Channels of Stablecoin Depegs: Intraday Evidence on Reserve Exposure, Venue Fragmentation, and the Speed of Re-Pegging

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Abstract

Stablecoin depegs are often treated as a single form of market stress. Using one- and five-minute Coin Metrics data around three episodes—the Silicon Valley Bank (SVB) reserve shock, the TerraUSD (UST) design failure, and the USDe venue dislocation—we show that their intraday dynamics depend on the channel through which the shock propagates. A source-documented measure of Reserve Stress Exposure (RSE), held to a fixed meaning across events, orders the cross-section of discounts around SVB, with the coefficient reaching approximately −213 basis points per exposure step; the first-hour post-disclosure path is unusual under exact label-permutation inference (two-sided $p = 0.048$). The same measure remains economically flat around Terra in the liquidity-screened sample, providing a falsification of a generic stablecoin-stress interpretation. In the USDe episode, contemporaneous price gaps across Binance, Bybit and MEXC exceed 3,000 basis points, documenting severe but temporary venue fragmentation. Extended windows further distinguish first re-entry from durable re-pegging: DAI and USDC recover only after 43 and 57 hours, respectively, following repeated re-breaches; UST does not recover within 72 hours; and USDe re-pegs jointly across venues within 115 minutes. Stablecoin depegs are therefore channel-specific in both severity and persistence, with distinct implications for reserve disclosure, stabilisation design and market microstructure.

JEL classification: G12, G14, G21, G28, F31.

Keywords: stablecoins; depegging; reserve exposure; market microstructure; venue fragmentation; re-pegging.

1. Introduction

Stablecoins are privately issued dollar claims that promise redemption at par while trading continuously on secondary markets. Their prices therefore act as a real-time gauge of how investors value the collateral, stabilisation mechanism, and market access which underpin that promise. When a shock raises doubts about any of these, deviations from par become visible publicly and at high frequency and may resolve

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— or fail to resolve — within minutes rather than days. The collapse of TerraUSD in May 2022 and the de-pegging of USDC after Circle's disclosure of reserves held at Silicon Valley Bank in March 2023 are salient illustrations: in each case the secondary-market price moved sharply before redemptions settled or the underlying balance-sheet uncertainty was resolved, revealing how the market priced the specific weakness the shock exposed.

A growing literature studies stablecoin instability, but largely at daily frequency and often one mechanism or one event at a time. Daily work documents the persistence of peg deviations (Wu et al., 2026), models depegging risk (Lee et al., 2025) and characterises run dynamics and flight-to-safety flows around the SVB episode (Anadu et al., 2024; Oefele et al., 2024). Intraday evidence remains scarce and single-event: Galati and Capalbo (2024) study minute-level volatility around SVB, but not a signed cross-section of exposure, and theoretical treatments of the reserve channel (Ahmed et al., 2024; Ma et al., 2025) are not taken to a multi-event panel. What this work leaves open is, at the frequency at which stress resolves, which mechanism governs which event: whether a token's ex-ante exposure to the channel through which a shock propagates predicts its de-pegging, and how quickly the peg is restored once it breaks. Daily data can mask precisely the within-event timing and cross-sectional variation needed to identify these questions, which is why an intraday design is necessary rather than a refinement. The economic relevance of these episodes is substantial: using same-day CoinGecko market-capitalisation data, we calculate that, as of 12 July 2026, stablecoins accounted for 13.5% of total cryptocurrency market capitalisation, while USDT and USDC jointly represented 83.7% of the stablecoin segment (authors' calculations based on CoinGecko, 2026a, 2026b).

We examine these questions using an intraday, multi-event design built on Coin Metrics one- and five-minute market candles. The analysis centres on three events spanning distinct mechanisms: the SVB banking-reserve shock, the Terra design failure, and the USDe venue dislocation of October 2025. The FTX and BUSD/Paxos episodes are retained in the institutional taxonomy as non-reserve benchmarks but are not part of the core intraday estimates. At its core is a source-documented measure of Reserve Stress Exposure (RSE), coded zero, one or two at the token level and held to a single, stable meaning: documented exposure to the reserve and banking channel of the SVB shock. RSE enters as a conditional predictor of signed intraday deviation in the reserve event, where it should bind, and is expected to be silent in the non-reserve events, where the operative drivers are named separately as design fragility or venue fragmentation. For the venue-specific event we measure cross-venue price dispersion directly, and across events we study the speed of re-pegging.

Our first result indicates the reserve channel in the SVB shock. Estimating abnormal deviations from par — each token demeaned by its own pre-event baseline — around Circle's reserve disclosure on 11 March 2023, we find that the discount after the disclosure is monotone in reserve-stress exposure: the directly exposed token, USDC, moves furthest into discount; indirectly exposed tokens are intermediate; and non-exposed tokens remain close to par, with the largest non-exposed coin, USDT, trading at a premium consistent with flight to safety. The pre-event baseline shows no detectable exposure gradient. Because direct exposure is identified from a single token and the cross-section of tokens is small, we read the evidence from the ordering across exposure groups and report token-bootstrap bands as deliberately conservative. The pattern is consistent with the SVB de-pegging being not a market-wide stablecoin sell-off but a channel-specific repricing of documented reserve exposure.

The paper makes three contributions. First, it provides an intraday, multi-event research design in which distinct economic mechanisms, banking-reserve exposure, design fragility, and venue fragmentation, are tested across depeg events rather than assumed ex ante. Second, it introduces a source-documented Reserve Stress Exposure variable with a single meaning, used as a conditional predictor where it should bind and as a falsification test where it should not. Third, it examines venue fragmentation as a distinct de-pegging channel and documents how re-pegging dynamics differ across reserve, design and venue shocks. Within the USDe episode, recovery is measured jointly across active venues, linking restoration of the peg to the re-establishment of cross-market price alignment. The remainder of the paper proceeds as follows. Section 2 sets out the related literature, institutional background and event taxonomy; Section 3 describes the data and empirical design; Section 4 presents the SVB result and the channel-specificity tests; Section 5 examines venue fragmentation in the USDe dislocation; Section 6 reports robustness and additional checks, including re-pegging dynamics; and Section 7 concludes.

2. Related Literature, Institutional Background and Event Taxonomy

This section situates the paper in the literature on stablecoin instability, sets out the institutional background that motivates treating depeg episodes as heterogeneous rather than interchangeable, and defines the exposure measure used throughout. Section 2.1 positions the paper against three strands of prior work; Section 2.2 describes the stabilisation mechanisms and event taxonomy that organise the empirical design; and Section 2.3 defines Reserve Stress Exposure.

2.1 Related literature and positioning

A first strand documents stablecoin peg deviations on daily frequency. Wu et al. (2026) study a daily panel of major dollar-pegged stablecoins and find that deviations are highly persistent, with lagged deviation accounting for most of the variation; once persistence is controlled for, trading-based variables have no uniform effect, and deviations widen and become more persistent under stress, a pattern they interpret as evidence of limits to arbitrage. Lee et al. (2025) take a prediction-oriented approach, modelling depegging risk, while Eichengreen et al. (2025) infer below-par devaluation risk from the spot and futures prices of a single coin. These studies share a daily frequency at which persistence dominates the empirical variation, making it difficult to isolate the exposure that drives a given depeg, and they do not distinguish systematically between events according to the mechanism through which the shock propagates. This mechanism-specific perspective is consistent with wider evidence that the transmission of a common shock can be state-dependent and operate through distinct macro-financial channels (Melo-Vega-Angeles and Chuquillanqui-Lichardo, 2025).

A second strand examines runs, flight-to-safety, and reserve composition. Anadu et al. (2024) document run dynamics and flight-to-safety in stablecoin flows around the SVB episode, including a "break-the-buck" threshold near $0.99 and the limited reserve exposure of several coins. Oefele et al. (2024) establish flight-to-quality between stablecoins and money-market funds during the same period. On the theoretical side, Ma et al. (2025) model stablecoin runs in which the centralisation of arbitrage shapes both the probability and severity of a discount, while Ahmed et al. (2024) provide a public-information treatment of the reserve channel illustrated by the USDC–FRAX case. Maex and Slavov (2025) relate reserve reporting and transparency to peg stability. This literature motivates the banking-reserve channel directly, but the empirical evidence is largely daily, theoretical, or focused on the SVB episode as a single case rather than as a signed cross-section of documented reserve exposure.

A third, smaller strand turns to intraday data and market microstructure. Galati and Capalbo (2024) study minute-level dynamics around SVB using a BEKK model and focus on volatility spillovers and contagion rather than on signed peg deviations conditional on documented exposure. Earlier high-frequency work on stablecoins, such as Barucci et al. (2022), establishes the feasibility of intraday analysis without addressing channel-specific exposure. Lyons and Viswanath-Natraj (2023) show that broader access to issuer arbitrage materially reduces peg deviations, providing a direct microstructure foundation for the distinction between secondary-market prices and primary-market stabilisation. More generally, persistent price differences across cryptocurrency markets reveal that capital, settlement and institutional frictions can limit apparently straightforward cross-venue arbitrage (Makarov and Schoar, 2020). Related evidence on price discovery across cryptocurrency exchanges shows that information leadership can differ materially across trading venues (Brandvold et al., 2015). More evidence from decentralised blockchain currency markets shows that arbitrage generally keeps stablecoin exchange rates aligned with traditional currency markets, although blockchain-specific costs can impede price efficiency (Ranaldo et al., 2026). The microstructure logic underlying our recovery analysis follows Brunnermeier and Pedersen (2009), in which the interaction of funding liquidity and market liquidity governs how far prices move away from fundamentals and how quickly arbitrage can restore them. For the algorithmic case, Liu et al. (2023) provide the anatomy of the Terra run, while Briola et al. (2023) document the accompanying high-frequency changes in market dependence.

Across these strands, three gaps remain. First, the evidence is predominantly daily, a frequency that may obscure the within-event timing and cross-sectional variation needed to identify exposure effects. Second, available intraday evidence is mostly single-event and volatility-based, rather than a signed, exposure-conditional cross-section estimated across several depeg episodes. Third, the falsification logic central to channel identification has not been systematically tested: whether a single, source-documented exposure measure binds in the event whose channel it captures while remaining silent in events driven by other mechanisms. We address these gaps with an intraday, multi-event design, a source-documented Reserve Stress Exposure measure held to a single meaning, and a recovery analysis that distinguishes temporary re-entry from durable re-pegging, with cross-venue recovery measured jointly in the USDe episode. Table 1 summarises the closest studies and the dimension along which the present paper departs from each.

Table 1.
Closest studies and the departure of the present paper.

Study	**Data and method**	**Focus**	**Departure of the present paper**
Wu, Yeh and Chu (2026)	Daily panel	Persistence; trading dynamics; limits to arbitrage	Intraday, exposure-conditioned cross-section of signed deviations
Eichengreen et al. (2025)	Daily; spot–futures	Below-par devaluation risk, single coin	Multi-coin intraday signed cross-section
Anadu et al. (2024)	Daily flows	Runs, flight-to-safety; break-the-buck near USD 0.99	Intraday prices conditional on documented reserve exposure
Oefele, Baur and Smales (2024)	Daily flows	Flight-to-quality around SVB	Intraday signed deviations by exposure group
Galati and Capalbo (2024)	Intraday; BEKK-GARCH	SVB volatility spillovers and contagion	Signed, exposure-conditional deviations rather than volatility spillovers
Barucci, Giuffra Moncayo and Marazzina (2022)	Intraday; high-frequency	Feasibility of high-frequency stablecoin analysis	Channel-specific, exposure-conditional, multi-event design
Liu, Makarov and Schoar (2023)	Event study; on-chain evidence	Anatomy of the Terra run	Terra used as a non-reserve falsification event in a multi-event design
Gadzinski et al. (2024)	Daily; co-movement	Stablecoin co-instability and "break-a-peg" dynamics	Per-event channel identification at intraday frequency
Ma, Zeng and Zhang (2025); Ahmed, Aldasoro and Duley (2024)	Theory	Reserve/arbitrage runs; public-information reserve channel	Intraday empirical test of the reserve channel across events
Maex and Slavov (2025)	Empirical; reserve reporting	Reserve transparency and peg stability	Documented reserve-exposure cross-section around a timestamped shock

Notes: This table reports the closest studies by empirical or conceptual proximity. The departure of the present paper is not the use of signed deviations alone, but the combination of intraday event time, documented Reserve Stress Exposure, multi-event falsification, and venue-fragmentation/re-pegging analysis.

2.2 Stablecoin mechanisms and event taxonomy

Stablecoins share the promise of par convertibility but differ in how that promise is maintained, and these differences determine the channel through which a shock propagates. We distinguish three stabilisation mechanisms. Fiat-reserve-backed coins, such as USDC, USDT and BUSD, hold off-chain reserves of cash and short-dated securities, and maintain par through redemption and primary-market arbitrage; their vulnerability therefore runs through the quality, location and accessibility of those reserves. Crypto-collateralised coins, such as DAI, are over-collateralised by on-chain assets and are exposed to the composition and market value of that collateral, including any indirect holdings of other stablecoins. Algorithmic coins, such as TerraUSD (UST), rely on an endogenous mint-and-burn arbitrage mechanism rather than an exogenous reserve, so their stability depends on continued confidence in the mechanism itself and is vulnerable to reflexive "death-spiral" dynamics (Liu et al., 2023). Primary- and secondary-market responses need not move together during stress: similar secondary-market peg deviations can coexist with materially different minting and redemption dynamics (Watsky et al., 2024).

Because the operative weakness differs across these designs, treating every de-pegging as a single "stablecoin stress" phenomenon conflates distinct economic channels. We therefore organise the empirical analysis around the event taxonomy in Table 2, which pre-commits, for each episode, to the shock type and the channel expected to operate. The central methodological implication is stated in Section 2.3: a measure of reserve exposure should help explain the cross-section of deviations only in the event whose channel is reserve-based, and should be silent elsewhere.

Table 2.
Event taxonomy and reserve stress exposure.

Event	Stabilisation mechanism affected	Shock type	Expected primary channel	RSE expected to bind
SVB / USDC (Mar 2023)	Fiat-reserve-backed	Banking / reserve	Reserve-stress exposure	Yes
Terra / UST (May 2022)	Algorithmic	Design failure	Design fragility	No
USDe dislocation episode	Synthetic-dollar / hedged	Venue dislocation	Venue fragmentation	No
FTX (Nov 2022)	Cross-cutting	Exchange / counterparty	Counterparty solvency	No; institutional benchmark
BUSD / Paxos (Feb 2023)	Fiat-reserve-backed	Issuer / regulatory	Regulatory halt	No; institutional benchmark
sUSD (Apr 2025)	Crypto-collateralised	Design / liquidity	Liquidity-support weakness	No / not tested as core event

Notes: FTX and BUSD/Paxos are retained as institutional non-reserve benchmarks and are not included in the core intraday estimation.

The SVB/USDC episode of March 2023 is the reserve event. Circle disclosed that approximately USD 3.3 billion of USDC reserves — close to eight per cent of the total — remained at the failed Silicon Valley Bank, and the secondary-market price fell below par before the federal backstop was announced (Circle Internet Financial, 2023). Because the shock operated through the location of bank reserves, exposure to those reserves, directly or through collateral, is the natural candidate channel. Subsequent evidence traces how constraints on primary-market redemptions and the exposure of DAI through its Peg Stability Module shaped the transmission and persistence of the SVB shock across stablecoins (Du et al., 2025).

The Terra/UST collapse of May 2022 is an algorithmic failure: confidence in the mint-and-burn mechanism evaporated and the coin entered a death spiral, with no exogenous reserve to arrest the decline (Liu et al., 2023). The operative channel is design fragility, not reserve exposure.

The USDe dislocation of October 2025 is treated as a venue event. USDe is a synthetic dollar maintained by hedged positions rather than by fiat reserves (Young, 2025), and the protocol's mint and redeem functions remained operational throughout the episode (Rodrigues, 2025). In our intraday data, the October 2025 deviation varies sharply across active venues: the discount is severe and closely in line on Binance and MEXC, while remaining materially smaller on Bybit. This cross-venue heterogeneity points towards fragmented price transmission rather than a common reserve shortfall as the operative channel.

The FTX failure of November 2022 provides an institutional counterparty benchmark. The shock originated in the solvency of a major exchange rather than in the reserves of a stablecoin, so reserve exposure would not be expected to order token responses in that setting (FTX Trading Ltd., 2022). Because exchange impairment and venue-specific trading conditions complicate a clean intraday comparison, we retain the episode in the taxonomy but do not include it in the core estimation.

The BUSD/Paxos episode of February 2023 provides an institutional regulatory benchmark. Following the New York State Department of Financial Services' direction to Paxos to cease minting BUSD, the coin lost market capitalisation steadily, while Paxos stated that its stablecoins had no exposure to Silicon Valley Bank (Anadu et al., 2024). The episode is therefore useful for distinguishing issuer and regulatory shocks from reserve stress, but its gradual adjustment does not provide the sharply timestamped intraday depeg required for the core design.

Finally, the April 2025 sUSD episode is not treated as a core anchor event because its deviation lacks a cleanly dated external trigger and is observed on a single, thin venue. sUSD nevertheless appears as a comparison token in the broader Terra sensitivity samples, subject to the same market-quality classification as other tokens. Its thin selected market is one reason why the strict-liquid sample is used for the primary Terra falsification. The separate April 2025 sUSD episode is reported for completeness in Appendix B.2, but we draw no event-level inference from it.

This taxonomy separates the events used in the core intraday analysis from related institutional benchmarks. Within the estimated event set, a source-documented exposure measure should bind in the SVB reserve shock and remain silent in the Terra design shock, while the USDe episode is examined through venue fragmentation rather than token-level reserve exposure. FTX and BUSD/Paxos illustrate additional non-reserve mechanisms but are not used as estimated falsification events.

2.3 Reserve Stress Exposure

The exposure measure used throughout the paper is Reserve Stress Exposure. It carries a single, stable meaning — documented exposure to the reserve and banking channel of the March 2023 SVB shock — and it is not redefined across events. This discipline is deliberate. Where reserves are not the operative channel, as in the Terra, USDe and sUSD episodes, the relevant driver is a separately named variable (design fragility, venue fragmentation, liquidity support), and RSE is expected to be silent. That silence is a falsification test of channel specificity rather than a missing value to be reinterpreted; holding the measure to one meaning is what allows its silence outside the reserve event to be informative.

RSE is coded as an ordinal variable at the token level:

- RSE = 2 (direct). The token's own reserves were documented as held, in part, at Silicon Valley Bank.
- RSE = 1 (indirect). The token had no direct reserves at SVB but was exposed through documented holdings of an affected coin or its collateral — for example through USDC held as collateral, a peg-stability module (PSM), a vault, or reserve composition.
- RSE = 0 (none). No documented reserve or banking exposure to the SVB shock through any channel.

In the final coding, every value above zero is source-documented and dated; Table 3 reports the coding and its basis. For the two cases in which the magnitude of exposure can be quantified from public disclosures, we additionally report a continuous measure of the documented share of reserves or collateral exposed. These values provide an economic calibration of the ordinal coding but are not used as a separate regression measure because comparable event-date exposure shares cannot be recovered for the remaining indirectly exposed tokens. USD Coin (USDC) is the only directly exposed token: Circle disclosed that approximately USD 3.3 billion of roughly USD 40 billion in reserves — about 8.25 per cent — remained at SVB (Circle Internet Financial, 2023), giving a continuous value of 0.0825. Dai (DAI) is exposed indirectly through the Maker peg-stability module's one-for-one USDC channel; scaling the USDC share of backing at the event date (approximately 0.52) by USDC's own exposure yields about 4.3 per cent. The remaining indirect tokens are coded as RSE = 1 on documented USDC-collateral or PSM channels, but their event-date exposure shares cannot be pinned down from dated public sources; we therefore use them only in the ordinal coding and treat them as robustness rather than primary observations.

Table 3.
Reserve Stress Exposure coding.

Token/group	RSE	Channel	Continuous exposure	Role in analysis	Documented basis
USDC	2	Direct	0.0825	Main	USD 3.3bn of approximately USD 40bn reserves held at SVB, based on Circle's disclosure of 11 March 2023.
DAI	1	Indirect	approximately 0.043	Main	Indirect exposure through the Maker PSM one-for-one USDC channel; approximate exposure computed as 0.52 × 8.25%.
FRAX	1	Indirect	Not quantified	Robustness	Held USDC as collateral into March 2023; event-date share not recovered, so FRAX is retained in the ordinal coding only.
Other documented indirect tokens: OUSD, USDD, MAI, RSV, UXD, alUSD, FEI	1	Indirect	Not quantified	Robustness / expanded sample	Documented USDC-collateral, reserve-composition, or PSM-style exposure.
Non-exposed tokens: USDT, BUSD, USDP, GUSD, TUSD, LUSD, sUSD and remaining controls	0	None	0	Controls / falsification	No documented SVB reserve or banking exposure.

Note: RSE is the ordinal Reserve Stress Exposure variable used in the main specification. Continuous exposure shares are reported for calibration only and are not used in estimation because comparable dated values are unavailable for most indirectly exposed tokens.

These mechanisms, together with an exposure measure held to a single meaning, yield two testable predictions. The first concerns severity and is channel-specific: in the reserve event, tokens with higher Reserve Stress Exposure should display larger signed intraday discounts; in the Terra design event, the same exposure measure should remain inactive; and in the USDe venue event, cross-market fragmentation rather than token-level reserve exposure should organise the price response (H1). The second concerns recovery. If depegs are channel-specific, their re-pegging paths should also differ by mechanism: a reserve shock may unwind slowly and non-monotonically, a failed stabilisation design may not restore par within the observation horizon, and a venue dislocation should resolve as prices converge across active markets (H2).

3. Data and Empirical Design

This section sets out the intraday data, the outcome variables, the event-study specification, and our approach to inference. A common event-time architecture is applied to the three core episodes, with the empirical object matched to the mechanism of each event. Reserve Stress Exposure is used to test whether the reserve channel binds around SVB and remains inactive around Terra, while cross-venue price dispersion captures the operative mechanism in USDe.

3.1 Intraday data and event windows

The data are market candles from Coin Metrics at one- and five-minute frequency, with price, trading volume and trade counts for each token–venue series (Coin Metrics, 2026). The series are drawn from Coin Metrics' market-candles product, which aggregates trade-level data from individual centralised venues into fixed-interval open–high–low–close candles with matched volume and trade counts. We query each token–venue–event series over a window bracketing its anchor rather than a single continuous sample, since the events span May 2022 to October 2025 and the relevant coins and venues differ across them. Prices are the candle close in the quote asset of the chosen market; where a market is USDT-quoted, we convert to a dollar basis using the contemporaneous USDT–USD price, which itself trades at a premium during the SVB episode and is handled as such in Section 6.1. The clean cross-sections contain four tokens in the SVB main sample and five in the Terra strict-liquid sample; the corresponding expanded samples contain eleven tokens each. The final USDe cross-section is reported with the venue-fragmentation results in Section 5. Liquidity varies sharply across venues: on the SVB markets the median five-minute candle records several hundred trades, whereas the thinner non-reserve venues record only a few dozen, which is precisely what the coverage matrix screens on.

Series quality matters more here than in daily work because Coin Metrics constructs gapless candles by carrying forward prices in intervals without trades, with volume set to zero (Coin Metrics, 2026). A forward-filled price is not a newly traded price. We therefore assess every token-event-venue with a coverage matrix that classifies it as usable, partial or unusable according to actual trading activity rather than candle completeness, and we exclude tokens that trade only on dead or broken markets. The core sample and selected markets are reported in Appendix Table B.1; the full coverage matrix is retained in the accompanying empirical workbook.

Event time is measured in minutes relative to a frozen anchor, $\tau = 0$, set for each event from a contemporaneous dated source or a price-rule timestamp. For SVB the anchor is Circle's disclosure that USD 3.3 billion of USDC reserves remained at Silicon Valley Bank, timestamped to 11 March 2023, 03:11 UTC (Circle Internet Financial, 2023). We take this disclosure as the anchor because it was the principal public signal of reserve exposure; an earlier banking-partner disclosure the previous evening belongs to the same information sequence, and we examine the pre-event window with that sequence in mind in Section 4. For Terra the anchor is the first sustained break of UST below 0.995 at its primary venue, on 7 May 2022 at 22:07 UTC; for USDe it is the corresponding price-rule timestamp on Binance, on 10 October 2025 at 21:20 UTC, the venue on which the dislocation is concentrated.

Each event is analysed within a fixed window around its anchor. The SVB window runs from $\tau = -60$ to $\tau = +120$ minutes, with the $[-60, -30]$ sub-window reserved as the pre-event baseline defined in Section 3.2. Terra is estimated at one-minute resolution over the same displayed event window, while USDe is estimated at one-minute resolution over the event-specific window reported in Section 5. Alternative samples and quote-asset treatments are examined in Section 6.1. For the re-pegging analysis in Section 6.3, the source windows are extended sufficiently to provide 72 hours of follow-up from the onset of a qualifying breach in SVB and Terra and 24 hours in USDe.

3.2 Outcome variables

The primary outcome is the signed deviation from par, in basis points. For token i on market j in event e at event-time minute τ,

$$dev_{i,j,e,\tau} = 10{,}000 \times (P_{i,j,e,\tau} - 1), \quad (1)$$

Where $P_{i,j,e,\tau}$ is the market price relative to the unit par value, so that negative values are discounts and positive values premia. We keep the sign because the economics differ by direction. A discount signals doubt about redemption, collateral quality, market access or arbitrage capacity; a premium more frequently reflects flight-to-safety demand or a temporary scarcity of the coin being bought. Collapsing the two into an absolute deviation would discard exactly the distinction the paper is about, so absolute deviations enter only as supplementary severity measures.

A signed deviation is not yet a clean measure of the event, because stablecoins routinely sit slightly above or below par well before any shock. We therefore work with an abnormal signed deviation, demeaning each series by its own pre-event level. For each token-event-market we compute a baseline as the average signed deviation over a clean pre-event interval; for SVB this is the window $\tau \in [-60, -30]$, placed before Circle's disclosure but stopping short of the final pre-disclosure minutes, which may already carry the SVB information sequence. The abnormal deviation is

$$abdev_{i,j,e,\tau} = dev_{i,j,e,\tau} - \overline{dev}_{i,j,e}^{pre} \quad (2)$$

and it is the dependent variable in the event study. A coin such as USDD that already traded at a structural discount before the disclosure should not be counted as more shocked simply because its level is low; only a widening relative to its own baseline is evidence of a reaction. Demeaning isolates that incremental response and prevents chronically off-par tokens from masquerading as the most affected.

We also record one-sided measures: a discount variable equal to the magnitude of the deviation when the coin trades below par, and a premium variable for the part above. These are used descriptively and in robustness analyses to keep devaluation pressure separate from flight-to-safety premia, but the signed abnormal deviation remains the preferred outcome throughout, since it preserves the direction of the response.

For the re-pegging analysis, the outcome is the duration from the onset of the first qualifying breach rather than from the event anchor. A qualifying breach must begin between $\tau = -30$ and $\tau = +120$ and requires two consecutive five-minute observations in which the token's absolute distance from par exceeds its mean pre-event absolute distance by more than 25 basis points. The baseline adjustment prevents tokens that normally trade slightly away from par from being classified as continuously depegged; bands of 10 and 50 basis points are used as sensitivity checks. First re-entry is the first return inside the band for two consecutive five-minute observations. We classify recovery as verified only when the re-entry is followed by at least 60 minutes of observed prices and no subsequent sustained re-breach within the administrative horizon. The horizon is 72 hours from breach onset for SVB and Terra and 24 hours for USDe. Token-events that do not achieve verified recovery by the relevant horizon are right-censored. For USDe, joint recovery additionally requires Binance, Bybit and MEXC to satisfy the recovery criterion simultaneously.

3.3 Event-study specification

The event study rests on two objects: abnormal-deviation paths and event-time coefficient paths. The first is descriptive. For each event we plot the average abnormal signed deviation around the anchor, separately for the relevant exposure groups — in SVB, the RSE = 0, RSE = 1 and RSE = 2 groups. We average across tokens without weighting, so that the picture is not mechanically driven by the largest coins, and the question the plot answers is simple: does the ordering of the deviations follow the exposure groups we fixed before observing the event response? Related evidence from conventional financial markets shows that responses to common shocks vary across firms and sectors, and that pre-shock characteristics help explain differences in market performance and resilience (Dadoukis et al., 2021; Sosa Castro et al., 2024).

The second object makes that ordering precise. For each event e and each event-time bin τ, we run a cross-sectional regression of the abnormal signed deviation on the channel predictor,

$$abdev_{i,e,\tau} = \alpha_{e,\tau} + \beta_{e,\tau} X_{i,e} + \varepsilon_{i,e,\tau} \tag{3}$$

estimated bin by bin on the token cross-section, with each token represented by its primary market. In the SVB event $X_{i,e}$ is the ordinal Reserve Stress Exposure, $RSE_i \in \{0,1,2\}$, so $\beta_{e,\tau}$ is the incremental abnormal deviation associated with a one-step increase in documented reserve exposure at that point in event time. Because the outcome is signed, a negative $\beta_{e,\tau}$ means that more exposed coins trade at a deeper abnormal discount. Tracing $\beta_{e,\tau}$ across τ gives the coefficient path that is the centre of the analysis. We suppress the market subscript because each token is represented by its selected primary market.

What identifies the reserve channel is not the sign alone but its timing. If the shock propagated through reserve and banking exposure, the path should show no systematic gradient during the clean baseline and become increasingly negative as information about the reserve exposure reaches the market. A gradient already present throughout the clean baseline would instead point to pre-existing differences or a confound correlated with exposure. We therefore read the pre-event coefficients as a built-in placebo: a reserve interpretation requires the gradient to appear at the information event, not to sit in the baseline. This is also why we demean over a window that stops short of the final pre-disclosure minutes, so that the pre-event coefficients are not absorbed into the baseline itself.

The same RSE specification is re-estimated around the Terra design shock, while the SVB exposure coding is kept fixed. Terra therefore provides the formal non-reserve falsification. If RSE captures a reserve-specific channel rather than generic stablecoin fragility, its coefficient should remain economically small and lack the negative event-time shape observed around SVB. Read this way, the silence of RSE in Terra is evidence that the variable tracks a documented reserve channel rather than general stress.

USDe is not treated as a cross-sectional RSE test because the relevant variation lies across venues trading the same token, for which token-level RSE is constant. Where a non-reserve event offers measurable variation in its operative mechanism, we instead examine that mechanism directly within the same event-time architecture. For USDe, the relevant object is cross-venue price dispersion. Terra is treated more conservatively: because the algorithmic mechanism directly affects a single design token, the positive evidence is the path of UST itself, together with the absence of an RSE gradient among the comparison tokens.

Taken together, the abnormal-deviation paths by exposure group, the SVB coefficient path, the Terra falsification, and the venue-dispersion evidence for USDe test the paper's central claim directly. The core cross-event comparison is the contrast between the negative RSE path in the SVB reserve shock and its economically flat counterpart in the Terra design shock; USDe then shows how a different mechanism can be identified through within-token variation across venues.

3.4 Inference, samples and interpretation

The intraday setting produces many observations during a narrow window, but the effective cross-section is still the number of tokens in the event, not the number of candles. We do not, therefore, treat minute-level observations as independent evidence in the usual panel sense. The coefficient paths are estimated bin by bin on the token cross-section, and we read inference at the token-event level. This distinction matters in stablecoin markets, where high-frequency prices are serially correlated, liquidity is uneven across coins, and some venues print sparse or mechanically repeated quotes.

For SVB we report two samples. The main sample holds the cleanest reserve comparison: directly exposed USDC, indirectly exposed DAI, and non-exposed controls such as USDT and BUSD. The expanded sample adds the remaining coins with documented indirect exposure or a valid control role, wherever the coverage matrix rates their market data usable or partial. We use the main sample as the transparent illustration of the mechanism and the expanded sample as the broader cross-sectional check, and we lean on the expanded sample for inference precisely because it carries more exposure variation. Group paths are unweighted token averages throughout. Weighting by market capitalisation or volume would let the largest coins dominate the very exposure comparison the paper sets out to test, so we do not.

Because pointwise bootstrap intervals may be wide in a small token cross-section, we complement them with an exact label-permutation test of the coefficient path. Holding token outcomes fixed, we reassign the observed RSE labels across tokens while preserving the original category sizes and enumerate all unique allocations. The primary statistic is the negative mean event-time RSE coefficient over the first post-disclosure hour, $[0, +60]$, so that larger values correspond to a more persistently negative exposure gradient. We report the exact one-sided p-value implied by the directional hypothesis and a two-sided p-value as a robustness check, with $[0, +120]$as a longer-window sensitivity. To assess the baseline path without relying on its mechanically centred mean, we additionally use the sum of squared coefficients over $[-, 60 - 30]$, with the maximum absolute coefficient as a robustness statistic. For the same reason we do not read individual event-time bins as standalone tests. The weight of the evidence rests instead on patterns that are economically coherent: the absence of an exposure gradient before the disclosure, the monotone ordering of abnormal deviations across the RSE groups afterwards, and the contrast between the RSE coefficient path in the reserve event and its counterparts elsewhere.

The same logic disciplines the Terra falsification. Its value comes from holding RSE fixed to its SVB reserve meaning: were the exposure measure relabelled for each event, its silence would carry no identifying content. We therefore judge the Terra result by whether the RSE coefficient is economically small and lacks the event-time shape observed around SVB, rather than by pointwise significance in a thin cross-section. USDe poses a different empirical question because RSE does not vary across venues trading the same token; there, the relevant evidence is whether cross-venue dispersion displays the sharp event-time movement that a common token-level exposure measure cannot explain.

All of this is read against the data-quality classification. Usable token-markets form the core evidence; partial markets enter only in expanded samples or robustness checks; unusable markets are dropped. Quote-asset heterogeneity is handled in the same spirit: USD-quoted markets are preferred where they exist, and a USDT-quoted market is kept only when it is the liquid and defensible venue for that token-event, with the matching checks in Section 6.1. The aim is not to maximise the number of coins but to keep a clean intraday design, in which a deviation reflects a traded price and an interpretable exposure rather than a stale candle or an accounting artefact.

This completes the design. We now put it to work, beginning with the reserve event: whether documented reserve exposure predicts abnormal discounts after the SVB disclosure, and whether it falls silent when the shock runs through another channel.

4. Results: Reserve Exposure and Channel Specificity

This section presents the empirical core of the paper. We begin with the reserve event, where documented reserve exposure should order the cross-section of intraday discounts (Section 4.1). We then re-estimate the same specification around the Terra design shock, where the exposure measure should fall silent (Section 4.2), and summarise the resulting cross-event contrast in Section 4.3.

4.1 The SVB reserve shock

The SVB episode is the one event in which reserve exposure is the operative channel, and it is therefore where Reserve Stress Exposure is expected to bind. We examine the intraday response in two steps: the path of abnormal deviations for each exposure group around Circle's disclosure, and the event-time coefficient that summarises how the cross-section of deviations depends on documented exposure.

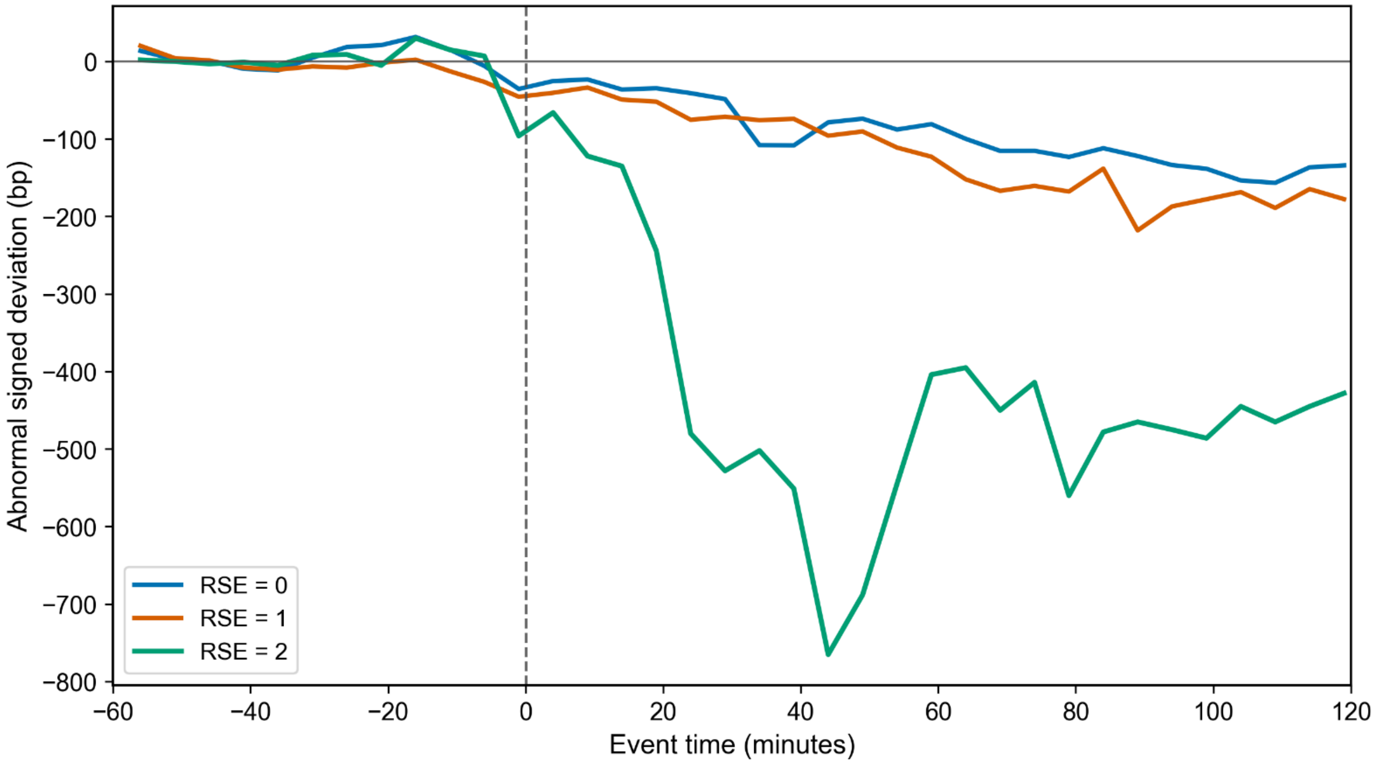

Fig 1. Abnormal signed deviations by RSE group, SVB event, USDT-normalised expanded sample.

Notes: The vertical dashed line marks the Circle SVB disclosure at 03:11 UTC on 11 March 2023. Event time is measured in minutes relative to the disclosure. USDT-quoted markets are converted to a dollar basis using contemporaneous Kraken USDT/USD prices.

Figure 1 plots the average abnormal deviation from par for each exposure group over event time. Through the baseline the three groups sit together near zero, by construction of the demeaning, and show no systematic separation. After the disclosure at 03:11 UTC they part in the order that documented exposure predicts. USD Coin, the only directly exposed coin and the sole member of the RSE = 2 group, falls furthest into discount; the indirectly exposed RSE = 1 coins move to an intermediate position; and the non-exposed RSE = 0 group stays close to its own baseline, with Tether drifting to a premium that is consistent with a flight to safety into the largest unaffected coin. The ordering is monotone in exposure, and it persists for the remainder of the window rather than reversing once the initial shock passes.

One detail of the pre-event window is worth stating plainly, because it bears on interpretation. The post-baseline bins preceding the disclosure already show a faint version of the same separation. We read this as evidence that the market was responding to a sequence of signals rather than to one announcement in isolation: Circle had disclosed a banking-partner exposure the previous evening, and 03:11 is the point at which the scale of the reserve exposure became public, not the first information to reach traders. The baseline window itself, which ends at $\tau = -30$, shows no unusual RSE separation in the formal joint permutation test reported below. The movement that emerges subsequently, but before the 03:11 disclosure, is therefore interpreted as part of the broader SVB information sequence rather than as evidence of a pre-existing baseline gradient.

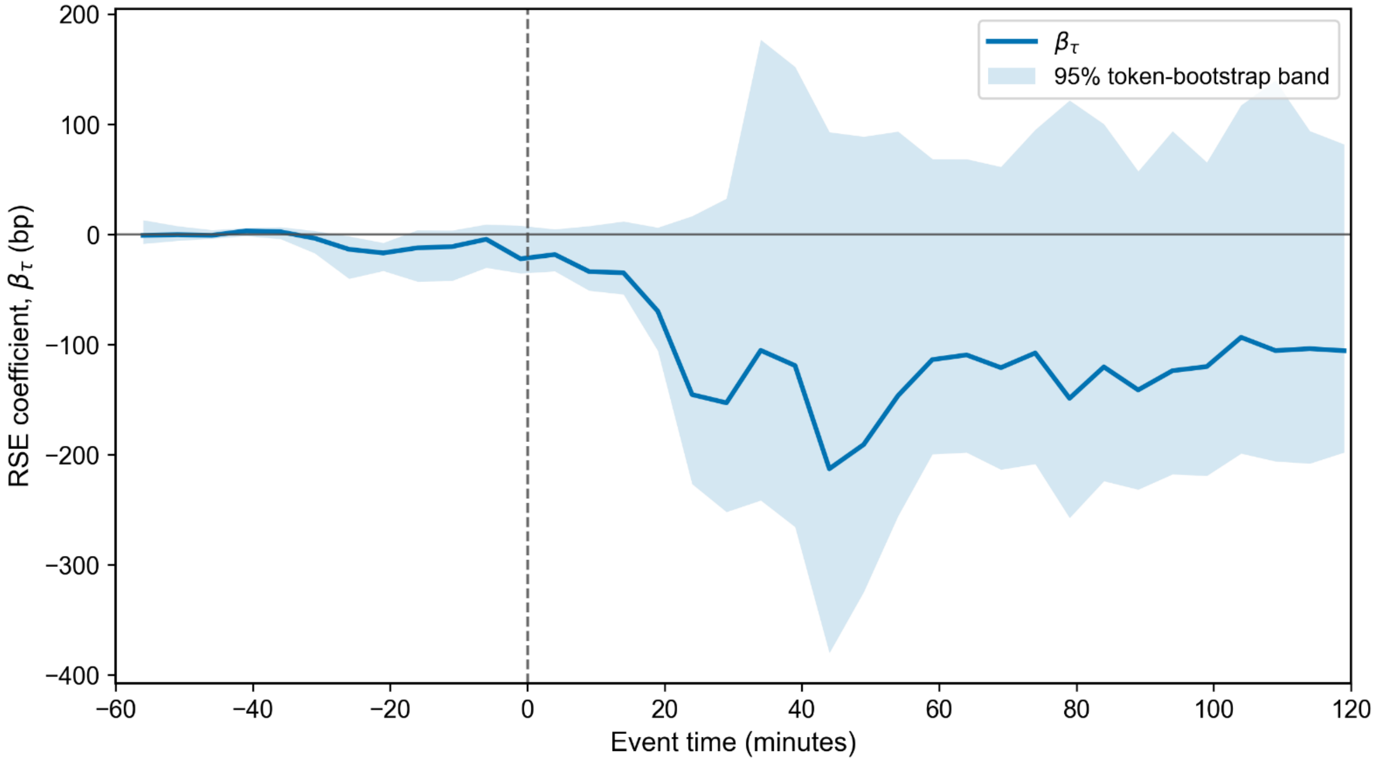

Fig 2. Event-time RSE coefficient, SVB event, USDT-normalised expanded sample.

Notes: The vertical dashed line marks the Circle SVB disclosure at 03:11 UTC on 11 March 2023. Event time is measured in minutes relative to the disclosure. USDT-quoted markets are converted to a dollar basis using contemporaneous Kraken USDT/USD prices. The shaded area reports 95% token-bootstrap confidence intervals.

Figure 2 makes the separation precise by plotting the event-time coefficient β_τ, the per-step change in abnormal deviation associated with a one-level increase in reserve exposure. The path is muted through the clean baseline. A negative gradient begins to emerge in the post-baseline minutes preceding the 03:11 disclosure, consistent with the broader SVB information sequence described above, and deepens materially afterwards, reaching approximately −213 basis points per exposure step around forty-five minutes past the anchor in the expanded sample. The point estimate remains negative through the end of the displayed window, although the expanded-sample confidence intervals are wide and include zero at several individual post-disclosure bins. We therefore interpret the evidence from the post-disclosure path as a whole and complement the pointwise bootstrap intervals with exact label-permutation inference.

Table 4.
Selected SVB event-time RSE coefficients (β_τ).

τ (min)	Expanded sample β_τ [95% CI]	Main sample β_τ [95% CI]
−26	−13.5 [−40.1, −1.7]	−2.7 [−26.5, 16.9]
−1	−22.2 [−35.3, 7.9]	−29.1 [−35.9, −15.8]
+4	−18.3 [−33.4, 4.6]	−18.3 [−37.4, −7.5]
+24	−145.5 [−226.6, 16.6]	−218.6 [−306.3, −136.5]

τ (min)	Expanded sample β_τ [95% CI]	Main sample β_τ [95% CI]
+44	−212.8 [−379.9, 92.8]	−362.7 [−439.8, −294.0]
+119	−105.6 [−197.9, 81.8]	−198.7 [−305.3, −93.8]

Notes: Abnormal signed deviation from par, in basis points, is regressed on $RSE_{ord} \in \{0, 1, 2\}$ bin by bin in event time. $\beta_\tau$is the per-step change in abnormal deviation associated with documented reserve exposure, so negative coefficients indicate that more exposed tokens trade at deeper abnormal discounts. Ninety-five per cent intervals are token-bootstrap percentile bands from 500 replications. The expanded sample contains 11 tokens; the main sample contains four: USDC, DAI, USDT and BUSD. As USDC is the only directly exposed token, the RSE = 2 category is identified from a single coin, and the intervals should be read accordingly. In the main-sample bootstrap, 467 of 500 replications (93.4%) retained sufficient RSE variation for coefficient estimation and were used to construct the percentile bands. All 500 replications were valid in the expanded-sample bootstrap. The selected post-baseline bins preceding the disclosure ($\tau = -26$ and $\tau = -1$) already move, consistent with the Circle disclosure being the principal signal within a broader SVB information sequence. Pointwise bootstrap intervals are complemented by exact label-permutation inference preserving the observed RSE category sizes. In the expanded sample, the mean coefficient over $[0, +60]$ is -112 basis points per exposure step (one-sided exact $p = 0.036$; two-sided exact $p = 0.048$). A joint baseline permutation test based on the sum of squared coefficients does not reject the null of no unusual RSE separation over $[-, 60 - 30]$ ($p = 0.720$).

The path-level permutation evidence provides a complementary assessment of the SVB result. In the expanded sample, which contains 2,772 unique reallocations of the observed RSE category sizes, the mean coefficient over $[0, +60]$ is -112 basis points per exposure step. The observed path lies in the lower tail of the exact permutation distribution (one-sided $p = 0.036$; two-sided $p = 0.048$). The evidence becomes less precise when the window is extended to $[0, +120]$ (one-sided $p = 0.057$; two-sided $p = 0.093$). In the four-token main sample, only 12 unique RSE allocations are possible, so the smallest attainable exact p-value is 0.083; the observed post-event path attains this bound. A joint baseline test provides no evidence of unusual RSE separation over $[-, 60 - 30]$ in the expanded sample ($p = 0.720$), with the conclusion unchanged when the maximum absolute baseline coefficient is used instead ($p = 0.753$).

Table 4 reports the coefficient at selected points in event time for both samples. The estimates are economically large: at the trough, a one-step increase in documented exposure is associated with a discount of around two to four hundred basis points, depending on the sample. We draw the inference from the path rather than from any single event-time bin. The expanded-sample bootstrap intervals are wide and include zero at several reported post-disclosure points, reflecting the small cross-section and the fact that the highest exposure category contains a single token. The exact permutation test complements those pointwise intervals by showing that the joint negative path over the first post-disclosure hour is unusual relative to alternative reallocations of the observed exposure labels. The four-token main sample provides the cleanest illustration of the exposure ordering, while the expanded sample provides the broader cross-sectional test.

Two qualifications follow from the structure of the event. The RSE = 2 category is identified from USD Coin alone, since it was the only coin with documented direct exposure, so the magnitude of the highest-exposure response is estimated from one series and should be read with that in mind. And because the cross-section is small, the token-bootstrap intervals are deliberately conservative; this is why the ordering across exposure groups, rather than pointwise significance, carries the argument. Neither qualification disturbs the central reading. After the disclosure, the cross-section of intraday discounts is ordered by documented reserve exposure, the pre-event window is flat, and the most exposed coin moves first and furthest.

This is the signature of a channel-specific repricing rather than an undifferentiated stablecoin sell-off: had the episode simply driven every coin away from par, exposure would not order the response as it does. Whether this ordering is specific to the reserve channel, or merely a generic feature of stablecoin stress that would appear in any depeg, is the question we put to the non-reserve events in the next section.

4.2 Terra design shock as falsification

The Terra episode provides a falsification exercise for the reserve-exposure channel. Unlike the SVB shock, the Terra collapse was not triggered by news about fiat reserve exposure at a banking institution. If RSE captures a reserve-specific mechanism, rather than a generic sensitivity to stablecoin stress, the RSE coefficient should not reproduce the negative event-time pattern observed around SVB.

We re-estimate the event-time RSE specification around the Terra anchor, keeping the SVB RSE coding fixed. UST is treated separately as the Terra design-token path and is excluded from the primary cross-sectional falsification samples. For USDT-quoted markets, prices are converted to a dollar basis using contemporaneous Kraken USDT/USD prices, and abnormal deviations are computed relative to the same pre-event baseline window, [−60, −30], used in the SVB analysis.

The results, reported in Table 5, differ sharply from those for the SVB reserve shock. In the strict liquid sample, the RSE coefficient remains economically small and statistically indistinguishable from zero throughout the event window. At the SVB-comparable event times, the post-anchor estimates range from −0.35 to 1.08 basis points per RSE step, with all token-bootstrap confidence intervals including zero. Figure 3 plots the corresponding coefficient path. This differs from the SVB estimates, where the RSE coefficient becomes large and negative after the Circle disclosure. As in the SVB analysis, the top of the exposure scale rests on USDC alone. Bootstrap validity shares below one reflect resamples with insufficient cross-sectional RSE variation to estimate the coefficient, and the percentile intervals are therefore constructed from valid replications only.

Table 5.
Terra falsification: event-time RSE coefficients.

Event time	Strict liquid (N = 5)	Primary (N = 7)	Expanded (N = 11)
-26	-0.17 [-3.52, 0.80]	-0.31 [-3.23, 0.45]	-0.23 [-2.08, 0.33]
-1	1.02 [-1.51, 8.33]	11.82 [-0.52, 44.35]	7.00 [-5.89, 28.25]
+4	0.46 [-1.47, 6.81]	10.86 [-0.84, 43.22]	9.24 [-0.19, 30.28]
+24	0.83 [-1.63, 8.00]	11.53 [-0.28, 45.13]	9.75 [0.11, 32.77]
+44	1.08 [-0.91, 7.19]	17.41 [0.06, 67.80]	11.30 [-5.04, 44.89]
+119	-0.35 [-3.81, 0.84]	3.52 [-1.05, 13.32]	5.68 [-0.19, 22.88]

Notes: The table reports event-time coefficients from regressions of abnormal signed deviations on the fixed SVB Reserve Stress Exposure (RSE) score around the Terra event anchor. Event time is measured in minutes relative to 22:07 UTC on 7 May 2022. The baseline window is [-60,-30]. USDT-quoted markets are converted to a dollar basis using contemporaneous Kraken USDT/USD prices. UST is excluded from the cross-sectional falsification samples and reported separately as the Terra design-token path. Brackets report 95% token-bootstrap confidence intervals. The strict liquid sample excludes UST, requires the share of repeated minute prices to remain below 0.80. Bootstrap replications are considered valid when the resampled cross-section retains at least two distinct RSE categories, providing sufficient variation to estimate the RSE coefficient. Across the event-time bins reported in the table, valid-replication shares range from 90.9% to 93.9% in the strict-liquid sample, from

97.8% to 98.6% in the primary sample, and from 99.6% to 100% in the expanded sample. Percentile intervals are constructed from the valid replications only.

The primary and expanded Terra samples display mildly positive point estimates at some horizons. We do not interpret this as evidence of a Terra RSE channel. First, the sign is opposite to the SVB reserve-exposure gradient. Second, the magnitudes are small relative to SVB. Third, the pattern disappears in the strict liquid sample. Leave-one-out diagnostics show that the mild positive shape in the primary and expanded samples is concentrated in sUSD, a thinly traded crypto-collateralised token. In the primary sample, excluding sUSD reduces the RSE coefficient from 11.53 to 1.11 basis points at $\tau = +24$ and from 17.41 to 1.54 basis points at $\tau = +44$. In the expanded sample, the corresponding coefficients fall from 9.75 to 1.97 basis points and from 11.30 to −0.42 basis points. The wider-sample positive path therefore largely disappears when sUSD is removed, whereas the strict-liquid sample is already economically flat. This pattern supports the interpretation that the wider-sample estimates reflect thin-market sensitivity rather than a reserve-exposure mechanism. Full leave-one-out results are reported in Appendix Table A.3.

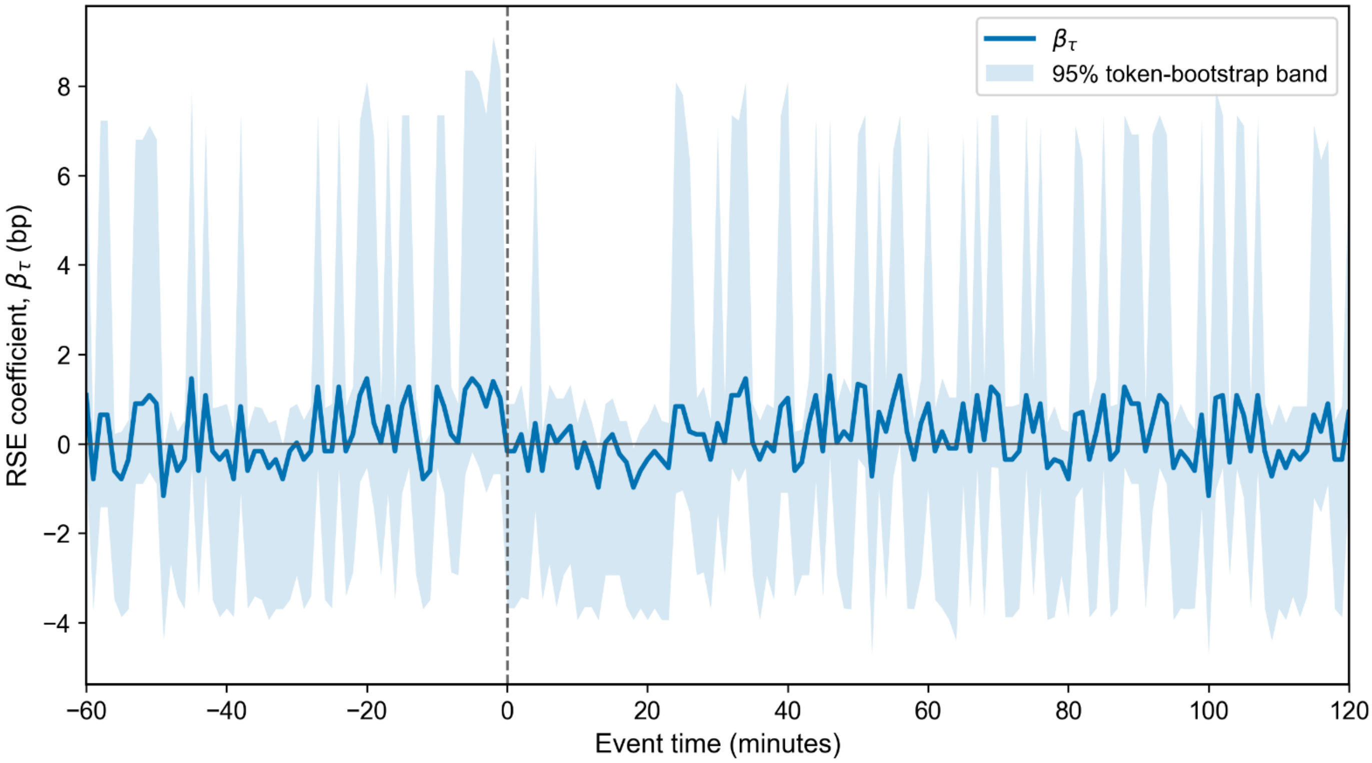

Fig 3. Event-time RSE coefficient, Terra event, strict liquid sample.

Notes: The vertical dashed line marks the Terra event anchor at 22:07 UTC on 7 May 2022. Event time is measured in minutes relative to the anchor. USDT-quoted markets are converted to a dollar basis using contemporaneous Kraken USDT/USD prices. The shaded area reports 95% token-bootstrap confidence intervals. The strict liquid sample excludes UST, requires positive median volume or trades, and requires a share of repeated minute prices below 0.80.

Figure 4 reports the UST path itself, documenting the initial intraday break and partial rebound around the Terra anchor. The path should not be read as capturing the full terminal collapse of UST, which unfolded over the following days (Briola et al., 2023; Liu et al., 2023); what it isolates is the initial high-frequency design-token stress that motivates the falsification exercise.

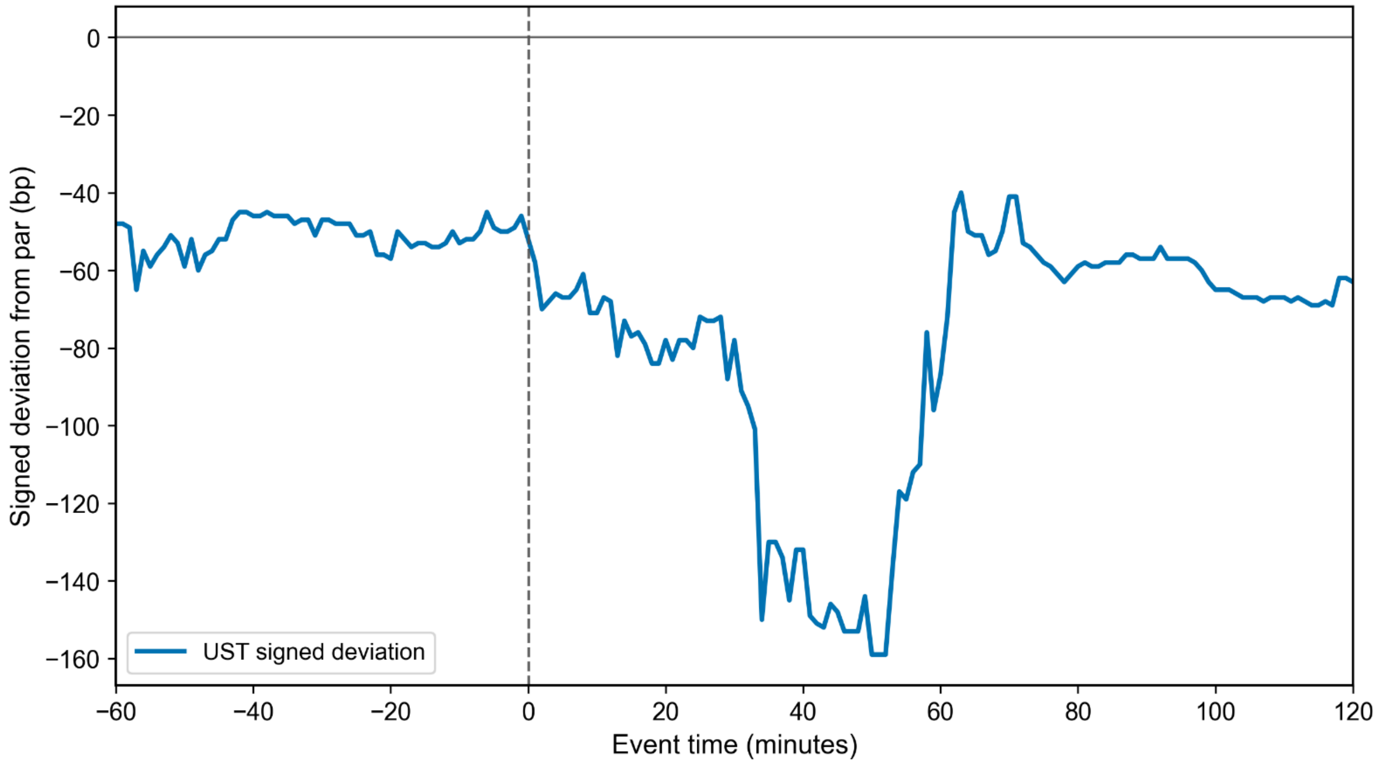

Fig 4. UST signed deviation around the Terra event.

Notes: The figure reports the signed deviation of UST from par on ftx-ust-usd-spot. The vertical dashed line marks the Terra event anchor at 22:07 UTC on 7 May 2022. Event time is measured in minutes relative to the anchor. The figure captures the initial intraday break and partial rebound, not the full terminal collapse of UST over the following days.

Taken together, the Terra results support a channel-specific interpretation of RSE. RSE predicts abnormal discounts around the SVB reserve and banking shock, but it does not produce a comparable negative gradient around the Terra design shock. The evidence therefore suggests that RSE is not simply capturing generic stablecoin fragility or broad market stress; its explanatory power is concentrated in the event where the reserve and banking channel is directly activated.

4.3 Cross-event channel specificity

The comparison between SVB and Terra provides the first direct test of whether RSE captures a reserve-specific channel or a more general stablecoin-stress factor. The two events are useful precisely because they are both severe depeg episodes, but their mechanisms diverge. SVB was a banking-reserve shock, in which documented exposure to the affected bank should matter. Terra was a design failure, in which the same reserve-exposure measure should not order the cross-section of non-UST stablecoins.

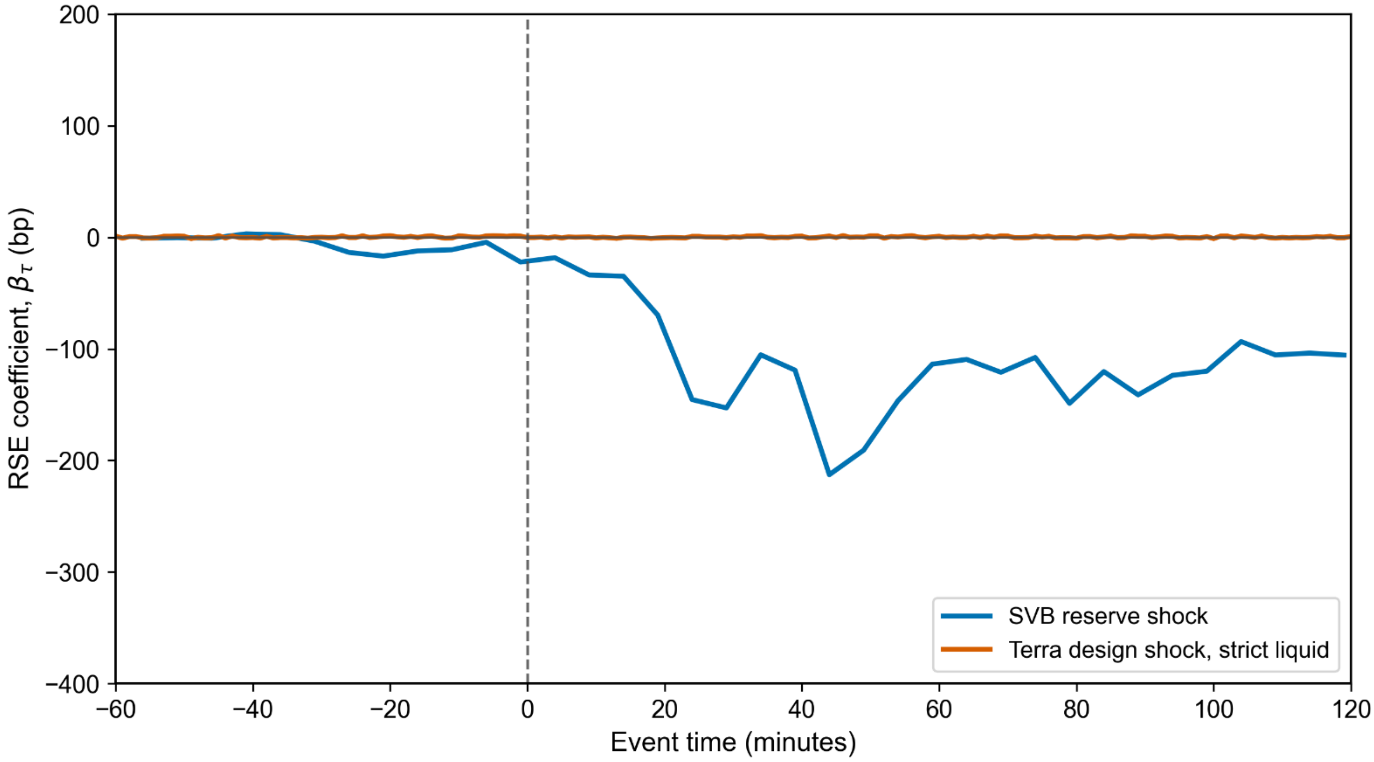

Fig 5. Event-time RSE coefficient: SVB reserve shock versus Terra design shock.

Notes: The figure compares event-time RSE coefficients for the SVB reserve shock and the Terra design shock. The SVB line uses the USDT-normalised expanded sample. The Terra line uses the strict liquid sample. Event time is measured in minutes relative to each event anchor. Both series are plotted on the same y-axis scale. USDT-quoted markets are converted to a dollar basis using contemporaneous Kraken USDT/USD prices.

Figure 5 places the two event-time RSE coefficient paths on the same scale. The contrast is stark. Around SVB, the coefficient begins to move negative in the post-baseline information sequence and deepens materially after the Circle disclosure, reaching roughly −213 basis points per exposure step at its trough, indicating that higher reserve exposure is associated with deeper abnormal discounts. Around Terra, using the strict liquid sample, the coefficient remains close to zero throughout the window, never exceeding about one basis point in absolute value after the anchor. The Terra line is not merely statistically weaker; it is economically flat when plotted on the same axis as the SVB response.

This cross-event contrast is the central evidence for channel specificity. RSE does not predict depegs whenever stablecoin markets are under stress. It predicts abnormal discounts in the event where the reserve and banking channel is directly activated, and it is muted in the design-shock event where that channel should not operate. The mild positive coefficients observed in the wider Terra samples do not overturn this interpretation: they are small relative to SVB, have the opposite sign, are removed by the liquidity screen, and are traced by leave-one-out diagnostics to thinly traded tokens rather than to the exposure measure itself.

The implication is that stablecoin depegs should not be treated as a single empirical object. The same market outcome — a deviation from par — can arise through different mechanisms, and the relevant predictor changes with the mechanism. For reserve shocks, documented reserve exposure orders the cross-section. For design shocks, the reserve-exposure gradient disappears and the event is better read through the path of the affected design token itself. The next section applies the same logic to a venue-specific dislocation, where the operative channel is not reserve exposure but cross-venue fragmentation.

5. Venue Fragmentation and the USDe Dislocation

5.1 Event construction and venue coverage

The USDe episode provides a setting in which the source of the dislocation can be examined within a single token across trading venues. Unlike the SVB event, where the identifying variation lies across tokens with different reserve exposures, the relevant variation here lies across markets trading the same instrument at the same time. USDe is a synthetic-dollar token supported by hedged positions rather than a conventional pool of fiat reserves. A common repricing of the token would ordinarily be expected to appear broadly across active venues, whereas sharp contemporaneous differences between venue prices point toward fragmented price transmission and incomplete cross-market price equalisation.

The event is anchored at 21:20 UTC on 10 October 2025, the Binance price-rule timestamp used in the data construction. The analysis uses one-minute candles over the window [−60,+120], with [−60,−30] as the pre-event baseline. One-minute resolution is necessary because the initial break and subsequent reversals occur within intervals that would be obscured in five-minute candles. All three core markets are quoted against USDT and are converted to dollar prices using the contemporaneous Kraken USDT/USD rate. As in the preceding event studies, each venue series is demeaned by its own baseline average, so the outcome is the abnormal signed deviation from par rather than the quoted-price level. Binance's own post-event account places the initial price trough at 21:20–21:21 UTC, with the severe de-pegging developing after 21:36 (Abrams, 2025), which independently corroborates both the anchor and the timing of the deepest dislocation in our data.

The core sample contains Binance, Bybit and MEXC. All three markets have complete one-minute coverage in the main window, positive trading activity and no prolonged sequence of frozen prices around the anchor. Their liquidity nevertheless differs substantially. Median one-minute dollar volume is approximately USD 5.1 million on Binance, USD 0.14 million on Bybit and USD 0.046 million on MEXC, with corresponding median trade counts of 572, 56 and 14. MEXC is therefore materially thinner than the other core venues, but it is still actively traded throughout the event window. The first sustained break occurs within two minutes of the anchor on each core venue, so the use of a common event time does not impose artificial alignment on any of them.

Gate.io is retained only in the expanded robustness sample because its price path contains a ten-minute frozen run around the event. Kraken and KuCoin are excluded from the quantitative analysis: both display high repeated-price shares and very limited trading activity, so their apparently shallow movements cannot be distinguished cleanly from stale quoting. The selection rule is therefore based on traded-price quality rather than on the availability of a complete candle series.

For each minute τ, we summarise fragmentation using the sample standard deviation of abnormal signed deviations across the three core venues, SD_τ:

$$SD_\tau = \left[\frac{1}{J_\tau - 1}\sum_{j=1}^{J_\tau}\left(AD_{j\tau} - \overline{AD_\tau}\right)^2\right]^{1/2}, \tag{4}$$

where $AD_{j\tau}$ is the abnormal signed deviation on venue j, and $J_\tau = 3$ in the core sample. The venue paths carry the main economic evidence, while the standard deviation provides a compact summary of their separation. We report the interquartile range and pairwise venue gaps as robustness checks. With three active venues, the sample IQR is mechanically equal to one-half of the cross-sectional range under the quantile rule used here and therefore does not provide an independent measure of dispersion.

5.2 Cross-venue price fragmentation

Figure 6 reports the abnormal signed deviations for the three core venues. Before the event, the series are closely aligned around their venue-specific baselines. The mean cross-venue standard deviation during $[-60, -30]$ is only 0.47 basis points, and none of the venues displays a persistent pre-event departure from the others. The alignment breaks at the anchor. At $\tau = 0$, Binance is already 298 basis points below its baseline, compared with discounts of 19 basis points on Bybit and 7 basis points on MEXC. Cross-venue dispersion rises immediately to 165 basis points.

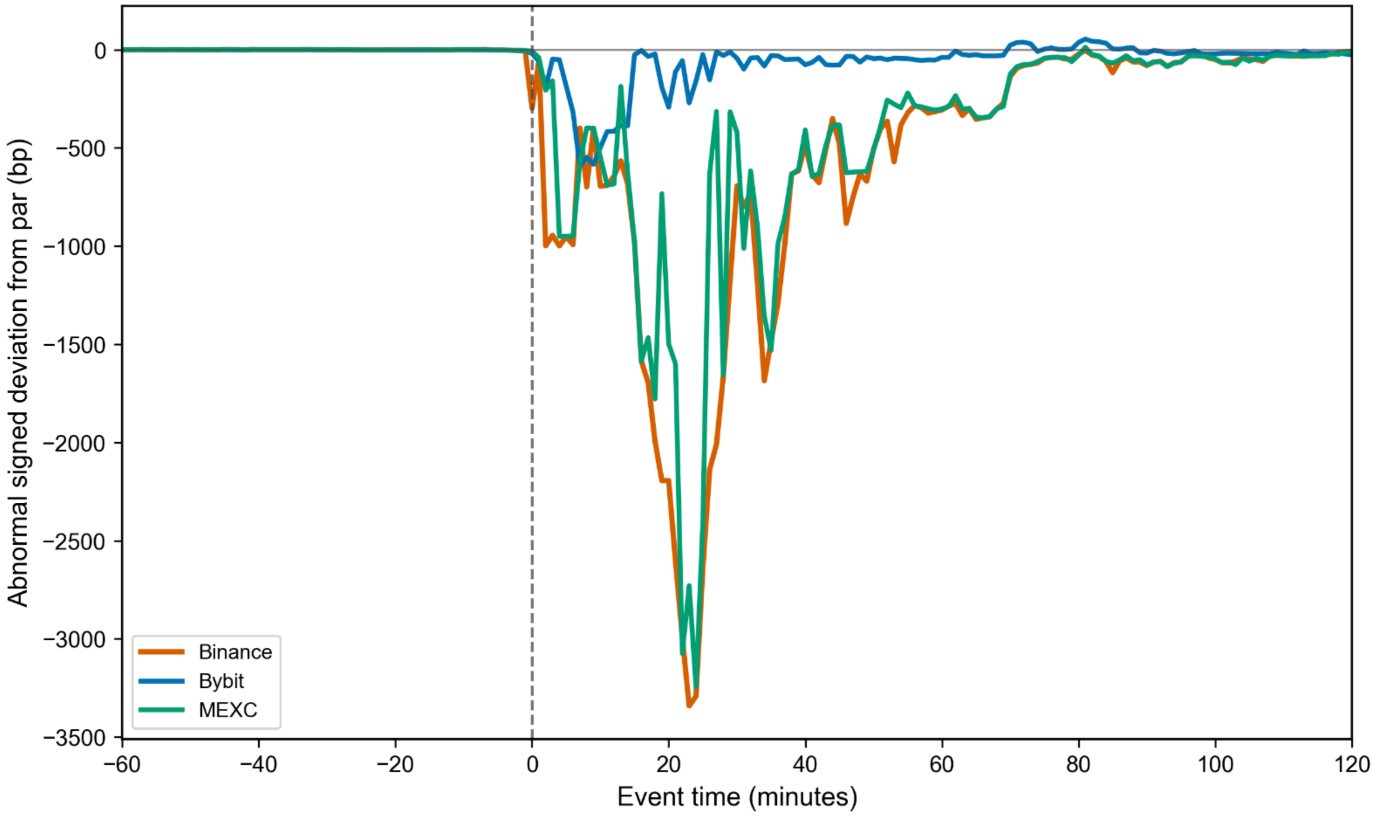

Fig 6. Abnormal signed deviations across core venues around the USDe dislocation.

Notes: The figure reports abnormal signed deviations from par for USDe on Binance, Bybit and MEXC. Each venue series is demeaned by its average signed deviation over the baseline window $[-60, -30]$. The vertical dashed line marks the frozen event anchor at 21:20 UTC on 10 October 2025. Event time is measured in minutes relative to the anchor. USDT-quoted prices are converted to a dollar basis using contemporaneous Kraken USDT/USD prices.

The subsequent path is not a uniform repricing of USDe. Binance and MEXC move into deep and closely aligned discounts, while Bybit remains materially closer to par. The separation reaches its maximum at τ=+24. At that point, the abnormal deviation is −3,293 basis points on Binance and −3,245 basis points on MEXC, but only −160 basis points on Bybit. The Binance–MEXC gap is approximately 48 basis points, whereas the Binance–Bybit and MEXC–Bybit gaps exceed 3,000 basis points. The resulting cross-venue standard deviation is 1,795 basis points.

The near overlap of Binance and MEXC should not be interpreted as evidence that the two venues process information independently. MEXC is the thinner market, and its prices may respond closely to liquidity or information originating elsewhere. The relevant point for the fragmentation result is narrower: the deep discount is observed on two active markets, while a third active market trading the same token at the same time remains substantially closer to par. A measure centred solely on a Binance-versus-rest wedge would therefore mischaracterise the realised cross-venue structure.

Table 6 reports selected points along the venue paths. The episode contains several reversals before the maximum divergence, but the same broad ordering recurs: Binance and MEXC experience the larger discounts, while Bybit is comparatively insulated. At τ=+5, for example, Binance and MEXC are both approximately 950 basis points below baseline, compared with 185 basis points on Bybit. The pattern reappears at τ=+15 and becomes considerably larger around the trough.

Table 6.
USDe abnormal deviations and cross-venue fragmentation.

Event time	Binance	Bybit	MEXC	Cross-venue SD	Cross-venue IQR
−26	−0.91	−0.39	0.83	0.89	0.87
−1	−5.11	−4.60	−4.37	0.38	0.37
0	−298.03	−19.40	−7.17	164.51	145.43
2	−998.40	−192.57	−206.35	461.32	402.92
5	−951.38	−184.57	−949.64	442.22	383.41
15	−982.00	−25.58	−977.24	550.82	478.21
24	−3,292.53	−159.63	−3,244.72	1,795.14	1,566.45
60	−306.79	−38.64	−301.04	153.19	134.08
120	−7.45	−26.97	−8.71	10.92	9.76

Notes: Venue columns report abnormal signed deviations from par in basis points, calculated relative to each venue's average deviation over $[-60, -30]$. Negative values indicate abnormal discounts. The core sample contains Binance, Bybit and MEXC. Cross-venue SD is the sample standard deviation across the three venue deviations. The IQR is reported for completeness; as discussed in Section 5.1, with three venues it is mechanically equal to one-half of the cross-sectional range under the quantile convention used.

A common deterioration in USDe's value may have contributed to the initial decline, but it cannot by itself explain why contemporaneous prices differ by more than 3,000 basis points across active venues. The evidence is instead consistent with a market in which the transmission of the shock, and the ability of arbitrage to equalise prices, differs sharply across trading locations. This is the same general class of friction that permits persistent price differences across cryptocurrency markets despite apparently straightforward arbitrage opportunities (Makarov and Schoar, 2020), although the present event unfolds over minutes rather than over the lower-frequency intervals examined in much of the earlier literature.

The result is therefore one of venue fragmentation rather than simply de-pegging severity. The object being priced is identical across the three markets, the prices are observed contemporaneously, and the quote asset is treated consistently. What varies is the venue on which the token is traded. That within-token design separates the fragmentation channel from the reserve-exposure channel identified around SVB and from the design failure observed in Terra.

5.3 Convergence after the dislocation

Figure 7 traces the evolution of cross-venue fragmentation. Dispersion is negligible through the baseline, rises sharply at the anchor and reaches 1,795 basis points at τ=+24. It then declines unevenly, with several temporary reversals as prices on Binance and MEXC move back towards the range observed on Bybit. The adjustment is substantial but not immediate: economically large differences across venues remain for roughly an hour after the peak.

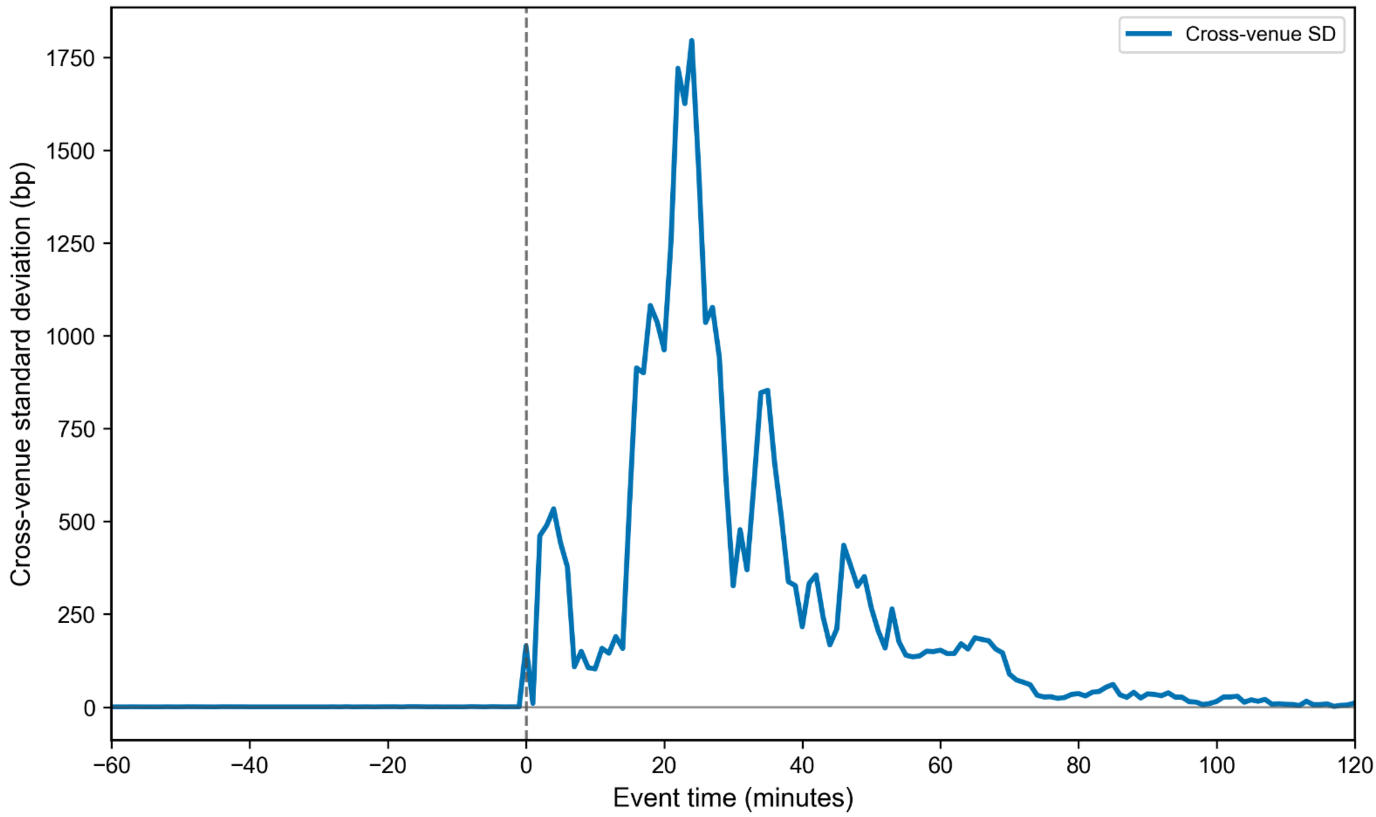

Fig 7. Cross-venue price fragmentation around the USDe dislocation.

Notes: The figure reports the sample standard deviation of abnormal signed deviations across the three core USDe venues—Binance, Bybit and event anchor at 21:20 UTC on 10 October 2025. USDT-quoted prices are converted to a dollar basis using contemporaneous Kraken USDT/USD prices.

To describe the pace of convergence without treating a single transient print as recovery, we require the fragmentation measure to remain below each threshold for at least ten consecutive minutes. Following the peak at $\tau = +24$, the cross-venue standard deviation remains below 500 basis points from $\tau = +38$, below 250 basis points from $+54$, below 100 basis points from $+70$, and below 50 basis points from $+74$. It falls persistently below 25 basis points only from $+104$. Most of the initial separation therefore closes within approximately one hour, but smaller price differences persist for considerably longer.

At the end of the two-hour window, the standard deviation has fallen to 10.92 basis points. This is small relative to the event peak, but it remains well above the baseline mean of 0.47 basis points. The venues therefore converge substantially without returning fully to their pre-event degree of integration. The distinction is economically relevant: the narrowing of the token's discount and the restoration of price alignment across venues are related, but they are not the same outcome.

The result is insensitive to the treatment of the quote asset. The fragmentation path calculated from raw USDe/USDT prices has a correlation of 1.000 with the dollar-normalised path, peaks at the same event minute and differs from it by no more than 2.51 basis points at any point. The common USDT/USD conversion therefore does not generate the cross-venue pattern. The IQR produces the same peak timing and nearly identical convergence thresholds. Adding Gate.io to the expanded sample also leaves the result largely unchanged: the expanded and core paths have a correlation of 0.997 and peak at the same event time. Gate.io nevertheless remains outside the core sample because of its frozen-price sequence around the anchor.

Taken together, the USDe evidence identifies venue fragmentation as a separate margin of stablecoin stress. The same token trades at sharply different contemporaneous prices across active markets, and the subsequent narrowing of those differences provides a direct measure of how quickly cross-venue price alignment is restored. Section 6.3 broadens the recovery analysis from this within-event comparison to re-pegging durations across tokens and events.

6. Robustness and Additional Checks

The preceding results rely on choices that are unavoidable in an intraday setting. Token coverage differs across venues, several otherwise suitable markets are quoted in USDT rather than directly in dollars, and some smaller stablecoins trade intermittently or display repeated prices. These features can affect both the measured deviation from par and the precision of the cross-sectional estimates. We therefore examine whether the main findings depend on the composition of the token sample, the treatment of thin markets, or the quote asset used to construct dollar prices.

The purpose of these checks is not to search across specifications for the strongest coefficient. The relevant question is whether the economic classification of the three episodes remains intact under defensible alternatives: whether reserve exposure continues to order the SVB response, whether the same exposure measure remains inactive in the Terra design shock, and whether the USDe result continues to reflect cross-venue price fragmentation. Section 6.1 considers alternative samples, liquidity screens and quote-asset treatments. Section 6.2 compresses the SVB response into a binary discount outcome and estimates a Firth-penalised logit, which is appropriate for the small and partly separated cross-section. Section 6.3 then extends the analysis beyond the initial event window and distinguishes temporary returns towards par from durable re-pegging.

6.1 Alternative samples, liquidity screens, and quote assets

The SVB results are first compared across the four-token main sample and the eleven-token expanded sample. The main sample contains the cleanest comparison among directly exposed USDC, indirectly exposed DAI, and the non-exposed USDT and BUSD. The expanded sample adds tokens with documented indirect exposure and additional non-exposed controls, subject to the market-quality classification described in Section 3.4. Expanding the cross-section reduces precision, particularly because USDC remains the only observation in the highest exposure category, but it does not alter the timing or direction of the result. The pre-disclosure path remains muted, while the post-disclosure coefficients are negative and the token responses retain the ordering implied by documented reserve exposure. The difference between the samples is therefore one of precision and composition rather than economic interpretation.

Quote denomination is a more specific concern in the expanded SVB sample. Several tokens are observed on USDT-quoted markets, and USDT itself traded above par during the episode. Reading the quoted token price as a dollar price would consequently mix movements in the token with movements in the quote asset. We approach this by converting each USDT-quoted price into dollars using the contemporaneous Kraken USDT–USD rate before computing signed and abnormal deviations. The dollar-normalised specification preserves the negative post-disclosure RSE path and its event-time shape. At $\tau = +44$, for example, the expanded-sample coefficient is −213 basis points per exposure step after normalisation, compared with about −220 basis points in the unadjusted specification. The adjustment therefore does not mechanically strengthen the result; it leaves the economic ordering and event-time shape intact while removing movements in the quote currency. The corresponding unadjusted estimates are reported in Appendix Table A.1.

The Terra falsification is more sensitive to the inclusion of thin markets. We therefore report three samples. The strict liquid sample excludes UST itself, requires positive median trading volume or trade counts, and removes markets for which repeated minute prices account for 80 per cent or more of the event window. The primary and expanded samples relax these screens and admit a broader cross-section. In the strict liquid sample, the post-anchor RSE coefficients range from −0.35 to 1.08 basis points per exposure step, with all token-bootstrap intervals including zero. The path is economically flat when placed on the same scale as the SVB estimates.

The wider Terra samples display mildly positive coefficients at some horizons, but this does not resemble the SVB reserve channel. The sign is opposite, the estimates are much smaller, and the pattern disappears after applying the liquidity screen. Leave-one-out diagnostics trace much of the wider-sample movement to sUSD, whose selected market is thin and contains little genuine trading activity. We therefore use the strict liquid sample for the falsification result and retain the wider samples as evidence of the sensitivity created by inactive or sparsely traded markets. This distinction is consequential: including more tokens does not necessarily strengthen an intraday design when the additional observations contain repeated rather than traded prices.

The USDe fragmentation result is also robust to the venue set and quote-asset treatment. The core sample consists of Binance, Bybit and MEXC, which provide complete one-minute coverage and show genuine trading activity around the anchor. Gate.io is excluded from the core sample because its price remains frozen for approximately ten minutes during the relevant sequence. Adding it to an expanded venue set nevertheless produces a fragmentation path correlated at 0.997 with the core path, with both measures reaching their maximum at the same event minute. The exclusion of Gate.io therefore protects the quality of the primary measurement without determining the substantive result.

All three core USDe markets are quoted in USDT. Recalculating fragmentation directly from the raw USDe/USDT prices produces a path correlated at 1.000 with the dollar-normalised series. The two paths peak at the same minute and differ by no more than 2.51 basis points at any point in the event window. The dispersion result is thus driven by differences in USDe prices across venues rather than by the common USDT–USD conversion. Alternative measures lead to the same conclusion. The interquartile range reproduces the peak timing and the subsequent convergence thresholds, while the pairwise gaps show that the result is not generated by a single isolated quote: Binance and MEXC experience deep and closely aligned discounts, whereas Bybit remains materially closer to par.

These checks qualify the strength of the inference without changing its economic content. Thin or partially inactive markets widen confidence intervals and can introduce short-lived coefficient shapes, which is why they are separated from the core samples. Among markets with defensible activity, however, the SVB exposure gradient survives sample expansion and dollar normalisation; the Terra RSE path remains flat after applying the liquidity screen; and the USDe fragmentation result is not explained by the choice of quote asset, dispersion statistic or core venue set. What the checks change is precision, not classification.

6.2 Direction of depegs and Firth-penalised logit

The event-study estimates in Section 4 preserve the magnitude of each token's response. As a complementary check, we ask whether RSE also predicts the direction of the depeg during the SVB episode. For each token, we define an indicator equal to one when the largest absolute deviation from par over $[0, +120]$ minutes is a discount and zero when it is a premium. Direction is determined from the price level relative to par rather than from the abnormal change relative to the pre-event baseline. This distinction is important: the binary specification records whether the token's most extreme departure from par is a discount or a premium, whereas the continuous estimates measure how far it moves relative to its own pre-event position.

The small cross-section and sparse outcome cells make conventional maximum-likelihood logit estimates unreliable. We therefore use the bias-reducing penalised likelihood proposed by Firth (1993), which remains well behaved in the presence of separation or near-separation (Heinze and Schemper, 2002). Table 7 reports profile-likelihood confidence intervals and likelihood-ratio p-values rather than relying on Wald inference. Average marginal effects are evaluated over the observations included in each specification.

In the four-token main sample, three tokens depeg in the discount direction and one in the premium direction. The RSE coefficient is positive at 0.789, corresponding to an average marginal effect of 0.164. Thus, a one-step increase in documented reserve exposure is associated with a 16.4 percentage-point increase in the estimated probability of a discount-direction depeg. The estimate is nevertheless imprecise: its 95 per cent profile-likelihood interval ranges from -1.286 to 5.434, and the likelihood-ratio p-value is 0.477. The sign is consistent with the reserve-exposure interpretation, but four observations cannot establish a statistically precise directional relationship.

Table 7.
Firth-penalised logit estimates for discount-direction depegs in the SVB event.

Specification	(N)	Discount outcomes	Premium outcomes	RSE coefficient	95% profile CI	Average marginal effect	Profile LR p-value
Main sample: RSE only	4	3	1	0.789	[−1.286, 5.434]	0.164	0.477
Expanded sample: RSE only	11	8	3	−0.124	[−1.951, 1.847]	−0.026	0.890
Expanded sample: RSE and liquidity	11	8	3	−0.111	[−1.904, 1.799]	−0.024	0.898

Notes: The dependent variable equals one when the token's largest absolute deviation from par over $[0, +120]$ minutes is a discount and zero when it is a premium. The main sample includes USDC, DAI, USDT and BUSD. The liquidity control is the standardised logarithm of one plus median pre-event US-dollar trading volume. Confidence intervals and p-values are based on the profile penalised likelihood. Average marginal effects are evaluated over the estimation sample.

The directional relationship does not extend to the broader cross-section. Eight of the eleven expanded-sample tokens have discount outcomes, but the RSE coefficient is −0.124 and the average marginal effect is −0.026. Both are close to zero, with a profile-likelihood p-value of 0.890. Controlling for the logarithm of pre-event dollar volume leaves the estimate virtually unchanged: the RSE coefficient becomes −0.111 and the marginal effect −0.024. Liquidity differences therefore do not explain the absence of a directional RSE relationship in the expanded sample.

This null result provides information about what the binary specification can and cannot recover. It assigns the same outcome to a mild discount in BUSD and the much larger decline in USDC, discarding precisely the variation in severity that identifies the exposure gradient in Section 4.1. In addition, several expanded-sample tokens already trade below par during the pre-event baseline, so a level-based indicator can classify them as discount outcomes even when their event-induced movement is modest. RSE strongly orders the magnitude and persistence of the SVB response, but it does not robustly classify every expanded-sample token as trading below rather than above par. The Firth estimates should therefore be read as a deliberately coarse robustness check, not as an alternative to the continuous event-study evidence.

The shorter $[0, +30]$and $[0, +60]$ windows lead to the same conclusion. The main-sample coefficient remains positive in both windows, while the expanded-sample estimates are also positive but imprecisely estimated. None is statistically distinguishable from zero under profile-likelihood inference. These sensitivity estimates are reported in Appendix Table A.2.

6.3 Re-pegging dynamics

The initial return towards par need not mark the end of a depeg. A token may re-enter its recovery band briefly and then move outside it again as redemption constraints, market access or arbitrage capacity remain impaired. We therefore distinguish the first sustained re-entry from verified recovery. As defined in Section 3.2, the duration clock begins at the onset of the first qualifying breach. Both breaches and re-entries require two consecutive five-minute observations, and recovery is verified only when a sustained re-entry is followed by at least 60 minutes of observed prices and no subsequent sustained re-breach within the administrative horizon.

The long-window sample contains eleven primary token-events: four in SVB, six in Terra and one joint USDe observation. Seven do not enter the duration risk set because they display no qualifying sustained breach. These comprise BUSD and USDT in the SVB event and all five non-UST comparison tokens in Terra. Table 8 reports the four observations that enter the risk set. Because these observations span three distinct mechanisms and only one is administratively censored, we report the token-event durations directly rather than estimate a pooled survival model. With only two qualifying observations in SVB and one in each of Terra and USDe, a Kaplan–Meier comparison would be determined almost entirely by individual observations.

Table 8.
First re-entry and verified re-pegging durations.

Event	Recovery unit	Breach onset, τ	First sustained re-entry	Sustained re-breaches	Verified recovery	Status
SVB reserve shock	DAI	−6	1,055 min (17 h 35 min)	4	2,600 min (43 h 20 min)	Recovered within 72 h
SVB reserve shock	USDC	−1	2,595 min (43 h 15 min)	2	3,400 min (56 h 40 min)	Recovered within 72 h
Terra design shock	UST	9	50 min	7	Not observed	Right-censored at 72 h
USDe venue dislocation	Binance, Bybit and MEXC jointly	−1	115 min (1 h 55 min)	0	115 min (1 h 55 min)	Recovered within 24 h

Notes: Event time τ is measured in minutes relative to the event-specific anchor. The recovery band permits an absolute distance from par no more than 25 basis points above the token or venue's mean absolute distance during the $[-60, -30]$ baseline. A qualifying breach and a sustained re-entry each require two consecutive five-minute observations. Verified recovery is the earliest sustained re-entry followed by at least 60 minutes of observed prices and no subsequent sustained re-breach within the administrative horizon. Durations are measured from breach onset. The horizon is 72 hours for SVB and Terra and 24 hours for USDe. The USDe row requires Binance, Bybit and MEXC to satisfy the recovery criterion simultaneously.

The recovery ordering is robust to alternative band definitions. Using a tighter 10-basis-point band, verified recovery occurs after 43 h 20 min for DAI and 57 h 45 min for USDC, while joint recovery across the three USDe venues occurs after 4 h 25 min. With a wider 50-basis-point band, the corresponding durations are 43 h 10 min, 43 h 15 min and 1 h 45 min. UST does not achieve verified recovery within the 72-hour horizon under any of the three band definitions. The precise duration is therefore sensitive to how tightly re-pegging is defined, particularly for USDC and USDe, but the cross-mechanism ordering is unchanged: the reserve-shock tokens recover on a multi-day horizon, the venue dislocation resolves within hours, and the failed design does not durably re-peg within the observation window. Full results for the 10-, 25- and 50-basis-point bands are reported in Appendix Table A.4.

The SVB episode displays slow and non-monotonic adjustment. DAI first re-enters its recovery band after 1,055 minutes, or 17 hours and 35 minutes, but this initial correction lasts only briefly. Four later sustained re-breaches postpone verified recovery until 2,600 minutes after breach onset, equivalent to 43 hours and 20 minutes. USDC adjusts more slowly still. Its first sustained re-entry occurs after 2,595 minutes, or 43 hours and 15 minutes, and two subsequent re-breaches delay verified recovery to 3,400 minutes, or 56 hours and 40 minutes. In both cases, the first return towards par substantially understates the duration of the reserve-related dislocation.

This pattern is consistent with price correction under slow-moving arbitrage capital. Traders may begin to narrow a discount before the balance-sheet capacity, settlement access or confidence needed to sustain the correction has been restored. Temporary re-entry and later relapse are therefore economically plausible even when the original information shock is no longer worsening (Duffie, 2010). We do not identify these individual frictions separately, but the distinction between first re-entry and verified recovery shows that the SVB adjustment was not completed when prices first moved back towards par.

UST presents a different recovery path. It first re-enters the band only 50 minutes after the qualifying breach, which, taken alone, could be read as a rapid correction. That interpretation is overturned by the longer window. UST subsequently experiences seven sustained re-breaches and never achieves verified recovery within 72 hours. The early rebound shown in Figure 4 is therefore a transient reversal within the developing collapse rather than restoration of the peg. Treating the first re-entry as the recovery time would misclassify the design failure precisely because it ignores the instability that follows.

The USDe dislocation resolves much more quickly. Across Binance, Bybit and MEXC jointly, the first sustained re-entry occurs 115 minutes after breach onset, and no later sustained joint re-breach is observed during the full 24-hour follow-up. Venue-level results show that Bybit re-enters after 85 minutes, whereas Binance and MEXC do so after 115 minutes. Joint recovery is therefore determined by the two venues that experienced the deepest discounts rather than by the more stable Bybit price. A one-minute sensitivity requiring ten consecutive observations yields a nearly identical joint duration of 117 minutes. The result is consequently not an artefact of five-minute aggregation or of using Binance alone as the representative series.

The duration evidence replicates the mechanism classification developed in the earlier sections. The reserve shock unwinds over almost two days and includes repeated relapses; the failed algorithmic design generates temporary rebounds but no durable recovery within the observation horizon; and the venue dislocation closes in less than two hours once prices realign across active markets. Given the small number of qualifying breaches, these differences should be read as event-level evidence rather than as estimated population effects. Even so, they show why re-pegging cannot be represented adequately by the first print back near par. The persistence of that return is itself part of the economic outcome.

7. Conclusion

This paper examines whether stablecoin depegs share a common anatomy or reflect the particular economic channel through which a shock arrives. Using one- and five-minute market data, we study three episodes in which the operative weakness differs: the SVB reserve shock, the Terra design failure and the USDe venue dislocation. The empirical design matches the object of interest to the mechanism of each event. Reserve Stress Exposure is held to a single, source-documented meaning and tested across SVB and Terra, while the USDe analysis exploits contemporaneous price variation across venues. We then extend the event windows to distinguish a temporary return towards par from durable re-pegging.

The SVB evidence is consistent with a reserve-specific repricing. After Circle disclosed the amount of USDC reserves held at Silicon Valley Bank, abnormal discounts were ordered by documented exposure: USDC moved furthest below par, DAI and the indirectly exposed tokens occupied an intermediate position, and the non-exposed group remained closer to its baseline, with USDT trading at a premium. In the expanded sample, the RSE coefficient reached approximately −213 basis points per exposure step around forty-five minutes after the disclosure. No comparable gradient appears during the clean pre-event baseline. The result is not generated by the treatment of USDT-quoted markets and remains economically similar across the main and expanded samples, although inference is necessarily limited by the small token cross-section and by USDC being the only directly exposed coin.

Terra provides the formal falsification. When the SVB exposure coding is carried unchanged into the Terra episode, the RSE coefficient remains economically flat in the strict liquid sample despite the severity of the underlying disruption. The contrast matters more than a generic finding that stablecoin prices become volatile during stress. The same exposure characteristic that orders the cross-section when banking reserves are impaired has little explanatory content when the stabilisation design itself is failing. Wider Terra samples are more sensitive to thinly traded tokens, bolstering the importance of distinguishing genuine high-frequency trading from repeated or stale prices.

The USDe episode reveals a different margin. At the peak of the event, the price gap between the deeply discounted Binance and MEXC markets and the materially more stable Bybit market exceeded 3,000 basis points, while the three-venue standard deviation rose from less than half a basis point in the baseline to almost 1,800 basis points. These differences cannot be explained by the common USDT quote conversion or by the choice of dispersion statistic. Prices subsequently converged across the active venues, and joint recovery was verified 115 minutes after the qualifying breach, with no later sustained joint re-breach during the 24-hour horizon. This within-token evidence shows that a large observed depeg need not reflect a common reassessment of the token's underlying backing; it may instead arise from impaired price transmission across trading venues.

The extended recovery windows further show why the first price observed near par is an incomplete measure of stability. DAI and USDC required 43 hours and 20 minutes and 56 hours and 40 minutes, respectively, to achieve verified recovery, after repeated re-breaches. UST returned temporarily to its recovery band after only 50 minutes but breached it seven more times and did not recover within 72 hours. The reserve shock therefore unwound slowly and non-monotonically, the failed algorithmic mechanism produced transient rebounds without restoration of the peg, and the venue dislocation closed comparatively quickly once prices realigned across markets. The persistence of the return to par is itself part of the economic outcome.

These findings have two more extensive implications. For empirical work, depegs should not be pooled without regard to the mechanism that generates them. A deviation from one dollar is an outcome, not an identification strategy; the relevant exposure and the appropriate unit of comparison depend on whether the shock originates in reserves, stabilisation design or market structure. Intraday data are especially valuable because they preserve direction, event timing, venue disagreement and subsequent relapse, all of which may be obscured at daily frequency. For market participants and supervisors, the evidence points to different objects of scrutiny across stablecoin designs: the accessibility and concentration of reserves, the resilience of the stabilisation mechanism, and the functioning of the venues through which prices are formed and arbitrage is carried out.

The conclusions remain event-level rather than population estimates. The number of clean episodes and qualifying token-events is small, the highest RSE category contains one coin, and the three events were selected because their mechanisms can be dated and measured with reasonable precision. The binary direction results are correspondingly imprecise and confirm that much of the identifying information lies in the magnitude and persistence of the response rather than in whether a token merely trades above or below par. The falsification structure is what gives the exposure result its content: RSE provides information not only because it orders the SVB response, but because the same fixed measure remains economically silent when its underlying channel is absent. Within those limits, the evidence supports a disciplined conclusion: depegs that look similar in price space can reflect different underlying failures. The channel shapes both the severity of the break and the durability of the return to par.

CRediT authorship contribution statement

Oscar Melo-Vega-Angeles: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Software, Visualization, Writing – original draft. **Maurizio Fiaschetti:** Conceptualization, Supervision, Formal analysis, Investigation, Methodology, Validation, Writing – review and editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The replication materials supporting the empirical results, including analytical datasets, code, and supporting outputs, are available through a temporary private repository: https://www.dropbox.com/scl/fo/ld6c71jo5n59t4vgasn89/AJCZLiodJXgZ0t8nEY7eYE?rlkey=g3hqv5wti5vf0ry9exyyida1p&dl=0 . A permanent repository and DOI will be provided upon publication.

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Appendix

Appendix A. Robustness Checks

A.1. Quote-asset normalisation in the SVB event

Several series in the expanded SVB sample are quoted against USDT. Because USDT itself traded above par during the episode, the primary expanded-sample specification converts those prices into dollars using the contemporaneous Kraken USDT–USD rate. Table A.1 compares the resulting RSE coefficients with estimates computed directly from the unadjusted quoted prices at the same selected event-time bins.

Table A.1.
Selected expanded-sample SVB RSE coefficients before and after USDT/USD normalisation.

Event time, τ	USDT-normalised βτ	95% token-bootstrap CI	Unadjusted βτ	95% token-bootstrap CI	Normalised minus unadjusted
−26	−13.5	[−40.1, −1.7]	−12.5	[−39.8, −0.5]	−1.0
−1	−22.2	[−35.3, 7.9]	−33.4	[−57.8, 19.9]	11.2
4	−18.3	[−33.4, 4.6]	−28.1	[−48.0, 12.8]	9.7
24	−145.5	[−226.6, 16.6]	−154.3	[−242.1, 19.7]	8.8
44	−212.8	[−379.9, 92.8]	−220.5	[−395.3, 89.1]	7.6
119	−105.6	[−197.9, 81.8]	−121.6	[−228.9, 74.8]	16.0

Notes: The dependent variable is the abnormal signed deviation from par in basis points, and βτ is the per-step change associated with the ordinal Reserve Stress Exposure score. The expanded sample contains 11 tokens. Confidence intervals are percentile bands from 500 token-bootstrap replications. The final column is calculated before rounding. Normalisation changes individual point estimates modestly and does not alter the negative post-disclosure path.

A.2. Firth-penalised logit sensitivity to the outcome window

Table A.2 reports the shorter-window versions of the directional-depeg specification in Section 6.2. The dependent variable equals one when the token's most extreme departure from par within the stated window is a discount and zero when it is a premium. The estimates use Firth's penalised likelihood.

Table A.2.

Firth-penalised logit estimates over shorter SVB outcome windows.

Outcome window	Sample	N	Discount / premium	RSE coefficient	95% profile CI	Average marginal effect	Profile LR p-value
[0,+30]	Main	4	2 / 2	1.799	[−0.452, 8.024]	0.294	0.133
[0,+30]	Expanded	11	7 / 4	0.382	[−1.314, 2.433]	0.089	0.663
[0,+60]	Main	4	2 / 2	1.799	[−0.452, 8.024]	0.294	0.133
[0,+60]	Expanded	11	6 / 5	0.88	[−0.816, 3.113]	0.204	0.322

Notes: The main sample comprises USDC, DAI, USDT and BUSD. The expanded sample contains 11 tokens. Confidence intervals and p-values are based on the profile penalised likelihood. Average marginal effects are evaluated over the observations in each specification. The shorter windows preserve the positive main-sample sign, but all estimates remain imprecise.

Table A.3.

Terra RSE coefficients with and without sUSD.

Event time	Primary: full	Primary: excl. sUSD	Expanded: full	Expanded: excl. sUSD
−26	−0.31	−0.22	−0.23	−0.20
−1	11.82	1.43	7	−0.60
4	10.86	0.79	9.24	1.72
24	11.53	1.11	9.75	1.97
44	17.41	1.54	11.3	−0.42
60	26.01	1.19	15.91	−2.42
119	3.52	0.23	5.68	3.07

Notes: The table reports event-time RSE coefficients for the Terra primary and expanded samples before and after excluding sUSD. RSE retains its fixed SVB reserve-exposure coding. The large reduction in the positive coefficients after excluding sUSD indicates that the wider-sample pattern is highly sensitive to this thinly traded token. The strict-liquid sample excludes sUSD and remains economically close to zero throughout the event window.

Table A.4.

Sensitivity of re-pegging durations to alternative recovery bands.

Event / recovery unit	10 bp: first re-entry	10 bp: verified recovery	25 bp: first re-entry	25 bp: verified recovery	50 bp: first re-entry	50 bp: verified recovery
SVB – DAI	1,055 min (17h35)	2,600 min (43h20)	1,055 min (17h35)	2,600 min (43h20)	1,030 min (17h10)	2,590 min (43h10)
SVB – USDC	2,660 min (44h20)	3,465 min (57h45)	2,595 min (43h15)	3,400 min (56h40)	2,595 min (43h15)	2,595 min (43h15)
Terra – UST	60 min (1h00)	Not observed	50 min	Not observed	25 min	Not observed
USDe – Binance, Bybit and MEXC jointly	135 min (2h15)	265 min (4h25)	115 min (1h55)	115 min (1h55)	75 min (1h15)	105 min (1h45)

Notes: The table varies the recovery band while holding the remaining primary recovery definition fixed. The band permits an absolute distance from par no more than 10, 25 or 50 basis points above the token- or venue-specific mean absolute distance during the pre-event baseline. Breaches and re-entries require two consecutive five-minute observations. Verified recovery requires at least 60 minutes of observed follow-up and no subsequent sustained re-breach within the administrative horizon. The horizon is 72 hours for SVB and Terra and 24 hours for USDe. USDe recovery requires Binance, Bybit and MEXC to satisfy the criterion jointly. UST does not achieve verified recovery under any band and is right-censored at the 72-hour horizon.

Appendix B. Data Quality and Exploratory Evidence

B.1. Core intraday sample and selected markets

Table B.1 records the token–market series used in the core empirical comparisons. Expanded and partial series are discussed in Section 6.1 and retained in the underlying coverage workbook; the table below focuses on the observations that define the main SVB comparison, the Terra strict-liquid falsification, the separate UST design-token path, and the USDe core venue set.

Table B.1.
Core token–market series used in the intraday analysis.

Event	Token	Selected market	Frequency	Empirical role
SVB	USDC	kraken-usdc-usd-spot	5m	Main sample; direct RSE
SVB	DAI	kraken-dai-usd-spot	5m	Main sample; indirect RSE
SVB	USDT	kraken-usdt-usd-spot	5m	Main sample; non-exposed control
SVB	BUSD	binance-busd-usdt-spot	5m	Main sample; non-exposed control
Terra	BUSD	binance.us-busd-usd-spot	1m	Strict-liquid comparison
Terra	DAI	coinbase-dai-usd-spot	1m	Strict-liquid comparison
Terra	TUSD	binance-tusd-usdt-spot	1m	Strict-liquid comparison
Terra	USDC	kraken-usdc-usd-spot	1m	Strict-liquid comparison
Terra	USDT	ftx-usdt-usd-spot	1m	Strict-liquid comparison
Terra	UST	ftx-ust-usd-spot	1m	Design-token path; excluded from RSE falsification
USDe	USDe	binance-usde-usdt-spot	1m	Core venue; anchor and primary path
USDe	USDe	bybit-usde-usdt-spot	1m	Core venue
USDe	USDe	mexc-usde-usdt-spot	1m	Core venue

Notes: USDT-quoted markets are converted to dollars using the contemporaneous Kraken USDT–USD rate. The Terra comparison sample excludes UST and applies the strict liquidity screen described in Sections 4.2 and 6.1. USDe fragmentation and joint recovery are measured across Binance, Bybit and MEXC.

B.2. The sUSD exploratory episode

sUSD is retained as an exploratory case rather than a core event. The available April 2025 series does not provide a cleanly dated external trigger, and the observable market is thin. In the five-minute coverage matrix, gate.io-susd-usdt-spot is classified as partial, with a median of two trades per candle and median dollar volume of approximately USD 121. The corresponding one-minute series records zero median trades and volume and is classified as unusable. These data limitations prevent a defensible event-time identification of a discrete sUSD shock.

Table B.2.
sUSD market-quality diagnostics for the exploratory April 2025 episode.

Market	Frequency	Observations	Minimum price	Median price	Median USD volume	Median trades	Status
gate.io-susd-usdt-spot	5m	289	0.6445	0.7558	121.21	2	Partial
gate.io-susd-usdt-spot	1m	15,840	0.5549	0.8554	0	0	Unusable

Notes: The five-minute series is USDT-quoted and thin; the one-minute series contains no median trading activity. sUSD is therefore excluded from the core event set and is not used for causal or falsification inference.

B.3. Additional USDe venue diagnostics

The core USDe analysis uses Binance, Bybit and MEXC. Gate.io is retained only in the expanded robustness exercise because its event path includes a ten-minute frozen-price sequence. Adding Gate.io produces a fragmentation path correlated at 0.997 with the three-venue core series and leaves the peak event minute unchanged. Kraken and KuCoin are excluded from the quantitative venue comparison because repeated prices and limited trading prevent their shallow movements from being distinguished cleanly from stale quotes.

References

Abrams, Z., 2025. Binance pays $283 million in compensation following Friday's depegs, covering user losses [WWW Document]. The Block. URL https://www.theblock.co/post/374295/binance-pays-283-million-in-compensation-following-fridays-depegs-covering-user-losses (accessed 6.28.26).

Ahmed, R., Aldasoro, I., Duley, C., 2024. Public information and stablecoin runs. BIS Working Papers: 1164.

Anadu, K., Azar, P.D., Cipriani, M., Eisenbach, T.M., Huang, C., Landoni, M., La Spada, G., Macchiavelli, M., Malfroy-Camine, A., Christina Wang, J., 2024. Runs and Flights to Safety: Are Stablecoins the New Money Market Funds? Federal Reserve Bank of New York Staff Reports 1073. https://doi.org/10.59576/sr.1073

Barucci, E., Giuffra Moncayo, G., Marazzina, D., 2022. Cryptocurrencies and stablecoins: a high-frequency analysis. Digit. Finance 4. https://doi.org/10.1007/s42521-022-00055-9

Brandvold, M., Molnár, P., Vagstad, K., Valstad, O.C.A., 2015. Price discovery on Bitcoin exchanges. Journal of International Financial Markets, Institutions and Money 36. https://doi.org/10.1016/j.intfin.2015.02.010

Briola, A., Vidal-Tomás, D., Wang, Y., Aste, T., 2023. Anatomy of a Stablecoin's failure: The Terra-Luna case. Financ. Res. Lett. 51. https://doi.org/10.1016/j.frl.2022.103358

Brunnermeier, M.K., Pedersen, L.H., 2009. Market liquidity and funding liquidity. Review of Financial Studies 22, 2201–2238. https://doi.org/10.1093/rfs/hhn098

Circle Internet Financial, 2023. An Update on USDC and Silicon Valley Bank [WWW Document]. URL https://www.circle.com/pressroom/3-3-billion-of-usdc-reserve-risk-removed-dollar-de-peg-closes (accessed 6.19.26).

Coin Metrics, 2026. Coin Metrics API [WWW Document]. URL https://docs.coinmetrics.io/api/v4/ (accessed 7.19.26).

CoinGecko, 2026a. Global Cryptocurrency Market Cap Charts [WWW Document]. URL https://www.coingecko.com/en/charts (accessed 7.12.26).

CoinGecko, 2026b. Top Stablecoins by Market Cap [WWW Document]. URL https://www.coingecko.com/en/categories/stablecoins (accessed 7.12.26).

Dadoukis, A., Fiaschetti, M., Fusi, G., 2021. IT adoption and bank performance during the Covid-19 pandemic. Econ. Lett. 204. https://doi.org/10.1016/j.econlet.2021.109904

Du, C., Sonawane, R., Watsky, C., 2025. In the Shadow of Bank Runs: Lessons from the Silicon Valley Bank Failure and Its Impact on Stablecoins. FEDS Notes. https://doi.org/10.17016/2380-7172.3958

Duffie, D., 2010. Presidential address: Asset price dynamics with slow-moving capital. Journal of Finance 65, 1237–1267. https://doi.org/10.1111/j.1540-6261.2010.01569.x

Eichengreen, B., Nguyen, M.T., Viswanath-Natraj, G., 2025. Stablecoin devaluation risk. The European Journal of Finance 31, 1469–1496. https://doi.org/10.1080/1351847X.2025.2505757

Firth, D., 1993. Bias reduction of maximum likelihood estimates. Biometrika 80. https://doi.org/10.1093/biomet/80.1.27

FTX Trading Ltd., 2022. Voluntary petition for non-individuals filing for bankruptcy, Case No. 22-11068.

Gadzinski, G., Castello, A., Liuzzi, V., Sargenti, P., 2024. Break a peg! A study of stablecoin co-instability. International Review of Financial Analysis 96, 103608. https://doi.org/10.1016/j.irfa.2024.103608

Galati, L., Capalbo, F., 2024. Silicon Valley Bank bankruptcy and Stablecoins stability. International Review of Financial Analysis 91. https://doi.org/10.1016/j.irfa.2023.103001

Heinze, G., Schemper, M., 2002. A solution to the problem of separation in logistic regression. Stat. Med. 21. https://doi.org/10.1002/sim.1047

Lee, Y.H., Chiu, Y.F., Hsieh, M.H., 2025. Stablecoin depegging risk prediction. Pacific-Basin Finance Journal 90, 102640. https://doi.org/10.1016/J.PACFIN.2024.102640

Liu, J., Makarov, I., Schoar, A., 2023. Anatomy of a Run: The Terra Luna Crash. NBER Working Paper w31160. https://doi.org/10.3386/w31160

Lyons, R.K., Viswanath-Natraj, G., 2023. What keeps stablecoins stable? J. Int. Money Finance 131. https://doi.org/10.1016/j.jimonfin.2022.102777

Ma, Y., Zeng, Y., Zhang, A.L., 2025. Stablecoin Runs and the Centralization of Arbitrage, NBER Working Paper. Cambridge, MA. https://doi.org/10.3386/w33882

Maex, S.A., Slavov, S., 2025. Initial evidence on the content and market implications of stablecoin reserve reporting. Journal of Accounting and Public Policy 51, 107309. https://doi.org/10.1016/j.jaccpubpol.2025.107309

Makarov, I., Schoar, A., 2020. Trading and arbitrage in cryptocurrency markets. J. financ. econ. 135, 293–319. https://doi.org/10.1016/j.jfineco.2019.07.001

Melo-Vega-Angeles, O., Chuquillanqui-Lichardo, B., 2025. From uncertainty to adjustment: the influence of the 2023 Israel–Hamas War on Latin American Stock Market Volatility. Financ. Res. Lett. 85, 108131. https://doi.org/10.1016/j.frl.2025.108131

Oefele, N., Baur, D.G., Smales, L.A., 2024. Flight-to-quality—Money market mutual funds and stablecoins during the March 2023 banking crisis. Econ. Lett. 234. https://doi.org/10.1016/j.econlet.2023.111464

Ranaldo, A., Viswanath-Natraj, G., Wang, J., 2026. Blockchain Currency Markets. Journal of Financial and Quantitative Analysis 1–30. https://doi.org/10.1017/S0022109026102841

Rodrigues, F., 2025. Ethena's USDe briefly loses peg during $19B crypto liquidation cascade [WWW Document]. CoinDesk. URL https://www.coindesk.com/markets/2025/10/11/ethena-s-usde-briefly-loses-peg-during-usd19b-crypto-liquidation-cascade (accessed 7.1.26).

Sosa Castro, M.M., Cabello Rosales, M.A., Ortiz Calisto, E.S., 2024. Impacto del Covid-19 y variables macroeconómicas en la capitalización de las empresas del IPC35 por sector: panel con FMOLS y DOLS. Ensayos Revista de Economía 43. https://doi.org/10.29105/ensayos43.1-2

Watsky, C., Allen, J., Daud, H., Demuth, J., Little, D., Rodden, M., Seira, A., 2024. Primary and Secondary Markets for Stablecoins. FEDS Notes. https://doi.org/10.17016/2380-7172.3447

Wu, S.-W., Yeh, F.-J., Chu, T.-L., 2026. Trading dynamics and state-dependent adjustment in stablecoin peg deviations. J. Behav. Exp. Finance 50, 101190. https://doi.org/10.1016/j.jbef.2026.101190

Young, G., 2025. USDe oracle design and risk management guidelines [WWW Document]. X (formerly Twitter). URL https://x.com/gdog97_/status/1977302774636540403 (accessed 6.12.26).