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特殊目的收購公司（SPACs）中私募投資公開股權（PIPE）交易的市場反應研究
The Market Reaction to PIPE Transactions in SPACs

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本論文係 陳棱 君（學號：B10703061）在國立臺灣大學財務金融系完成之學士班學生論文，於民國 113 年 3 月 31 日承下列考試委員審查通過及口試及格，特此證明。

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摘要

私募投資公開股權（Private Investment in Public Equity, PIPE）在特殊目的收購公司（Special Purpose Acquisition Companies, SPACs）的合并交易中扮演著重要角色。本研究透過觀察 SPAC 價格變化來探討市場對 PIPE 交易的反應。研究發現，市場對普通股 PIPE 交易呈現正面反應，且當目標公司未公開時，此正面反應更為顯著。此外，由避險基金主導的 PIPE 交易相較於其他類型投資者所主導的交易，市場反應更為強烈，這歸因於避險基金嚴謹的分析與迅速的資本部署能力。總體而言，本研究結果表明，PIPE 投資的時機與 PIPE 的投資者類型顯著影響市場對 SPACs 中 PIPE 交易的看法。

關鍵字：私募投資公開股權（PIPE）、特殊目的收購公司（SPACs）、市場反應、投資者類型、對沖基金、業務合併公告（BCA）、累積異常報酬（CAR）

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Title: The Market Reaction to PIPE Transactions in SPACs

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Abstract

Private investment in public equity (PIPE) plays a significant role in special purpose acquisition companies (SPACs). In this study, I investigated the market reaction to common stock PIPE transactions in SPACs. I found that the market reacted positively to common stock PIPE transactions, with even stronger positive reactions when the targets were undisclosed. In addition, PIPE transactions led by hedge funds generated stronger market reactions compared with those led by other types of investors, likely due to hedge funds' rigorous analysis and swift capital deployment. Overall, my results suggest that PIPE investment timing and investor type significantly influence market perceptions of PIPE transactions in SPACs.

Keywords: Private Investment in Public Equity (PIPE), Special Purpose Acquisition Companies (SPACs), Market Reaction, Investor Types, Hedge Funds, Business Combination Announcement (BCA), Cumulative Abnormal Returns (CAR).

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1. Introduction

For private businesses looking to go public, special purpose acquisition companies (SPACs), commonly referred to as blank-check companies, provide an alternate strategy. Created solely to raise capital through initial public offerings (IPOs) by selling units—each comprising a share bundled with a fraction of a warrant—SPACs aim to acquire private companies within the subsequent 18 to 24 months following their IPOs. Sponsors with expertise in a particular industry or business sector commonly form SPACs to pursue deals in that area. From mid-2020 to 2021, the SPAC market experienced an unprecedented boom, becoming a dominant force in United States (US) IPOs. According to SPAC Analytics, at its zenith, SPACs constituted 63% of all IPOs, raising $163 billion. High market liquidity drove this surge, with issuance volumes escalating nearly sixfold from $13.6 billion in 2019 to an extraordinary $83.4 billion in 2020.

SPAC IPO investors have two options: either proceed with a deal once the sponsor announces an agreement with a target, or redeem their shares and get their money back plus interest. They can keep their warrants even if they choose to withdraw, which gives them a risk-free chance to assess a private company investment. High redemption rates jeopardize the success of a merger deal because they reduce the deposited proceeds. A SPAC may issue debt or raise more capital through a private investment in public equity (PIPE) deal if it needs more money to complete a merger. SPACs raise additional funds through PIPE transactions, which involve the sale of securities common stock, convertible preferred stock, convertible debt, warrants, etc. PIPEs not only provide essential capital for SPAC transactions but also serve as a certification mechanism, signaling the quality of the deal to public investors.

This study's objective was to explore the market reaction to common stock PIPE transactions in SPACs. Specifically, I analyzed the differential effect of the timing of PIPE transactions relative to business combination (BC) announcements and investor types on the announcement returns of PIPE investments. This framework allowed for a comprehensive analysis of how investor identity and investment timing jointly influence market reactions to PIPE investments in SPACs. Using comprehensive data from *PrivateRaise* spanning 2015-2023, I investigated 456 SPAC PIPE investments across various investor categories and transaction stages.

This study categorized PIPE investments in SPACs based on two key dimensions: investment timing and investor type. The timing classification comprised three distinct phases: pre-Business Combination Announcement (BCA), post-BCA, and de-SPAC periods. Each phase presented a unique information environment and its own strategic considerations for investors. During the pre-BCA phase, PIPE investments signaled confidence in sponsor capabilities in target search. Post-BCA phase investments addressed funding requirements while providing enhanced negotiating positions. De-SPAC PIPE investments more closely resembled traditional PIPE transactions in publicly traded firms.

The analysis further classified PIPE investors into three primary categories based on their investment objectives and roles: hedge funds, which typically focus on short-term trading opportunities; strategic investors who are private equity and venture capital firms that provide technical know-how and other advisory services besides investment; and other institutional investors. This classification enabled me to examine how different investor types influence market reactions across various SPAC stages.

First, I documented the distribution of PIPE transactions across security types in SPACs. Common stock represented the predominant security type, comprising more than half of total transactions with a mean size of $141.86 billion. Prepaid warrants comprised 23.04% with 358 transactions, whereas convertible debt accounted for 9.07% with 141 transactions. Within the 456 common stock PIPE investments, insurance companies exhibited the largest mean investment size at $178.33 million.

Second, I examined how various PIPE investor types influence market reactions across distinct announcement periods. Using event study methodology, I analyzed cumulative abnormal returns around PIPE announcements across the full sample during the SPAC period and subperiods relative to BC announcements.

I found positive market reactions to PIPE investments, with systematic variation across investor types and announcement timing. My findings demonstrated higher cumulative abnormal returns in the pre-Business Combination Announcement (BCA) period at 6.37% compared with 2.10% in the post-BCA period. This pattern was particularly pronounced for hedge fund investments, which generated significant positive returns pre-BCA. Conversely, private equity, venture capital firms, and sovereign wealth funds showed improved performance in the post-BCA period. These differential effects suggest that market reactions vary with investor identity and timing, reflecting distinct value creation mechanisms across investor types and SPAC lifecycle stages. The stronger pre-BCA returns may reflect reduced information asymmetry and enhanced strategic positioning opportunities before target identification. Additionally, the timing effect suggests that investors value early-stage PIPE commitments as signals of deal quality and sponsor capability.

In this study, I significantly contribute to the burgeoning literature on SPACs and PIPE transactions. First, within SPACs, my research builds upon existing work, particularly by Lin et al. (2021) and Gahng et al. (2023). The study by Lin et al. underscores SPAC sponsors' pivotal role, highlighting that those sponsors with higher network centrality perform better across various metrics. Leveraging this insight, my study takes a nuanced approach by investigating the effect of various types of PIPE investors on SPAC outcomes. Additionally, examination of SPACs from 2015 to March 2021 by Gahng et al. sheds light on SPAC mergers' cost dynamics compared with traditional IPOs. My research further delves into SPACs' temporal aspects, scrutinizing the influence of PIPE investments at different stages of the SPAC cycle, thereby extending the understanding of SPAC dynamics.

Second, in the domain of PIPE transactions, my study contributes by drawing upon the comprehensive study by Floros and Sapp (2012) and a more recent exploration by Liu and Joseph (2023) within the context of SPACs. Floros and Sapp's (2012) research on multiple PIPE transactions challenges the conventional view of PIPEs as a single fundraising tool, offering insights into firms' motivations for choosing multiple PIPE offerings. Building on this foundation, Liu and Joseph's (2023) investigation into PIPE investments in SPACs from 2003 to 2021 enhances our understanding of PIPE investors' strategic role, both before and after the BC announcement. By emphasizing the timing and effect of PIPE investments in SPACs, my study extends the current literature, offering a nuanced perspective on PIPE transactions' evolving landscape within the dynamic context of SPACs.

Collectively, this study not only contributes to the evolving literature on SPACs and PIPE transactions but also provides valuable insights for practitioners and investors navigating these intricate financial landscapes.

2. Literature review and hypothesis development

2.1 Literature review

The existing research shows that SPAC sponsors are essential in overall SPAC performances. Lin et al. (2021) measured the quality of SPAC sponsors through the degree, closeness, betweenness, and eigenvector centrality of their professional network connections in private equity (PE) and ventures. By analyzing 390 SPACs that issued IPOs from 2003 to June 30th, 2020, they proved that sponsors with higher network centrality perform better in various ways. First, sponsors with better networks can attract more extraordinary IPO and PIPE deals, allowing SPACs to choose better targets using the available funds. High-quality sponsors with extensive deal sourcing experience are not only willing to disclose more information to detail their deals but also increase their chances of merger and acquisition success by 3.7%. Although SPACs underperform in the overall market, better-connected sponsors can increase shareholder value over the long term. Over the two years after a BC, a 2.1% rise in post-merger monthly Fama-French three-factor alpha is linked to a one standard deviation increase in PE network centrality. It also correlates with a 15.2% higher pre-merger revenue and a 17.4% higher post-merger Tobin's Q. Sponsors with high network centrality seek to reduce the SPAC's leverage after the target goes public, as high debt hinders young companies' growth.

SPACs are often compared to widely known traditional IPOs to clearly explain the difference. In their study of 153 SPACs that went public between 2015 and the end of March 2021, Gahng et al. (2023) discovered that merging with a SPAC is comparatively more costly than a typical IPO. This is because the SPAC IPO underwriter also collects commissions on redeemed shares. Underwriting commissions are typically paid by SPAC in phases, with 2%

paid at the time of the initial public offering and the remaining amount in the event of a successful merger or acquisition. If the proposed deal is not promising, sponsors may offer concessions, such as forfeiting their promote shares, or underwriters may forfeit commissions to attract more participants to the merger. During the SPAC period, investors and sponsors were winners, with an average annual return of 23.9%. However, on average, a common stock investor lost money during his deSPAC period, whereas a warrant investor made a positive profit. PIPE investors earned significantly higher returns than public market investors during the deSPAC period, primarily because PIPE investors could purchase shares at an average discount of 20.1% to the market price at the time of the deSPAC. However, investors still lagged behind the market.

As PIPE rocketed over the years, it is worth discussing more deeply. Unlike previous studies that assumed that PIPEs are single fundraising tools, Floros and Sapp (2012) researched multiple PIPE transactions, the majority of 14,958 PIPE transactions from 1995 to 2008. According to the study, firms that do not meet Seasoned Equity Offering (SEO) criteria and urgently need cash to support their research and development or daily operations will seek PIPE offerings. In such a situation, several PIPE issues are selected rather than a single major PIPE in order to prevent a shareholder vote and the imposition of less favorable terms. Because identifying firms' performance through the first few offerings is difficult, the investor composition is widely diversified and usually has a positive market response, signaling the collaboration of new investors with favorable deals. After a few offerings, stock returns may drop as transactions become less uninformative, resulting in domination by hedge funds acting as last-resort investors in the PIPE market. However, PIPE issuers usually

do not consider market reaction because firms with negative initial announcement returns are more likely to issue successive PIPEs than firms with positive initial announcement returns.

PIPE is becoming a common tactic in SPAC transactions due to its convenience and speed in fundraising. Liu and Joseph (2023) examined PIPE investments' function before and after the BC announcement. A total of 1075 deals out of the sample of 1650 SPACs from 2003 to 2021 received a PIPE investment, with 1053 of those deals taking place before the BC announcement. A PIPE investment significantly increases a SPAC's speed and durability, almost as much as if the deal had a certification effect. PIPE-invested SPACs have 6.9% higher discounts and 5% higher abnormal announcement returns in post-BC announcement SPACs. Hence, it is unsurprising that PIPE investors received relatively more investor rights than issuer rights after the BC announcement. As SPAC allows its investors to redeem their shares, draining the proceeds from the trust account, PIPE investors, such as hedge funds, which can provide instant capital, are more crucial at this stage. Early PIPE investment is less favorable for investors in terms of pricing and friendliness. This is not true for strategic investors with industry expertise, however, as they are more appreciated at this stage. Instead, it applies to SPACs and similar-sized non-SPAC deals.

2.2 Hypothesis Development

Expanding on the body of existing literature, my study's goal was to explore PIPE transactions' influence on SPAC outcomes, specifically focusing on market reactions and the role of different investor types. The hypotheses were formulated based on theoretical frameworks and empirical evidence from prior research.

Hypothesis 1: PIPE transactions have a positive market reaction in SPACs.

This hypothesis is grounded in the signaling theory, which suggests that PIPE investments serve as a certification of the deal's quality. When a SPAC announces a PIPE investment, it signals to the market that sophisticated investors have vetted and approved the transaction, thereby increasing investor confidence. Liu and Joseph (2023) found that SPACs receiving PIPE investments, especially those announced pre-BC, experience higher abnormal returns. This positive market reaction is attributed to the perceived endorsement from reputable PIPE investors, who conduct thorough due diligence before committing funds. Furthermore, the infusion of capital through PIPE transactions enhances the SPAC's financial stability, reducing the risk associated with high public shareholder redemption rates and positively influencing market perception.

Hypothesis 2: The effect of PIPE timing is different between pre-BCA and post-BCA.

The market reaction to PIPE investments likely varies between pre- and post-BCA periods due to differences in the information environment and certification value. PIPE investments in the pre-BCA period generate stronger positive market reactions due to higher information asymmetry. During the target search phase, uncertainty about the potential deal value is highest. Early-stage PIPE investments, therefore, provide valuable certification of sponsor quality and deal potential. The magnitude of market reactions to PIPE investments decreases in the post-BCA period. Once BC details are disclosed, information asymmetry diminishes, potentially reducing the certification value of subsequent PIPE investments.

Hypothesis 3: Hedge fund investors generate a stronger market reaction than PE and venture capital investors.

This hypothesis is based on the distinct investment strategies and time horizons of hedge funds compared with PE and venture capital (VC) firms. Hedge funds are known for their agility and focus on short-term gains, often leveraging their investments to capitalize on immediate market opportunities. This short-term focus aligns with SPACs' post-BC phase, where immediate capital infusion is critical to offset redemptions and ensure the merger's completion. The study by Floros and Sapp (2012) highlighted that hedge funds, acting as last-resort investors, provide the necessary liquidity, which is crucial for SPACs at later stages. Consequently, the market perceives hedge fund investments as a strong positive signal due to their rigorous analysis and swift capital deployment capabilities. In contrast, PE and VC investors, while bringing valuable industry expertise and long-term strategic support, may not elicit the same immediate positive market reaction due to their longer investment horizons and focus on operational improvements post-merger. Therefore, we expect hedge fund investments in PIPE transactions to have a more pronounced positive effect on market reactions compared with those by PE/VC investors.

By investigating these hypotheses, this study's goal is to contribute to the understanding of how various types of PIPE investors influence SPAC outcomes, providing valuable insights for investors, policymakers, and industry practitioners.

3. Institutional Background of SPACs and PIPEs

A SPAC is a blank-check business that generates money through an IPO process to fund the purchase of an existing but as-yet-unknown company within 18 to 24 months. This contrasts the traditional approach of private companies seeking IPOs or direct listings to gain

access to public markets. A SPAC's main participants include a sponsor, investors, and an operating company called a target.

A SPAC is formed by a group of managers or an organization known as the sponsor. The sponsor, typically a wealthy investor or an industry expert, identifies appropriate targets and takes the SPAC public within two years. The sponsor receives 20% of the SPAC IPO shares from a SPAC founder at a discounted price (as low as $0.005 per share), called promote shares. However, these shares are subject to more extended lock-up restrictions and do not include voting rights or redemption privileges like other SPAC shares.

Public investors can participate in SPAC IPOs by purchasing SPAC units, typically priced at $10 each. One common share and a portion of a warrant make up a typical SPAC unit. The holder of the warrant is entitled to buy common stock at $11.50 within five years of a successful SPAC merger. However, exercising these warrants may dilute existing investors' holdings. After a specified period following the start of trading, SPAC units are unbundled, enabling the trading of warrants and common shares independently. All proceeds from an IPO are deposited into a trust account and generally accessible only after the acquisition.

In a SPAC IPO, a portion of the underwriter's fee is paid upfront, whereas the remaining amount is deferred until after a successful merger. Typically, 2% of the proceeds is paid upfront. The sponsor's investment partially covers target search expenses and underwriting fees. Sponsors invest their own funds in the SPAC and purchase private warrants to cover underwriting fees and other costs until the merger is finalized.

At the same time, the sponsor searches for potential target companies interested in going public via a SPAC. SPACs typically aim to merge with a partner within 18 to 24

months of their IPO. These targets are often in industries complementary to the sponsor's expertise, which is frequently specified in the SPAC IPO prospectus. Once potential targets are identified, discussions about the minimum required cash infusion begin. Generally, the target company must meet at least 80% of the trust value.

After the announcement, shareholders vote to either accept or reject the merger. A majority vote is required, and stock redemptions must remain below a certain threshold for the merger to proceed. These conditions incentivize sponsors to identify strong targets that align with their SPAC investors' interests. A defining feature of the SPAC structure is the redemption option, which differentiates it from traditional IPOs. After the merger, shareholders can redeem their shares for their pro-rata share of the trust value. This ensures SPAC IPO investors can recover their initial investment plus interest, unlike traditional IPO investors. Moreover, investors can retain their warrants even after redeeming shares, making this a risk-free investment with upside potential and added liquidity.

However, redemption options reduce the trust's value and the target's available capital. To address potential redemption issues, SPACs often include minimum funding requirements in their merger agreements. If the trust's value falls short, sponsors may renegotiate the deal or pursue a PIPE to raise additional capital. Sponsors, leveraging their extensive networks, often seek PIPE investors to rebuild trust. In some cases, the sponsor may also participate as a PIPE investor.

Redemption options give SPAC IPO investors a money-back guarantee but also lower the target's capital and the trust's value. SPACs establish minimum requirements for the proceeds received in a merger agreement due to this possible redemption issue. Sponsors can renegotiate and accept a lower offer if the trust score drops below this. The target might

pursue a PIPE or take a new deal that requires less funding. To rebuild trust, sponsors—who typically have extensive networks—look for PIPE investors. In addition, the sponsor may serve as a PIPE investor.

If the shareholder vote is favorable and redemption levels remain below the threshold, the SPAC completes the merger with the target, initiating the deSPAC phase. At this point, the target company becomes publicly traded and receives funding from the SPAC. This process effectively serves as the private company's IPO. Beyond bringing the private company public, sponsors often take active roles in the newly merged firm, typically as board members. Their industry expertise allows them to provide valuable guidance. After the merger, target shareholders usually hold the majority stake in the combined entity.

If the merger fails, the SPAC continues its search for a new target until its 24-month deadline. If no merger is completed within this period, the IPO proceeds and any interest that has accumulated in the trust account must be returned to public shareholders. Because sponsors are compensated only through founder shares and warrants, they lose their entire investment, which becomes worthless upon liquidation.

4. Data and Variables

4.1 Data source

My sample period spanned 2015 to 2023 and included 1,554 SPAC-PIPE deals from the *PrivateRaise* database. This database provides detailed information on not only SPAC IPOs but also PIPE transactions. I obtained data on sponsor type, total amount invested, and investment dates from *PrivateRaise* to develop a deeper understanding of the composition of PIPE investors. Additionally, stock price data were collected from *CRSP*.

4.2 Classification of PIPE investor types

We divided the various investor classes that participate in SPAC PIPEs into three groups: hedge funds, strategic investors, and other investors, following Lin and Joseph (2023). Hedge funds combine the funds of accredited investors and use sophisticated investment strategies to try to turn a profit. Strategic investors are VCs and PE firms. Both are businesses that make investments in businesses and then leave by selling the equity financing made. Strategic investors participate in SPACs by producing information, offering technical know-how, and offering advisory services regarding corporate governance and operations. Other than hedge funds, PE, and VC, the rest of the investor types such as Corporation, Mutual Fund Financial Institution, Corporate Insider, Family Office and many more are considered other investors. Many investors participate in a single PIPE transaction. I characterized PIPEs based on the largest investor in each transaction. For example, if a hedge fund serves as the largest investor in a PIPE, I classified the PIPE as one led by a hedge fund investor.

Besides differentiating PIPE investors based on their types, we differentiated SPAC PIPEs based on when the PIPE investment occurred in a SPAC's life cycle. We classified each unique SPAC PIPE into three periods: pre-BC announcement (*pre-BCA*), post-BC announcement (*post-BCA*), and de-SPAC period. Pre-BCA PIPE is a PIPE transaction that occurs between a SPAC IPO and a BC announcement, whereas a post-BCA PIPE occurs between a BC announcement and the BC completion. PIPEs that occur during the de-SPAC period are primarily similar to conventional PIPE financing for publicly listed firms, and they are fundamentally different from PIPE investments during the SPAC period. Consequently,

I concentrate on PIPE transactions that were carried out during the SPAC period in this research.

4.3 PIPE Transactions in SPACs

Table 1 shows the summary statistics of the proceeds of each security type of PIPE transactions in SPAC. In the analysis of PIPE transactions in SPACs, common stock represents the prevalent security type, accounting for 50.36% (780) of total transactions. Prepaid warrants constitute the second largest category with 23.11% (358) of transactions, followed by convertible debt at 9.10% (141 transactions). Non-convertible preferred stock and other convertible securities are the least utilized.

The issuance amounts for PIPE transactions in SPACs exhibit substantial variation across security types. Common stock has a median issuance of $50.00 billion and a mean of $141.86 billion. Prepaid warrants represent the second most common security type with a notably smaller mean issuance of $9.79 billion. Although non-convertible preferred stock appears only once in the sample, it records the highest issuance amount at $163.35 billion. The median issuance across all security types is $25.00 billion, demonstrating that the considerable heterogeneity in PIPE transaction values within SPACs.

[Insert Table 1]

Given that common stock constitutes the majority of transactions and provides readily available market pricing data, I concentrated on common stock PIPE transactions. In Table 2, the first column shows the total number of PIPEs each year of the sample period. The

second column reports the mean values of corresponding SPAC IPO proceeds. I calculate the percentage of IPO proceeds as the ratio of common stock PIPE investments to their corresponding SPAC IPO proceeds in the third column, and the percentage of discount is the PIPE offer security price over the SPAC IPO price in the fourth column.

An analysis of common stock PIPE transactions per year reveals notable trends and variations in terms of frequency, IPO proceeds, and discount percentages. The number of transactions increased markedly from 2015 to 2024, reaching its peak of 314 transactions in 2021. This surge coincided with the highest percentage of IPO proceeds of 60.53% in 2021, suggesting increased reliance on PIPE financing. In contrast, 152 transactions had high IPO proceeds of 59.49% but a relatively low discount of 3.09% in 2020. Over the sample period, the mean percentage of IPO proceeds is 46.22%, with an average discount of 12.95%, indicating the economic significance of PIPE financing in SPAC transactions.

[Insert Table 2]

Table 3 presents the distribution of PIPE investments by the lead investor type. The lead investor type is identified as the investor who invests in a PIPE transaction with the largest amount of investment among all types of investors. The hedge funds are the dominant investors and execute 153 investments (33.55% of total) with a mean investment size of $48.28 million. VC and PE firms represent the second-largest investor category, with 115 investments (25.22%) averaging $78.07 million. Corporate and strategic investors, whereas less frequent with 54 investments (11.84%), maintain the highest mean investment size of $86.40 million. Financial institutions and mutual funds demonstrate substantial participation

with mean investments of $76.12 million and $71.10 million, respectively. The remaining investor categories, including sovereign wealth funds, insurance companies, and broker-dealers, exhibit varying levels of participation and investment sizes.

[Insert Table 3]

5. Announcement return of PIPE investment

5.1 Event study

In this section, I analyze market reactions to PIPE transactions during the SPAC period, categorizing PIPE investments into pre-BCA and post-BCA periods. To assess market reactions to PIPE transactions, I use the market-adjusted model as part of my event study methodology:

$$AR_{i,t} = R_{i,t} - R_{m,t},$$

where $R_{i,t}$ represents the return of stock i on day t, and $R_{m,t}$ denotes the market return on day t. I calculate abnormal returns by subtracting the market return from the daily return. Following established literature (Dimitrova, 2017; Kolb & Tykvova, 2016), Russell 2000 is the benchmark index that I use. I compute the cumulative abnormal return (CAR) for firm i by aggregating abnormal returns within the event window. The average cumulative abnormal returns (ACARs) are calculated as:

$$CAR_{i(T1,T2)} = \sum AR_{i,t}$$

$$ACAR_{(T1,T2)} = (1/n) \sum CAR_{i(T1,T2)}$$

The analysis employs event windows of [−2, +2] and [−1, +3] to capture potential information leakage and market anticipation effects surrounding the announcement dates.

5.2 Univariate tests

Figure 1 illustrates the cumulative abnormal returns (CARs) around PIPE investment announcements within the [-2, +2] window. The data exhibit minimal pre-announcement effects, with CARs of 1.4% at t-2 and 1.5% at t-1. A substantial price reaction occurs on the announcement date, with CARs increasing to 6.0%. The positive valuation effect persists through t+1, reaching 6.2%, before moderating to 5.8% at t+2. Therefore, Figure 1 indicates the significant economic value creation associated with PIPE investment announcements.

[Insert Figure 1]

Table 4 presents a total CAR of 5.79%, with a higher pre-BCA return of 6.37% compared with 2.10% post-BCA, highlighting the critical influence of timing in realizing gains from PIPE investments in SPACs. In addition, Table 4 shows CARs for PIPE investments across investor types before and after BC announcements. Hedge funds show the highest overall CAR of 9.66%, with strong pre-BCA returns of 11.29%. However, it declines to -1.84% post-BCA, suggesting early market timing advantages. Mutual funds demonstrate similar success with pre-BCA returns of 9.30% and an overall CAR of 9.04%, reflecting institutional investor confidence. Broker-dealers and financial institutions achieve pre-BCA returns of 6.83%, showing effective early market positioning. PE and VC firms, despite frequent participation with 115 deals, show modest returns of 2.21% overall, improving from 1.93% pre-BCA to 4.54% post-BCA. Corporate investors experience declining performance from 2.59% pre-BCA to -1.44% post-BCA. Individual investors and

sovereign wealth funds achieve notable post-BCA returns of 8.03% and 7.71%, respectively, although with limited transaction frequency.

Overall, my findings suggest that market reactions to PIPE investments differ across investor types and vary between pre- and post-BC announcements.

[Insert Table 4]

5.3 Multivariate tests

In this section, I want to conduct multivariate regressions to examine market reactions to PIPE transactions.

$$Y_i = \beta_1 \text{HF PIPE}_i + \beta_2 \text{PE/VC PIPE}_i + \Gamma \cdot X_i + FE + \varepsilon_{i,t} \qquad (1)$$

The dependent variable, *Y*, is cumulative abnormal returns within the [-2, +2] window surrounding PIPE announcements. The key independent variables include $HF\ PIPE$, an indicator variable equal to 1 if the largest PIPE investor is a hedge fund, and *PE/VC PIPE*, an indicator variable equal to 1 if the largest investor is a private equity or venture capital firm. We control for ln(IPO Proceeds), the natural logarithm of SPAC IPO proceeds. Standard errors are clustered by SPAC IPO year, and the model incorporates year fixed effects.

[Insert Table 5]

Table 5 presents multivariate regression results across three specifications. The pre-BCA analysis reveals hedge fund participation is associated with positive abnormal returns of 4.6%, significant at the 5% level, whereas PE/VC investments show negative returns of -

3.8%, significant at the 1% level. The post-BCA period exhibits reversed but statistically insignificant effects. The full sample indicates that PE/VC investments yield negative returns of -2.6%, significant at the 5% level, whereas hedge fund participation shows positive yet insignificant returns of 3.7%. IPO proceeds show no significant relationship with CARs across specifications. Overall, these results indicate systematic variation in market reactions to PIPE investments based on the investor type and announcement timing relative to the BCA period.

6. Conclusions

This study examined PIPE investments' role during the SPAC period. I found that PIPE transactions have positive announcement returns. Furthermore, the positive market reactions to PIPE investments are more evident for pre-BC announcement timing relative to BC announcements than post-BC announcements. Additionally, the market reactions vary with investor types. Hedge funds generate positive market sentiment in the pre-BCA period, likely due to their expertise in capitalizing on short-term value opportunities. Conversely, PE and VC investments initially face market skepticism but show improved performance post-BCA, reflecting their potential for long-term strategic value creation. These findings contribute to our understanding of how different investor types influence SPAC outcomes and highlight the importance of timing in PIPE investment strategies.

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Figure 1. SPAC timeline

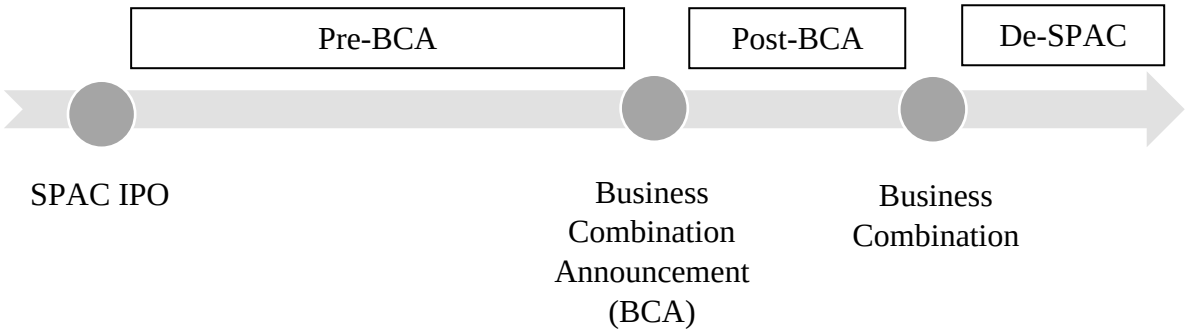

Figure 2. Announcement returns around common stock PIPE transactions

Cumulative Abnormal Return (CAR) is calculated within the window [-2, +2] surrounding the common stock PIPE transactions.

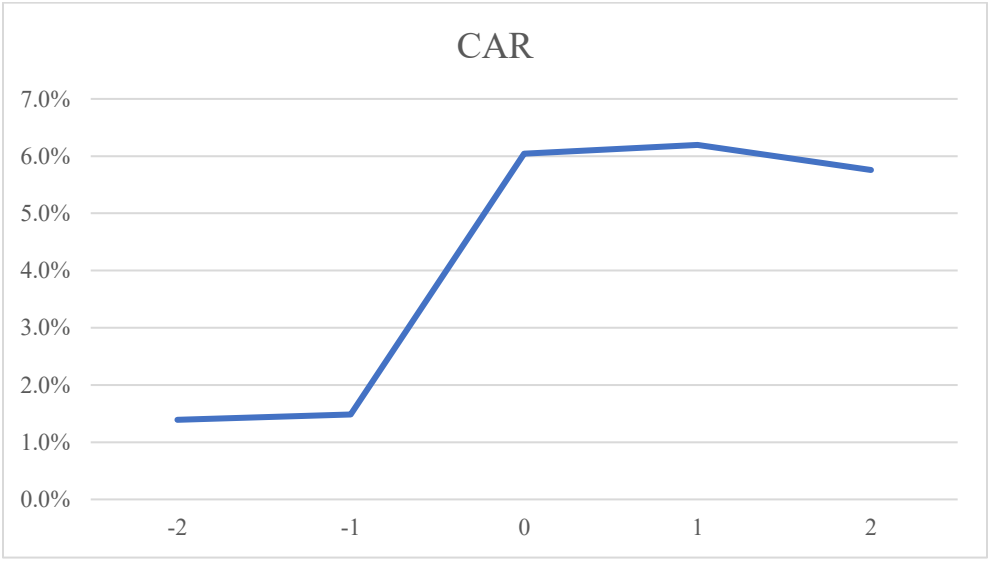

Table 1. Security types of PIPE transactions in SPAC

The table shows the summary statistics of proceeds of each security type of PIPE transactions in SPAC during the period from 2015 to 2023. All issuance amounts are reported in billions of USD.

Security Type	No.	Mean	p25	p50	p75
At-the-Market Offering	115	126.61	50.00	100.00	150.00
Common Stock	779	141.86	9.64	50.00	165.00
Debt: Convertible	141	141.54	10.90	30.00	150.00
Debt: Non-Convertible	10	74.85	3.00	18.56	132.30
Equity Line	77	134.23	50.00	100.00	125.00
Other: Convertible	2	7.25	4.50	7.25	10.00
Preferred Stock: Convertible	65	67.98	10.00	25.00	75.00
Preferred Stock: Non-Convertible	1	163.35	163.35	163.35	163.35
Prepaid Warrant	358	9.79	6.60	8.05	10.28
Total	1,548	106.10	8.00	25.00	116.00

Table 2. Analysis of common stock PIPE transactions per year

This table displays the total number of common stock PIPEs, the proportion of proceeds from common stock PIPEs to SPAC IPO proceeds by year. The %Discount is computed as [{1 – (PIPE offer price/SPAC IPO Price) *100}]. IPO proceeds are described in billions of USD.

Year	Frequency	IPO Proceeds	%IPO proceeds	%Discount
2015	8	132.25	11.29	19.17
2016	13	384.26	45.29	0.93
2017	21	287.84	29.77	14.48
2018	32	281.28	31.46	6.37
2019	43	261.07	25.13	8.16
2020	152	290.24	59.49	3.09
2021	314	294.94	60.53	1.60
2022	84	221.98	36.19	23.40
2023	112	272.22	14.00	54.84
Total	779	280.08	46.28	12.97

Table 3. Leading Investors in SPAC by investment size

This table shows the investment size and type of investor participation across repeated PIPE offerings. The table above displays the investment size in millions of USD and the number of observations for each investor type.

Investor Type	Investment Size ($mil)	Frequency
Broker-Dealer	28.58	4
Corporate Insider/Affiliate	12.60	9
Corporation/Strategic	86.40	54
Financial Institution	76.12	39
Foreign Investment House	25.44	8
Hedge Fund	48.28	153
Individual Investor	18.99	8
Insurance Company	178.33	3
Mutual Fund	71.10	43
Private Equity/Venture Capital	78.07	115
Sovereign Wealth Fund	87.57	6
Trust/Endowment/Pension/Family Office	22.35	9
Unknown	60.63	5
Total	64.21	456

Table 4. Cumulative abnormal return on the announcement of PIPEs

The table presents the CAR for all common stock PIPE investments within the window [-2, +2] surrounding the PIPE transaction announcement dates, characterized by the investor types. Pre-BCA refers to PIPE transactions that occur before the announcement of the BC, whereas Post-BCA refers to those that occur after the announcement of the BC.

	Whole		Pre-BCA		Post-BCA	
Investor type	Mean	Freq.	Mean	Freq.	Mean	Freq.
Broker-Dealer	5.00%	4	6.83%	2	3.18%	2
Corporate Insider/Affiliate	3.54%	9	5.97%	5	0.51%	4
Corporation/Strategic	2.14%	54	2.59%	48	-1.44%	6
Financial Institution	6.60%	39	6.83%	37	2.34%	2
Foreign Investment House	1.75%	8	2.33%	5	0.78%	3
Hedge Fund	9.66%	153	11.29%	134	-1.84%	19
Individual Investor	-0.49%	8	-1.71%	7	8.03%	1
Insurance Company	3.44%	3	3.90%	2	2.52%	1
Mutual Fund	9.04%	43	9.30%	39	6.44%	4
Private Equity/Venture Capital	2.21%	115	1.93%	103	4.54%	12
Sovereign Wealth Fund	1.70%	6	0.49%	5	7.71%	1
Trust/Endowment/Pension/Family Office	0.85%	9	1.34%	5	0.24%	4
Unknown	11.41%	5	-0.88%	2	19.60%	3
Total	5.79%	456	6.37%	394	2.10%	62

Table 5. Multivariate regressions on market reactions to announcements of PIPEs

This table presents the displays of OLS regressions analyzing market reactions to the announcements of common stock PIPE transactions. The first column represents the full sample, the second column focuses on PIPE transactions occurring before the BC announcement, and the third column includes PIPE transactions occurring after the BC announcement. The dependent variable is the CAR for all common stock PIPE investments within the window [-2, +2] surrounding the PIPE transaction announcements. *HF* is a dummy variable equal to 1 if the largest investor in the PIPE transaction is a hedge fund, and 0 otherwise. *PE/VC* is a dummy variable equal to 1 if the largest investor is a private equity or venture capital firm, and 0 otherwise. *ln(IPO Proceeds)* represents the natural logarithm of total proceeds from the corresponding SPAC IPOs. Year fixed effects are included. ***, , and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)
VARIABLES	Whole	Pre-BCA	Post-BCA
HF	0.037	0.046**	-0.081
	(0.021)	(0.017)	(0.046)
PE/VC	-0.026**	-0.038***	0.005
	(0.010)	(0.008)	(0.073)
Ln(IPO Proceeds)	-0.041	-0.057	-0.008
	(0.046)	(0.062)	(0.035)
Constant	0.847	1.200	0.222
	(0.889)	(1.227)	(0.652)
Year FE	Yes	Yes	Yes

Observations	456	394	62
R-squared	0.072	0.110	0.109