# Online Resource 1

Supplementary Appendix for
"Triangular Pricing Consistency and Limits to Arbitrage in Ethereum Markets"

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This supplementary appendix does not replace or expand the headline empirical claims in the manuscript; rather, it reports supporting robustness and diagnostic checks referenced in the main text. All values are taken from existing project outputs and diagnostics.

## A1. Longer 2019–2026 Coinbase and Binance Panel Summary

Table A1 compares the headline Coinbase baseline with longer local panels. The longer panels preserve the near-zero signed mean and low AR(1) pattern, but the Coinbase long sample spans materially different market regimes and is therefore treated as context rather than a replacement for the 2022–2023 event design.

Table A1: Long-sample wedge moments

| Sample | Hours | Mean | Mean abs. basis points | Std. | AR(1) | Half-life bars | ADF-style $t$ |
|---|---|---|---|---|---|---|---|
| Coinbase baseline | 13,100 | -0.0646 | 2.6552 | 3.8683 | 0.0315 | 0.20 | -110.9 |
| Coinbase long | 63,964 | -0.0258 | 3.4388 | 5.1276 | 0.0491 | 0.23 | -240.8 |
| Binance USDT long | 63,924 | -0.0092 | 1.3621 | 1.9601 | 0.0241 | 0.19 | -246.8 |

The baseline window is 2022-01-01 to 2023-06-30. The long-sample window is 2019-01-01 to 2026-04-19.

Replication file references:

- `05_results_robustness/full_range_local/moments_baseline_vs_coinbase_longsample.csv`
- `05_results_robustness/full_range_local/moments_by_venue.csv`

## A2. Event-Window Sensitivity Checks

The event-window sensitivity exercise perturbs each pre-specified event window by $-2, -1, 0, +1, +2$ days on both endpoints and uses calm-period buffers of 0, 7, 14, 21, and 28 days. Across the 25 cells per event, each event has a higher mean absolute wedge than its corresponding calm comparison. FTX remains the strongest event in every cell.

Table A2: Event-window sensitivity summary

| Event | Event/calm ratio range | Welch $t$-statistic range | Ranking stable |
|---|---|---|---|
| FTX | 1.58–1.80 | 4.03–6.19 | yes |
| USDC–SVB | 1.36–1.64 | 2.73–4.85 | yes |
| Terra/Luna | 1.19–1.27 | 2.37–3.52 | yes |

A random-window placebo draws 200 calm windows with the same 216-hour length as the pre-specified FTX window, outside all three event windows with a 14-day buffer. The FTX mean absolute wedge is 4.4721 bp; 1.50% of random calm windows are at least that large. The 95th percentile of random-window means is 4.0959 bp.

Replication file references:

- `05_results_robustness/event_sensitivity/event_window_sensitivity_table.csv`
- `05_results_robustness/event_sensitivity/placebo_summary.txt`

## A3. Pseudo-Wedge Placebo

The pseudo-wedge breaks contemporaneous triangular consistency by lagging the ETH/BTC leg by 24 hours:

$$\tilde{\epsilon}_t = \log P_t^{ETH/USD} - \log P_{t-24h}^{ETH/BTC} - \log P_t^{BTC/USD}.$$

If the reported wedge were just a generic artifact of combining three log-price series, this pseudo-wedge would look similar to the true contemporaneous wedge. It does not.

Table A3: Pseudo-wedge placebo

| Series | Mean | Mean abs. | Std. | 99th abs. pct. | AR(1) | AR(24) |
|---|---|---|---|---|---|---|
| | | basis points | | | | |
| True $\epsilon_t$ | -0.0636 | 2.6570 | 3.8708 | 13.3715 | 0.0316 | 0.0096 |
| Pseudo lagged ETH/BTC | -4.5667 | 132.3463 | 189.5128 | 647.4964 | 0.9578 | -0.0064 |

Matched Coinbase sample: 13,076 hourly observations.

Replication file references:

- `05_results_robustness/placebo/pseudo_triangle_summary.txt`

## A4. Gate.io Fee Sensitivity

The Gate.io order-book exercise has 524 common event-hour observations across the Terra/Luna, FTX, and USDC–SVB windows. The primary manuscript specification uses a 10 bp per-leg taker-fee assumption. Table A4 varies the per-leg fee from 5 to 20 bp. No positive after-fee executable breach appears under any listed fee assumption.

Table A4: Gate.io fee-sensitivity check

| Fee per leg (bp) | Max forward gap (bp) | Max reverse gap (bp) | Breach count | Breach share |
|---|---|---|---|---|
| 5 | -9.1074 | -8.0907 | 0 | 0.0000 |
| 10 | -24.1186 | -23.1019 | 0 | 0.0000 |
| 15 | -39.1374 | -38.1207 | 0 | 0.0000 |
| 20 | -54.1637 | -53.1470 | 0 | 0.0000 |

Replication file references:

- 05_results/diagnostics/gate_orderbook_diagnostics.txt

## A5. Data Construction and Synchronization Checks

The baseline and Binance extension use intersection-only hourly synchronization with no forward fill or interpolation. The retained samples have near-complete hourly coverage over 2022-01-01 through 2023-06-30.

Table A5: Synchronization and coverage checks

| Sample | Expected hours | Actual bars | Coverage (%) | Gaps | Missing bars |
|---|---|---|---|---|---|
| Coinbase true-USD | 13,104 | 13,100 | 99.9695 | 1 | 4 |
| Binance USDT | 13,104 | 13,103 | 99.9924 | 1 | 1 |

The Coinbase ETH/BTC leg has the highest stale-print rate among the baseline legs at 2.6565% of retained hourly bars; the corresponding Binance ETHBTC stale-print rate is 0.6182%. No stress window overlaps the identified missing-data gaps. For Gate.io, the event-hour coverage is 216 of 216 Terra/Luna hours, 214 of 216 FTX hours, and 94 of 96 USDC–SVB hours, giving 524 common event-hour observations after dropping four missing common hours.

Replication file references:

- 05_results_robustness/data_audit/data_integrity_summary.json
- 03_data/metadata/sample_design.md
- 05_results/diagnostics/gate_orderbook_diagnostics.txt