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Market Efficiency and Predictable Supply Shocks: Short-Selling Returns Around IPO Lockups

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ABSTRACT

This paper examines whether predictable post-listing restricted-share events are associated with short-selling returns. Using Yahoo Finance price data, a systematic backtest was conducted on 26 usable events from a 27-event candidate universe spanning 2020-2025. The pre-specified trade enters at the close three trading days before the event reference date and exits at the close three trading days after it. The T+3 rule produced a 58% win rate, a 4.07% average raw short return, and a 4.42% average market-adjusted return. The standard deviation of market-adjusted returns was 12.31%, and the conventional 95% t interval ranged from -0.55% to 9.39%. The interval includes zero, so the results are suggestive rather than conclusive. These estimates identify an association in a selected historical sample, not a causal effect or directly executable excess return. Borrow fees, transaction costs, slippage, and share availability could materially reduce realized performance.

1. INTRODUCTION

When a company conducts an Initial Public Offering (IPO), meaning it lists on a stock exchange for the first time, insiders such as employees and early investors are not permitted to sell their shares immediately. Instead, they must wait until a predetermined lockup period concludes, which typically lasts 180 days. This restriction exists because if insiders were to liquidate large portions of their holdings immediately after the IPO, it could signal a lack of confidence in the company and severely depress the stock price.

When the lockup period expires, those previously restricted shares become eligible for public sale. Because many insiders have accumulated substantial unrealized gains and have been unable to access liquid capital for six months, a meaningful portion often chooses to sell. This creates a sudden increase in the supply of shares available in the market. Under basic supply and demand principles, if supply increases while demand remains constant, asset prices tend to decline.

Importantly, the relevant restriction terms are disclosed in SEC prospectuses and transaction filings months in advance. Conventional IPOs generally use a final prospectus, while direct listings and de-SPAC transactions may use different resale or lockup documents. Some filings also permit staged or earnings-based early releases. This study uses the frozen event dates listed in Appendix Table A1 and

treats the 180-day contractual backstop as the reference date when an earlier-release clause was not separately coded.

1.1 Context and Problem Statement

The Efficient Market Hypothesis (EMH) proposes that publicly available information is reflected in stock prices. IPO lockup expiration creates a useful test of this idea because the date is regulatory and predictable, yet it does not by itself provide new information about a company's operations or cash flows. If markets fully incorporate the expected increase in tradable shares, the expiration should not produce a repeatable abnormal return.

According to traditional finance theory, the market should smoothly price in an upcoming share unlock well in advance, leaving no room for abnormal returns after the actual expiration date. In reality, structural frictions, high borrowing costs, and risk aversion often stop capital from moving efficiently. This friction delays the market's adjustment and creates temporary price distortions.

1.2 Research Gap and Objectives

While older academic literature clearly documents a price drop around lockup expirations, a major gap remains regarding how these dynamics play out in today's market ecosystem (2020-2025). The modern trading landscape looks completely different than it did a decade ago. Today, High-Frequency Trading (HFT) algorithms dominate market volume, retail options and equity trading have seen a massive renaissance, and short-selling vehicles are highly sophisticated.

Whether these structural shifts have eliminated the historical lockup pattern remains an open question. This paper evaluates whether a systematic event-window strategy remains associated with positive returns in a modern sample. The design does not establish causality or guarantee that the reported returns could be implemented after trading frictions.

This study examines whether a predictable increase in potentially tradable shares is associated with short-term price pressure around post-listing restriction dates. A reliable pattern means a positive average market-adjusted short return across the selected events, rather than a guaranteed profit on every trade. Short selling involves borrowing shares, selling them, and later repurchasing them. If prices decline, the shares can be repurchased for less than the original sale price. The study therefore tests for a historical association within the 26-event sample.

To evaluate this hypothesis, a purpose-built Python script retrieved historical stock price data through the yfinance interface to Yahoo Finance and simulated the strategy across 26 usable events from the 2020 through 2025 public-debut cohorts. The frozen event universe was selected with a rule-based screen rather than later price performance. Two exit rules were compared: T+3 and T+5. Because both rules were selected and evaluated on the same observations, the comparison is exploratory.

1.3 Key Academic Contributions

This study makes three contributions to research on IPO lockups, supply-driven price pressure, and limits to arbitrage:

1. Temporal Extension: The study examines IPO lockup expirations from 2020 through 2025, extending earlier evidence into a period shaped by faster information flow, algorithmic trading, and greater retail participation. It therefore tests whether a previously documented anomaly remains visible in a newer market environment.
2. Event-Window Comparison: The study compares short holding periods around a known supply event. This helps identify when price pressure appears strongest within the sample and whether it fades soon after expiration.
3. Theoretical Integration: The study connects an applied backtest to price-pressure theory, downward-sloping demand for individual stocks, divergence of opinion, and limits to arbitrage. This connection offers a possible explanation for why public information may still be associated with short-term price movements.

2. LITERATURE REVIEW AND THEORETICAL FRAMEWORK

IPO lockup expirations have been studied extensively, and earlier work consistently reports abnormal price declines and increases in trading volume near expiration. However, documenting a decline does not by itself explain its cause. The main debate is whether insider sales reveal negative information or whether a predictable increase in supply temporarily pushes prices downward. This distinction matters because an informational explanation treats the decline as a response to beliefs about firm value, while a price-pressure explanation treats it as a market-friction response to additional shares becoming available. This paper contributes to that debate by examining whether the pattern remains visible from 2020 through 2025, after major changes in trading technology, information speed, and investor participation.

2.1 Historical Empirical Foundations

Foundational literature heavily documents the market disruptions that occur when insider restrictions lift. Field and Hanka (2001) analyzed nearly 2,000 IPOs and documented a permanent increase in trading volume of roughly 40% at lockup expiration. This volume surge was accompanied by negative abnormal returns of approximately 1% to 2% concentrated in the few days surrounding the event. Furthermore, the price decline was roughly three times larger for venture-backed firms than for non-venture-backed firms. This result is highly intuitive: venture capital investors typically hold large ownership stakes and face strong structural incentives to liquidate positions and return capital to limited partners once legally permitted.

Similarly, Bradley et al. (2001) examined more than 2,500 IPOs from 1988 to 1997 and confirmed the presence of significant negative abnormal returns at lockup expiration. Importantly, their work demonstrated that post-IPO price performance predicts the magnitude of the eventual drop. Firms that experienced substantial price run-ups after going public exhibited larger drops at expiration, indicating that insiders eagerly timed sales to realize accumulated gains.

Additional research has expanded on these mechanics by focusing on valuation and sentiment. Ofek and Richardson (2003) showed that valuation levels and divergence of opinion play a major role in lockup-related price pressure. Firms with higher valuation ratios and greater dispersion in investor beliefs experienced more pronounced declines, suggesting that lockup expirations heavily interact with broader market inefficiencies.

Gao (2005) further documented that the magnitude of this supply shock directly depends on the fraction of shares becoming eligible for sale. Firms in which a larger percentage of total shares were locked up experienced much stronger price and volume effects. This key finding reinforces a supply-based explanation for the anomaly rather than a purely fundamental or informational one.

2.2 Theoretical Frameworks: Downward-Sloping Demand and Limits to Arbitrage

To properly evaluate the relationship between IPO lockup expirations and subsequent returns, two primary competing theories from financial economics must be considered: the Information Content Hypothesis and the Price Pressure/Downward-Sloping Demand Hypothesis.

The Information Content Hypothesis proposes that insider selling may communicate a negative signal about a firm's prospects. Yet the expiration date itself is known in advance, and eligibility to sell does not prove that insiders actually sell or possess new information. If prices move mainly because investors interpret insider sales as a negative signal, the effect should depend on observed selling and the information inferred from it.

By contrast, the Price Pressure Hypothesis (Scholes, 1972) and the downward-sloping demand framework (Shleifer, 1986) suggest that individual stocks are not perfect substitutes. When a large number of shares becomes tradable, the market may require a temporary price discount to absorb the additional supply. Venture capital fund timelines, employee liquidity needs, and founder diversification can intensify this effect without changing the firm's underlying value.

Miller's (1977) divergence-of-opinion theory and Shleifer and Vishny's (1997) limits-to-arbitrage framework help explain why the effect may persist. Newly public firms often have uncertain valuations and wide disagreement among investors. At the same time, shorting these stocks may involve limited share availability, borrowing costs, high volatility, and the possibility of rapid price increases. These risks can prevent traders from fully correcting a predictable price pattern. Together, the theories lead to a testable relationship: lockup expiration increases potential share supply, and greater supply may be associated with negative stock returns when demand cannot adjust immediately.

3. METHODOLOGY

3.1 Research Design, Hypotheses, and Variables

This study uses an event-study framework to measure returns around the selected restriction-date windows. The design identifies an association between the event window and returns; it does not isolate the exact causal effect of insider selling. The data are evaluated against two competing hypotheses:

- Null Hypothesis (H0): The mean market-adjusted short return across the selected lockup-expiration windows is zero or negative, indicating no positive average strategy return in the sample.
- Alternative Hypothesis (H1): The mean market-adjusted short return across the selected lockup-expiration windows is positive, indicating a positive average strategy return in the sample.

The hypotheses are evaluated using the mean market-adjusted return, its dispersion and confidence interval, the percentage of profitable trades, and comparisons across listing routes, years, and sectors. Because the sample contains 26 usable events, all estimates are interpreted as sample evidence rather than definitive proof that the pattern applies to every new listing. Two core variables are tracked throughout the backtest:

- Independent Variable (Restriction-Date Event Window): The six-trading-session window beginning three trading days before the frozen event reference date (T-3) and ending three trading days after it (T+3). If the reference date is a weekend or exchange holiday, Day 0 is the first trading session on or after that date.
- Dependent Variable (Market-Adjusted Short Return): The simulated stock short return minus the corresponding SPY short return over the same entry and exit dates. This benchmark adjustment reduces broad-market influence but does not control for sector, size, momentum, or company-specific news.

3.2 Event Selection

Selection bias is a major risk in historical backtesting because researchers may unintentionally choose events that support the expected result. Candidate events were enumerated from U.S.-listed public-debut prospectuses and transaction filings in SEC EDGAR and screened using the frozen rules below. The complete 27-event candidate universe, including the excluded event, is disclosed in Appendix Table A1 with the primary filing URL and accession number for each observation.

The frozen selection rules were:

1. Temporal Range: The company completed its U.S. public-market debut between January 2020 and September 4, 2025, the date 180 days before the original study cutoff.
2. Size Constraint: Initial market capitalization exceeded $1 billion. The threshold focuses the study on larger listings with greater expected trading volume and potential stock-borrow availability, although actual borrow availability is not observed.
3. Documented Restriction: The primary SEC filing stated a 180-day lockup, a 180-day contractual backstop, or a comparable post-closing restriction. Modified and staged terms were retained in the original frozen universe and are identified explicitly in Appendix Table A1.
4. Listing Route and Geography: The security was listed on a U.S. exchange. Conventional IPOs form the core sample. The frozen universe also contains two direct listings and three de-SPAC transactions with modified restriction structures. A listing-route sensitivity check excludes the

four usable nontraditional events; MTTR, the fifth, was already excluded for unavailable price data.

Applying the rules produced 27 candidate events across six cohorts. Twenty-six had usable price data. Matterport (MTTR) was excluded after its delisting because the required historical series was unavailable in the selected source. The exclusion was based on data availability rather than return direction. For filings with staged or earlier release clauses, the frozen date can represent the 180-day backstop rather than the first date on which every restricted share became saleable. The main results are therefore best interpreted as a standardized post-listing event-window test; Appendix Table A1 provides the exact filing source and term note for every candidate.

3.3 Price Data

Daily adjusted closing prices were downloaded with the yfinance Python library, which retrieves historical market data from Yahoo Finance. For each event, the program collected 20 trading sessions before and after the reference date for both the company and SPY. Weekends and exchange holidays were skipped, and no prices were interpolated. When the reference date was not a trading session, Day 0 was the first session on or after that date. The same adjustment basis, retrieval window, and trading rule were applied to every event.

3.4 Trade Structure and Parameter Testing

For each event, a simulated short position is initiated at the adjusted closing price three trading sessions before Day 0 (T-3). It is covered at the adjusted close on T+3 for the principal analysis. Overlapping trades are evaluated independently. The sequential equity curve compounds the event returns for illustration and does not model concurrent capital requirements.

Two exit rules were compared: the market close five trading sessions after Day 0 (T+5) and the market close three trading sessions after Day 0 (T+3). T+3 performed better within this sample. Because the same observations were used to compare and report both rules, the result is exploratory and T+3 is not described as an independently validated optimum.

Table 1. In-sample comparison of T+3 and T+5 exits for the same 26 events. Differences are exploratory because both rules were selected and evaluated on the same observations.

Metric	Exit at T+3	Exit at T+5	Difference
Win Rate	58% (15/26)	50% (13/26)	+8 percentage pts
Avg Return/Trade	+4.07%	+1.77%	+2.30%
Sample-scaled return-to-dispersion	2.02	0.73	+1.29
Max Drawdown	-24.6%	-31.5%	Better by 6.9%

Within the 26-event sample, the T+3 exit rule performed better across the reported metrics. This pattern suggests that much of the measured price pressure may be concentrated in the first three trading sessions after Day 0. Holding through T+5 added exposure to later price movements without improving this

sample's results. The remaining analysis uses T+3 as the reporting rule while treating its advantage as sample-specific.

To evaluate trades cleanly and uniformly, the raw return of each individual short position is calculated using the following structural formula:

$$r_i = \frac{P_{entry,i} - P_{exit,i}}{P_{entry,i}} \times 100$$

Under this specific short-selling framework, a positive return signifies that the equity price declined over the holding period, resulting in a profitable trade. Conversely, a negative return indicates that the equity price increased, representing a financial loss.

To isolate the unique operational impact of the lockup expiration from broader macroeconomic trends, a market-adjusted return metric is calculated. The market-adjusted return systematically subtracts the matching directional return of the SPY benchmark over the exact same holding period:

$$AR_i = r_i - r_{SPY,i}$$

This adjustment reduces the contribution of broad directional market movement during the event window. It does not isolate the effect of the restriction date from sector movement, momentum, earnings, analyst actions, or company-specific information.

The reported return-to-dispersion statistic is calculated as:

$$S_{sample} = \sqrt{N} \times \frac{\bar{r} - r_f}{s(r)}$$

where N is the number of trades (26), the numerator compares the mean raw short return with a per-event risk-free rate of zero, and s(r) is the sample standard deviation. The reported value of 2.02 is not calendar-annualized; it is a sample-scaled descriptive statistic and should not be interpreted as an implementable annual Sharpe ratio.

Maximum drawdown is calculated from the chronological compounded event-trade equity curve as the largest peak-to-trough percentage decline. The backtest excludes transaction costs, stock-borrow fees, changes in share availability, recall risk, and execution slippage. These omissions can reduce or prevent realized returns.

3.5 Metric Definitions, Uncertainty, and Audit

To define the event-study measures, the raw short return for event i is:

$$r_i = \frac{P_{entry,i} - P_{exit,i}}{P_{entry,i}}$$

The corresponding SPY return is calculated over the same dates. The market-adjusted, or abnormal, return is:

$$AR_i = r_i - r_{SPY,i}$$

A positive abnormal return means that the stock fell more than SPY, or increased less than SPY, during the event window.

For Figure 2, abnormal daily returns are added together within each event from T-3 through day t:

$$CAR_{i,t} = \sum_{\tau=-3}^{t} AR_{i,\tau}$$

The average cumulative abnormal return across all 26 events is:

$$CAAR_t = \frac{1}{N} \sum_{i=1}^{N} CAR_{i,t}$$

These measures show the average return pattern around the event date. They are different from the chronological portfolio curve, which compounds trades in the order they occurred:

$$V_t = V_{t-1}\left(1 + r_t\right)$$

Maximum drawdown measures the largest decline from a previous peak in this curve:

$$MDD = min_t\left[\frac{V_t}{max_{\tau \le t} V_\tau} - 1\right]$$

Uncertainty is reported using the sample standard deviation and a conventional 95% t interval for the mean market-adjusted return. Because the study includes only 26 events and some event windows overlap, the results should be interpreted as suggestive rather than conclusive. The 95% interval ranges from -0.55% to 9.39%, meaning that the data do not rule out a zero average return.

A chronology audit confirmed that all 26 displayed raw returns equal (Entry - Exit) / Entry within the stated rounding. Event dates that fall on weekends or exchange holidays are mapped to the first trading session on or after the reference date. T-3 and T+3 then count exchange sessions. Overlapping trades remain independent observations in the event table.

The audit preserves the frozen sample and reported headline statistics. Appendix Table A1 separately flags conventional IPOs, direct listings, de-SPAC transactions, staged terms, and early-release clauses so readers can reproduce or revise the event-date definition without silently changing the original universe.

4. RESULTS

4.1 Overall Performance

Table 2. Headline performance of the frozen T-3 to T+3 backtest. Returns exclude borrowing fees, transaction costs, slippage, and availability constraints.

Metric	Result
Total Trades	26
IPO Classes Covered	2020, 2021, 2022, 2023, 2024, 2025
Excluded (no data)	1 - MTTR (delisted)
Win Rate	15/26 (58%)
Average Short Return per Trade	+4.07%
Average Market-Adjusted Return	+4.42%
Sample-scaled return-to-dispersion	2.02
Max Drawdown	-24.6%
Best Trade	CRCL +29.1% (Nov 2025)
Worst Trade	RDDT -11.0% (Sep 2024)
Exit Timing Used	T+3 (in-sample; exploratory)

4.2 Statistical Uncertainty

The mean market-adjusted return is positive, but the uncertainty is wide. The conventional 95% t interval ranges from -0.55% to 9.39% and includes zero. The result should therefore be described as suggestive rather than definitive.

Table 3. Statistical uncertainty for the 26 reported market-adjusted event returns.

Statistic	Estimate
Mean market-adjusted return	4.42%
Sample standard deviation	12.31%
95% t interval	-0.55% to 9.39%

4.3 Implementation-Cost Sensitivity

Historical stock-loan observations were unavailable, so the sensitivity applies hypothetical round-trip costs to the 4.07% average raw short return. Borrow cost assumes an eight-calendar-day holding period and equals the annual fee multiplied by 8/365.

Table 4. Hypothetical implementation-cost sensitivity for the average raw short return. The calculation assumes shares are available to borrow for every event.

Scenario	Borrow fee p.a.	Trading costs	Slippage	Total drag	Net mean
Low	2%	0.10%	0.10%	0.24%	3.83%
Moderate	10%	0.20%	0.30%	0.72%	3.35%
High	30%	0.30%	0.50%	1.46%	2.61%
Stress	100%	0.50%	1.00%	3.69%	0.38%

The sensitivity does not solve the more serious implementation problem of hard-to-borrow or unavailable shares. If a stock cannot be located, the trade cannot be executed; this creates a possible selection constraint rather than a simple cost deduction.

4.4 Listing-Route Sensitivity

The frozen universe contains modified public-debut structures. Excluding the two usable direct listings (RBLX and COIN) and two usable de-SPAC events (OPEN and IONQ) leaves 22 conventional IPO or carve-out observations. The mean remains positive and increases in this route-purity check, indicating that the headline average is not created by those four events. This check does not resolve early-release-date ambiguity within conventional IPO filings.

Table 5. Listing-route sensitivity using the frozen trade returns. MTTR is not part of either result because its historical price series was unavailable.

Sample	Trades	Wins	Mean raw	Mean market-adjusted
Frozen usable universe	26	15	4.07%	4.42%
Excluding OPEN, RBLX, COIN, IONQ	22	15	5.43%	5.94%

4.5 Full Trade Log

Every usable event trade is shown below, including all losses. Entry and exit dates follow the exchange-session rule described in Section 3.5.

Table 6. Complete 26-event trade log using adjusted closing prices. Event dates are frozen reference dates; weekend and holiday dates map to the first trading session on or after the reference date. Raw and market-adjusted returns are shown before costs.

Event date	Ticker	Entry date	Exit date	Entry	Exit	Raw	Mkt. adj.	Result
2021-03-15	SNOW	2021-03-10	2021-03-18	$227.11	$216.70	+4.6%	+4.1%	WIN
2021-06-07	DASH	2021-06-02	2021-06-10	$149.83	$144.85	+3.3%	+2.5%	WIN
2021-06-07	AI	2021-06-02	2021-06-10	$76.15	$58.08	+23.7%	+22.9%	WIN
2021-06-08	ABNB	2021-06-03	2021-06-11	$144.19	$148.44	-3.0%	-4.3%	LOSS
2021-06-19	OPEN	2021-06-16	2021-06-24	$16.65	$17.10	-2.7%	-3.7%	LOSS
2021-09-06	RBLX	2021-09-01	2021-09-10	$84.45	$87.88	-4.1%	-2.6%	LOSS
2021-09-27	COUR	2021-09-22	2021-09-30	$35.21	$31.65	+10.1%	+12.1%	WIN
2021-10-11	COIN	2021-10-06	2021-10-14	$250.38	$260.00	-3.8%	-5.6%	LOSS
2021-12-20	DOCS	2021-12-15	2021-12-23	$55.71	$51.54	+7.5%	+7.1%	WIN

Event date	Ticker	Entry date	Exit date	Entry	Exit	Raw	Mkt. adj.	Result
2022-01-14	MNDY	2022-01-11	2022-01-20	$240.54	$214.67	+10.8%	+15.7%	WIN
2022-01-24	DUOL	2022-01-19	2022-01-27	$87.70	$86.88	+0.9%	+5.5%	WIN
2022-01-25	HOOD	2022-01-20	2022-01-28	$13.69	$12.73	+7.0%	+8.1%	WIN
2022-03-30	IONQ	2022-03-25	2022-04-04	$13.18	$13.58	-3.0%	-3.9%	LOSS
2022-04-12	GTLB	2022-04-07	2022-04-18	$49.87	$50.50	-1.3%	+1.1%	LOSS
2022-05-02	BRZE	2022-04-27	2022-05-05	$40.87	$37.31	+8.7%	+9.5%	WIN
2022-05-09	RIVN	2022-05-04	2022-05-12	$33.92	$24.30	+28.4%	+36.9%	WIN
2023-10-31	KVUE	2023-10-26	2023-11-03	$16.88	$17.50	-3.6%	-9.0%	LOSS
2024-03-12	ARM	2024-03-07	2024-03-15	$140.85	$126.97	+9.8%	+10.5%	WIN
2024-03-17	CART	2024-03-13	2024-03-21	$35.35	$37.82	-7.0%	-8.5%	LOSS
2024-03-18	KVYO	2024-03-13	2024-03-21	$24.72	$26.94	-9.0%	-10.5%	LOSS
2024-09-17	RDDT	2024-09-12	2024-09-20	$59.63	$66.17	-11.0%	-12.9%	LOSS
2024-10-22	RBRK	2024-10-17	2024-10-25	$39.48	$39.40	+0.2%	+0.8%	WIN
2025-07-22	VG	2025-07-17	2025-07-25	$16.22	$14.50	+10.6%	+9.1%	WIN
2025-08-12	SAIL	2025-08-07	2025-08-15	$20.03	$20.47	-2.2%	-4.0%	LOSS
2025-09-24	CRWV	2025-09-19	2025-09-29	$124.86	$122.52	+1.9%	+1.9%	WIN
2025-11-14	CRCL	2025-11-11	2025-11-19	$98.30	$69.72	+29.1%	+32.1%	WIN

4.6 Individual Trade Returns

To evaluate whether the positive average is broadly distributed rather than produced by one observation, Figure 1 shows the raw return for every usable event trade.

Green bars denote positive raw short returns and red bars denote losses. The chart is descriptive and does not include implementation costs.

The horizontal blue baseline shows the mean return of 4.07% across the 26 trades. The distribution suggests that the positive mean is not produced by only one trade, but the variation also shows that the event is not uniformly profitable. A 58% win rate represents a modest majority within the sample, and several losses show that company-specific information and market conditions can outweigh lockup-related selling pressure. The results are therefore consistent with a probabilistic pattern, not a guaranteed trade.

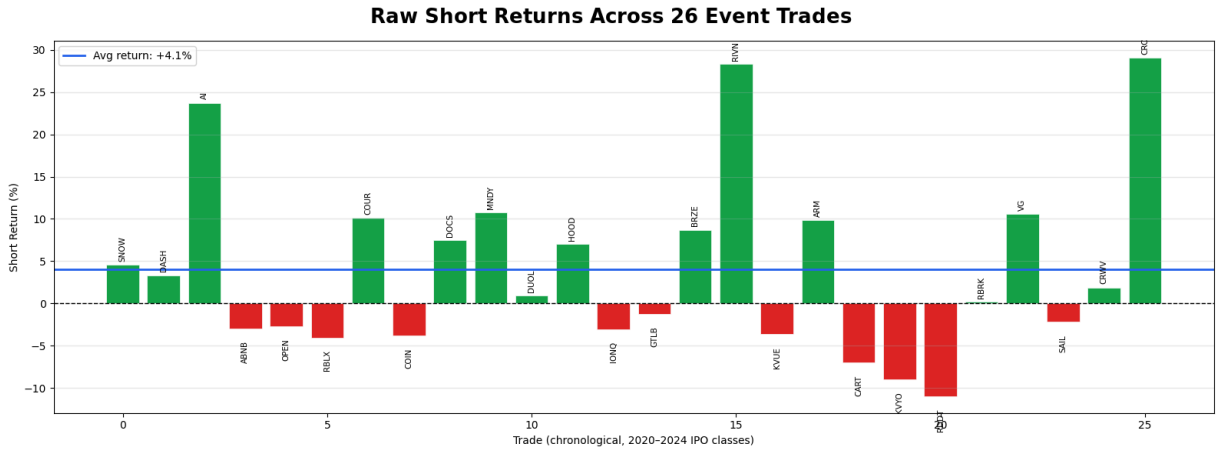


Figure 1. Raw T-3 to T+3 short return for each of the 26 usable events. Green bars are gains, red bars are losses, and the horizontal line is the 4.07% sample mean; costs are excluded.

4.7 Average Price Drift (CAAR)

To show the average timing pattern, Figure 2 reports cumulative average abnormal short returns around the event reference date.

The y-axis measures the average market-adjusted return a short seller would have steadily accumulated since initiating the position at the market close on T-3. Because this chart maps a short-selling framework, a rising line directly indicates that the underlying equities are falling in price, thereby generating paper profits for the position. Relative event Day 0 denotes the official legal lockup expiration date. The green shaded zone strictly highlights the active execution window of the strategy from T-3 to T+3. The red shaded zones on both sides trace the historical price behavior before the position is opened and after the trade is fully liquidated.

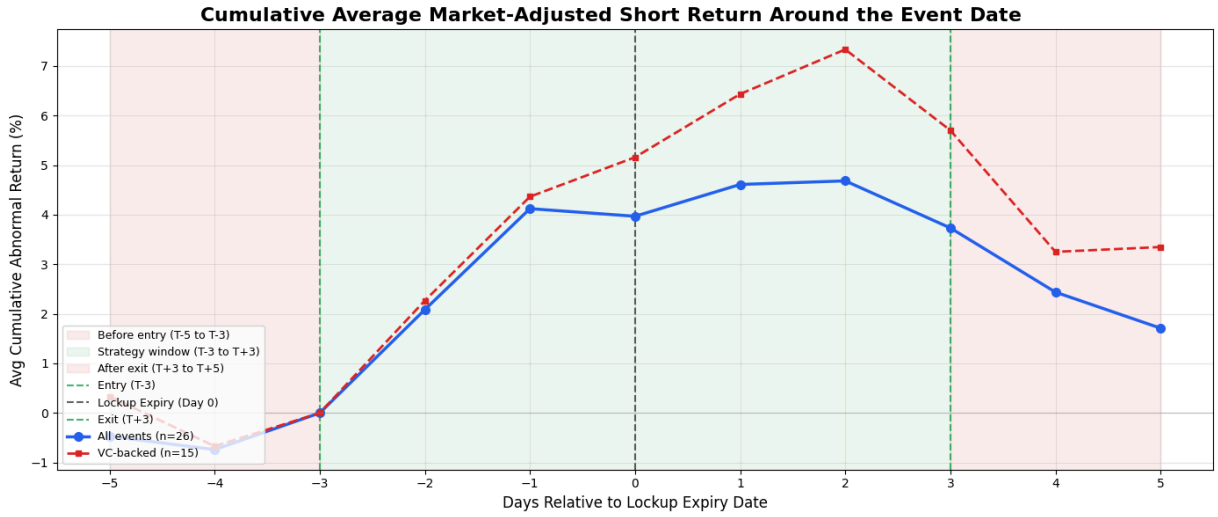


Figure 2. Cumulative average market-adjusted short return from T-5 to T+5 for all events and the venture-backed subgroup. The green band marks the reported T-3 to T+3 strategy window; the subgroup is exploratory.

The cumulative return line begins rising before Day 0, which is consistent with the possibility that traders anticipate the unlock and adjust positions in advance. By T-1, the average cumulative return is above 4% in the chart. This movement may reflect expectations of future selling, but it could also reflect momentum, company news, or broader conditions affecting newly public stocks. The chart therefore supports an anticipatory-price-pressure explanation without proving that insider selling is the only cause.

The venture capital-backed subgroup reaches approximately 7.3% on T+2, compared with a full-sample peak of about 4.7%. This difference is consistent with Field and Hanka's (2001) finding that lockup effects were larger for venture-backed firms. One possible explanation is that venture investors hold concentrated positions and face incentives to return capital. However, the subgroup is small, so the comparison should be treated as suggestive rather than conclusive.

Chart 2 also provides exploratory evidence about timing. Both the full-sample and venture-backed lines peak at T+2 before declining through T+3 and toward T+5. In this sample, an earlier exit would have retained more of the measured gain. This observation was identified after examining the data, so it should be treated as a hypothesis for future testing rather than an established optimal rule.

The chart also shows a slight movement before the T-3 entry point. This raises a question for future research about whether an earlier entry could capture more of the pre-expiration decline. Any alternative window would need to be evaluated on new observations to avoid choosing a rule solely because it fits the current sample.

Together, the entry and exit patterns suggest that the timing of price pressure may begin before expiration and fade soon afterward. The open-source code allows the result to be replicated, but alternative parameters should be validated with data outside the present sample before drawing stronger conclusions.

4.8 Illustrative Equity Curve vs. SPY

To illustrate the sequence of trade outcomes, Figure 3 compounds a theoretical $10,000 balance through the 26 event trades in chronological order.

The solid blue line shows the lockup strategy, while the gray dashed line shows the SPY benchmark over the 2020-2025 timeline. The difference between the two lines illustrates how the sequence of event trades would have compounded under the model's assumptions. It does not represent a directly investable comparison because the strategy is active only during selected event windows and excludes borrowing costs, transaction costs, and execution constraints. The chart should therefore be interpreted as an illustration of historical sample performance rather than proof of long-term commercial viability.

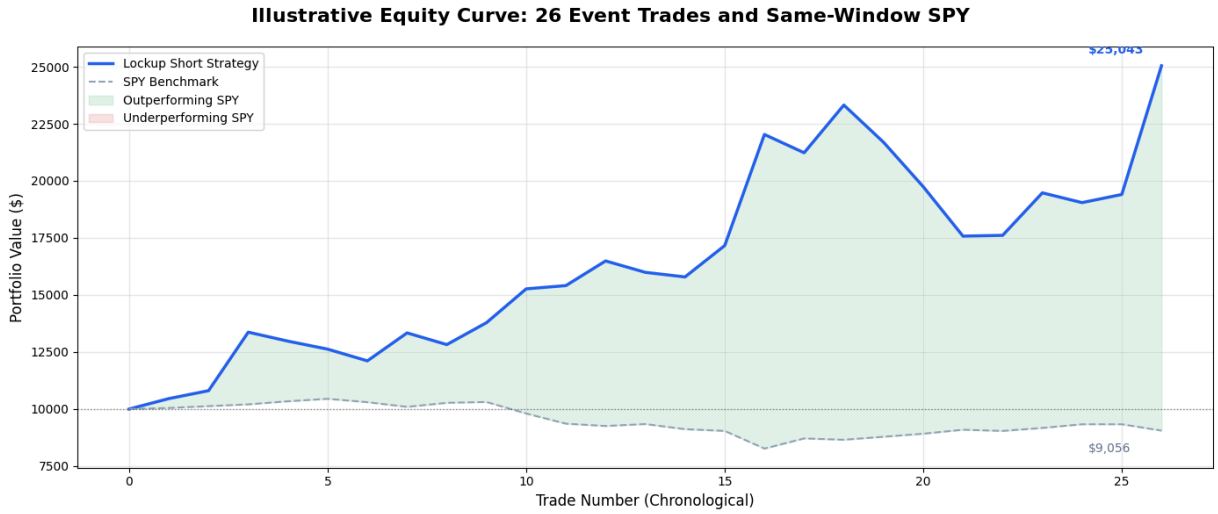


Figure 3. Chronological compounding of the 26 raw event returns from a hypothetical $10,000 starting balance compared with same-window SPY outcomes. The comparison excludes costs, borrow constraints, overlapping-capital requirements, and continuous market exposure.

4.9 Exploratory Performance by Sector

Figure 4 presents exploratory sector-level win rates and mean market-adjusted returns.

The largest sector subgroup is cloud technology, with a 71% win rate across seven trades: Snowflake (SNOW), GitLab (GTLB), Braze (BRZE), monday.com (MNDY), Klaviyo (KVYO), Rubrik (RBRK), and CoreWeave (CRWV). This subgroup is large enough for a basic comparison within the dataset, but seven events are still insufficient for a broad sector-level conclusion.

The remaining sectors contain only a few events, so one result can move a sector's win rate to 0% or 100%. The stronger result in cloud technology may be consistent with greater valuation uncertainty and disagreement among investors, as described by Miller's (1977) divergence-of-opinion framework. However, sector, valuation, venture backing, and IPO year overlap in this sample, so the analysis cannot isolate which factor caused the difference.

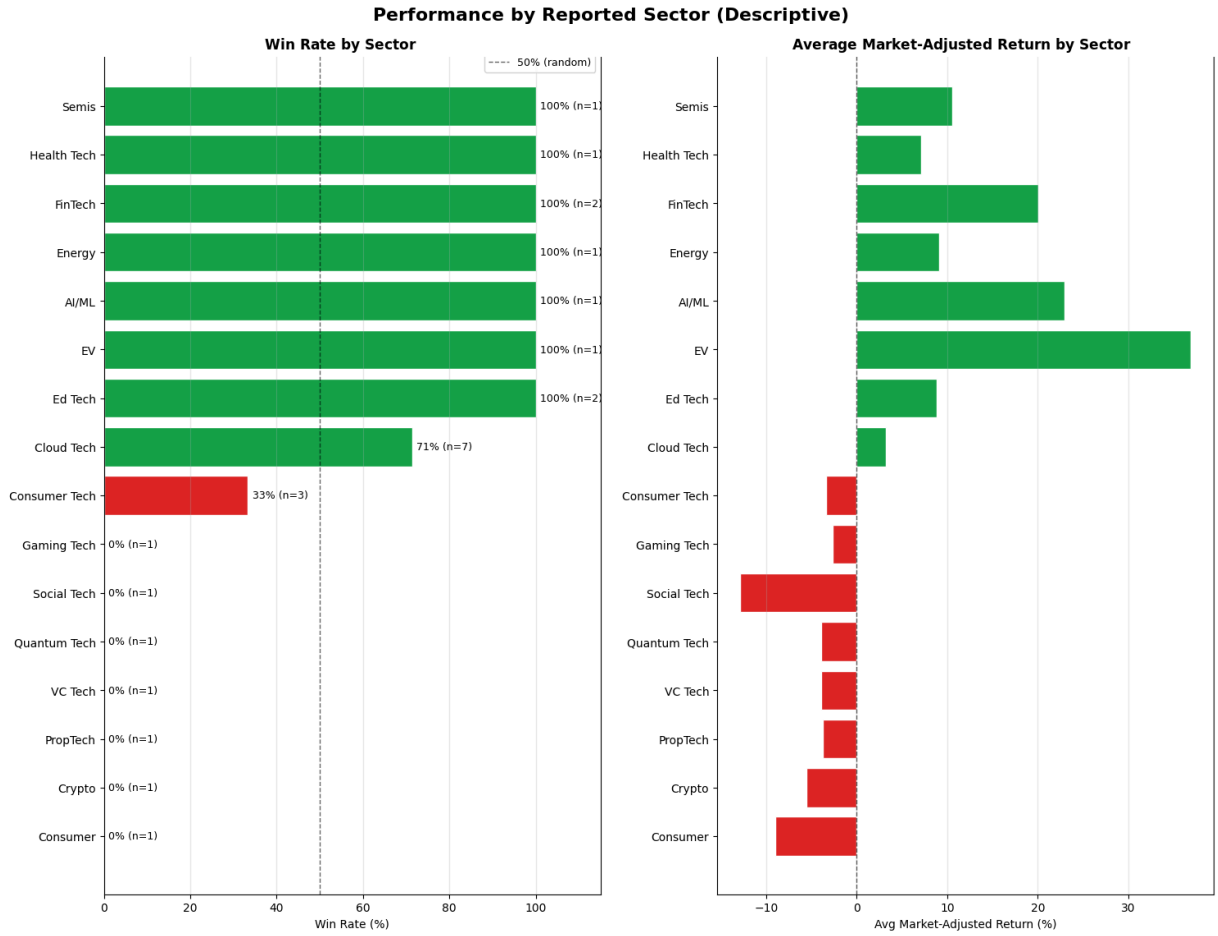


Figure 4. Win rate and mean market-adjusted return by reported sector. Most sectors contain only one or a few observations, so the bars are descriptive rather than inferential.

4.10 Exploratory Performance by Year

Figure 5 presents exploratory annual win rates and average raw short returns to show whether the sample result is concentrated in one cohort.

The primary objective of this distribution analysis is a baseline consistency check. If the strategy's positive returns were concentrated entirely within a single calendar year, it would suggest the backtest was an accidental byproduct of a specific market environment (such as a secular bear market) rather than the structural supply shock itself.

The strategy records positive results across multiple annual groups in the sample, which reduces the likelihood that the full result comes from only one year. However, the number of events per year is small and uneven. The yearly comparison therefore provides a consistency check rather than proof that the effect is independent of market conditions.

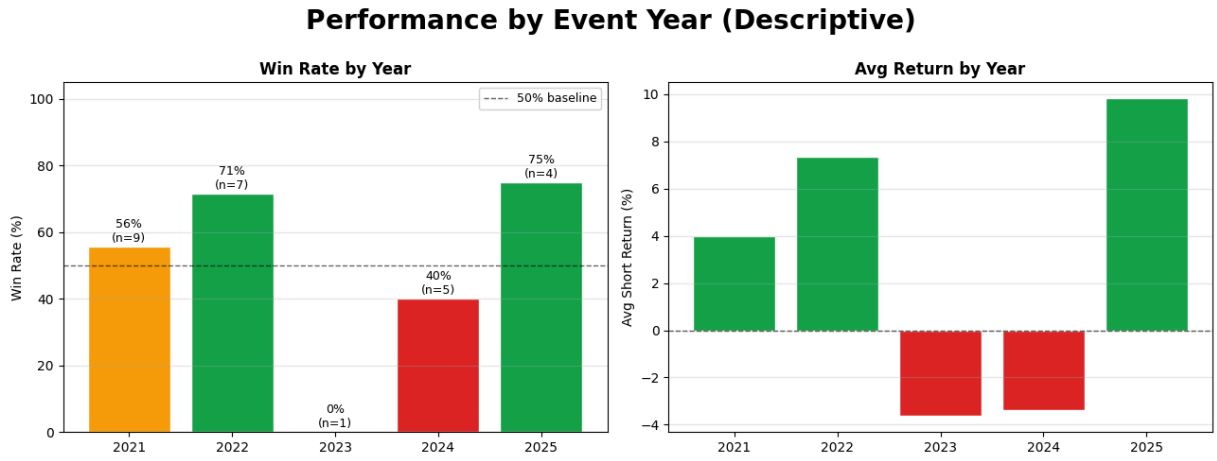


Figure 5. Win rate and mean raw short return by event year. Annual sample sizes are small and uneven, so the chart is a consistency check rather than evidence that the effect is independent of market conditions.

5. DISCUSSION

5.1 Theoretical Interpretation

The results are consistent with a price-pressure explanation, but they do not establish that supply changes caused the returns. Restriction dates do not change company cash flows, yet they can increase the number of shares potentially available for sale. The positive average short return is therefore compatible with Scholes's (1972) price-pressure hypothesis and Shleifer's (1986) downward-sloping demand framework.

The timing also matters. Part of the measured decline occurs before Day 0, suggesting that investors may anticipate the expiration rather than react only after it occurs. The pattern weakens after the first few post-expiration trading days, which is consistent with temporary pressure being absorbed by the market. At the same time, the study does not observe actual insider sales for every company. The results therefore show an association between the expiration event and returns, not direct proof that insider selling caused each price movement.

The variation across trades supports the limits-to-arbitrage explanation. If the opportunity were costless and certain, competition should remove it before expiration. Instead, newly public stocks may have limited borrow availability, high borrowing fees, high volatility, and a risk of sharp price increases. As Shleifer and Vishny (1997) argue, risk and capital constraints can prevent arbitrageurs from fully correcting a known pattern. Miller's (1977) framework also helps explain why the effect may be stronger in firms with uncertain valuations and greater disagreement among investors.

5.2 Academic and Practical Significance

The academic contribution is not the discovery of lockup-related price pressure, which earlier research already documents. Instead, the study tests whether that relationship remains visible in a 2020-2025 sample after major changes in trading technology and investor participation. The findings are broadly consistent with earlier work while adding a recent event window and a transparent trade-level backtest.

The practical contribution is narrower. The study shows how a public regulatory date can be converted into a fixed event rule and evaluated across a disclosed universe. The positive mean and 58% win rate identify a historical association, not a directly executable excess return. The 95% interval includes zero, and realized performance would depend on borrow availability, borrowing fees, transaction costs, slippage, recalls, and execution quality.

5.3 Alternative Explanations and Limitations

Several alternative explanations remain. Newly public companies may experience momentum, earnings announcements, analyst actions, sector-wide movement, or company-specific news near the reference date. SPY adjustment controls only for broad market direction. The study also does not observe actual insider sales for every company. In addition, several filings contain staged or early-release provisions, and two direct listings lack a conventional IPO underwriter lockup. These features create event-date measurement risk even though the frozen reference dates and exact sources are now disclosed.

The sample size of 26 events is the main limitation. Market-adjusted returns have a 12.31% sample standard deviation, and the 95% t interval for the 4.42% mean is -0.55% to 9.39%. Because this interval includes zero, the result is suggestive rather than conclusive. Small and uneven subgroups also make annual and sector comparisons sensitive to individual observations.

Future work should pre-specify the T+3 rule and test it on new observations without retuning. One plan is a walk-forward design: choose the exit rule using earlier cohorts, freeze it, and evaluate each later cohort once. A second plan is a prospective out-of-sample test of public debuts after September 4, 2025 using verified first-release dates, pre-defined route exclusions, sector-adjusted benchmarks, actual share-unlock quantities, and observed stock-loan costs.

6. CONCLUSION

This study evaluated whether selected post-listing restriction-date windows are associated with short-selling returns using 26 usable events from 2020-2025. The T-3 to T+3 rule produced a 58% win rate, a 4.07% average raw short return, a 4.42% average market-adjusted return, and a sample-scaled return-to-dispersion statistic of 2.02. Market-adjusted returns had a 12.31% standard deviation, and the conventional 95% interval was -0.55% to 9.39%, so the estimate remains uncertain.

The full trade log shows that the result is a probabilistic pattern rather than a rule that works in every case. Losses in Reddit (RDDT), Klaviyo (KVYO), and Instacart (CART) demonstrate that momentum, investor demand, company news, and market conditions can outweigh lockup-related pressure. This variation is important because it limits how confidently the average result can be applied to an individual IPO.

The comparison of exit windows provides an exploratory timing result. T+3 performed better than T+5 in the same 26 observations, suggesting that the measured effect may fade within several trading sessions. Because the comparison was selected and evaluated in-sample, T+3 should not be described as optimal until it succeeds in a pre-specified independent test.

The main limitations are the 26-event sample, event-date ambiguity in modified or early-release clauses, nontraditional listing routes in the frozen universe, and the absence of direct insider-sale and securities-lending data. The cost sensitivity shows that the mean remains positive under the stated assumptions, but hard-to-borrow or unavailable shares can make some trades impossible rather than merely more expensive.

Because restriction terms are public, the results raise a market-efficiency question. Their persistence is compatible with limits to arbitrage, including stock-loan constraints, volatility, and event-specific risk. Overall, the study identifies a historical association between predictable post-listing windows and short-term returns. It does not prove a causal supply effect or a directly executable trading profit, and the size and reliability of the relationship require confirmation in larger independent samples.

DATA AND CODE AVAILABILITY

Public analysis notebook: https://colab.research.google.com/drive/1ZaB29bk8f3bQPrSXjO-e05qOTSxt2jjk?usp=sharing. Public GitHub profile: https://github.com/AadiCS. Revision archive date: September 2, 2026. The complete candidate universe and exact primary SEC filing links are reproduced in Appendix Table A1. A permanent repository-level release or DOI was not available in the source materials supplied for this revision.

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APPENDIX A. CANDIDATE-EVENT UNIVERSE AND PRIMARY LOCKUP SOURCES

Table A1 discloses all 27 candidate events before the price-data exclusion. The event date is the frozen date used by the backtest. It is not necessarily the first date on which every restricted share became saleable when a filing contained staged, earnings-based, price-triggered, or holder-specific provisions. The source column links the exact primary SEC filing used to document the term.

Table A1. Complete candidate-event universe, frozen reference date, listing route, term treatment, and exact primary SEC filing source.

Ticker	Event date	Route	Term treatment	Primary SEC filing
SNOW	2021-03-15	IPO	180-day backstop	SEC 424B4, accession 000162828020013667
DASH	2021-06-07	IPO	Staged early release; 180-day backstop used	SEC 424B4, accession 000119312520313884
AI	2021-06-07	IPO	Up to 180 days	SEC 424B4, accession 000162828020017290
ABNB	2021-06-08	IPO	Earnings/121-day modified term; frozen reference date used	SEC 424B4, accession 000119312520315318
OPEN	2021-06-19	De-SPAC	Earlier of 180 days after closing or price trigger	SEC 424B3, accession 000110465920130150
RBLX	2021-09-06	Direct listing	No conventional underwriter lockup; modified reference comparison	SEC 424B4, accession 000119312521075435
COUR	2021-09-27	IPO	Earlier of 180 days or earnings-based release	SEC 424B4, accession 000119312521102478
COIN	2021-10-11	Direct listing	No conventional underwriter lockup; modified reference comparison	SEC filing, accession 000162828021006850
DOCS	2021-12-20	IPO	180 days with early-release provisions	SEC 424B4, accession 000162828021012935
MNDY	2022-01-14	IPO	Earlier of 180 days or earnings-based release	SEC 424B4, accession 000110465921080087
DUOL	2022-01-24	IPO	180 days; automatic early release possible	SEC 424B4, accession 000162828021014753
HOOD	2022-01-25	IPO	125-day modified term; frozen 180-day reference used	SEC 424B4, accession 000162828021015076
IONQ	2022-03-30	De-SPAC	Holder-specific 180-day and 365-day tranches	SEC 424B3, accession 000119312521244892

Ticker	Event date	Route	Term treatment	Primary SEC filing
GTLB	2022-04-12	IPO	Earlier of 180 days or earnings-based release	SEC 424B4, accession 000162828021020056
BRZE	2022-05-02	IPO	Earlier release provisions; 180-day backstop used	SEC 424B4, accession 000119312521333968
RIVN	2022-05-09	IPO	180 days; underwriter waiver possible	SEC 424B4, accession 000119312521328239
KVUE	2023-10-31	IPO/carve-out	180-day term; sponsor distribution restrictions	SEC 424B4, accession 000162828023015837
ARM	2024-03-12	ADR IPO	180-day lockup/RSU timing	SEC 424B4, accession 000119312523235320
CART	2024-03-17	IPO	Earlier of 180 days or earnings-based release	SEC 424B4, accession 000119312523237900
KVYO	2024-03-18	IPO	Earlier of 180 days or earnings-based release	SEC 424B4, accession 000162828023032570
RDDT	2024-09-17	IPO	Earlier of 180 days or earnings-based release	SEC 424B4, accession 000162828024012380
RBRK	2024-10-22	IPO	Earlier of 180 days or earnings-based release	SEC 424B4, accession 000119312524118478
VG	2025-07-22	IPO	180-day term	SEC 424B4, accession 000119312525012218
SAIL	2025-08-12	IPO	180-day term; waiver possible	SEC 424B4, accession 000119312525026566
CRWV	2025-09-24	IPO	Earlier of 180 days or earnings-based release	SEC 424B4, accession 000119312525067651
CRCL	2025-11-14	IPO	Earlier of post-Q3 earnings release or 180 days	SEC 424B4, accession 000119312525135795
MTTR	2022-01-18	De-SPAC	180 days after combination; excluded for unavailable prices	SEC 424B3, accession 000119312521194323

ABOUT THE AUTHOR

Aadi Shelat is a senior at Brookline High School in Brookline, Massachusetts. He is interested in economics and finance and hopes to continue conducting research throughout college.