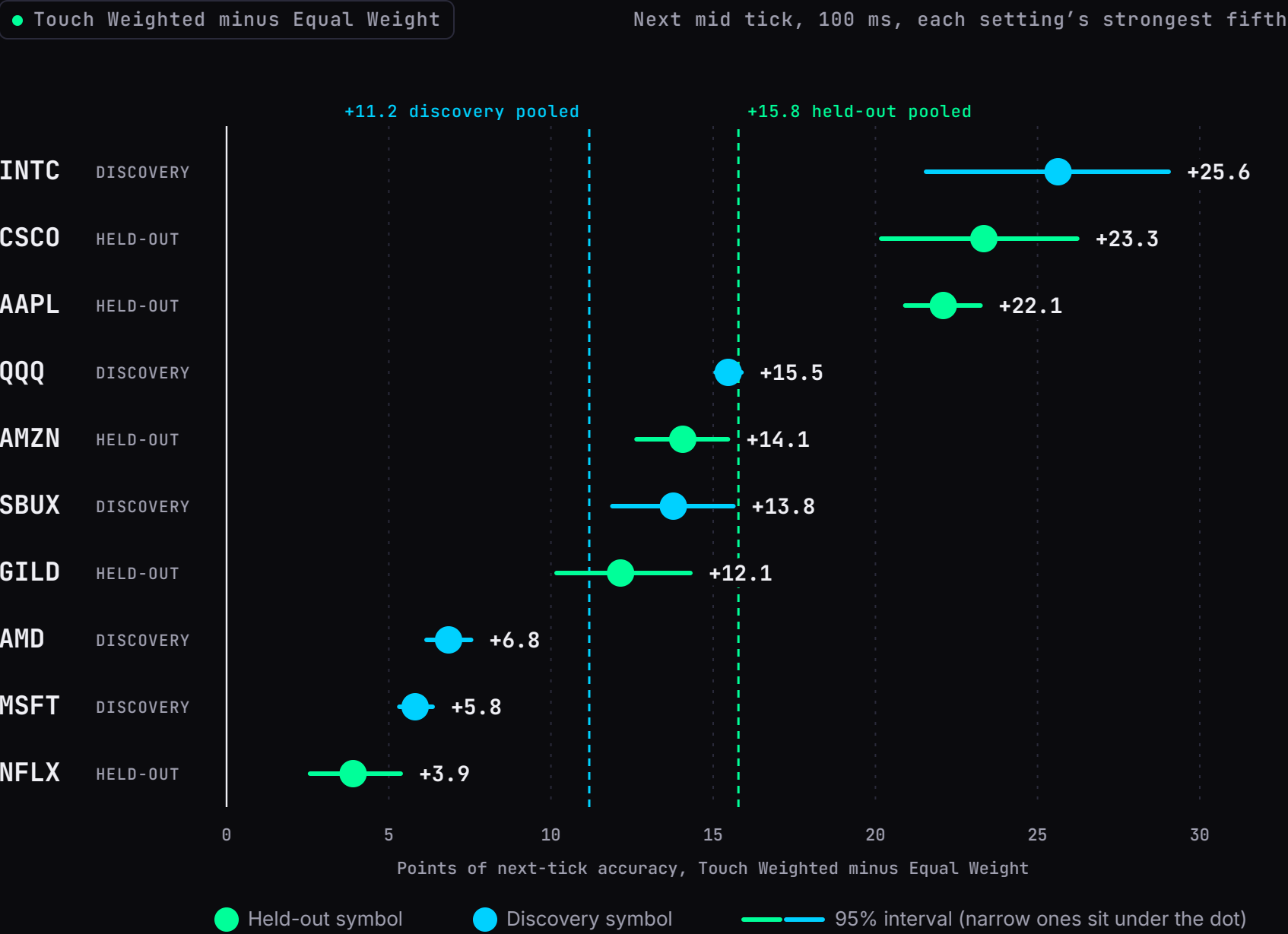
CTAS

Each value is read from the moment it could have been seen, never from a time stamp that runs ahead of it. The article also tests each tile against the cheapest free rule that makes the same call, and reports where the tile ties or trails it.

The chart shows the strongest figure for four of the six tiles, with its scope on the row. VPIN and Market Resilience Bias are counted in their chapters. One day, one venue, hit rates not profits. The article has the full scorecard and every limit.

Decide the rules first. Read each value only when it could have been seen. Set every hit rate against its base rate and the cheapest free rule.

Six Study Tiles, One NASDAQ Day · visualhft.com/blog



Symbols where Touch Weighted was ahead

10 of 10

Ten liquid symbols, 22 August 2023.

Held-out symbols, pooled

+15.8 pts

AAPL, AMZN, CSCO, GILD, NFLX.

Discovery symbols, pooled

+11.2 pts

QQQ, AMD, INTC, MSFT, SBUX.

08

THE WEIGHTING

One setting, ten symbols

A whole-book sum lets size far from the touch dominate. Touch Weighted multiplies each level's size by $1 / (1 + d)^2$, where d is the level's distance from its own side's best price, measured in spreads. A level one spread away counts a quarter. Two spreads away counts a ninth.

Weight given to a level: $1 / (1 + d)^2$, with d in spreads

At the touch, $d = 0$		1
One spread away, $d = 1$		1/4
Two spreads away, $d = 2$		1/9
Three spreads away, $d = 3$		1/16

We scored each setting on its own strongest fifth of readings, against the same price series: how often the tile's sign called the next mid-price tick. Touch Weighted was ahead on **all ten** liquid symbols. Pooled, the lead was **15.8 points** on the five held-out liquid symbols and **11.2** on the five liquid discovery symbols.

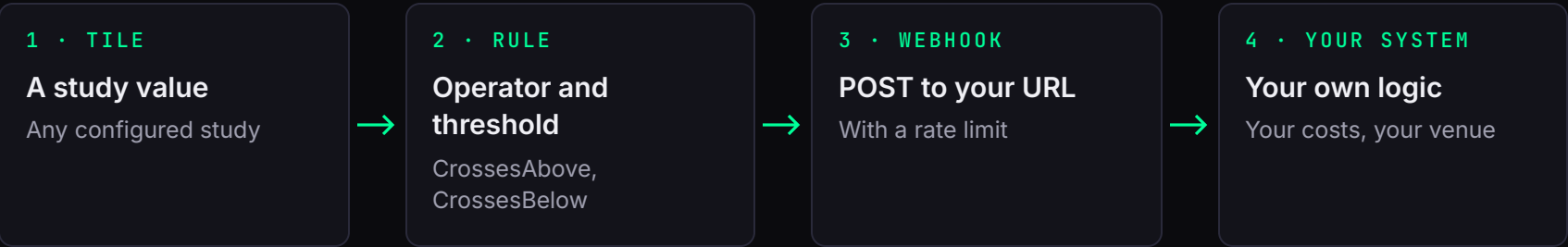
One session, NASDAQ, 22 August 2023. Hit rates before trading costs. Lines show a 95% interval around each symbol's difference.

Weighting by distance from the touch put the tile ahead of the Equal Weight setting on all ten liquid symbols we tested.

A recorded comparison of two settings. Not a trade.

Rule Name	Total Conditions	Total Actions	Status	Actions
TestRule	1	1	Running	
				Add New Rule

Trigger Rules: one rule, running



Condition operators

5

Equals, GreaterThan, LessThan, CrossesAbove, CrossesBelow.

Webhook request

POST

To your URL, with headers and a JSON template.

Rate limit

Seconds

Set in seconds or longer, so a flipping condition cannot flood your endpoint.

09

THE HAND-OFF

From a tile to your own system

Watching a tile builds intuition. Acting inside the time a book changes means handing it to software. A trigger rule connects any study metric to an HTTP call: pick a configured study, an operator and a threshold, then add a webhook.

```
{
  "rule":      "{{rulename}}",
  "metric":    "{{metric}}",
  "condition": "{{condition}}",
  "threshold": "{{threshold}}",
  "value":     "{{value}}",
  "timestamp": "{{timestamp}}"
}
```

Example template. The {{metric}} placeholder needs VisualHFT 0.1.12 or later.

Three examples from the article of what a trigger can carry: an **OTR spike** as a context flag that widens tolerances for a few seconds; **LOB Imbalance** as a filter that confirms or vetoes a price rule you already run; a low **Market Resilience** score as a cue to slow child orders after a hit to the book. Test each one on your own costs.

A trigger rule turns a tile into an event your own system can act on. The testing discipline stays yours.

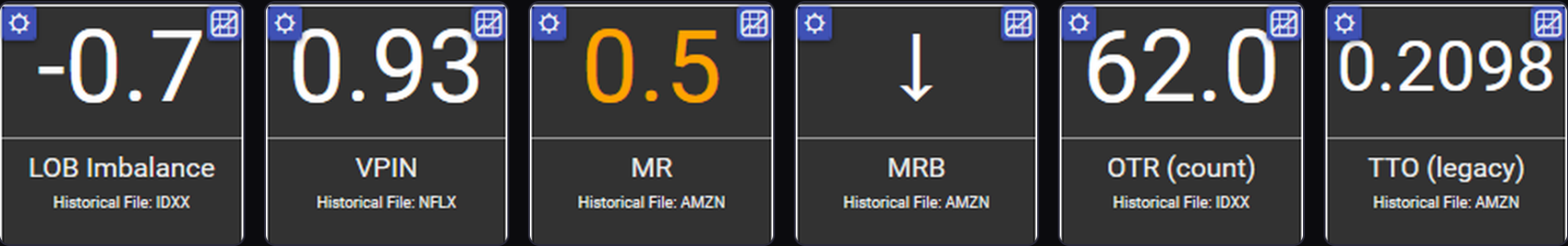
Test it on your venue, at your aggregation level, against your own costs.

ISSUE 01

Final print

We replayed the full NASDAQ session of 22 August 2023 through the VisualHFT study plugins. Before testing, we wrote down what each tile’s research says should happen. Then we captured one real moment per tile, two for Market Resilience Bias, seven in all, and counted how often that picture appears across the day.

The strongest figures, with their scope. On the next mid tick at 100 ms, scoring each setting on its own strongest fifth of readings per symbol, the Touch Weighted setting of the LOB Imbalance tile was ahead of its Equal Weight setting on **ten of ten** liquid symbols, by **15.8 points** on the five held-out liquid symbols. In an exploratory scan of 43 OTR spikes (its strongest 1% of readings, 100 ms) on held-out symbols, the next ten seconds ran more volatile than normal **69.8%** of the time, against 49.9% at random moments. Hit rates, before trading costs. Every capture is a mechanism, not a trade. The method, the pooled figures, and the limits are in the article.



THE SIX TILES AT THE MOMENT OF EACH CAPTURE · MECHANISM, NOT A TRADE



Liquidity isn’t invisible. You’ve just never seen it this way.

The observability and decision terminal for quantitative and electronic trading desks. Observe, Monitor, Diagnose, Replay and prove, Act.

[Read the research](#)

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Six Study Tiles, One NASDAQ Day

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VisualHFT Terminal

The observability and decision terminal for quantitative and electronic trading desks. Observe, Monitor, Diagnose, Replay and prove, Act.

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This issue describes what study tiles showed on one trading session and how often. It is not investment advice and makes no price forecast; hit rates describe one past session. Nothing here is a recommendation to buy, sell, or hold any instrument. Data: NASDAQ TotalView-ITCH, 22 August 2023, replayed in VisualHFT, 14 symbols, 10 levels per side. Hit rates are before trading costs.