**Deep Dive: Tier 1 & Tier 2 Exploitation Signals**

Let me break down each one like you're learning this for the first time.

**TIER 1: Almost Certainly Happening**

**1. Spread Capture Degradation**

**What It Is (Simple Explanation)**

Imagine you're at a farmer's market trying to buy 100 apples over an hour:

**Beginning of the hour:**

* Vendor says: "I'll sell for $1.10, or buy from you for $1.00"
* Middle price: $1.05
* You buy at $1.06 (just 1 cent above middle) ✅ Great deal!

**End of the hour (after buying 80 apples):**

* Same vendor now says: "I'll sell for $1.20, or buy from you for $1.00"
* Middle price: $1.10 (same as before)
* You buy at $1.17 (7 cents above middle) 🔴 Bad deal!

**Why?** The vendor realized you're a big buyer and adjusted prices against you.

**How to Measure It**

# For each wave of execution

spread\_capture[wave] = (ask - fill\_price) / (ask - bid)

# Example calculations:

Wave 1:  Bid=$100.00, Ask=$100.10, You fill at $100.04

         Spread capture = (100.10 - 100.04) / (100.10 - 100.00)

                        = 0.06 / 0.10 = 60% ✅

Wave 40: Bid=$100.00, Ask=$100.10, You fill at $100.08

         Spread capture = (100.10 - 100.08) / (100.10 - 100.00)

                        = 0.02 / 0.10 = 20% 🔴

Degradation: 60% → 20% = 40% worse

**Real Example with Numbers**

Let's trace a real 1M share VWAP order:

WAVE 1 (9:30 AM) - Market doesn't know you yet

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Market quotes: $100.00 bid / $100.10 ask

Spread: 10 cents

Mid-point: $100.05

Your order: Buy 25,000 shares

Your fills:

  - 8,000 shares @ $100.04 (1 cent from mid)

  - 10,000 shares @ $100.05 (at mid)

  - 7,000 shares @ $100.06 (1 cent from mid)

Average fill: $100.050

Spread capture: 50% ✅ Excellent!

Cost: 25,000 × $0.000 markup = $0

WAVE 10 (10:00 AM) - Market starting to notice

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Market quotes: $100.02 bid / $100.12 ask

Spread: 10 cents (same size)

Mid-point: $100.07

Your order: Buy 25,000 shares

Your fills:

  - 6,000 shares @ $100.08 (1 cent from mid)

  - 12,000 shares @ $100.09 (2 cents from mid)

  - 7,000 shares @ $100.10 (3 cents from mid)

Average fill: $100.088

Spread capture: 32% ⚠️ Getting worse

Cost vs. Wave 1: +$950 extra

WAVE 25 (11:15 AM) - Market fully adapted

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Market quotes: $100.04 bid / $100.16 ask

Spread: 12 cents (widening!)

Mid-point: $100.10

Your order: Buy 25,000 shares

Your fills:

  - 3,000 shares @ $100.12 (2 cents from mid)

  - 10,000 shares @ $100.13 (3 cents from mid)

  - 12,000 shares @ $100.15 (5 cents from mid)

Average fill: $100.136

Spread capture: 20% 🔴 Very bad

Cost vs. Wave 1: +$2,150 extra

WAVE 40 (12:45 PM) - Market squeezing you

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Market quotes: $100.05 bid / $100.20 ask

Spread: 15 cents (really wide now!)

Mid-point: $100.125

Your order: Buy 25,000 shares (last big wave)

Your fills:

  - 2,000 shares @ $100.15 (2.5 cents from mid)

  - 8,000 shares @ $100.17 (4.5 cents from mid)

  - 15,000 shares @ $100.19 (6.5 cents from mid)

Average fill: $100.178

Spread capture: 15% 🔴🔴 Terrible

Cost vs. Wave 1: +$3,200 extra

**What You're Looking For**

**Healthy execution:**

Spread capture stays 45-55% throughout

Maybe slight degradation (5-8%) is normal

**Warning signs:**

Degradation >15%: ⚠️ Market adapting

Degradation >25%: 🔴 Being exploited

Degradation >40%: 🔴🔴 Serious problem

**Why This Happens (The Mechanism)**

**Market Maker Psychology:**

Wave 1-5: "Random buyer, normal flow"

├─ Risk: Low (small position)

├─ Action: Compete for your order

└─ Spreads: Normal

Wave 10-20: "Wait, this guy keeps buying..."

├─ Risk: Medium (building inventory)

├─ Action: Widen spreads slightly

└─ Calculation: "I'm now long 200K shares because of him"

Wave 30-40: "Definitely a large algo, probably ending soon"

├─ Risk: High (huge inventory risk)

├─ Action: Widen spreads aggressively

└─ Calculation: "Squeeze him on last waves while I can"

**2. Quote Fading (Depth Reduction)**

**What It Is (Simple Explanation)**

Imagine you're at a concert ticket window:

**Before you arrive:**

* Sign says: "100 tickets available at $50"
* You think: "Great! Plenty of supply"

**You walk up and say "I'll buy 80 tickets":**

* Clerk says: "Actually, we only have 30 tickets at $50"
* Clerk says: "The other 70 are now $55"
* The "100 tickets" mysteriously disappeared

**What happened?** Other sellers saw you coming and pulled their tickets, or raised prices.

**How to Measure It**

# Snapshot order book at intervals

# 10 seconds before your order arrives

depth\_before = bid\_size\_at\_level\_1 + bid\_size\_at\_level\_2 + ...

# At the moment you send order

depth\_during = bid\_size\_at\_level\_1 + bid\_size\_at\_level\_2 + ...

# Calculate fading

fade\_pct = (depth\_before - depth\_during) / depth\_before \* 100

**Real Example with Order Book**

Let's watch the order book as you approach:

T-10 seconds (before you arrive)

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BIDS (people wanting to buy)    ASKS (people wanting to sell)

$99.98: 15,000 shares          $100.02: 18,000 shares ← You want to buy from here

$99.97: 22,000 shares          $100.03: 25,000 shares

$99.96: 18,000 shares          $100.04: 30,000 shares

$99.95: 25,000 shares          $100.05: 22,000 shares

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Total ask-side depth: 95,000 shares within 4 cents

T-3 seconds (you're about to send order)

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BIDS                           ASKS

$99.98: 15,000 shares          $100.02: 12,000 shares ← 6K shares disappeared!

$99.97: 22,000 shares          $100.03: 18,000 shares ← 7K shares disappeared!

$99.96: 18,000 shares          $100.04: 22,000 shares ← 8K shares disappeared!

$99.95: 25,000 shares          $100.05: 15,000 shares ← 7K shares disappeared!

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Total ask-side depth: 67,000 shares

Quote fading: (95,000 - 67,000) / 95,000 = 29% depth vanished! 🔴

T=0 seconds (you send order for 40,000 shares)

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BIDS                           ASKS

$99.98: 15,000 shares          $100.02: 0 shares (you bought all 12K)

$99.97: 22,000 shares          $100.03: 0 shares (you bought all 18K)

$99.96: 18,000 shares          $100.04: 12,000 shares (you bought 10K)

$99.95: 25,000 shares          $100.05: 15,000 shares

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Result: You had to sweep through 3 price levels

        Average fill: $100.027 (vs expected $100.02)

        Extra cost: $280 on 40K shares

**What Happened Here?**

Original plan:

├─ 18K @ $100.02

├─ 22K @ $100.03

└─ Total cost: $4,000,940

What actually happened:

├─ 12K @ $100.02 (only got part of expected liquidity)

├─ 18K @ $100.03

├─ 10K @ $100.04 (had to go to next level)

└─ Total cost: $4,001,080

Lost $140 because liquidity vanished

**Tracking Across Your Entire Order**

Wave 1 (9:30 AM)

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Pre-arrival depth: 85,000 shares

At-arrival depth: 82,000 shares

Fade: 3.5% ✅ Normal market dynamics

Wave 10 (10:15 AM)

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Pre-arrival depth: 88,000 shares

At-arrival depth: 71,000 shares

Fade: 19% ⚠️ Starting to notice you

Wave 25 (11:45 AM)

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Pre-arrival depth: 92,000 shares

At-arrival depth: 54,000 shares

Fade: 41% 🔴 Definitely fading away from you

Wave 40 (1:15 PM)

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Pre-arrival depth: 95,000 shares

At-arrival depth: 38,000 shares

Fade: 60% 🔴🔴 Major liquidity withdrawal

**What You're Looking For**

Normal market behavior:

├─ 0-10% fade: ✅ Natural fluctuation

├─ 10-20% fade: ✅ Normal for larger orders

└─ Consistent across waves

Warning signs:

├─ 20-35% fade: ⚠️ Market getting cautious

├─ 35-50% fade: 🔴 Liquidity providers avoiding you

├─ >50% fade: 🔴🔴 Active avoidance

└─ INCREASING fade over time: 🔴 Definite adaptation

**3. Post-Trade Price Reversion**

**What It Is (Simple Explanation)**

You're trying to board a crowded subway:

**You pushing in:**

* You squeeze through the crowd
* Everyone gets pushed back
* Very crowded at the door

**5 minutes after you're in:**

* People redistribute naturally
* Space opens up again
* Back to normal density

**If the crowd was ONLY reacting to you** (not genuinely more people), then the crowding was artificial/temporary.

**How to Measure It**

# Your average fill price

avg\_fill\_price = weighted\_average(all\_your\_fills)

# Price shortly after you're done (5, 15, 30 minutes)

price\_after\_5min = market\_price(completion\_time + 5\_minutes)

price\_after\_15min = market\_price(completion\_time + 15\_minutes)

# Reversion

reversion\_5min = (avg\_fill\_price - price\_after\_5min) / avg\_fill\_price \* 10000  # in bps

**Real Example - Two Scenarios**

**SCENARIO A: Genuine Demand (Good)**

Your VWAP order: BUY 500K shares of AAPL

Execution: 9:30 AM - 11:30 AM

Average fill: $180.50

Timeline after completion:

11:30 AM: $180.52 (at completion)

11:35 AM: $180.55 (5 min later)

11:45 AM: $180.61 (15 min later)

12:00 PM: $180.58 (30 min later)

12:30 PM: $180.64 (1 hr later)

Reversion: NEGATIVE (price went UP)

Interpretation: ✅ Your buying reflected genuine demand

                ✅ Market agreed with your direction

                ✅ No exploitation, you moved market legitimately

**SCENARIO B: Temporary Manipulation (Bad)**

Your VWAP order: BUY 500K shares of XYZ

Execution: 9:30 AM - 11:30 AM

Average fill: $45.20

Timeline after completion:

11:30 AM: $45.25 (at completion - peak)

11:35 AM: $45.16 (5 min later) ⬇️

11:45 AM: $45.09 (15 min later) ⬇️⬇️

12:00 PM: $45.11 (30 min later)

12:30 PM: $45.13 (1 hr later)

Reversion: +8.8 bps in 15 minutes 🔴

Interpretation: 🔴 You pushed price up artificially

                🔴 Market didn't agree with the level

                🔴 You were "buying the offer" from patient sellers

                🔴 Likely being gamed

**Visual Chart of Both Scenarios**

SCENARIO A - Genuine Demand (Good)

Price

$180.70 ┤                              ╱─

$180.60 ┤                          ╱──╯

$180.50 ┤   ┌────execution────┐──╯

$180.40 ┤──╯                  ↑

$180.30 ┤                  Done here

        └──────────────────────────────────> Time

        9:30          11:30          12:30

✅ Price continues up after you're done

✅ Your buying was informative, not manipulative

SCENARIO B - Temporary Manipulation (Bad)

Price

$45.30  ┤

$45.25  ┤              ╱╲← Peak when you finish

$45.20  ┤   ┌─────────╯  ╲

$45.15  ┤──╯                ╲──

$45.10  ┤                     ╲────

$45.05  ┤

        └──────────────────────────────────> Time

        9:30          11:30          12:30

🔴 Price falls back after you're done

🔴 Your buying created temporary, artificial pressure

🔴 You paid inflated prices

**The Detailed Timeline Example**

Let's track every 5 minutes after a 1M share buy order:

Your Order Completion: 11:30:00 AM

Average fill price: $100.12

Total cost: $100,120,000

Post-Completion Price Action:

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Time     Price    Change   Cumulative Reversion

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11:30    $100.12   --      0.0 bps (baseline)

11:35    $100.09  -$0.03   -3.0 bps ⚠️

11:40    $100.06  -$0.03   -6.0 bps 🔴

11:45    $100.04  -$0.02   -8.0 bps 🔴

11:50    $100.05  +$0.01   -7.0 bps 🔴

11:55    $100.06  +$0.01   -6.0 bps 🔴

12:00    $100.07  +$0.01   -5.0 bps 🔴 (stabilizing)

12:15    $100.08  +$0.01   -4.0 bps

12:30    $100.09  +$0.01   -3.0 bps

13:00    $100.10  +$0.01   -2.0 bps (final level)

Analysis:

├─ Peak reversion: 8 bps at T+15 minutes

├─ Stabilized at: -2 bps (permanent impact)

├─ Temporary impact: 6 bps (8 - 2)

└─ You overpaid by 6 bps on temporary moves

Cost of temporary impact:

1,000,000 shares × $0.06 = $60,000 wasted! 🔴

**What Different Reversion Amounts Mean**

0-2 bps reversion:

✅ Normal, healthy execution

✅ Your impact was real/permanent

✅ Market agreed with your trade

2-4 bps reversion:

⚠️ Borderline - some temporary impact

⚠️ Monitor but not alarming

⚠️ Could be normal volatility

4-8 bps reversion:

🔴 Significant temporary impact

🔴 You pushed price artificially

🔴 Likely being exploited

>8 bps reversion:

🔴🔴 Severe exploitation

🔴🔴 Market gamed you badly

🔴🔴 Urgent need to change strategy

**Why This Happens**

**Legitimate Market Impact (Small Reversion):**

You buy → Supply/demand shifts → New equilibrium

Price stays elevated because real demand increased

**Exploitation (Large Reversion):**

Market makers see you coming

→ They lift offers before you arrive

→ You buy at elevated prices

→ They immediately sell back after you're done

→ Price returns to "fair" level

→ They pocket the difference

**TIER 2: Very Likely**

**4. Maker-Taker Imbalance**

**What It Is (Super Simple Explanation)**

Imagine two ways to buy something on eBay:

**Maker (Patient):**

* You post: "I'll buy for $99 max"
* You wait for a seller to accept
* eBay PAYS you $0.50 for providing liquidity
* **You earn a rebate**

**Taker (Impatient):**

* You see someone selling for $100
* You click "Buy It Now"
* eBay CHARGES you $0.50 for taking liquidity
* **You pay a fee**

**Normal marketplace:** 50% maker, 50% taker (balanced)

**Your VWAP algo:** 88% taker, 12% maker (always impatient)

**Problem:** You're ALWAYS paying fees, NEVER earning rebates = expensive!

**How to Measure It**

# From your execution report

total\_maker\_fills = count(fills where you\_added\_liquidity)

total\_taker\_fills = count(fills where you\_removed\_liquidity)

maker\_pct = maker\_fills / (maker\_fills + taker\_fills)

taker\_pct = taker\_fills / (maker\_fills + taker\_fills)

**Real Example with Fees**

YOUR ORDER: Buy 1,000,000 shares

Venue: Nasdaq

├─ Maker rebate: -$0.0020 per share (you EARN money)

└─ Taker fee: +$0.0030 per share (you PAY money)

SCENARIO A: Balanced execution (50/50)

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500,000 shares as maker:

  └─ You EARN: 500K × $0.0020 = $1,000

500,000 shares as taker:

  └─ You PAY: 500K × $0.0030 = $1,500

Net fees: -$500 (you pay $500)

SCENARIO B: Your actual execution (12/88)

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120,000 shares as maker:

  └─ You EARN: 120K × $0.0020 = $240

880,000 shares as taker:

  └─ You PAY: 880K × $0.0030 = $2,640

Net fees: -$2,400 (you pay $2,400)

DIFFERENCE: $1,900 extra cost! 🔴

**Why This Happens with VWAP**

**VWAP algo behavior:**

Every 5 minutes, algo wakes up and says:

"I need to buy 50,000 shares RIGHT NOW to stay on VWAP"

Algorithm logic:

├─ Send market orders (immediate execution) ← Always taker

├─ Or aggressive limit orders slightly above ask ← Always taker

└─ Rarely posts passive orders below ask ← Would be maker

Result: You're always the aggressor, always taking liquidity

**Comparing Wave by Wave**

WAVE 1 (9:30 AM) - Market fresh, maybe some maker fills

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Total fills: 50

├─ Maker: 12 fills (24%) ✅

└─ Taker: 38 fills (76%)

Fees: Net -$120

WAVE 10 (10:30 AM) - Market knows you, less patient

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Total fills: 50

├─ Maker: 6 fills (12%) ⚠️

└─ Taker: 44 fills (88%)

Fees: Net -$180

WAVE 25 (12:00 PM) - Desperate to fill, all aggressive

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Total fills: 50

├─ Maker: 2 fills (4%) 🔴

└─ Taker: 48 fills (96%) 🔴

Fees: Net -$240

WAVE 40 (1:30 PM) - Final push, maximum aggression

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Total fills: 50

├─ Maker: 0 fills (0%) 🔴🔴

└─ Taker: 50 fills (100%) 🔴🔴

Fees: Net -$250

Pattern: Maker % declining over time = getting more desperate

**What This Really Means (Beyond Fees)**

**It's not just about the $2,400 in fees. It signals:**

High taker % means:

├─ You're always crossing the spread (paying full spread)

├─ You're never patient (market knows you're desperate)

├─ Your orders are time-sensitive (exploitable)

└─ You're not hiding (very visible aggressive flow)

This correlates with:

├─ Higher adverse selection

├─ Worse fill prices

└─ Overall worse execution quality

**What Different Ratios Mean**

20-40% maker:

✅ Balanced, healthy execution

✅ Mix of patience and urgency

✅ Good signaling to market

40-60% maker:

✅ Very patient (maybe TOO patient)

✅ Risk of not completing order

✅ But excellent execution quality

10-20% maker:

⚠️ Somewhat aggressive

⚠️ Acceptable for time-sensitive orders

⚠️ Watch for cost increases

<10% maker:

🔴 Highly aggressive

🔴 Always paying full spread

🔴 Signals desperation to market

🔴 Your current situation (12% maker)

**5. Effective vs. Quoted Spread Divergence**

**What It Is (Simple Example)**

You're at a gas station:

**Sign says (Quoted Spread):**

* Regular: $3.50/gallon
* "Price you see at the pump"

**Your receipt shows (Effective Spread):**

* You paid: $3.73/gallon
* "Price you actually paid"

**Difference:** You paid 6.6% more than advertised! 🔴

**Why?** Hidden fees, "pump optimization charge," credit card fees, etc.

In trading, if quoted spread is $0.10 but you consistently pay $0.17 effective, you're being singled out.

**How to Calculate**

# Quoted spread (what everyone sees)

quoted\_spread = ask\_price - bid\_price

# Your effective spread (what you actually paid)

if you're\_buying:

    effective\_spread = 2 × (fill\_price - midpoint)

# Ratio

spread\_ratio = effective\_spread / quoted\_spread

**Real Example - Normal vs. Exploited**

**NORMAL EXECUTION:**

Market quotes at time of your order:

├─ Bid: $100.00

├─ Ask: $100.10

├─ Mid: $100.05

└─ Quoted spread: $0.10

Your fill: $100.06

Effective spread you paid: 2 × ($100.06 - $100.05) = $0.02

Spread ratio: $0.02 / $0.10 = 0.20 (you captured 80% of spread) ✅

This is normal - you paid 20% of the quoted spread

**BEING EXPLOITED:**

Market quotes at time of your order:

├─ Bid: $100.00

├─ Ask: $100.10

├─ Mid: $100.05

└─ Quoted spread: $0.10

Your fill: $100.13 ← Wait, this is ABOVE the quoted ask!

Effective spread you paid: 2 × ($100.13 - $100.05) = $0.16

Spread ratio: $0.16 / $0.10 = 1.6 (you paid 60% MORE than quoted) 🔴

HOW? The quote "moved" right as you arrived

**Detailed Timeline of Exploitation**

Let me show you exactly how this happens:

9:35:00.000 - You decide to buy

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Market shows:

  Bid: $100.00 (50,000 shares)

  Ask: $100.10 (45,000 shares) ← Quoted spread: $0.10

You think: "I'll pay $100.10 max"

9:35:00.050 - Your order hits the market (50 milliseconds later)

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Market NOW shows:

  Bid: $100.00 (50,000 shares)

  Ask: $100.14 (30,000 shares) ← Ask jumped up!

The $100.10 offer vanished, replaced by $100.14

9:35:00.075 - Your order fills

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You get filled at: $100.12 (average, sweeping through levels)

  ├─ 15,000 shares @ $100.11

  ├─ 20,000 shares @ $100.12

  └─ 15,000 shares @ $100.13

Effective spread: 2 × ($100.12 - $100.05) = $0.14

Quoted spread (when you decided): $0.10

Ratio: 1.4 (you paid 40% more than expected) 🔴

**What Happened Behind the Scenes?**

**HFT Strategy:**

T=0ms: HFT sees large buy order indicator (could be from:

       ├─ Pattern recognition

       ├─ Order flow analysis

       └─ Predictable timing)

T=10ms: HFT cancels $100.10 offer (pulls liquidity)

T=15ms: HFT posts new offer at $100.14 (widens spread)

T=50ms: Your order arrives, pays $100.12 average

T=100ms: HFT sells to you, makes profit

T=500ms: HFT reposts at $100.10 (spread returns to normal)

**Tracking This Across Your Order**

WAVE 1 (9:30 AM)

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Quoted spread: $0.10 (average during wave)

Your effective spread: $0.11

Ratio: 1.1 ✅ Only 10% worse, acceptable

WAVE 10 (10:15 AM)

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Quoted spread: $0.10

Your effective spread: $0.14

Ratio: 1.4 ⚠️ 40% worse, starting to see pattern

WAVE 25 (11:45 AM)

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Quoted spread: $0.10

Your effective spread: $0.18

Ratio: 1.8 🔴 80% worse, definitely being targeted

WAVE 40 (1:15 PM)

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Quoted spread: $0.10

Your effective spread: $0.22

Ratio: 2.2 🔴🔴 More than DOUBLE, severe exploitation

**The Cost**

Order size: 1,000,000 shares

Stock price: $100

If spread ratio stayed at 1.1 (Wave 1 level):

Total extra cost: 1M × $0.001 = $1,000

Actual (degrading to 2.2):

Wave 1-10:  250K shares × $0.001 = $250

Wave 11-25: 250K shares × $0.004 = $1,000

Wave 26-40: 500K shares × $0.008 = $4,000

Total extra cost: $5,250

You paid $4,250 MORE because ratio degraded! 🔴

**What Different Ratios Mean**

Ratio 0.0 - 0.5:

✅✅ Excellent! You're getting price improvement

✅✅ Filling better than quoted spread

Ratio 0.5 - 1.0:

✅ Normal, healthy execution

✅ Paying less than full spread

Ratio 1.0 - 1.3:

⚠️ Paying full spread plus a bit more

⚠️ Acceptable for aggressive orders

⚠️ Watch for trends

Ratio 1.3 - 1.7:

🔴 Paying significantly more than quoted

🔴 Likely being targeted

🔴 Your situation in later waves

Ratio > 1.7:

🔴🔴 Severe exploitation

🔴🔴 Quotes moving away from you systematically

🔴🔴 Need immediate strategy change

**6. Fill Probability Degradation**

**What It Is (Simple Analogy)**

You're trying to buy concert tickets online:

**First 5 minutes of sale:**

* You click "Buy"
* Success! You get tickets 80% of the time

**After 30 minutes (after buying many tickets):**

* You click "Buy"
* "Sorry, sold out" 60% of the time
* But you refresh and see tickets ARE available!
* The system is blocking YOU specifically

**In trading:** Your limit orders stop filling even though market trades at your price.

**How to Measure**

# For limit orders only

for each\_wave:

    limit\_orders\_placed = count(limit\_orders\_sent)

    limit\_orders\_filled = count(limit\_orders\_that\_executed)

    fill\_rate[wave] = limit\_orders\_filled / limit\_orders\_placed

# Track over time

degradation = fill\_rate[early\_waves] - fill\_rate[late\_waves]

**Real Example - Getting Shut Out**

**WAVE 1 (9:30 AM) - Market Fresh**

You place limit orders:

├─ 10 orders @ $100.05 (mid-point)

├─ Market trades: $100.04, $100.05, $100.06, $100.05, $100.05

└─ Your fills: 8 out of 10 orders ✅

Fill rate: 80%

Interpretation: Normal market behavior

**WAVE 15 (11:00 AM) - Market Noticing You**

You place limit orders:

├─ 10 orders @ $100.07 (mid-point)

├─ Market trades: $100.06, $100.07, $100.07, $100.08, $100.07

└─ Your fills: 5 out of 10 orders ⚠️

Fill rate: 50% (down from 80%)

What happened to the other 5 orders?

├─ Market traded at $100.07 three times

├─ But YOU didn't get filled

└─ Someone else with same price got filled instead 🔴

**WAVE 30 (12:30 PM) - Being Avoided**

You place limit orders:

├─ 10 orders @ $100.10 (mid-point)

├─ Market trades: $100.09, $100.10, $100.10, $100.11, $100.10

└─ Your fills: 2 out of 10 orders 🔴

Fill rate: 20% (down from 80%)

Market traded at your price 3 times but you only filled twice?

└─ You're being skipped in the queue! 🔴🔴

**Why This Happens - Queue Position Gaming**

**Normal market (FIFO - First In, First Out):**

Order Book at $100.10 ask:

Position 1: Trader A - 5,000 shares (arrived at 9:30:00.000)

Position 2: You - 10,000 shares (arrived at 9:30:00.100) ← Your spot

Position 3: Trader B - 8,000 shares (arrived at 9:30:00.200)

When buy order comes:

└─ Trader A gets filled first (FIFO) ✅

**When you're being gamed:**

Order Book at $100.10 ask:

9:30:00.000: Position 1: Trader A - 5,000 shares

9:30:00.100: Position 2: YOU - 10,000 shares ← You post limit order

9:30:00.150: \*\*\* HFT detects your order \*\*\*

9:30:00.151: Position 1: Trader A - 5,000 (still there)

9:30:00.152: Position 2: HFT - 20,000 shares ← HFT jumps ahead

9:30:00.153: Position 3: YOU - 10,000 shares ← You got pushed back!

9:30:00.200: Position 4: Trader B - 8,000 shares

How did HFT jump ahead of you?

├─ Cancel-replace games

├─ Different order types

└─ Sub-penny pricing

**Example of Sub-Penny Gaming**

Your order: Buy limit @ $100.10

HFT sees this

HFT posts: Buy limit @ $100.1001 ← Just $0.0001 better!

When market seller comes:

├─ Exchange prioritizes HFT (better price by $0.0001)

├─ HFT gets filled at $100.1001

├─ HFT immediately sells to market at $100.11

└─ You never get filled

HFT profit: $0.0099 per share

Your cost: Missed opportunity + had to chase price

**Detailed Timeline Example**

YOUR ORDER: Buy 500,000 shares using passive limits

WAVE 1-5 (9:30-9:50 AM)

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Strategy: Post limit orders at mid-point

Results:

├─ Orders placed: 50

├─ Orders filled: 42

├─ Fill rate: 84% ✅

├─ Avg fill price: $100.047 (excellent!)

└─ Time to fill: 8 seconds average

WAVE 10-15 (10:15-10:45 AM)

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Strategy: Same (post at mid-point)

Results:

├─ Orders placed: 50

├─ Orders filled: 32 ⚠️

├─ Fill rate: 64% (down 20%)

├─ Avg fill price: $100.052 (worse)

└─ Time to fill: 18 seconds average (slower!)

What changed?

├─ Market IS trading at your prices

├─ But you're not getting the fills

└─ Someone is getting ahead of you

WAVE 25-30 (12:00-12:30 PM)

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Strategy: Same (getting desperate)

Results:

├─ Orders placed: 50

├─ Orders filled: 18 🔴

├─ Fill rate: 36% (down 48% from start!)

├─ Avg fill price: $100.061 (much worse)

└─ Time to fill: 35 seconds (very slow)

Outcome:

├─ You're being systematically avoided

├─ Have to chase with market orders

└─ Pay way more than you should

WAVE 40 (1:15 PM - Final Wave)

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Strategy: Forced to use market orders (desperate)

Results:

├─ Limit orders tried: 20

├─ Limit orders filled: 3 🔴🔴

├─ Fill rate: 15% (terrible!)

├─ Switch to market orders: 47 orders

└─ Avg fill price: $100.089 (paid full spread)

Total damage:

├─ Started with 84% passive fill rate

├─ Ended with 15% passive fill rate

└─ Cost difference: ~3-4 bps per share

**The Cost Calculation**

If fill rates stayed at 84%:

├─ 420,000 shares via limits (good prices)

├─ 80,000 shares via markets (paying spread)

└─ Avg cost: $100.052

Actual with degradation:

├─ 210,000 shares via limits (early waves)

├─ 290,000 shares via markets (later waves)

└─ Avg cost: $100.074

Cost difference:

500,000 × ($100.074 - $100.052) = $11,000 wasted! 🔴

**What Different Degradation Levels Mean**

0-15% degradation:

✅ Normal market dynamics

✅ Acceptable variation

15-30% degradation:

⚠️ Market becoming selective

⚠️ Monitor closely

30-50% degradation:

🔴 Definitely being avoided

🔴 Adjust strategy (more aggressive)

>50% degradation:

🔴🔴 Systematic avoidance

🔴🔴 You're on someone's "toxic flow" list

🔴🔴 Need complete strategy overhaul

**Summary: What To Check First**

If you can only do **3 checks**, do these:

**1. Post-Trade Reversion (Easiest)**

Wait 15 minutes after order completes

Compare price to your average fill

>4 bps reversion = 🔴 Problem

**2. Spread Capture Degradation (Medium)**

Calculate spread capture for first 25% vs. last 25%

>15% degradation = 🔴 Problem

**3. Effective vs. Quoted Spread (Medium)**

Calculate ratio for each wave

Ratio increasing above 1.5 = 🔴 Problem

These three give you a complete picture with minimal data requirements.