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Abstract

Special purpose acquisition companies (SPACs), which have existed in the United States in some form or another since the 1980s, reached new heights of popularity in 2020. By the very next year, SPACs dominated the IPO scene and became the primary vehicle for a private firm seeking to go public. However, by 2022, the popularity of SPACs had already begun to show signs of significant decline. The uniquely rapid rise and fall of SPACs' relevance in financial markets warrants investigation into their popularity and usefulness, especially given how recently this phenomenon occurred. This paper provides a background on the SPAC structure alongside some of the key regulations that underpin it. In addition, SPAC initial public offerings are analyzed to characterize the rate of success that these companies have in going public and the primary drivers thereof. Next, the returns generated by SPACs are examined to determine how well they perform. Finally, in light of the preceding analysis, this paper discusses whether any clear factors that explain SPAC popularity are identified and proposes what the future may hold for SPACs, given the latest empirical evidence, trends, and media coverage. This paper employs an analysis of a cross-sectional data sample that is generally larger than that of other influential papers on the topic, including Zhang, Ritter, and Gahng (2021) and Klausner, Ohlrogge, and Ruan (2022), making it a unique entry into this space of empirical research.

Special Purpose Acquisition Companies (SPACs), die in den Vereinigten Staaten in der einen oder anderen Form seit den 1980er Jahren existieren, erreichten im Jahr 2020 einen neuen Höhepunkt der Popularität. Schon im nächsten Jahr dominierten SPACs die IPO-Szene und wurden zum Hauptvehikel für eine Privatunternehmen, das den Börsengang anstrebt. Allerdings zeigte die Popularität von SPACs bereits im Jahr 2022 Anzeichen eines deutlichen Rückgangs. Der einzigartig schnelle Anstieg und Rückgang der Bedeutung von SPACs auf den Finanzmärkten erfordert eine Untersuchung ihrer Beliebtheit und Nützlichkeit, insbesondere angesichts der Tatsache, dass dieses Phänomen erst vor kurzem aufgetreten ist. Dieses Papier bietet einen Hintergrund zur SPAC-Struktur sowie einige der wichtigsten Vorschriften, die ihr zugrunde liegen. Darüber hinaus werden SPAC-Börsengänge analysiert, um die Erfolgsquote dieser Unternehmen beim Börsengang und die Haupttreiber dafür zu charakterisieren. Als nächstes werden die von SPACs generierten Renditen untersucht, um festzustellen, wie gut sie abschneiden. Abschließend wird in diesem Papier im Lichte der vorangegangenen Analyse erörtert, ob eindeutige Faktoren identifiziert werden, die die

Beliebtheit von SPACs erklären, und Vorschläge gemacht, was die Zukunft für SPACs angesichts der neuesten empirischen Erkenntnisse, Trends und Medienberichterstattung bereithalten könnte. Dieser Artikel verwendet eine Analyse einer Querschnittsdatenstichprobe, die im Allgemeinen größer ist als die anderer einflussreicher Artikel zu diesem Thema, darunter Zhang, Ritter und Gahng (2021) und Klausner, Ohlrogge und Ruan (2022), was ihn zu einem macht einzigartigen Einstieg in diesen Bereich der empirischen Forschung.

Introduction

Recent years have witnessed the rapid growth in popularity of special purpose acquisition companies, or “SPACs,” in the U.S. market, with these entities accounting for, in some years, roughly up to three-quarters of all initial public offerings (IPOs).¹ SPAC acquisitions cover a span of companies, from small firms in niche industries to widely recognized names across the U.S. market, such as BuzzFeed, Jamba Juice, DraftKings, and 23andMe. The public spotlight on SPACs has intensified, with recognizable figures like Shaquille O’Neal, Martha Stewart, Jay-Z, and Steph Curry seeking involvement in SPAC-based deals.² Proponents of SPACs cite various factors that make these entities valuable in capital markets, including fairer valuations and quicker time-to-market for target firms and positive returns for investors.³ Despite such incentives, media reports in the summer of 2022 declared that “The SPAC boom is officially a thing of the past.”⁴ The ephemeral nature of SPACs warrants an extensive study, especially in light of how ubiquitous these entities had become and how meteoric the growth in SPAC capital holdings had been.

This paper provides analysis surrounding the landscape for SPACs and the returns that they generate to shareholders. In general, this paper addresses whether the proliferation of SPACs was justified by the benefits they offer or if SPACs essentially constituted a bubble which eventually burst due to its fundamental shortcomings. To investigate this, blank check

¹ “Earning the premium: A recipe for long-term SPAC success,” McKinsey & Company, 2020, https://www.mckinsey.com/~/media/McKinsey/Industries/Private%20Equity%20and%20Principal%20Investors/Our%20Insights/Earning%20the%20premium%20A%20recipe%20for%20long%20term%20SPAC%20success/Earning-the-premium-A-recipe-for-long-term-SPAC-success_vF.pdf.

² <https://news.crunchbase.com/public/athletes-and-celebrities-join-the-spac-boom-sec-takes-notice/>; <https://www.cnbc.com/2020/09/29/indoor-farming-start-up-appharvest-joins-the-spac-craze-to-go-public.html>; <https://www.businessinsider.com/jay-zs-roc-nation-enters-into-partnership-top-cannabis-spac-2020-11>

³ Bazerman, M. & Patel, P. *SPACs: What You Need to Know*. Harvard Business Review, July-August 2020, <https://hbr.org/2021/07/spacs-what-you-need-to-know>.

⁴ Li, Y. *SPAC market hits a wall as issuance dries up and valuation bubble bursts*. CNBC, 2022, <https://www.cnbc.com/2022/08/03/spac-market-hits-a-wall-as-issuance-dries-up-and-valuation-bubble-bursts.html>.

company data was retrieved from the SEC and supplemented with IPO, merger, and share price data. The analysis proceeds as follows: first, SPAC IPOs are examined to identify trends in popularity, size, and success rates. A logistic regression model is specified wherein binary IPO outcomes (success or failure) are regressed against the primary variable characteristics of the IPO: the offering size, the size of the available over-allotment, fees, warrants, and a binary classification for the IPO's underwriter that captures the bank's status as a bulge bracket or boutique bank. The model reveals that larger over-allotments and a larger fractional warrant included in the offering positively impact the likelihood of the success of the IPO, while time-fixed effect variables reveal that IPOs were less likely to succeed during the 2007-2008 subprime mortgage crisis. An OLS model is also specified wherein the amount of the over-allotment available in the offering is regressed against the same explanatory variables, as this represents the market demand for the security and acts as another indicator of IPO success. Only the fees regressor appears as significant, confirming that as accrued IPO fees rise, investors may demand fewer shares. A number of possible explanations for the economic interpretation of the significant variables in both models are provided.

Next, the returns yielded by SPAC equities are analyzed across a variety of different holding periods that span from the IPO to as far as 180 days post-merger. Returns are annualized to create comparability between different holding periods and to align SPACs with different measures of elapsed time in completing various milestone activities. In addition, a logarithmic transformation is applied in the calculation of returns, both to align to what is customary in other literature and to soften the impact of a handful of highly positive outliers. This analysis reveals that the long-term returns for an investor who enters the SPAC during the IPO are poor. The average logarithmic rate of return to SPAC equity 180 days after its merger deal has been completed is -27%. Furthermore, returns improve as the holding period gets shorter, but remain meager, which implies that optimal shareholder strategy likely includes redeeming shares or trading them on the secondary market, thereby exiting the SPAC while retaining warrants. This may not suit retail investors who may prefer a buy-and-hold strategy and may be less equipped than their institutional counterparts to track deadlines for shareholder redemptions.

The paper concludes with a characterization of the future of SPACs. First, there is acknowledgement that some of the advertised benefits of SPACs for target companies are genuine. On average, while the first day returns for SPACs are generally positive, implying some degree of underpricing of their securities, they are smaller than those for companies

who elected to go public via a traditional IPO. This suggests that SPACs receive a fairer valuation and are subject to a lesser degree of underpricing, an outcome that is true both for the pre-merger SPAC and the post-merger de-SPAC company. Additionally, the time between a SPAC merger announcement and completion of the deal is roughly half of the time required to complete a traditional IPO. However, financing the merger with an equity consideration ensures that target company shareholders bear some of the dilution inherent in SPACs. Given these results, the paper finds that the SPAC structure benefits sponsors, is perhaps sub-optimal for IPO investors, and provides an inconclusive return for target firms. From these mixed outcomes, especially for investors and target firms, it is difficult to understand why SPACs became so popular in the first place. The relative implosion in popularity that ensued in 2022 makes considerably more sense and provides a more realistic outlook on SPAC popularity moving forward.

In Part I of this paper, the mechanics and history of SPACs are covered, including popular perceptions around specific elements of SPAC functionality. In Part II, the landscape of the SPAC industry is wrought out in empirical detail. In Part III, the drivers of SPAC IPO outcomes are analyzed to determine what influences a successful offering. In Part IV, SPAC merger deals, and, more specifically, the returns generated for investors at the IPO stage through various later-stage milestones, are examined to illustrate empirically how well these entities perform. On the basis of this data, the future for SPACs is discussed in Part V.

I. SPAC Mechanics and History

A. SPAC Lifecycle

The U.S. Securities and Exchange Commission (SEC) characterizes a SPAC as “a company with no operations that offers securities for cash and places substantially all the offering proceeds into a trust or escrow account for future use in the acquisition of one or more private operating companies.”⁵ The lifecycle for such a company can be decomposed into four constituent phases: SPAC formation; initial public offering; target search and negotiation; and merger and post-merger operations.

1. Formation

⁵ U.S. Securities and Exchange Commission, Division of Corporate Finance. *CF Disclosure Guidance: Topic No. 11*, 2020. <https://www.sec.gov/corpfin/disclosure-special-purpose-acquisition-companies>

SPAC formation and organization is initiated by its sponsor — the entity which pools founding capital to cover start-up costs, approves members of its board of directors, and allocates founding shares to its members. The sponsor files form S-1 (or F-1, if it is a foreign entity) with the SEC, which is a registration statement required under the Securities Act of 1933. This document, which may be amended in subsequent filings as needed, defines the foundation and scope of the SPAC, including key personnel and their credentials, potential conflicts of interest within the SPAC’s management team, the industry/industries that will be a focus for acquisition, and the terms of the IPO, amongst other items.

Regarding the IPO, the specific securities on offer can be located on the S-1 form. Here, the sponsor confirms how many units are for sale, as well as each unit’s constituent pieces. A unit is defined as a share, generally consisting of Class A Common Stock bundled with some amount of warrants or rights. A warrant is effectively an option contract that allows the holder to be issued new stock at a specified price within a specified period of time (rights tend to function very similarly). Most commonly, units are issued with fractional warrants, with a caveat that only full warrants may be exercised. While SPACs may offer only common stock in the IPO, a unit-based offering has become the gold standard.

As compensation for undertaking the SPAC’s formation, the sponsor is entitled to later receive the “promote.” The SEC defines this compensation as a 20% stake of the SPAC’s post-IPO proceeds, which is only received once a successful merger occurs.⁶ Within the S-1 filings themselves, the promote is generally defined a bit more granularly as the conversion of Class B founder shares issued to the sponsor at the time of formation into Class A common shares at such a ratio that will yield the 20% stake.

2. Initial Public Offering

The SPAC IPO, once consummated in conjunction with the underwriter(s) listed as representatives in the SPAC’s registration forms, is made known by filing form 8-K with the SEC. This document contains the quantity and price at which the SPAC’s offered shares were sold, the extent of the over-allotment (if any) that was exercised, and the gross proceeds from the IPO. Generally, the underwriter will engage in a fixed commitment offering, in which they purchase all shares on offer from the SPAC before selling them to public investors. As a form of compensation for this commitment, underwriters benefit from the spread, which can

⁶ U.S. Securities and Exchange Commission, Release 33-11048. March 30, 2022, <https://www.sec.gov/rules/proposed/2022/33-11048.pdf>, p. 9, footnote 11.

be characterized as discounts and commission earned on the stock purchased. Essentially, the underwriter will purchase the stock on offer from the SPAC at a price lower than what it sells the same stock to investors at.

Proceeds from the IPO are placed into a trust account and invested in interest-bearing fixed-income instruments, commonly Treasury notes.⁷ Neither the interest generated on the trust account nor the principal funds themselves may be used in any way, except for to pay income taxes in the case of the fund's interest, or, with regard to the principal funds, to either enact a merger or to pay redeeming shareholders, as discussed later in this paper.⁸

The units sold during the IPO remain intact and subject to some lockup period before they may begin to trade on secondary markets. Additionally, the constituent stocks and warrants that comprise the units may also begin trading on the secondary market under their own symbols at some later date. Generally, the units, stocks, and warrants are all listed on the SPAC's S-1 form alongside their corresponding trading symbols.

3. Target Search

After the IPO succeeds, the SPAC's sponsor may begin the search for a suitable target for acquisition, which, once completed, is often referred to as the initial business combination. SPACs will have until their pre-defined expiration date to negotiate a successful deal, unless shareholders vote to extend to the SPAC's deadline. While the sponsor may suggest industries and regions in its prospectus in which it will focus the target search, most documentation also provides the key clarification that the SPAC may pursue a merger in any industry or region whatsoever.⁹ This is a unique feature of SPACs, as shareholders have only some small indication of what business they are getting into, with no guarantees or legal protections confining the sponsor to negotiations within a certain scope.

If the sponsor is unable to negotiate a successful deal with a potential target, and shareholders do not vote to extend the SPAC's lifespan, then the SPAC must cease all operations. At this point, the trust account is liquidated, with shareholders receiving a pro-rata

⁷ Klausner, M., Ohlrogge, M., & Ruan, E. *A Sober Look at SPACs*, Yale Journal on Regulation, 2022. <https://law.stanford.edu/wp-content/uploads/2022/07/2022-01-24-A-Sober-Look-At-SPACs-Yale-Journal-on-Regulation.pdf>, p. 237.

⁸ Information sourced from across various SPAC S-1 filings. For an example, refer to ARYA Sciences Acquisition Corp III filing on July 21, 2020, section "SUMMARY", subsection "Proceeds to be held in trust account" on page 14, accessed via the SEC EDGAR database, https://www.sec.gov/Archives/edgar/data/1808805/000114036120016469/nt10013610x1_s1.htm.

⁹ ARYA S-1 filing, section "SUMMARY", subsection "General", p. 2.

share of the total account balance. The warrants or rights held by shareholders become worthless at this point.

4. Merger and Post-Merger

Upon finding a suitable target for acquisition, the sponsor will enter into a phase of due diligence and negotiation. Most SPAC prospectuses acknowledge a risk factor at this juncture, namely that the SPAC's pre-defined expiration date provides the target company with leverage in negotiations that may allow them to push for a higher valuation or more accommodating terms in the merger.¹⁰ The consideration for the merger is also defined, and may consist of equity, cash, or some combination thereof. Once approved by the target firm, the two companies enter into a Business Combination Agreement, and again file with the SEC. Here, items such as the pre-transaction equity value of the target firm, or the post-transaction merged company's board composition may also be defined.

If the sponsor desires to proceed with a merger, then a motion is put in front of shareholders who may vote accordingly. The outcome of the vote, as well as how many shares were represented during the vote, is made public in a subsequent 8-K filing. This vote introduces another unique feature of SPACs: shareholders may vote to proceed with the merger while simultaneously redeeming their shares in the SPAC. Redemption entitles the shareholder to exchange their share(s) for a pro-rata portion of the trust account, while still permitting the shareholder to retain any warrants or rights they may possess. High shareholder redemption rates often push the sponsor to locate additional funding with which to complete the deal, and this usually takes the form of private investment, or "PIPE" investment. The structure of PIPE financing varies. Financiers may invest at a discount or may be compensated by the sponsor in the form of an equity transfer.¹¹

Should the proposal be voted down, the SPAC will begin searching for a new target and the process begins anew. If the proposal is approved, the merger moves forward in what is known as the "de-SPAC" process. Generally, deals are structured as a form of a reverse merger, wherein SPAC shares are converted to shares in the post-merger entity, shares and options in the target firm are similarly converted, and the new trading symbol is defined. The funds in the SPAC's trust account can then be injected into the post-merger company for general business purposes. At this point, the target company is effectively operating as

¹⁰ ARYA S-1 filing, section "RISK FACTORS", p. 31.

¹¹ Klausner, Ohlrogge, & Ruan. *A Sober Look at SPACs*. p. 238.

before, albeit now as a public entity, subject to greater regulation and scrutiny, but with more working capital from the de-SPAC transaction.

B. Uniformity in SPAC Terms

Many elements pertaining to the formation, offerings, and financing of SPACs and their acquisitions have become standardized in recent years. Table 1 summarizes these items:

Table 1: Standardized SPAC features

IPO offering	Units, consisting of common stock and warrants
IPO unit offering price	\$10/unit
Overallotment available	15% of gross offering
Underwriter spread	5.5%
Warrant strike price	\$11.50
Warrant expiration timeframe	5 years
SPAC expiration timeframe	24 months (unless extended via vote)
Sponsor promote	20% of post-IPO/pre-merger SPAC value
PIPE financing	Required

Regarding the SPACs themselves, initial financial statements all tend to share a similar composition, with negative net income and significant debt accrual, often taking the form of offering costs shouldered by the sponsor. Of course, this is of little surprise given the defining nature of SPACs at this stage as companies with no idiosyncratic business operations. Additionally, a significant portion of SPACs are incorporated in the Cayman Islands in order to take advantage of certain tax benefits¹², which potentially lessens the impact of trust account withdrawals to shareholders.

C. Dilution

Inherent in the SPAC structure outlined above are various mechanisms of dilution impacting the value of equity. Often, registration documents identify these mechanisms for the benefit of shareholders, but the impact thereof may not be explicitly quantified. Typically, SPAC dilution comes in the form of underwriting fees, warrants, the sponsor's promote, and PIPE financing. A paper published in 2020 examined forty-seven SPACs that completed a business combination between January 2019 and June 2020 in an effort to measure the

¹² Appleby Global. *The use of Cayman Islands Structures for SPAC IPOs*.
<https://www.applebyglobal.com/publications/the-use-of-cayman-islands-structures-for-spac-ipos/>

average impact of these mechanisms and determine how the cost of dilution was borne throughout the company.¹³ Ultimately, the study finds that the median SPAC only bears \$5.70 per share in net cash at the time of the initial business combination, and concludes that non-redeeming shareholders bear the brunt of this value reduction. This is due to the fact that these shareholders buy into the SPAC at \$10 per share and subsequently give up nearly half of that value to dilution.

D. SPAC Regulation

SPACs began to emerge in the 1990s¹⁴ as an alternative to blank check companies which proliferated in the 1980s and offered penny stocks, and which had already been regulated under rule 419 of the Securities Enforcement Remedies and Penny Stock Reform Act of 1990 (PRSA). This regulation imposed stricter filing and disclosure rules for blank check companies in an effort to tamp down fraudulent behavior that had begun to spread throughout the penny stock industry, illustrated perhaps most notably in the exploits of Jordan Belfort, the founder of the Stratton Oakmont brokerage house, who was chronicled in the 2013 Hollywood film *The Wolf of Wall Street*. SPACs, as new legal entities, were not subject to rule 419's requirements, yet adhered to most of the requirements outlined therein anyway.¹⁵ In this way, the SPAC became a re-branding of its predecessor, the blank check company, and as empirical data shows, continued its slow and steady growth through the 1990s and early 2000s until exploding in 2020 and 2021.¹⁶ The SEC has since given voice to dissatisfaction with the current level of regulation governing SPAC disclosure and has issued proposed measures to clarify and better illustrate the conflicts of interest and risks inherent in the SPAC structure, such as the dilution structure covered above.¹⁷

Critics of the SPAC structure point to a different flaw that they believe warrants additional regulation and yet has not been addressed. This is the problem of the “empty vote,” first characterized in a 2006 paper by Henry T. C. Hu and Allan Shivers Chair, two professors from the University of Texas Law School, and later discussed in a 2022 paper co-authored by Usha Rodrigues and Michael Stegemoller, professors at the University of

¹³ Klausner, Ohlrogge, & Ruan. *A Sober Look at SPACs*

¹⁴ Heyman, D. *From Blank Check to SPAC: The Regulator's Response to the Market, and the Market's Response to the Regulation*. Entrepreneurial Business Law Journal, vol. 2, no.1, 2007, pp. 523-533.

¹⁵ Heyman, D. pp 540; U.S. Securities and Exchange Commission, Release 33-11048, pp. 9-10

¹⁶ See empirical data below, Part II.

¹⁷ U.S. Securities and Exchange Commission, Release 33-11048, p. 16

Georgia and Baylor University respectively.¹⁸ The empty vote issue effectively captures the shareholder conflict of interest in voting to approve a merger while simultaneously exiting the SPAC by redeeming shares. These papers reference the 1988 Delaware case *Blasius Industries, Inc. v. Atlas Corp.*, which examined the validity of holding a shareholder vote to prevent the expansion of the Atlas Corporation's board. Extrapolated beyond this myopic scope, Hu and Chair reference the judicial opinion that shareholder votes constitute the core basis for legitimate authority over a company,¹⁹ and Rodrigues and Stegemoller suggest that the de-coupling of shareholder votes and their stake in the SPAC undermines this authority, further suggesting that no amount of SEC-mandated disclosures would help retail investors receive fair treatment when investing in SPACs.²⁰ While the SEC has acknowledged the problem of the empty vote,²¹ no regulatory changes beyond those to the level of disclosure have been suggested.

The level of regulation around SPACs remains a topic of intense debate, with some researchers suggesting that current requirements are sufficient and that increased regulation may only force capital to flow through other markets instead.²² The SEC's own point of view on the matter appears to be one that straddles the fence; a willingness to try and make the risks and uncertainties of SPACs more concrete and plainly stated, while leaving the underlying structure of the SPAC untouched.

II. The SPAC Landscape

A. Data and Sources

The empirical data that follows in this paper is the author's own work, unless otherwise noted, and is sourced primarily from three repositories: the SEC's Electronic Data Gathering, Analysis, and Retrieval System (EDGAR); S&P Capital IQ, which is the research division of S&P Global, a provider of ratings, data, and research; and the Center for Research in Security Prices (CRSP). While a variety of informative proprietary third-party SPAC aggregation services are available (such as SPACtrack.io or SPACresearch.com), reliance on

¹⁸ Hu, H. & Black, B. *The New Vote Buying: Empty Voting and Hidden (Morphable) Ownership*. Southern California Law Review, Vol. 79, 2006, pp. 811-908; Rodrigues, U. & Stegemoller, M. *Disclosure's Limits*. Yale Journal on Regulation, Vol. 40:37, 2022, pp. 37-43

¹⁹ Hu & Black, p.816

²⁰ Rodrigues & Stegemoller, pp. 41-42

²¹ US Securities and Exchange Commission, Release 33-11048, p.14, reference footnote 29

²² Heyman, D. p. 551.

these outlets was eschewed to avoid any possible selection bias or confounding influences that might stem from relying on a data sample of unknown origin.

The SEC EDGAR database provided the foundation for all subsequent analysis. Within the SEC, all registered companies are assigned a four-digit Standard Industrial Classification (SIC) code. Code 6770 has been set aside for blank check companies/SPACs; however, after the initial business combination, SPACs may inherit the SIC code aligned to their merger target's area of operations. For example, Roth CH Acquisition II Co., a SPAC formed in 2020, merged in 2021 with Reservoir Media, Inc., a female-founded independent music company operating, and is currently listed under SIC code 7900, the designation for Amusement and Recreation Services. From this basis, the foundational population of SPACs for consideration was created. All companies listed under the 6770 SIC code were pulled into the working dataset, as well as any companies from outside this designation, but who have a S-1 form on file containing indications of a previous 6770 designation. It should be noted that this may not paint a complete picture of SPAC activity registered under the SEC, as SPACs headquartered in foreign countries but registering for the ability to trade on U.S. exchanges would file form F-1. However, given the relative geographic dominance of SPAC activity originating in the U.S., this data should contain a significant majority of SPACs.

At this stage, the data was further refined through the use of S&P Capital IQ (SPCIQ), both directly through the subscription-based website as well as through the companion Excel plug-in. First, SPACs were sorted out from possible misfit companies that received SIC code 6770 as a function of proximity rather than accuracy. This is to say that, amongst certain unique and niche outlier companies, some financial services companies such as asset management firms can also be found under the same SIC code but are clearly not appropriate for the study. To sort out such firms, the data was augmented with the SPAC status field from SPCIQ; if the SPAC status was not populated for the given company, they were filtered out from the dataset. No limitations were placed on timeframe, which sets this study apart from some of the leading literature in this space, such as the influential 2022 Klausner, Ohlrogge, and Ruan paper "A Sober Look at SPACs," which examines fewer than 50 SPACs. In contrast, the initial working population for this paper consisted of over 2,520 qualifying companies. Additional SPAC-level information was pulled in from SPCIQ as well, such as the SPAC expiration date and the target industries in which it would seek a merger, as listed in the prospectus. Note, SPCIQ applies some categorization when storing the target

industries, which is to say that these may not reflect the industries verbatim as written in the prospectus but may instead be sorted into pre-defined buckets established by SPCIQ.

IPO and merger transactional data was then added into the dataset. SPCIQ stores transaction-level identifier keys from which corresponding data can be retrieved. As a SPAC generally will only attempt an IPO once, only the first IPO transaction key was considered. Using this key, various elements such as the IPO announcement and completion dates, the lead underwriter, the size of the offering, various fees, some pre-IPO financial information, and the warrants included in the IPO were pulled in. SPCIQ did not have IPO information for every SPAC in the initial population — only 1,596 IPOs were studied, representing roughly 63% of the initial population. Some of this is correctly captured in the fact that not every SPAC had made it to the IPO stage at the time of the study and was in its pre-IPO stage. However, in other cases, SPCIQ simply did not have the information; this was more commonly observed with older, pre-2000s SPACs.

As it pertains to merger transactions, a SPAC may attempt or even consummate multiple mergers in its lifespan, though most only complete a single merger. In our dataset, only the earliest completed merger was considered, along with any other terminated deals that may have occurred beforehand. Within the analyzed population, all SPACs that were able to consummate a merger did so within the first three attempted deals, and usually on the first attempt. Additional data were pulled in using the transaction keys for these first three deals as applicable, which included the SPAC target (often listed as the buyer, given the reverse merger structure of deals), the deal announcement, closure, and, where applicable, the termination dates, and the value of the deal. While additional data would have been desired, such as the deal's specific equity and cash considerations or the level of PIPE financing required, the data was not available for a large enough subset of the population to warrant inclusion. Of 718 SPACs that SPCIQ recorded in the de-SPAC status, 694 companies had available merger deal information.

Finally, the data was complemented with pricing information from CRSP, from which shareholder returns were calculated and compared. Understanding the value of the investment to shareholders throughout the lifecycle of a SPAC was of significant importance to this study. Of the 694 SPACs with deal data, most of which did successfully complete a merger, only 451 SPACs were located in the CRSP database. Part of this disparity may be explained by the time lag observed in the CRSP data. At the time of the study, the available CRSP data

only went through June 30, 2022, which introduces a significant gap between the SEC and SPCIQ data, which are more reflective of real-time conditions. There are some additional limitations; where necessary, a crosswalk was created to link time series data for the pre-merger SPAC, under one identification number, to the data for the post-merger entity, which, in some cases, was logged under a different identification number. In some cases, no post-merger identifier could be located, and the time series cuts off shortly after the merger date. For such firms, returns were calculated only where possible, depending on the relevant holding period for examination. Information on the mathematical formulas used in calculating returns can be found in the Appendix.

B. The Rise of the SPAC

1. Agents and Motivation

As already noted, SPACs began to emerge in the 1990s in response to tightening regulation around their predecessors, blank check companies offering penny stocks. Under the guise of willful adherence to Rule 419 of the PRSA, SPACs slowly began to garner investor confidence. Eventually, this was reflected in the participation of larger investment banks entering into the SPAC underwriting sphere, which Michael Stegemoller cites as a primary driver of the growing interest of venture capitalists in SPACs in a 2022 New York Time Article.²³ The data supports this sentiment in some form, with more parity in the underwriting market prior to 2017, which began to consolidate at the top in 2018, even despite the existence of a still relatively fragmented market. Effectively, larger banks took a larger share of the underwriting market, and whatever was left over fell to various smaller banks, which is reflected in Figure 1 and Figure 2.

²³ Goldstein, M. “*SPACs Were All the Rage. Now, Not So Much*”, The New York Times, June 2, 2022, <https://www.nytimes.com/2022/06/02/business/spacs-inflation-regulation.html>

Figure 1: Shares of underwriting market prior to late 2010s SPAC boom

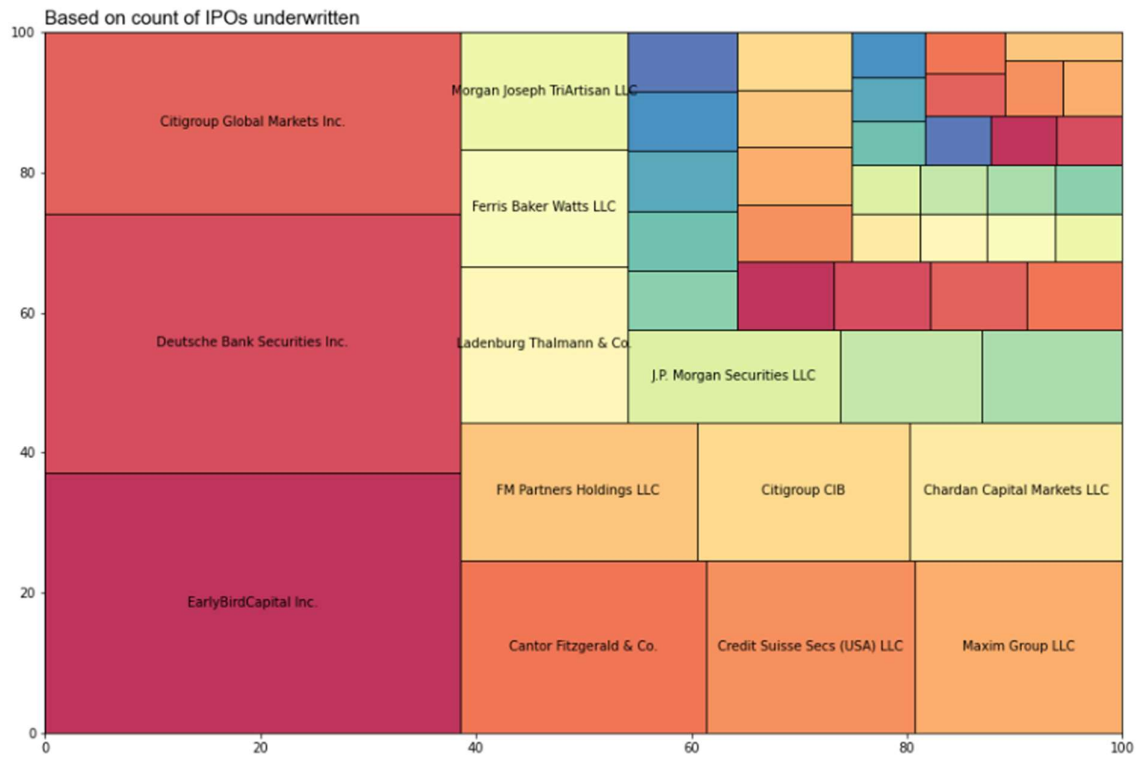


Figure 2: Shares of underwriting market at onset of late 2010s SPAC boom

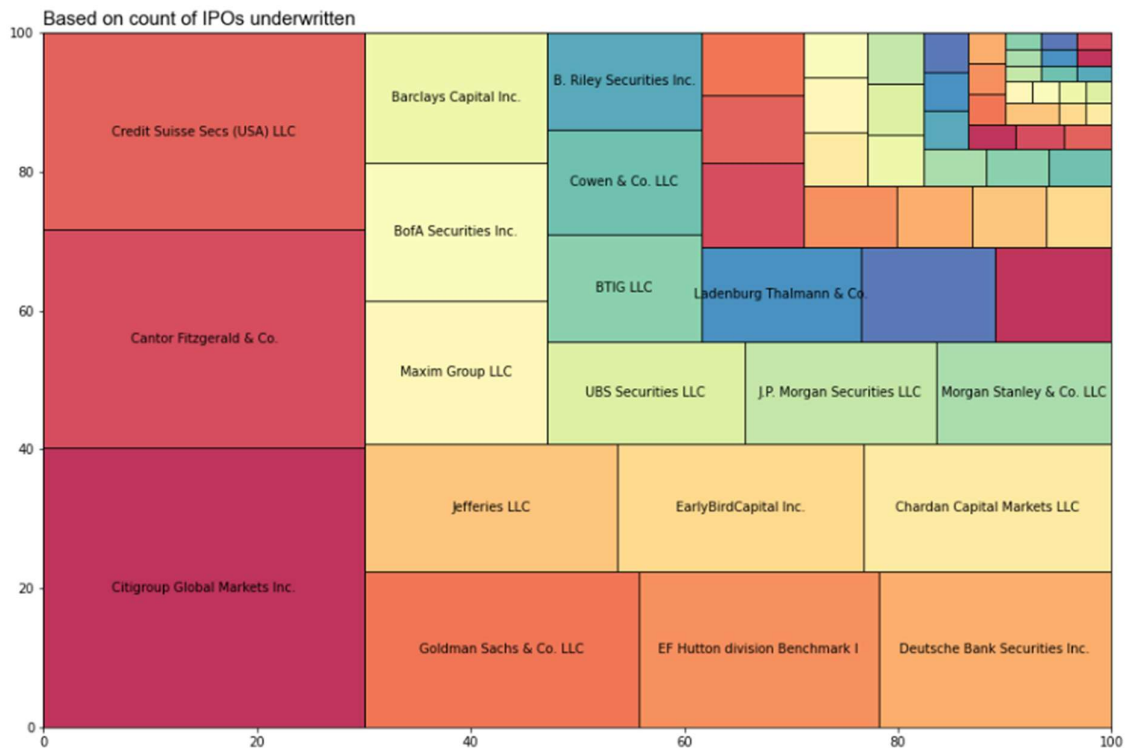


Figure 1 reflects some degree of participation by bulge bracket banks such as Deutsche Bank and Citigroup, but on equal or near-equal footing with them are boutique banks, such as the leading firm in early SPAC underwriting, EarlyBirdCapital, Inc. Contrasted with the layout of the market after 2017, bulge bracket banks and other recognizable names in investment banking dominated the scene, led by Citigroup, Credit Suisse, and Goldman Sachs. Perhaps motivated by the ability to churn out standardized IPOs in exchange for somewhat smaller fees than in a typical IPO, the involvement by these banks played a role in fostering the burgeoning of the SPAC market.

At the same time, for the market to grow, there must be investors willing to buy the units on offer. Until the late 2010s, finance and investment remained a relatively esoteric realm, led and exploited, in part, by large brokerage houses, investment banks, and private equity firms, and the activities of these agents were only highlighted and made understandable to the broader public when a financial crisis demanded it, such as the 2007-2008 subprime mortgage crisis or the European sovereign debt crisis. With the advent of online, low or no-fee trading made available to investors through financial services platforms such as Merrill Edge, eToro, and Robinhood, retail investors gained greater access than ever before to capital markets. In a period from 2017 to 2021, Robinhood saw its user base grow from roughly 2 million users to over 17 million users, with total assets under management growing from \$4.5 million to just under \$100 million.²⁴ A Charles Schwab study cites 15% of U.S. stock market participants as having entered the market in 2020, and a Bloomberg study attributes nearly 20% of market activity in the first half of 2020 to retail investors.²⁵ With banks perhaps preparing for Basel III and its increased capital ratios and a subsequent slowdown in institutional trading activities, retail investors gained a foothold in the market. Zhang, Ritter, and Gahng also cite retail investor participation as a driving force in the SPAC boom in their 2021 paper.²⁶

From an institutional investment standpoint, it can be argued that SPACs represented an opportunity to buy into a public company at a fairly low price in the hopes of receiving a significant return in the future. Around the time of the SPAC boom, interest rates had fallen sharply. Figure 3 illustrates the development of the Federal Funds Effective Rate, a key basis

²⁴ Nasr, T. *Robinhood Statistics 2023: Assets Under Management (AUM), Number of Users, Revenue, & More*. Investing in the Web, 2023. <https://investingintheweb.com/brokers/robinhood-statistics/>

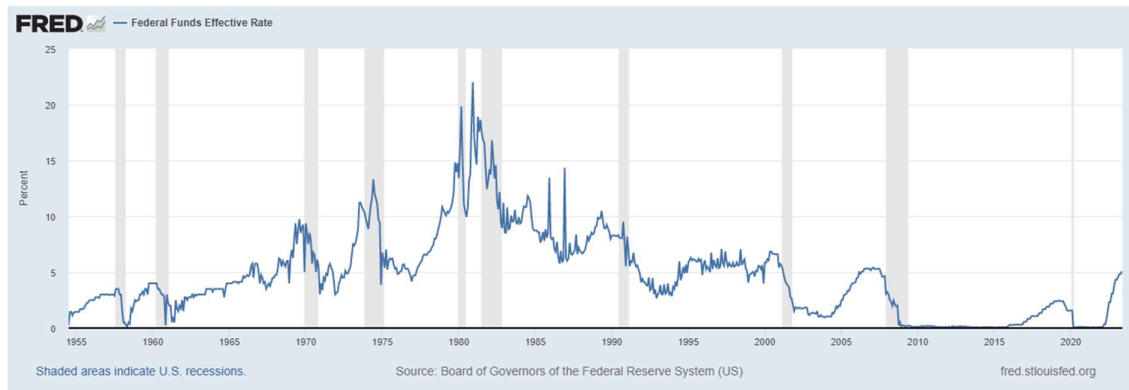
²⁵ Krishan, A. *The Rise of the Retail Investor*. Forbes, 2022.

<https://www.forbes.com/sites/forbesagencycouncil/2022/11/04/the-rise-of-the-retail-investor/?sh=66357a4a1755>

²⁶ Gahng, M., Ritter, J., & Zhang, D. *SPACs*, pp.33

of the prevailing interest rates offered on fixed-income assets. By mid-2020, in large part due to the U.S. government's attempts to stimulate an economy still ravaged by the COVID-19 pandemic, interest rates fell to nearly 0%, crippling the value of bond holdings. As interest rates fall, the price of bonds increases, offering potential investors a potentially worse return on their investment as compared with an equity investment.

Figure 3: Federal funds effective rate (1954 - present)²⁷



These developments may have pushed investors to focus in on equities markets, and the relatively low price of SPAC units combined with their built-in access to options in the form of warrants would provide significant upside. The participation of big banks in underwriting SPAC IPOs may have helped enflame investor desire, however this gives way to a chicken-or-the-egg puzzle: did investors start buying into SPACs because they were underwritten by reputable banks, or did reputable banks start underwriting SPACs because the market demand for them was so high, and they represented easy access to fee profits?

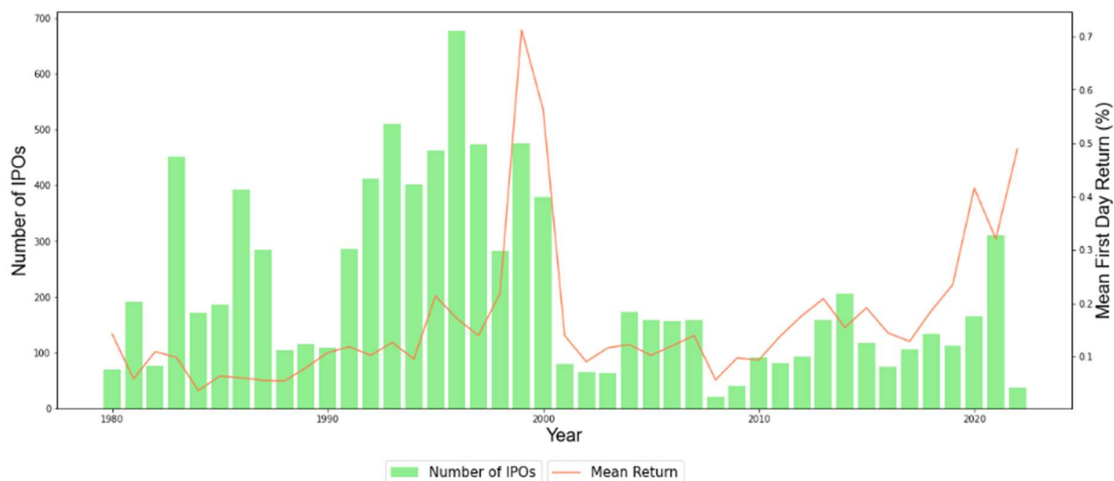
While the answer to that question may be murky, it remains academic without considering the role of private companies seeking to go public via a SPAC merger. Their willingness to participate constitutes a ceiling on the growth of the SPAC market. Proponents of SPACs offer a number of reasons why they are a beneficial alternative to the traditional IPO. Firstly, target companies have the upper hand in negotiations with SPACs, which can lead to higher valuations than with a traditional IPO. Consider the built-in expiration date that SPACs have upon formation. With this as public knowledge, a target firm knows that the SPAC depends on quickly negotiating a deal or else it risks liquidation.

²⁷ St Louis Fed (FRED), Federal Funds Effective Rate Data (not seasonally adjusted), 1954 – 2023, <https://fred.stlouisfed.org/series/DFE>

Beyond this, the sponsor of the SPAC risks failing to receive the promote, their primary incentive for forming the SPAC, if a deal is not successful. The combination of these factors means that a SPAC benefits from meeting a target firm at their desired valuation, whereas in a traditional IPO, a company is reliant on the valuation of the underwriter whose motives for underpricing the company are well-documented. Loughran and Ritter describe a conflict of interest observed in IPOs, whereby underwriters favor institutional clients with whom they have a successful track record of business with and from whom they receive commissions, dependent on those clients' profits.²⁸ With an underpriced IPO, clients generate greater first-day profits which in turn means greater commissions to the underwriter. Beyond this, underwriters have the simple motive to ensure that the IPO is successful or risk losing their commissions and fees altogether. While a best-efforts agreement is an option for underwriters, this usually requires a forfeiture of any commission, which can make up the lion's share of profit from the underwriting. As a result, a fixed-commitment agreement is usually preferable, and to minimize the risk of failing to turn all purchased shares over, underwriters may underprice the offering to ensure that the interest expressed during the book-building process is locked in.

For an empirical look at IPO underpricing, we can consider average first day returns for IPOs²⁹:

Figure 4: IPO activity and first-day returns



²⁸ Loughran, T. & Ritter, J. *Why has IPO Underpricing Changed Over Time?* Financial Management, Vol. 33, No. 3, 2004, pp. 8-9

²⁹ Ritter, J. *Initial Public Offerings: Underpricing*. Revised February 3, 2023, <https://site.warrington.ufl.edu/ritter/files/IPOs-Underpricing.pdf>

Around the time of the SPAC boom, median first day returns on traditional IPOs ranged from 18.6% to 48.9%, and the money left on the table by the issuer was as high as roughly \$30 billion, in aggregate. Thus, for some companies, a SPAC merger may have represented a means of avoiding these pitfalls and garnering a fairer price on the offering at a time when IPO underpricing was considerable and growing.

In addition to valuation benefits, SPACs offer private companies the benefits of not having to directly incur the fees associated with IPOs, mostly related to paying the underwriter and a legal team, as well as a quicker turnaround in reaching the public market. From the outset, a traditional IPO may take anywhere from twelve to eighteen months to complete, while a SPAC merger can be consummated in three to six months.³⁰ This means a much quicker capital injection to the target firm. The compressed timeline may simultaneously cause headaches for the target firm by precipitating the need to establish internal controls and auditing procedures at a level befitting a public company, but these obstacles can still be overshadowed by the upside.

With all of this said, the simple rationale behind a rush to go public via SPAC merger may come down to trying to imitate the success of those who have come before. 2020 saw a number of astronomically successful SPAC deals across a variety of industries, signaling to the broader market that a SPAC merger deal can yield significant results. The year's leader in returns, QuantumScape, an electric vehicle battery manufacturer, saw its stock price peak at \$131.67 by late December, only a month after going public, representing a whopping 1,200% gain on the offering price of \$10. Similarly, DraftKings, a leader in the online sports betting and fantasy gaming sphere, saw its stock hit \$63.78 by early October, after merging to go public in April of the same year. Of course, while such returns are more likely a result of these businesses' underlying business models and growth potential, they still conveyed the message that going public with a SPAC works.

³⁰ Lambert, J. *Why so many companies are choosing SPACs over IPOs*. KPMG. <https://advisory.kpmg.us/articles/2021/why-choosing-spac-over-ipo.html>

2. Empirical Evidence

Stemming from the aforementioned conditions, growth amongst SPACs shot up. More reputable players entered the game, institutional investors sought high returns in a period of depressed interest rates, retail investors had more access to markets than ever before, and some of the daring few companies who entered the SPAC space were handsomely rewarded. The market reacted, and SPAC activity shot up tremendously:

Figure 5: SPAC IPO activity over time

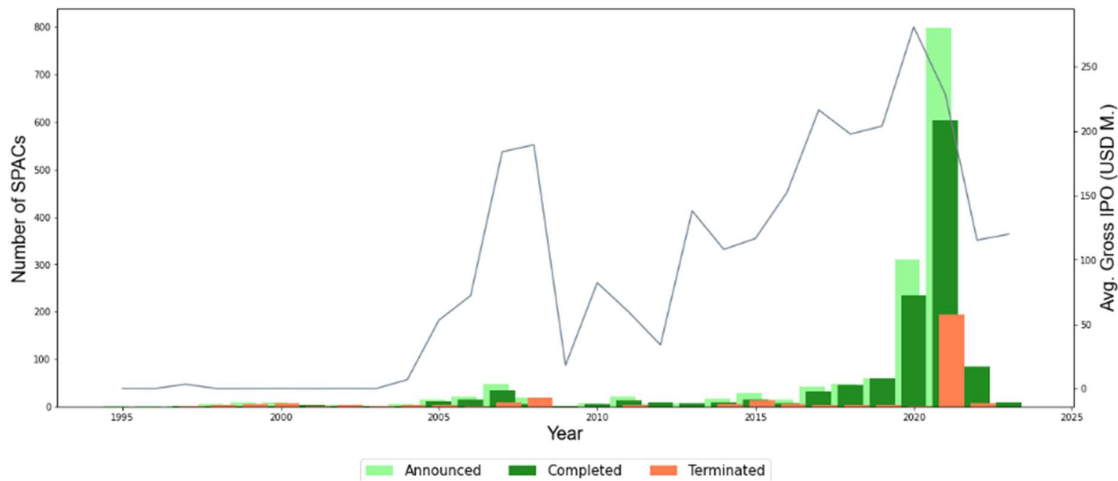


Figure 5 illustrates the trends observed in the dataset for this paper. The number of successful SPAC IPOs jumped nearly 300% from 2019 to 2020, growing from 59 to 235, and peaked at 604 one year later, representing a 924% rise in SPAC IPO activity. More money was flowing into SPACs as well; in a period from 2015 to 2020, the average gross offering for a SPAC IPO grew 140%, rising as high as \$280 million in 2020. Table 2 identifies the smallest and largest SPAC IPOs, based on their gross offering, in the dataset for this paper. Here, the growth from 2015 to 2020 is exemplified; Pershing Square's IPO represents a multimillion percentage increase in the offering size from that of Sky Pass Corp's IPO, just five years earlier.

Table 2: Smallest, largest SPAC IPOs in dataset

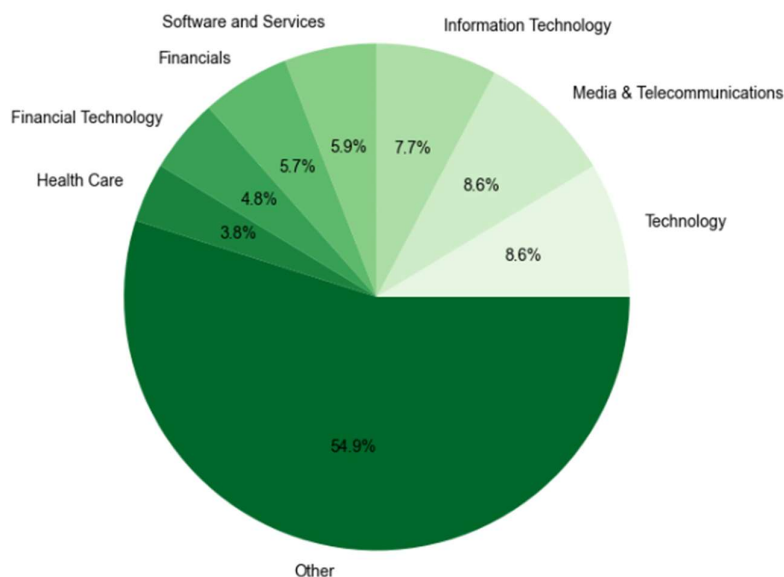
Name	IPO Announcement Date	Book Manager	Offering Price	Gross Offering (USD million)
4 Brandon I, Inc.	1999-02-03	Self	\$0.05	0.005
Sky Pass Corp.	2015-06-04	Self	\$0.01	0.0107
New England Acquisitions, Inc.	2001-06-20	Self	\$2.00	0.015

Whiskey Acquisition, Inc.	2015-12-18	Self	\$0.02	0.02
NAS Acquisition, Inc.	2014-09-16	Self	\$0.02	0.02

Name	IPO Announcement Date	Book Manager	Offering Price	Gross Offering (USD million)
Pershing Square Tontine Holdings, Ltd.	2020-06-22	UBS Securities	\$20.00	4,000
Spinning Eagle Acquisition Corp.	2021-06-24	Goldman Sachs	\$10.00	2,000
Foley Trasimene Acquisition II	2020-08-03	Credit Suisse	\$10.00	1,300
Churchill Capital Corp VII	2021-01-11	Citigroup	\$10.00	1,200
Austerlitz Acquisition Corp. II	2021-02-10	Credit Suisse	\$10.00	1,200

With more money, SPACs gained access to larger targets, further legitimizing their foothold in the market. As the SPAC craze wore on into 2021, more IPOs were abandoned, possibly due to competition or waning demand (to be discussed later), but the market had truly grown significantly. Target industries cited in SPAC registration documents showed signs of consolidation in a few industries, but generally spanned a wide range:

Figure 6: Industries for target acquisition cited in prospectus, SEC filings



The technology and software markets received the most SPAC attention, but a significant number of filings also cited healthcare, entertainment, energy, pharmaceuticals, and hotels as industries for planned entry.

III. The Initial Public Offering

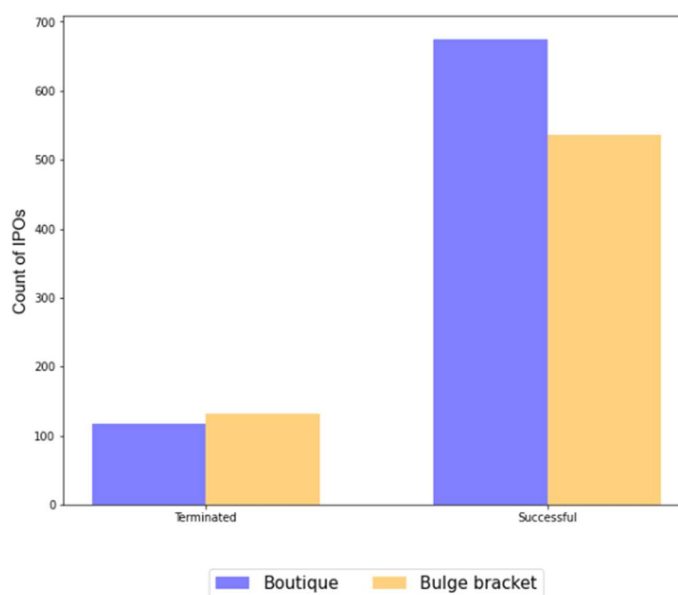
As discussed, the SPAC structure is fairly boilerplate in nature. Despite this, figure 5 indicates a significant number of SPAC IPO failures during the height of the boom. As such, a determination of the most important factors influencing SPAC IPO success is warranted. The major variances observed from one IPO to the next are: the underwriter; the size of the offering; the size of the fees incurred; and the fraction of warrants included in the units, if any are included at all. This paper will examine a number of hypotheses around these variables to better determine what makes a SPAC desirable or successful at its IPO stage. We can consider the success of a SPAC on two levels: first, does the SPAC's IPO succeed; second, are underwriters able to generate enough interest from buyers to exercise the full over-allotment made available to them and raise more capital for the SPAC?

A. Underwriters

As cited previously, Professor Michael Stegemoller claims that the reputability of larger banks starting to underwrite SPAC IPOs was a major contributing factor to their rapid growth. In theory, a major name signals to investors that the company on offer is a solid investment, otherwise these banks risk alienating investors by selling them junk stocks. As such, we can compare the outcomes for bulge-bracket banks³¹ to the rest. Within the dataset, 1,460 IPOs that were either completed or terminated have a lead underwriter listed; 668 offerings land in the bulge-bracket group and 792 offerings land in the boutique group. An examination of the binary outcome of the IPOs across these groupings yields the following outcome:

³¹ Using the Investopedia classification for specific banks, such as BofA, Citi, Credit Suisse, et. al. <https://www.investopedia.com/terms/b/bulgebracket.asp#:~:text=%22Bulge%20bracket%22%20is%20a%20slang,advertisement%20of%20a%20new%20issue.>

Figure 7: IPO outcomes across underwriter banking sectors



There do not appear to be any notable differences between the groups, as the ratio of boutique banks to bulge bracket banks remains relatively intact for each of the subgroups of terminated and successful IPOs. Bulge bracket banks account for 45.75% of the population's IPOs. In turn, they account for 53.01% of terminated IPOs and 44.27% of successful IPOs. This suggests that there is no major additional benefit in contracting with a large bank when the goal is, very simply, IPO success. In fact, given the slightly higher ratio of representation in the terminated IPO sample, it would suggest that, if anything, bulge bracket banks fail to reach this goal more often than their counterparts. In any event, getting an IPO over the finish line is not to be confused with creating an optimal offering, as big banks may be able to offer better terms on underwriting fees or they may be able to drum up greater gross proceeds in the form of exercised overallotments.

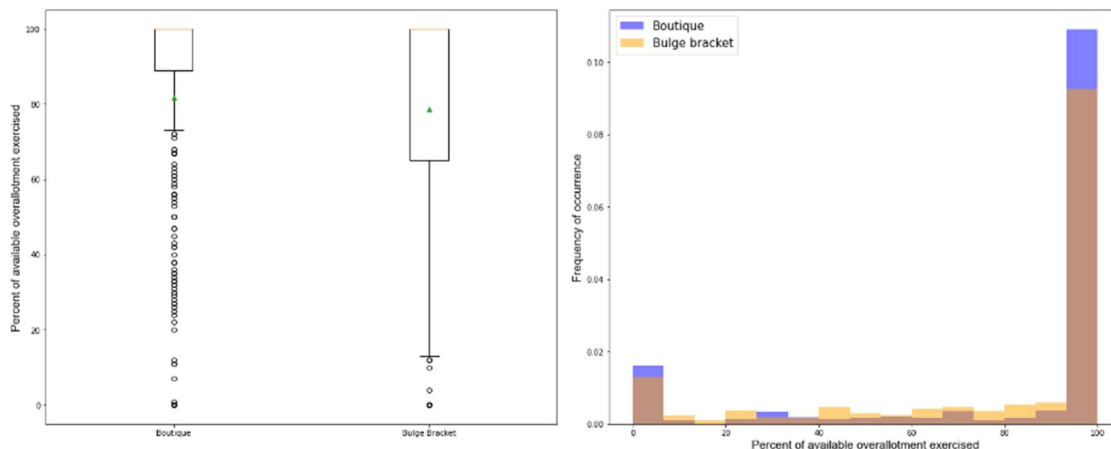
1. Overallotments

Regarding the latter point of overallotments, data shows that overallotments have historically nearly always been included in a SPAC IPO. This is unsurprising given the primary function of the overallotment — to raise more capital in the offering if demand is present. However, it is worth considering whether bulge bracket banks are better at creating this excess demand, perhaps during the book-building process, than boutique banks, in which case this would constitute a material advantage for the SPAC in contracting with a larger bank during the pre-IPO phase. Whether an overallotment is made available or not, as defined in the security registration documents and underwriting agreement, is largely up to the SPAC;

however, how regularly this overallotment is exercised in full may be indicative of a difference in performance or capability between the bulge and boutique sectors.

First, a deficiency in the dataset must be acknowledged. SPCIQ does not list data on available overallotments and exercised overallotments as individual data points prior to 2018. Consider the Nebula Acquisition Corp. IPO, which was initially completed on January 9th, 2018, with the overallotment exercised in part by January 16th, 2018. The SPCIQ database counts 25,000,000 shares offered prior to overallotment and 27,500,000 total shares on offer, implying an available overallotment of 2,500,000 shares. However, this is misleading; on Nebula's latest amended S-1 form, an overallotment of up to 3,750,000 shares is made evident.³² The 2,500,000 shares overallotment implied by SPCIQ is, instead, the exercised portion of the overallotment.³³ As such, the following analysis will focus on the subset of data in/after 2018 with reliable differentiation between available and exercised overallotments, but this may introduce some confounding effects. Primarily, considering that 2018 fell in towards the beginning of the SPAC boom, it may be the case that any differentiation between bulge bracket and boutique banks in effecting greater use of the overallotment is smoothed out. This is to say, as SPACs became a hot investment, full use of the overallotment may be more a reflection of the market and less a reflection of the underwriter. The data shows the following breakdown across the two banking sectors:

Figure 8: Percentage of overallotment exercised across underwriter banking sectors



³² Sourced from Nebula Acquisition Corporation amended S-1 form, filed on January 10, 2018, <https://www.capitaliq.spglobal.com/apiv3/docviewer/documents?mid=54292223>

³³ Sullivan, K. *Nebula Acquisition Corporation, Sponsored by True Wind Capital, Announces Closing of Initial Public Offering*. PR Newswire, 2018. <https://www.prnewswire.com/news-releases/nebula-acquisition-corporation-sponsored-by-true-wind-capital-announces-closing-of-initial-public-offering-300582397.html>

Focusing on the box plot, the median for both samples is 100%, while the boutique sector shows more skew towards lower percentages of allotments exercised. In general, looking at the histogram, it is apparent that the majority of banks in either sector exercise all of, or nearly all of, the available overallotment. Boutique banks, which represent a higher portion of the sample population, expectedly are present in greater number, but consistent in relative proportion, in the two most dominant bins, the “full exercise” and the “no exercise” bins. As such, it is not immediately evident that there exists any relationship between the underwriter’s banking segment and the ability to either consummate a successful IPO or to exercise more of an available overallotment of shares during the IPO process. This relationship will be formalized further via logistic regressions, while population tests can be found in Appendix C.

Interestingly, Deutsche Bank IPOs did demonstrate a significantly lower mean exercised portion of their available overallotments than their peers. This indicates that, while there may be no difference in contracting with a boutique bank as opposed to a bulge bracket bank, there may be a benefit in choosing any other bulge bracket bank than Deutsche Bank. While there are certainly many market or macroeconomic factors that could influence this, Deutsche Bank’s mean percentage fell nearly ten points lower than that of all other banks. This outcome appears to be driven by a handful of high-profile SPAC IPOs, with offerings ranging from \$200 million to \$750 million, where no overallotment whatsoever was exercised.

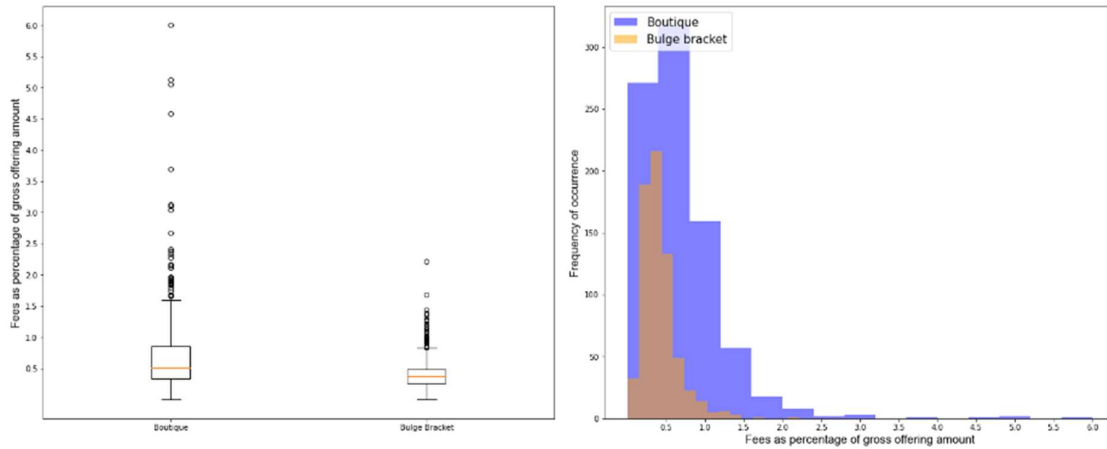
2. Underwriting Fees

The relationship between underwriters and fees offers a somewhat more compelling case in favor of bulge bracket banks. While in a traditional IPO, there are any number of idiosyncratic factors and complexities related to the company going public that can command higher underwriting fees, these factors typically don’t exist in a SPAC IPO due to its standardized nature. Non-SPAC IPO fees vary from 2 to 7% of the gross offering size³⁴, but tend to be slightly lower with a SPAC IPO. The data below aggregates the three largest fees contributors: accounting fees; legal fees; and “other” fees (presumably related to general

³⁴ Langa, P. *Underwriting Your Underwriter (IPO)*/ Forbes, 2023.
<https://www.forbes.com/sites/forbesfinancecouncil/2023/04/20/underwriting-your-underwriter-ipo/?sh=68d6e62c4e34>

administrative and contracting functions). The distribution of these “total” fees as a proportion of the corresponding IPO’s gross offering is found in figure 9.

Figure 9: Underwriting fees across different banking sectors



The median underwriting fee falls between 0.5% and 1.0% of the SPAC’s gross offering amount, with bulge bracket banks’ fees often slightly lower than their counterparts.³⁵ There may be a number of explanations for this, however speculative. First, bulge bracket banks may have a steadier pipeline of work and can rely on more regular fee income than boutique banks, effectively relying on fee quantity over size. Furthermore, smaller banks may have to impose more aggressive fees in order to better reward and retain talent. Generally, larger banks with more capital at their disposal are better positioned to offer more favorable employment terms; larger legal and accounting fees may help boutique banks mitigate the threat that larger banks pose in this regard.

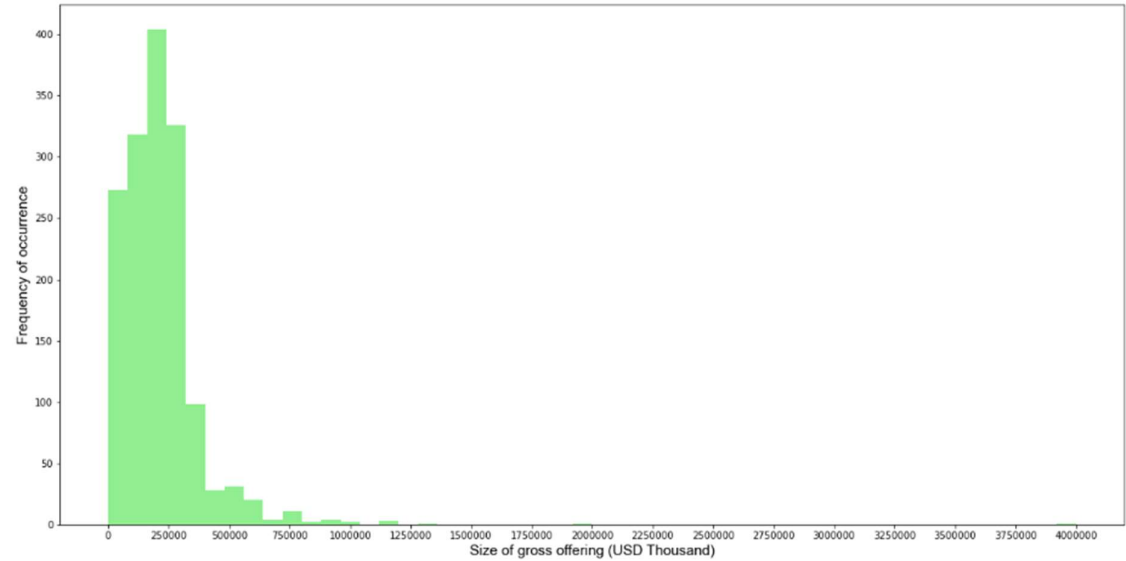
It is worth noting that the data plots above omit three outliers from the boutique bank distribution, where more than 10% of the offering was taken in fees. While the differences between the two populations are mostly comparable, the combination of a slightly higher median value and higher outliers in the boutique population is indicative that boutique banks may be a worse option for the sponsor in forming their SPAC, or, at least, the benefits may be less tangible. The relationship between IPO success and the size of underwriting fees will also be formalized in a logistic regression.

B. Offering Size

³⁵ Some fee contributors have been omitted, partially due to scarcity of data and partially due to their nature as a less significant contributor (printing fees, SEC registration fees). As such, the true median values may be one or two tenths of a percentage point higher.

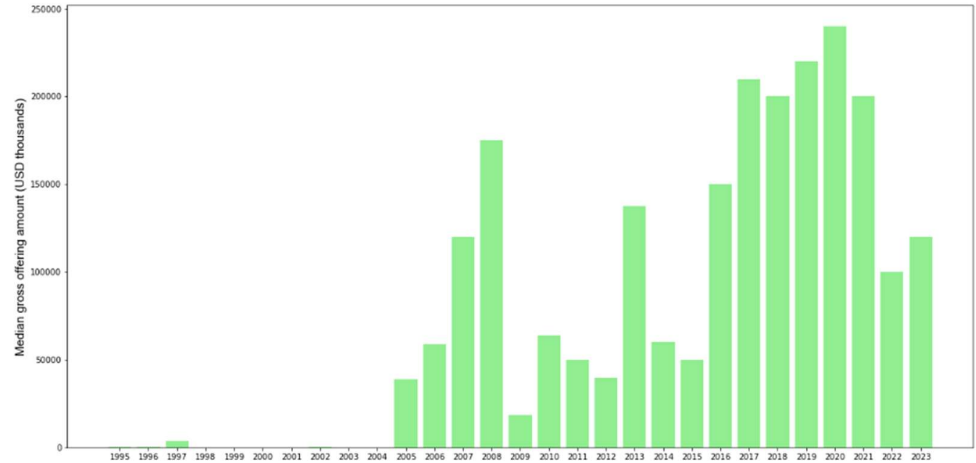
The size of the IPO is the variable with the most observed variance. As recently as 2019, in the case of Lucent Inc., a SPAC formed with a one-cent offering, the planned gross proceeds from the IPO were only \$30,000. On the other end of the spectrum, in June 2020, famous investor and hedge fund manager Bill Ackman launched the Pershing Square Tontine SPAC with planned proceeds of \$4,000,000,000. Given the breadth of offerings that have taken place between these bookends, the relationship between offering size and IPO outcomes is worth examination. The general distribution of SPAC IPO sizes is as follows:

Figure 10: SPAC IPO gross offering amount distribution (USD thousands)



This data captures 1,527 IPOs that are in a terminal status (completed or terminated) and where SPCIQ has published the offering size. The median datapoint is at \$200,000,000 USD; however, the data has morphed significantly over time:

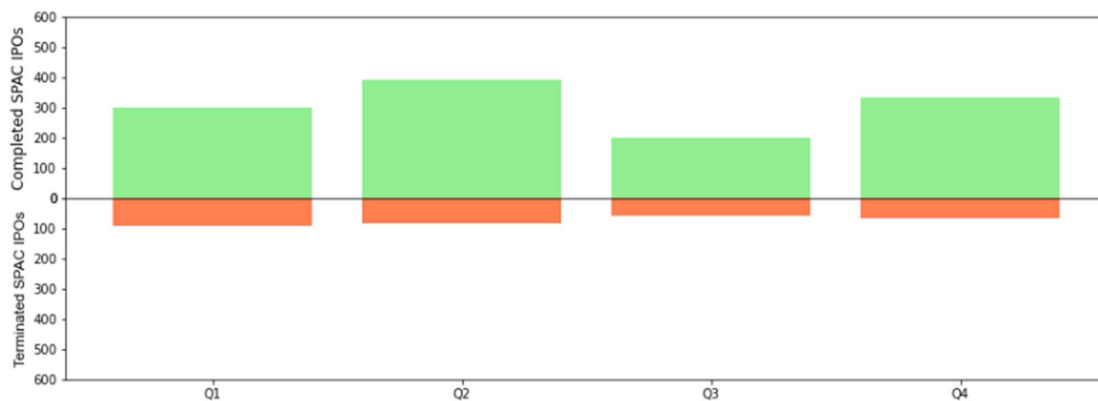
Figure 11: SPAC IPO gross offering amounts across time



It appears that growth in SPAC IPO size was on a very positive trajectory until the subprime mortgage security crisis had settled, as offerings shrank significantly in 2009. However, the growth resurged and by 2020, the median SPAC IPO sought \$240,000,000 in gross proceeds. As mentioned before, by 2020 both the frequency and size of IPOs had grown significantly, and it's precisely the IPOs from this time period that really define the population's median offering size.

The relationship between the gross offering size and the success of the IPO is, however, not immediately apparent.

Figure 12: Binary IPO outcomes across gross offering size quartiles



IPOs in the sample were divided into quartiles with the following ranges of gross offerings: less than \$100,000,000; between \$100,000,000 and \$200,000,000; between \$200,000,000 and \$260,000,000; and everything greater than \$260,000,000. In theory, a larger planned gross offering opens the door for a sponsor to evaluate a wider array of targets for acquisition, and investors may view this as a means of aligning sponsor and shareholder incentives. This is to say, if the sponsor has more money available to them, they may be less inclined to pursue a panic merger solely to ensure receipt of the promote and may be willing to pursue a company with good fundamentals and a solid business plan, thereby also benefitting the SPAC's shareholders. While this should seem like the sponsor goal from the outset, it is not always the case.³⁶ Thus, more money in the trust account should encourage higher rates of IPO success. Somewhat obscuring this influence are specific rules implemented by the NASDAQ stock exchange, whereby the SPAC *must* target firms whose fair market value accounts for at

³⁶ Klausner et. al., *A Sober Look at SPACs*. p. 247

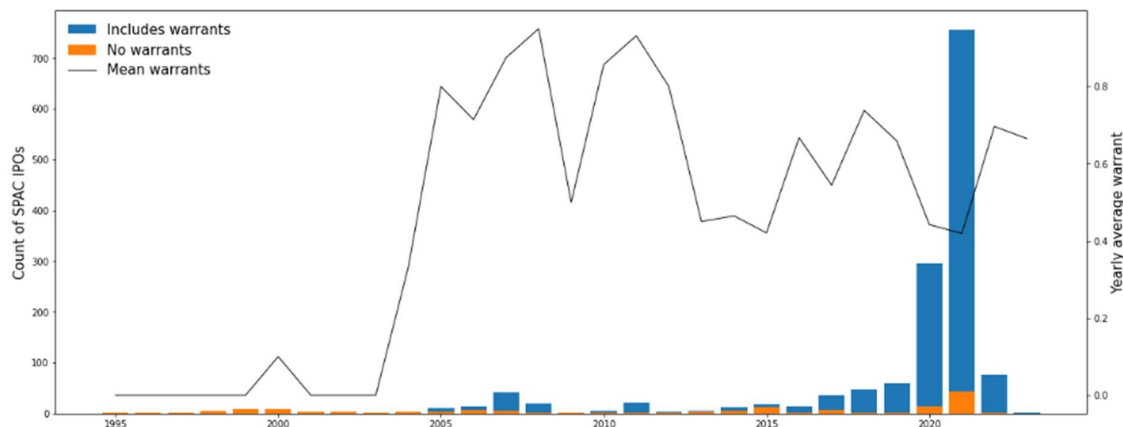
least 80% of the balance in the SPAC trust.³⁷ This functions to narrow the scope of the sponsor when evaluating targets, although as the size of the trust account grows, investors can trust that the acquired firm likely has a healthy means of generating revenue and future dividends, if nothing else, assuming these are priced in to the final target valuation.

As figure 12 indicates, there do not appear to be any meaningful differences between the quartiles. The ratio of terminated IPOs to successful ones is relatively consistent across the board, implying that the size of the offering does not directly influence the shareholder decision on whether to invest or not.

C. Warrants

On the surface, the inclusion of warrants in the units on offer, and the shareholder right to keep the warrants during redemption, constitutes what is perhaps the most meaningful incentive to investors in the IPO. Warrants function as a guarantee to investors that, even if they elect to walk away from the SPAC in exchange for interest on their initial investment, they still maintain access to all of the upside that the de-SPAC transaction may yield. Indeed, the prevalence of including warrants at all, which was not always a given in SPAC offerings, indicates that sponsors understand and respect the influence that warrants have over the IPO's success. The development of warrants and their inclusion in SPAC IPOs is illustrated in figure 13:

Figure 13: IPO warrant development over time



It should be noted that the average number of warrants depicted in earlier years is skewed through smaller sample sizes; as there were fewer SPACs in earlier years, any outlier

³⁷ NASDAQ exchange listing rule IM-5101-2, <https://listingcenter.nasdaq.com/rulebook/nasdaq/rules/nasdaq-5100-series>

offerings push the average heavily in one direction. However, the median warrant is less informative, as the inclusion of a half-warrant accounts for roughly one-fifth of all data points and typically represents the median. The average is more characteristic of how the SPAC industry moved as a whole over time. As figure 13 depicts, warrants were unheard of in the earliest years of SPAC development but became a mainstay during the peak of SPAC popularity.

The relationship between warrants and IPO success, as with offering size, may also be somewhat murky in theory. While a warrant offers investors protection, it also acts to possibly dilute shareholder value. After the IPO, the compounding effects of shareholder redemptions and overhanging warrants that impact each shareholder becomes even more pronounced.³⁸ How much this is accounted for by investors during the IPO is unclear. These complexities are acknowledged by the SEC in their disclosure proposals, as they call for the inclusion of a warrant-based dilution sensitivity analysis in shareholder disclosures.³⁹

D. Regression Models

1. Logistic Regression on IPO Outcome

The variable elements underlying a SPAC IPO often have an unclear influence, given the lack of clear alignment between the underwriters, investors and sponsors. To better formalize the relationship between the IPO and its constituent pieces, a logistic regression model is proposed. This model specification is chosen in order to understand the predictive impact of our variables on one simple outcome: the success or failure of the IPO. This model also accounts for any potential time-fixed effects by bucketing each SPAC into a given time period. Consider, for example, how the subprime mortgage crisis or how the SPAC boom and subsequent celebrity involvement may have altered investor behavior. The regression models in this section specify the following regressors: offering size (USD millions), overallotment size (USD millions), total fees, standardized as a relative portion of the offering size; warrants, represented numerically (one-half warrant becomes 0.5 warrants); a dummy variable on whether the underwriter is a bulge bracket bank or not; and time-fixed effect dummy variables.

³⁸ Klausner, et. al. *A Sober Look at SPACs*. pp. 248-249

³⁹ US Securities and Exchange Commission, Release 33-11048, pp. 38-39

Logistic regression models, which are a form of a machine learning algorithm, may be biased if the sample size is not large enough.⁴⁰ In such cases, it has become standard practice to generate synthetic data. Fortunately, the IPO dataset used in this logistic regression requires no such augmentation. A 2018 study confirms that a minimum sample size of 500 observations generally offers unbiased statistics and further suggests a sample size of $100 + 5i$, where i is the number of regressors, as necessary.⁴¹ With 1,527 observations and eight regressors (dropping one time-fixed effect regressor to avoid multicollinearity), both recommendations for unbiased statistics are met. Additional model diagnostic tests can be found in Appendix A.

2. OLS Regression on Overallotments

An ordinary least-squares regression model is also proposed to determine the impact of the same regressors on the demand generated for the IPO, as measured by the portion of the overallotment that is exercised by the underwriter. While there may be additional factors influencing the decision or ability to exercise the overallotment, such as terms specified in the underwriting agreement or overarching market conditions, this model will assume that these factors will be too vague to quantify and will be omitted as potential regressors. The dataset will be limited to successful IPOs, as terminated IPOs will have no overallotment exercised and will introduce potentially confounding effects into the model. Furthermore, the dataset will filter out any IPOs where no overallotment was made available to the underwriters.

3. Model Results

Table 3 presents the regression model results:

Modeling Outcomes of SPAC IPOs		
Dependent variable:	Success/failure of IPO	Overallotment exercised as portion of available

⁴⁰ Rainey, C. & McCaskey, K. *Estimating logit models with small samples*. Political Science Research and Methods, Vol. 9, 2021. <https://www.cambridge.org/core/services/aop-cambridge-core/content/view/712F6039372475B650B123E9A1FE60E6/S2049847021000091a.pdf/estimating-logit-models-with-small-samples.pdf>

⁴¹ Bujang, M. et. al. *Sample Size Guidelines for Logistic Regression from Observation Studies with Large Population: Emphasis on Accuracy Between Statistics and Parameters Based on Real Life Clinical Data*, The Malaysian Journal of Medical Science, Vol. 25, No. 4, pp.122-130

	Logit Model	OLS Model
	(1)	(2)
const	-0.256 (0.302)	1.011*** (0.081)
Gross offer	-0.02 (0.047)	-0.005 (0.008)
Overallotment available	1.282*** (0.446)	
Total fees	-0.705 (0.776)	-0.028*** (0.009)
Warrants	2.127*** (0.265)	0.021 (0.037)
Bulge Bracket	-0.015 (0.157)	-0.023 (0.023)
Mortgage Crisis	-1.494*** (0.441)	0.001 (0.094)
Post Mortgage Crisis	0.671* (0.345)	-0.103 (0.074)
Post Covid	0.559* (0.322)	-0.182** (0.072)
Observations	1,527	1,127
R ²		0.031
Adjusted R ²		0.025
Residual Std. Error	1.000 (df=1518)	0.322 (df=1119)
F Statistic	(df=8; 1518)	5.112*** (df=7; 1119)
Note: *p<0.1; **p<0.05; ***p<0.01		

3a. Logistic Model

Beginning with the logistic regression model, the coefficients must be transformed somewhat for a clearer economic interpretation of their meaning. Because the coefficients, as stated above, are the logarithmic odds that the response variable is equal to 1 (which in this case, signifies a successful IPO) with a one unit increase in the given regressor, the coefficient is understood as a measure of influence on the odds ratio between a terminated and successful IPO. For example, while not statistically significant, the bulge bracket regressor coefficient is -0.011, which means that an IPO underwritten by a bulge bracket bank has 0.98 times the odds of a successful IPO than an offering underwritten by a boutique

bank, implying better outcomes for boutique banks. For more information on the transformation of the model's coefficients, refer to Appendix B.

Firstly, the coefficient on the intercept is not significant. This is to say, the null hypothesis of the coefficient being equal to zero is not rejected, and thus the probability of a successful SPAC is 50%, all other things equal. This may not be particularly interesting, with so many other features defining an IPO and especially after having accounted for time-fixed effects. After all, it is documented that IPOs tend to occur in waves, based on macroeconomic conditions, the business cycle, and general investor sentiment.⁴² The logistic regression model produces three coefficients which *are* significant at the 1% level: the overallotment available, expressed in \$100 million units; the warrants included in the units on offer; and the dummy variable capturing time-fixed effects during the subprime mortgage crisis. For brevity, the probability transformation for these coefficients is captured in the table below:

Table 4: Logit model coefficient transformation

Regressor	Coefficient	Probability
<i>Overallotment Available</i>	1.282	78.28%
<i>Warrants</i>	2.127	89.35%
<i>Mortgage Crisis Dummy</i>	-1.494	18.33%

For numerical regressors, such as the overallotment and the warrants, the economic interpretation shifts based on given units. The model implies that a \$100 million increase in the available overallotment increases the probability of IPO success by about 78%. As regulations typically limit the “greenshoe option” to 15% of the initial offering, this has limited economic meaning, however it suffices to say that structuring an IPO with *less* than the maximum available 15% overallotment will reduce the probability of IPO success. A more rudimentary interpretation may be that investors don't want to invest in a SPAC where the sponsors themselves are not convinced of a high demand. A small overallotment may signal, through some additional layers of subtext, that the sponsors are not confident in their own ability to consummate a merger.

Warrants are expressed in the dataset strictly as their numerical representation; a unit including one-fourth of a warrant implies an observation value of 0.25. As such, the model

⁴² Pastor, L. & Veronesi, P. *Rational IPO Waves*. The Journal of Finance, Vol. 60, No. 4, 2005, pp. 1713-1757

implies that the addition of one full warrant increases the probability of SPAC success by 89%, which is the strongest indication that the model provides. And again, this is unsurprising given the previous analysis around the role of the warrant to investors. Warrants essentially contain all the upside value of a SPAC investment regardless of an investor's decision to walk away from their initial equity stake. In practice, a sponsor deciding to structure their offering with a full warrant is rare and would have implications for dilution beyond the IPO that may adversely impact both the sponsor and shareholders.

Lastly, a significant impact on SPAC success was observed during the subprime mortgage crisis of 2007 – 2008. IPOs were 18.33% less likely to succeed during this timeframe, which is representative of the overall market volatility during this period and the lack of investor confidence, as many were reeling from major losses and unsure of the impacts of pending market regulations.

Interestingly, the thesis posited by Michael Stegemoller that the SPAC boom relied largely on the introduction of bigger banks to the scene is, in the context of this model, rejected. While not covered by this model, it may alternatively be posited that the SPAC boom was underscored by behavioral patterns in investors; investors were drawn to SPACs because they heard of other investors entering the game and so on. The marketed benefits of SPACs to target companies are not without merit, and so as one or two influential names either formed a SPAC or went public with a SPAC, it is not unlikely that the relevance of SPACs would snowball. Consider the 2019 merger of Richard Branson's Virgin Galactic, a uniquely innovative company offering commercial spaceflight, with Social Capital Hedosophia.⁴³ This deal placed SPACs in the spotlight as a major name elected to take its cutting-edge business model public through such a merger, a decision that may have spurred other CEO's and company boards to consider following suit.

3b. OLS Model

The OLS model's dependent variable is the proportion of the available over-allotment that is exercised. This acts a measure of how high demand for the IPO actually was. Again, given the boilerplate nature of SPACs at the time of IPO, it is interesting to consider what separates their abilities to raise this additional capital. While the answer may partially lie in

⁴³ Sheetz, M. *Virgin Galactic shares debut as the space tourism company begins trading under the ticket SPCE*. CNBC.com, 2019. <https://www.cnbc.com/2019/10/28/virgin-galactic-stock-trading-debut-on-nyse-under-the-ticker-spce.html>

less measurable — or more difficult to obtain — factors (marketing strategy, direct placements, sponsor credentials), the connection to the statistically significant variables is telling.

Firstly, the intercept in the OLS model implies that the market will generally demand the entirety of any available overallocation. This provides a sort of baseline for the investor appetite for SPAC IPOs. Within the sample, 73.3% of all SPAC IPOs that included a greenshoe option saw at least 90% of the option exercised, while 67.5% of the sample IPOs saw the entire greenshoe option exercised. It is unclear what exactly creates such high investor demand, given the lack of any immediate operational cash flows into the SPAC once public. Investor optimism around potential targets is one possible explanation, as investors may desire to obtain as large of a stake as possible in an operational private business. Alternatively, these may be investors looking simply to capitalize on the risk-free return offered by SPACs and scoop up as many free warrants as possible. The payoff for this approach will be discussed in some detail in the next section.

Additionally, the growth of total fees undertaken in forming the SPAC also has a significantly negative impact on demand for the overallocation. This result is somewhat surprising, as these fees typically are immaterial to investors; fees are generally paid by the sponsors and are not covered by the funds held in the trust account. However, these may act as a proxy for the unpreparedness of the SPAC sponsor or some unknown complexity within the SPAC structure. For example, large accounting fees, which are a constituent piece of the total fees regressor, may imply that the SPACs' financial documents were not in accordance with certain public accounting standards, which in turn implies a lack of foresight or capability by the sponsor. Similarly, incurring large legal fees relative to the size of the offering may act as a signal for a nuanced or idiosyncratic complexity in the sponsor/shareholder structure, perhaps pointing to the existence of obscured asymmetries in the rights or payoffs to sponsors versus those of the investors.

In any event, this model may simply not provide a very effective breakdown of the factors influencing the use of overallocations during a SPAC IPO, as the adjusted R-squared statistic of 0.025 is extremely low. This suggests that, perhaps, there are better potential explanatory variables to select, or even that the dependent variable is one that may be difficult to model. Some transformations of the data were attempted but yielded no substantial improvements to the goodness-of-fit.

IV. Mergers and Returns

The primary motivation for every agent in the SPAC lifecycle is to be a party to a merger and to reap the benefits thereof, which vary from agent to agent. From a shareholder perspective, regardless of shareholder identity (PIPE/institutional or retail), participation in equity investment generally assumes that the benefit will take the form of a positive return on investment. Beyond that, investors in equities also seek risk-adjusted returns; this is to say, investors want to be compensated for the risk that their investment might perform poorly with the possibility of realized gains in excess of what more risk-free securities might offer, such as Treasury notes or bonds. In this section, SPAC equity performance will be analyzed to determine how effectively SPACs meet these investor goals, and if this performance explains the popularity of SPACs as investment vehicle.

Merger deal data for this section comes from SPCIQ. SPACs that successfully completed an IPO were checked for any successful merger within their first three negotiated deals (the decision to limit analysis to the first three deals was made as a function of level of effort and is somewhat arbitrary). Companies with successful deals were cross-referenced against the CRSP database and daily pricing data was collected. Returns were calculated from the daily pricing data. Deal data was located for 694 SPACs, of which pricing data was located for 451 SPACs.

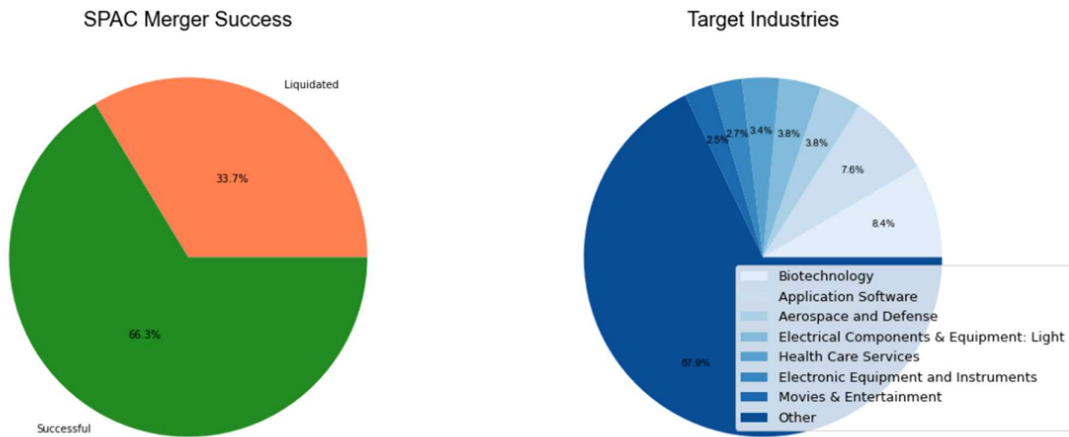
Returns are analyzed across various holding periods to determine any potential trends in SPAC performance, i.e., to determine if there exists evidence to suggest that SPACs perform better in the long run than during the pre-merger period. Returns are annualized to account for different holding periods; when comparing returns at the time of merger, for example, this will create comparability between a SPAC that took 150 days to merge and one that took 300 days to merge. The returns are made logarithmic to soften the impacts of outliers during regression and to create more visual acuity in the data. Finally, various subsections of SPACs can be benchmarked against market indices and fixed-income offerings to determine the quality of SPAC equity performance in a more general context.

A. Post-IPO Landscape

To better understand the post-IPO SPAC world, empirical data is provided. Most notably, two-thirds of all SPACs that successfully go public also successfully consummate a

merger. Some studies suggest that this figure may be closer to 90%⁴⁴, but miss more recent data, which suggests that competition or saturation in the market for SPAC investment may have forced more SPACs to disband. Figure 16 illustrates the primary industries in which targets operated.

Figure 14: Post-IPO outcomes, target industries



Interestingly, given the right-hand chart, there appears to be divergence between the industries cited in SPAC prospectuses and the industries in which SPACs complete their acquisitions. IPO prospectuses primarily listed technology and software firms as their desired targets, and to be clear, companies in those industries do participate in SPAC mergers, but so do a significant number of firms operating in aerospace and defense, health care, and entertainment. The rationale behind this divergence is unclear, though some hypotheses can be offered. First, this may suggest that the target industries listed in the prospectus are provided merely as a matter of formality than as an indicator of the sponsor's true intention, which could be misleading to potential investors. Second, this may indicate failures on the sponsor's behalf to successfully negotiate a deal with their first target and the subsequent pivot to a different industry. Third, it may be the case that there was a lack of viable targets in the desired industries. In reality, the reasoning is likely some combination of all of the above.

Consider the example of the Tailwind Acquisition Corporation, which was founded in May 2020 and completed its IPO just over three months later. In the original prospectus for Tailwind, it proclaims a focus on "consumer internet, digital media, and marketing

⁴⁴ *Earning the premium: A recipe for long-term SPAC success.* McKinsey & Company.

technology sectors” for its target search.⁴⁵ Tailwind signed a letter of intent with QOMPLX, Inc. in January 2021, which was characterized in investor presentations as a leader in risk analytics⁴⁶, which was not a clear fit in Tailwind’s scope of industries. This deal fell through and, eventually, Tailwind would complete a merger in January 2023 with Nuburu, Inc., a maker of precision lasers for use in precision manufacturing, perhaps an even further departure from the originally cited scope.⁴⁷ While the merger with Nuburu may have been the result of the sponsor refocusing after the first failed deal, the first deal was already only on the fringes of the industries cited in the prospectus. It may be the case that QOMPLX simply offered what the sponsor believed was a promising investment opportunity, which might support the first hypothesis for the divergence characterized above. In any event, such examples serve to highlight the significant degree of target uncertainty facing investors. In the dataset for this paper, 10% of SPACs with successful mergers experienced a deal failure during prior negotiations. Given the strong incentive of the sponsor to complete any deal, this represents a 10% chance of acquiring a company operating in a vastly different industry from what was previously expected and all that comes with the industry trends or macroeconomic factors are driving that industry.

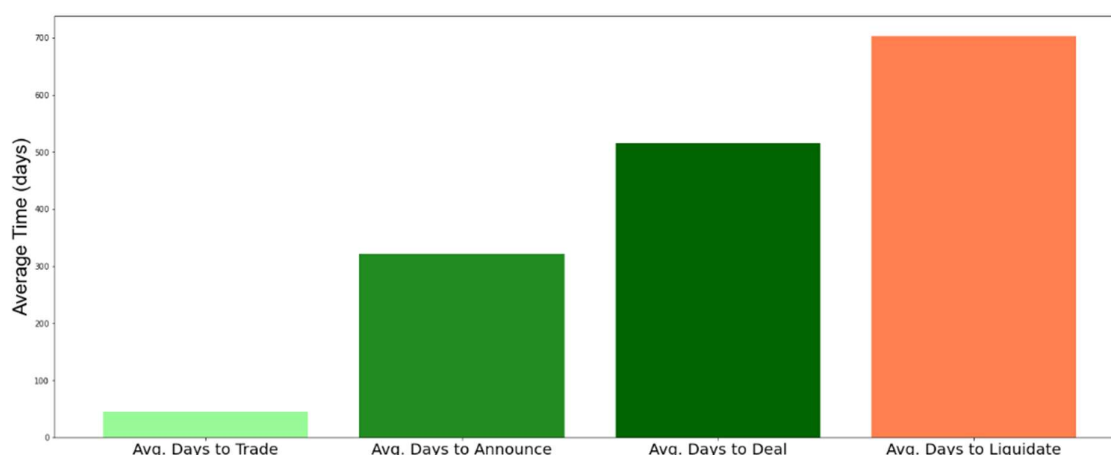
Further characterization of the post-IPO SPAC landscape is provided in figure 17. Here, the average time to complete a variety of landmark post-IPOs activities is illustrated. Note, these durations are given as total days, not solely as business or trading days. On average, SPACs begin trading (largely as a function of exchange/SEC regulations and/or underwriter discretion) 45 days after the IPO; the first merger deal is announced in just under a year after the IPO; due diligence is completed and a deal is consummated in 515 days; and if necessary, the SPAC is liquidated in just under two years, which more or less aligns with the pre-defined 48-month lifespan.

⁴⁵ Tailwind’s SEC prospectus filing dated September 1, 2020, https://www.sec.gov/Archives/edgar/data/1814215/000110465920101440/tm2022659-13_424a.htm

⁴⁶ Tailwind’s 8-K filing dated March 2, 2021, https://www.sec.gov/Archives/edgar/data/1814215/000110465921030358/tm218267d1_ex99-2.htm

⁴⁷ Haddad, M. *Tailwind Acquisition Corp. (TWND) Closes NUBURU Deal*. SPACInsider.com, 2023. <https://www.spacinsider.com/news/mhaddad/tailwind-closes-nuburu-deal>

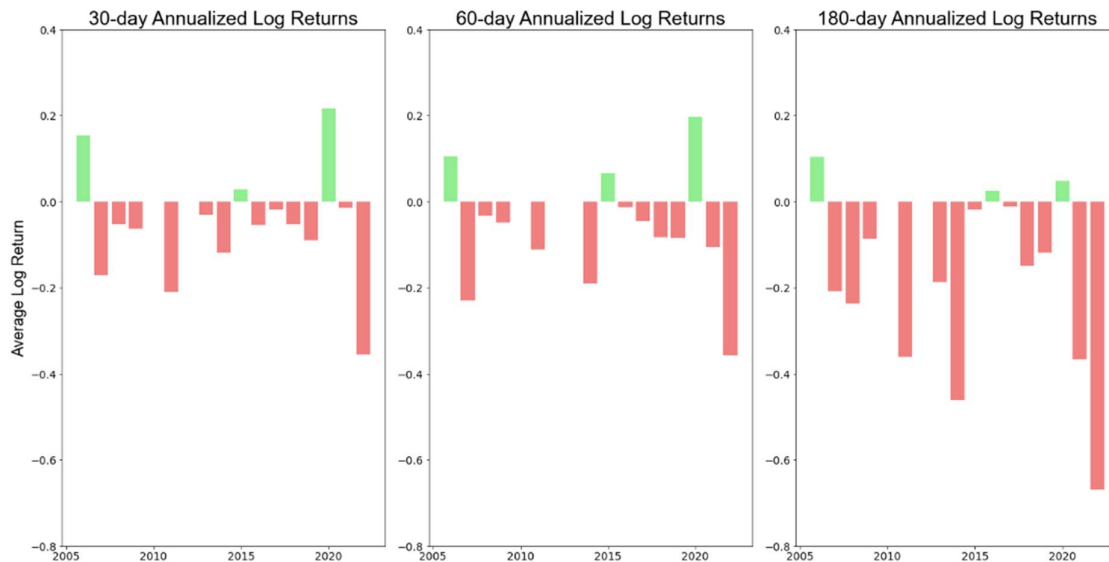
Figure 15: Post-IPO SPAC activities, average times to complete



B. Post-Merger Returns

As mentioned during the IPO analysis, the possibility that time-fixed effects exist within the data is very real, and even more so within the context of equity returns which are often dependent on the business cycle. It is important to note that the holding periods explored in the data do not span the average length of a business cycle and may therefore be significantly influenced by overarching market conditions. The time-series illustration of the average logarithmic rate of return for SPACs in figure 16 indicates the development of good and bad years for SPACs. Each SPAC was bucketed into a given calendar year based on the date the deal was completed. There is potential for spillover; for example, the 180-day returns for a deal completed in December 2021 would mostly have been a function of conditions in the 2022 calendar year but would be bucketed into the 2021 year. Effectively, this just provides a means of organizing the data and is not significantly impactful. Additionally, there are not an equal number of observations in each year, so the averages are not directly comparable year-over-year. This figure solely provides a glimpse of the behavior of SPACs over time as it was observed in the data.

Figure 16: Average SPAC returns across various holding periods over time

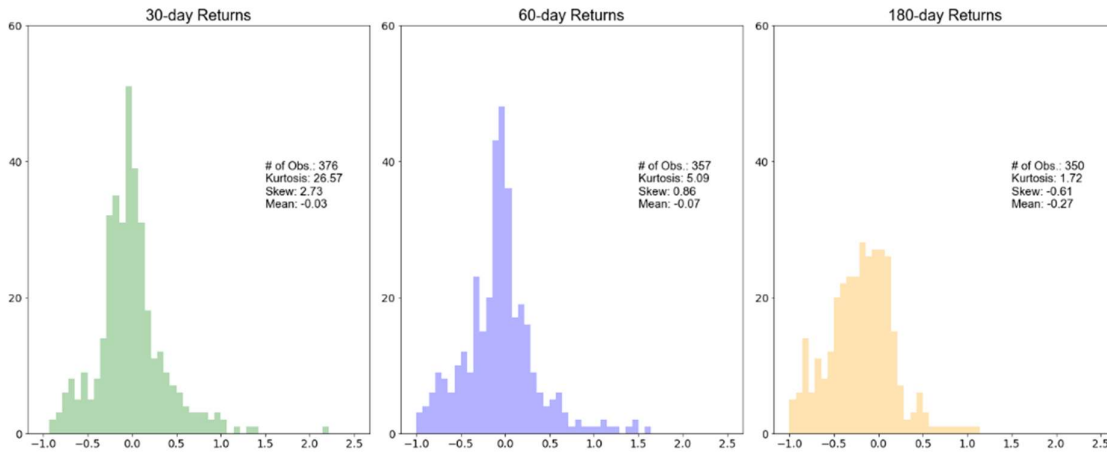


Most notably, 2020 was the highest upside year for SPACs, which is unsurprising as it was the breakout year for SPAC popularity. Additionally, in 2020 the market saw a significant post-COVID rebound which propelled the S&P 500 to all-time highs. By 2021, SPAC returns regressed in a negative direction, possibly as the result of more competition for targets amongst SPACs, begetting a period of less scrupulous due diligence on targets or less selectivity by the sponsors, or due to macroeconomic factors that somewhat hampered equity markets, such as growing inflation, lingering post-COVID market uncertainty, and the looming conflict between Russia and Ukraine. While the latter items may have had some role in poor SPAC performance, it is likely these negative returns are a greater reflection of the SPAC industry itself. The S&P 500 posted an enormous 26.89% simple return in 2021⁴⁸ (which translates to an annualized log rate of return of 23.8%), very much the antithesis of what was observed in the SPAC data.

The distributions of returns across the 30-day, 60-day, and 180-day holding periods provide further insight into SPAC performance post-merger.

⁴⁸ Miao, H. & Macheel, T. *S&P 500 ends 2021 with a nearly 27% gain, but dips in final trading day*. CNBC.com, 2021. <https://www.cnbc.com/2021/12/30/stock-market-futures-open-to-close-news.html>

Figure 17: Annualized log return distributions in post-merger windows



Beginning with the distribution of returns 30 days following the completion of the initial business combination, the mean value was -3%. In this period, the market is beginning to re-assess the value of the SPAC as a function of its target company. The negative mean return could imply that non-redeeming shareholders are pessimistic on the target company, or have simply valued it below the SPAC's price, and may be looking to dump stocks of the newly formed entity within the first month. It is unclear what proportion of these non-redeeming shareholders are retail investors and what proportion are institutional investors. Given the option to redeem shares at the time the merger is voted on, it would appear counter-intuitive to hang on to shares through the merger, only to sell them at a loss very shortly thereafter. Such behavior may be characteristic of more complex investment strategies employed by institutional investors, who may use SPACs as a hedging instrument, or perhaps by PIPE financiers who bought into the SPAC at a discount and can still make a profit by selling shares at a price lower than the initial offering price, as long as it exceeds their own purchase price.

This distribution also demonstrates relatively large positive skewness, which implies that there are some number of SPACs that actually experienced large gains in this window. Table 5 summarizes the best and worst performers within this timeframe.

Table 5: Best and worst performing SPACs in 30-day post-merger holding period

Best performing SPACs:

SPAC	Target	Date of Merger	Offering Price	Price @ 30 Days	Simple Return	Log Return	Annualized Log Rate of Return

Kensington Capital Acquisition Corp.	QuantumScape Corp.	2020-11-25	\$10.00	\$114.77	1,047.7%	465.18%	486.74%
Live Oak Acquisition Corp.	Danimer Scientific, Inc.	2020-12-29	\$10.00	\$48.51	385.1%	157.92%	215.08%
Novus Capital Corp.	AppHarvest, Inc.	2021-01-29	\$10.00	\$30.45	204.5%	111.35%	140.15%
Social Capital Hedosophia Holdings Corp. II	Opendoor Technologies, Inc.	2020-12-18	\$10.00	\$26.03	160.3%	95.67%	131.77%
Star Peak Energy Acquisition Corp.	Stem, Inc.	2021-04-28	\$10.00	\$25.34	153.4%	92.98%	119.50%

Worst performing SPACs:

SPAC	Target	Date of Merger	Offering Price	Price @ 30 Days	Simple Return	Log Return	Annualized Log Rate of Return
ECP Environmental Growth Opportunities Corp.	Fast Radius, Inc.	2022-02-04	\$10.00	\$1.74	-82.6%	-174.87%	-163.24%
Dynamics Special Purpose Corp.	Senti Biosciences, Inc.	2022-06-08	\$10.00	\$1.97	-80.35%	-162.71%	-145.21%
Roth CH Acquisition III Co.	QualTek Services, Inc.	2022-02-14	\$10.00	\$2.50	-75.0%	-138.63%	-133.51%
Draper Oakwood Technology Acquisition, Inc.	Reebonz Holding, Ltd.	2018-12-19	\$10.00	\$1.77	-82.3%	-173.16%	-128.72%
Athena Technology Acquisition Corp.	Heliogen, Inc.	2021-12-30	\$10.00	\$3.35	-66.5%	-109.36%	-125.13%

Many studies on the topic of mergers and the subsequent abnormal returns experienced both by acquirers and by targets suggest that acquiring firms suffer a drop in their stock price around the time of the merger announcement, while target firms enjoy a bump in their share price. A 2008 paper by Dirk Hackbarth and Erwan Morellec finds an average -0.52% cumulative abnormal return to acquirers in a three-day period (spanning the day before, of, and after the announcement), while simultaneously finding an 18.21% CAR for the target firm.⁴⁹ These CAR statistics reflect the idea that the acquirer must pay a premium in order to complete the acquisition. The premium acts to fend off competition from other firms and may price in intangible benefits to the acquirer, such as the potential for market expansion or operational synergies. In a reverse merger, however, the SPAC's target

⁴⁹ Hackbarth, D. & Morellec, E. *Stock Returns in Mergers and Acquisitions*. The Journal of Finance, Vol. 63, No. 3, 2008

is, in effect, the acquirer, and the SPAC itself the target — this is the very mechanism that allows the formerly private company to go public through the merger. With this in mind, it may not be surprising that the post-merger company's shares lose value, although the incongruity of the SPAC merger structure to the mergers covered by these empirics suggests this may be an apples-to-oranges comparison. While SPACs may indeed have had competition to consummate a merger, especially as the SPAC boom wore on, with the lack of any operational synergies between the SPAC and its target, it stands to reason that the merger price would be somewhat closer to the fair and accurate book value of the target. As such, the merger premium should be minimized as well as the negative impact to the post-merger firm's share price.

Finally, the impact of warrants issued during the IPO on the post-merger company's share price is worth consideration. In theory, as the SPAC approaches or exceeds \$11.50 per share after the merger, investors know that outstanding warrants are likely to be exercised. When this happens, investors exchange capital for newly issued shares. However, to the extent that the pre-exercise SPAC share price exceeds the warrant strike price, the amount of cash per share in the SPAC falls, thus dragging down the post-exercise SPAC share price. Consider a stock whose price steadily continues to grow beyond the strike price. Investors with different preferences and risk aversion will have different preferences on when to exercise their warrants; however, the continual rise in the stock price will generally correlate with higher rates of outstanding warrants being exercised. This trade-off between price growth and the growth in outstanding shares, which then lowers the amount of cash per share, in turn, depresses the market price for the stock and, in effect, tends to act as a ceiling on the post-merger price. Non-redeeming investors have an incentive to offload shares before the warrant strike price is hit, or risk bearing the subsequent dilutive impact.

Within the dataset for this paper, only 54.5% of all post-merger SPACs ever reach or exceed the warrant strike price. The median number of days it stays in this price range is 54 days. This means that for many SPACs, the warrants provide no tangible benefit to shareholders, at least terms of being able to exercise the option and receive discounted shares. However, considering that SPAC shares and warrants trade separately shortly after the IPO, the benefits of trading warrants as opposed to exercising warrants must be considered. A 2021 study cites a price-weighted average one-year buy-and-hold return for warrants of 13.5%, with the return for out-of-the-money warrants (which represents a significant portion

of warrants issued in SPACs) at 104.3%.⁵⁰ Considering the mean returns for post-merger SPACs, the returns on warrant trading, and the potential impact of dilution on those who remain invested in the SPAC, a strategy of redeeming shares and selling warrants (possibly before the merger when the options are closer to being in-the-money and suffer less from theta decay) appears to significantly outperform a buy-and-hold strategy.

C. Shorter Holding Periods

While it is evident that SPACs tend to perform poorly post-merger, shareholders may still be able to realize value from their investment from holding the equity over some duration in the pre-merger phase. In this section, returns at the time a merger deal is announced and at the time the deal is completed are examined. Consider, a deal announcement is very positive news for shareholders. Their investment is primed to flow into an operating business which can benefit from its listing on a public exchange to generate higher revenues and, ideally, higher net earnings. As such, investors may eschew their right to redeem SPAC shares in exchange for a stake in the improved earning potential of the post-merger company. While this is evidently not the case in practice, this is, in theory, the mindset of the investor prior to the merger.

1. Returns at Merger Completion

For the sake of comparison to post-merger returns, the analysis continues with investor returns at the time the merger is completed, the nearest in proximity. A time-series chart of annual returns yields a similar outcome to post-merger returns.

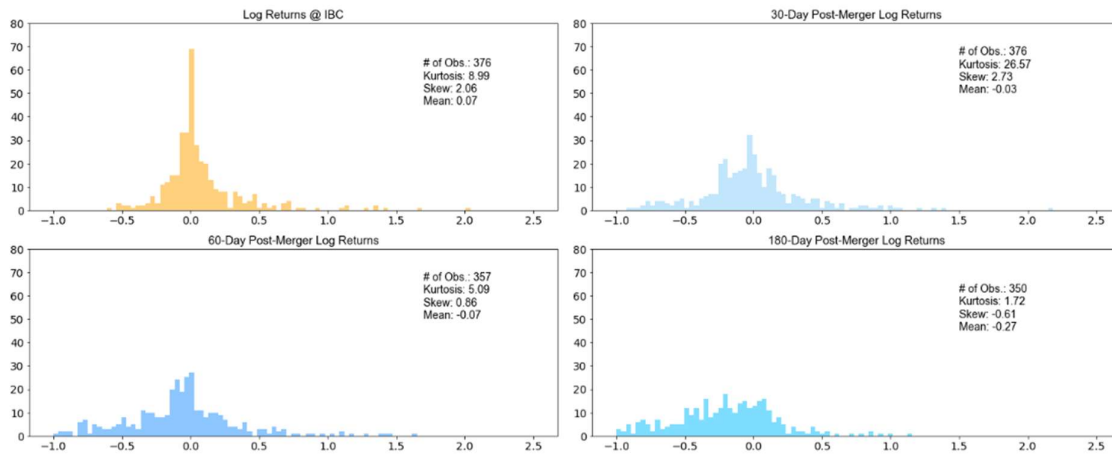
Figure 18: Average SPAC returns at merger completion over time



⁵⁰ Gahng, M., Ritter, J., & Zhang, D. *SPACs*. The Review of Financial Studies, forthcoming

The major contrast here is that there are some additional years that turn a positive return on average, which suggests that an investment held only until merger completion may perform better than any post-merger holding period. This is formalized further with a comparison of return distributions.

Figure 19: Annualized log return distributions in merger, post-merger windows



Indeed, the mean return at the time of the initial business combination is higher than for the 30-day post-merger holding period and is the first distribution with a positive mean return. Beyond this, the positive skew in this distribution again implies that, at this point in time, there are a number of SPACs that are even outperforming the mean 7% annualized logarithmic rate of return. Table 6 summarizes this distribution's best performers:

Table 6: Best performing SPACs at the time of merger completion

SPAC	Target	Date of Merger	Offering Price	Price @ Merger	Simple Return	Log Return	Annualized Log Rate of Return
Kensington Capital Acquisition Corp.	QuantumScape Corp.	2020-11-25	\$10.00	\$23.50	135.0%	85.44%	203.83%
Social Capital Hedosophia Holdings Corp. II	Opendoor Technologies, Inc.	2020-12-18	\$10.00	\$29.50	195.0%	108.18%	168.03%
Star Peak Energy Acquisition Corp.	Stem, Inc.	2021-04-28	\$10.00	\$26.61	166.1%	97.87%	140.64%
Live Oak Acquisition Corp.	Danimer Scientific, Inc.	2020-12-29	\$10.00	\$24.20	142.0%	88.38%	135.54%
INSU Acquisition Corp. II	Metromile, Inc.	2021-02-09	\$10.00	\$18.00	80.0%	58.78%	134.09%

Many of the same SPACs that performed well post-merger were performing well at the time of the merger, which perhaps reflects investor optimism around the announced target.

One hypothesis for the outperformance of SPACs at this point in time is that the boilerplate pricing of SPAC IPO shares at \$10 creates an artificially high floor for the post-merger entity. When SPAC shares, which tend to trade around \$10 until the merger is completed, convert to shares in the now-public post-merger entity, the market price no longer reflects the value of the SPAC, but rather the value of the formerly private company. And in many cases, this value can be well below \$10 per share, especially after considering the impact of dilution in the form of the sponsor's promote and downward price pressure exerted by the warrant overhang. This idea was explored in a 2022 paper by Harvard Law School professors Holger Spamann and Hao Guo, in which they dub the impact of the artificial pre-merger price floor as the "SPAC trap."⁵¹ They claim that, even if the SPAC was priced according to the market and not at a pre-defined value, investors would still suffer as a result of the redemption rights each share possesses. For example, even if the market priced the SPAC at \$5 after its IPO, sophisticated traders would know that each share represented a \$10 initial investment stake with the rights to a pro-rata portion of the trust account and would therefore purchase shares at the \$5 market value until the market price rose accordingly. The authors assert that, "the availability of SPACs' 'approve and redeem' strategy renders [a market-based SPAC appraisal] worthless," and that no price below the SPAC offering price can exist prior to completing a merger. Thus, the value of a share at or before the time of redemption must almost certainly exceed the value of a share after the merger, except in the demonstrably rare cases where the SPAC target's true market value per share exceeds the \$10 SPAC offering price. For this reason, investors who hold SPAC shares should be wary of potential targets and do a thorough analysis of potential dilution costs and target fundamentals to understand the benefits and costs of keeping their equity.

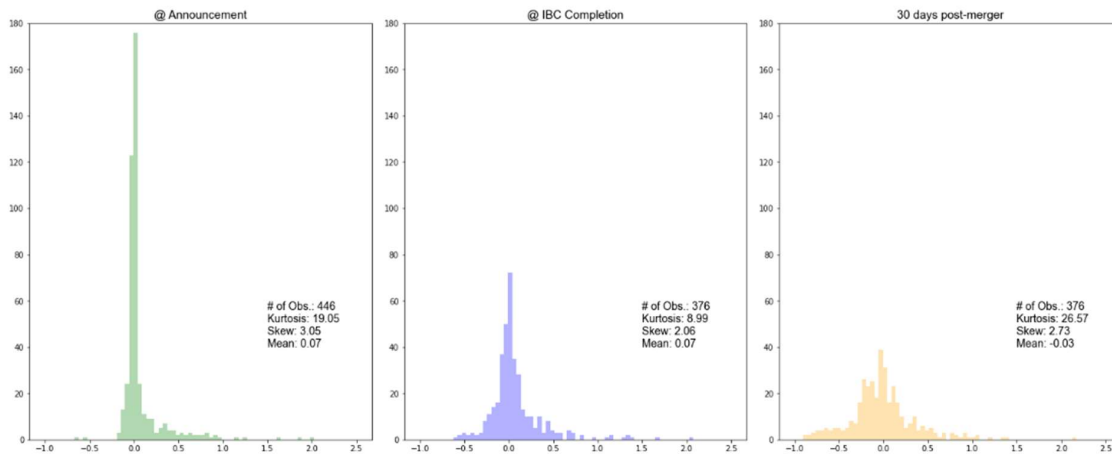
2. Returns at Time of Deal Announcement

At the time a letter of intent is signed, and a planned merger deal is announced, the SPAC still effectively has no operations and no indication of future earnings. This is in contrast with the returns examined in the previous section, where the SPAC's market price at least, in theory, begins to reflect the future earnings potential of the SPAC's target. As such,

⁵¹ Spamann, H. & Guo, H. *The SPAC Trap: How SPACs Disable Indirect Investor Protection*. Yale Journal on Regulation, Vol. 40, No. 75

one might expect that the SPAC price prior to deal announcement is relatively immobile. While a share still enables its holder to a pro-rata portion of the interest-bearing trust account, this only provides investors with the risk-free rate. Furthermore, because warrants trade separately, shareholders do not benefit from some embedded value of the option. Figure 22 compares returns across these holding periods and the 30-day post-merger holding period.

Figure 20: Annualized log return distributions in pre-merger, merger, post-merger windows



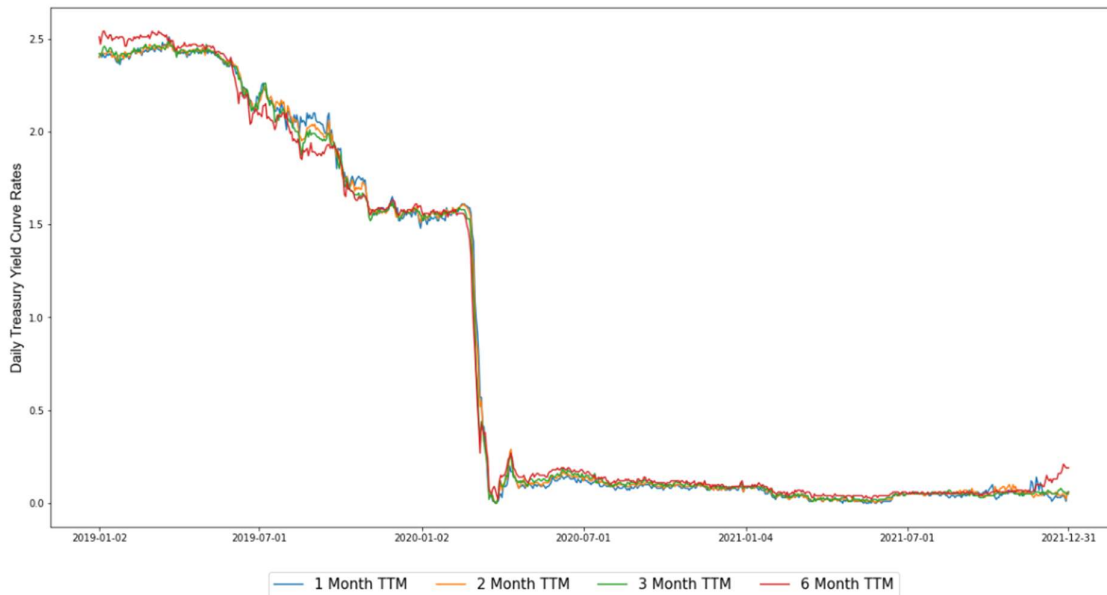
Interestingly, SPAC returns at the time of deal announcement have the most favorable distribution yet, with a mean annualized logarithmic rate of return of 7%, the same as the distribution of returns at the time of deal completion, and more positive skew. This positive performance is considered on the basis of two factors: the interest generated by investing the money in the trust account and investor overconfidence.

Regarding the former, consider that a share entitles its holder to a pro-rata portion of the money in the trust account. That money is invested in U.S. treasury notes or other qualifying money-market funds with a maturity typically no longer than 180 days, or six months, where it accrues interest. As such, because investors in the SPAC have no guarantee that a merger will occur at this point, the share price ought to primarily reflect the value of the interest accrued in the trust account and the pro-rata portion thereof that the shareholder has a claim to. In effect, this implies that IPOs that were completed at a time when the yields on Treasury notes are relatively high should have higher returns at the time the deal is announced than their low-yield counterparts. Beyond that point, the SPAC price may start to fluctuate based on news or expectations surrounding the target company. Of course, there may be residual price impacts based on investor expectations, as will be discussed, but the

trust account represents the only concrete future cash flows to (redeeming) investors at this point in time.

Figure 23 illustrates the yield for different maturity fixed-income instruments as they developed over time.

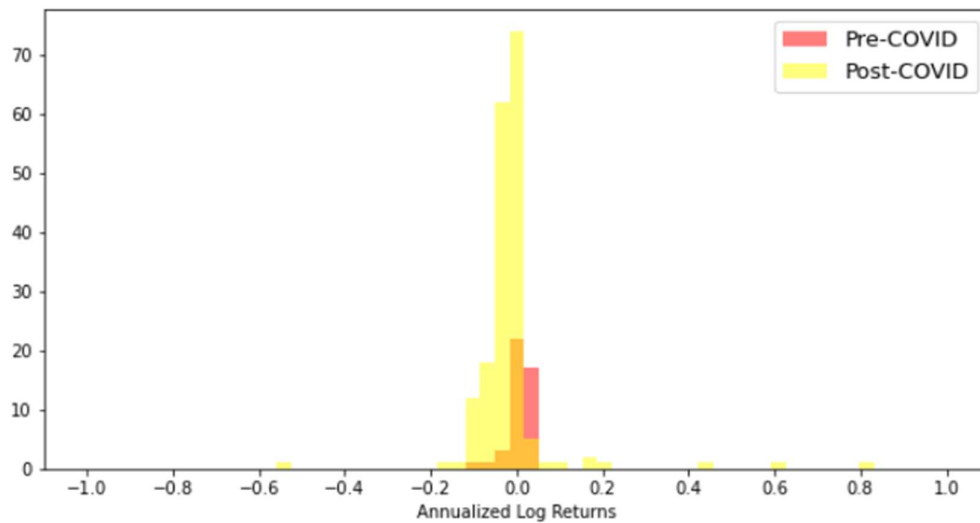
Figure 21: U.S. Treasury note yield development across different times to maturity



During the SPAC boom, the COVID pandemic had major implications for U.S. interest rates. The government raced to slash interest rates in order to prop up consumer spending, keeping the economy afloat.⁵² Following the line of reasoning suggested earlier, it is implied that SPACs formed prior to COVID invested their trust account funds at higher rates and would have been more successful than their post-COVID counterparts, at least considering returns realized at the time a merger deal is announced. This hypothesis will be tested formally in an ordinary least-squares regression, but for now, the pre- and post-COVID return distributions can be overlaid:

⁵² Milstein, E. & Wessel, D. *What did the Fed do in response to the COVID-19 crisis?* The Brookings Institution, 2020. <https://www.brookings.edu/research/fed-response-to-covid19/>

Figure 22: Annualized log returns at the time of deal announcement for pre-COVID, post-COVID samples



The pre-COVID population's median logarithmic annual rate of return is 1.4% compared to the post-COVID population's value of -1.8%. However, because these distributions have a very different number of observations, a T-test is employed to determine if this observed difference is simply due to sampling noise or due to statistical inference. Recall that the relevant test statistic is standardized by the number of observations in each distribution. The T-test yields a test statistic of 1.3614, but more importantly given the unlikeliness of a normal distribution, a p-value of 0.1748 which implies that the null hypothesis cannot be rejected — that returns were not meaningfully larger in the pre-COVID group than the post-COVID group. In turn, this suggests that the drastic cuts in interest rates had no real impact on SPAC stock performance in this holding period, which in turn suggests that the interest-bearing function of the trust account played little or no role in SPAC performance.

The other supposed factor influencing these returns, investor overconfidence, is outlined in a 2021 paper. The authors suggest that there exists a significant portion of unsophisticated investors who incorrectly believe they will digest information regarding the SPAC and its prospects and will redeem their shares when the information is bad. The paper essentially concludes that unsophisticated investors overprice the optionality of share redemption and warrants, because they will fail to properly employ that optionality.⁵³ This may well be true of investors on the secondary market, who move the stock price prior to the merger deal announcement (again, it is assumed that news from the merger deal itself moves

⁵³ Banerjee, S. & Szydlowski, M. *Harnessing the Overconfidence of the Crowd: A Theory of SPACs*. 2021. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3930346

the stock price thereafter). These investors are effectively pricing in two things: the upside potential for whatever merger the SPAC pursues and the option to walk away with the risk-free rate on their investment if the upside potential seems limited. Whether these investors are sophisticated or not, these positive returns imply a demand for SPAC equity that, reasonably, derives the majority of its value from the optionality described here.

D. Influence of Speed

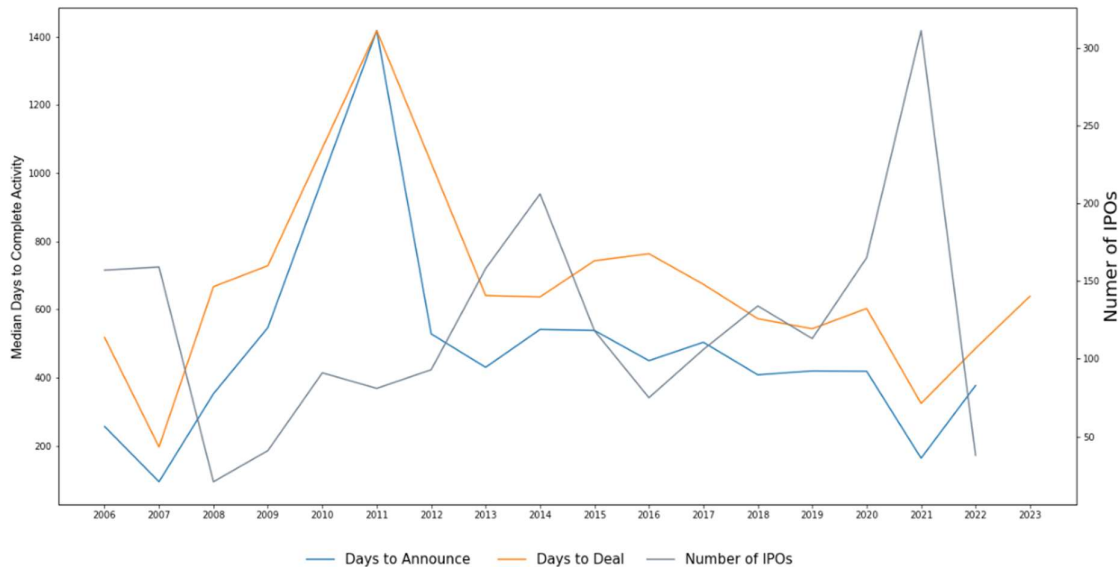
So far, the analysis of SPAC returns has focused primarily on varying durations of investment. The initial supposition was that SPACs represented a chance to purchase equity with potentially significant upside at a fixed price, with free options that represented even greater embedded value in the purchase. In reality, the data shows that the fixed price is often set too high, with SPAC targets' market valuation falling after they go public, which consequently keeps the options out-of-the-money, rendering them useless. Altogether, this suggests that the only investors who stand to benefit are those who redeem their shares prior to merger and/or trade their warrants on the secondary market. In summary, a shorter duration of investment often proves beneficial.

In this section, more time-based variables are considered, namely, the time elapsed prior to announcing a deal and the time elapsed prior to effecting the merger. In theory, these variables reflect the efficiency of a sponsor. A sponsor that begins negotiations with a target shortly after IPO fundraising is complete signals that they may have had a clear target in mind and that they feel confident about their ability to complete a deal. By contrast, a sponsor that must vote to extend its merger deadline signals any number of possible sponsor quality issues, from poor negotiation tactics to a lack of a strategy, or even general inactivity by the sponsor in pursuing a target. In any event, if the market values sponsor efficiency, there is the possibility that this is priced into the SPAC somewhere during its lifecycle. In practice, there may be additional nuance that informs these variables. For example, the quick completion of a merger may instead reflect a willingness by the sponsor to get any deal done, regardless of the target's upside. However, considering that sponsors would still prefer to open the door to higher upside on their stock in the form of a quality merger target, all else equal, these nuances will be disregarded for the time being.

During the peak of the SPAC boom, the time elapsed between SPAC IPO and deal announcement and completion began to shorten. Possibly, increased competition in the marketplace forced sponsors to work faster than ever before, or risk losing out on their

preferred target. Simultaneously, target companies may have been ready to buy in on the purported benefits of going public in this manner, marking an increased willingness to participate from their end.

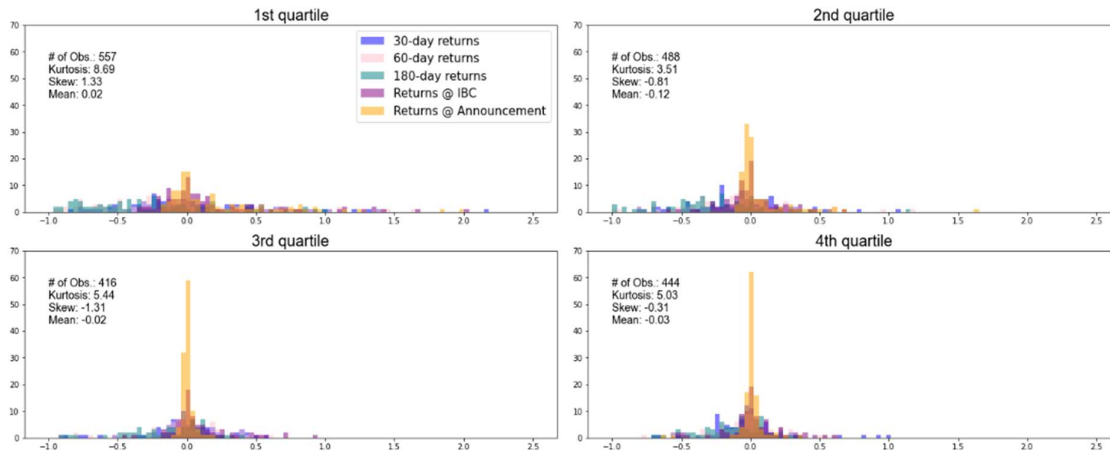
Figure 23: Development of median duration of time between IPO and deal announcement, completion



By 2022, however, total SPAC activity declined, as well as the rate at which these milestone events were achieved. The market as a whole showed signs of cooling as the number of total IPOs fell from 311 in 2021 to only 38 in 2022. Generally, there appears to be an inverse relationship between how “hot” the market for IPOs is and the time that elapses before SPACs enter into agreements with targets and complete a deal.

The influence of speed on SPAC returns is visualized with a quartile-based breakout of returns from every holding period defined previously. Quartiles are defined based on the elapsed time prior to completion of the merger and are based on the sample-wide median. The 1st quartile, or fastest SPACs, demonstrates the most significant volatility of returns with substantial upside, while the distributions for the remaining quartiles gradually fall towards the middle. While this suggests the possibility of a significant relationship between deal completion speed and SPAC performance, the histograms muddle together returns from all holding periods. To determine the statistical significance of these relationships, regression analysis will be implemented.

Figure 24: SPAC returns for quartiles of deal completion speed



E. Regression Models

Five OLS regression models were specified to consider the effects of factors heretofore discussed on SPAC returns across different equity holding periods. So far, only speculation has been provided to characterize the influences driving these returns. However, in this section, the analysis will seek to formalize statistically significant relationships between SPAC variables and the returns they produce.

Before analyzing the results themselves, diagnostic tests must be implemented to ensure that the conclusions drawn from the models are reliable. Model diagnostic tests can be found in Appendix A. Additionally, dummy variables have been created for the various industries in which SPAC targets operate. This is done to pull out the confounding effects from any industries that saw potentially abnormally high or low returns during the SPAC boom (such as artificial intelligence and defense), as those returns would otherwise be attributed to the companies themselves.

Table 7: Return regression output

Modeling SPAC Returns Across Holding Periods					
	Annualized Log Rate of Return				
	Returns @ Announcement	Returns @ Deal Completion	30-day Returns	60-day Returns	180-day Returns
	(1)	(2)	(3)	(4)	(5)
const	-0.107	0.233	0.129	0.427	0.035

	(0.305)	(0.393)	(0.625)	(0.588)	(0.563)
Gross Offer	0.020**	0.011	0.019	0.018	0.040**
	(0.008)	(0.011)	(0.018)	(0.017)	(0.016)
Warrants	0.004	0.082	0.137	0.122	0.087
	(0.044)	(0.064)	(0.1)	(0.096)	(0.092)
Terminated Deal Dummy	0.022	0.018	0.158	0.290*	0.255*
	(0.059)	(0.089)	(0.138)	(0.151)	(0.148)
Years to Announce	-0.082*	0.079	0.139	0.499***	0.449***
	(0.044)	(0.064)	(0.101)	(0.145)	(0.141)
Years to Deal	-0.022	-0.122**	-0.188**	-0.500***	-0.368***
	(0.039)	(0.058)	(0.092)	(0.142)	(0.138)
Mortgage Crisis	0.024	-0.326	-0.283	-0.32	-0.365
	(0.262)	(0.337)	(0.536)	(0.507)	(0.485)
Post Mortgage Crisis	0.142	-0.245	-0.193	-0.283	-0.341
	(0.245)	(0.314)	(0.499)	(0.465)	(0.445)
Post Covid	0.184	-0.133	-0.12	-0.233	-0.516
	(0.244)	(0.314)	(0.498)	(0.464)	(0.444)
Biotechnology	0.045	-0.026	-0.034	-0.182	0.059
	(0.177)	(0.23)	(0.364)	(0.339)	(0.325)
Software	0.019	-0.002	0.051	-0.02	0.105
	(0.178)	(0.23)	(0.366)	(0.341)	(0.326)
Electrical	0.085	0.085	0.051	-0.09	0.202
	(0.177)	(0.229)	(0.363)	(0.338)	(0.323)
Defense	0.002	0.015	-0.07	-0.164	0.053
	(0.182)	(0.235)	(0.374)	(0.35)	(0.337)
Health Care	0.047	0.012	-0.162	-0.328	-0.059
	(0.177)	(0.229)	(0.363)	(0.337)	(0.324)
Entertainment	-0.033	-0.072	-0.156	-0.207	0.08
	(0.179)	(0.232)	(0.368)	(0.344)	(0.329)
Machinery	0.232	0.052	-0.023	-0.188	0.064
	(0.181)	(0.233)	(0.371)	(0.345)	(0.33)
Consulting	-0.017	-0.04	-0.187	-0.277	0.049
	(0.182)	(0.237)	(0.376)	(0.349)	(0.334)
Oil	-0.013	0.073	-0.002	-0.119	0.111
	(0.184)	(0.242)	(0.385)	(0.358)	(0.343)
Other	0.072	0.044	0.034	-0.107	0.139
	(0.173)	(0.222)	(0.353)	(0.328)	(0.314)
Observations	446	370	376	357	350
R ²	0.155	0.078	0.048	0.076	0.132
Adjusted R ²	0.119	0.031	0	0.027	0.084
Residual Std. Error	0.242 (df=427)	0.310 (df=351)	0.493 (df=357)	0.458 (df=338)	0.438 (df=331)
F Statistic	4.335*** (df=18; 427)	1.656** (df=18; 351)	0.999 (df=18; 357)	1.540* (df=18; 338)	2.784*** (df=18; 331)

Note:

*p<0.1; **p<0.05; ***p<0.01

Regarding the models, none have a particularly high adjusted R-squared statistic, which again signals that these models are likely lacking some of the nuance that would be required to better model SPAC returns. Given that SPAC equity, like almost all publicly traded equity, is likely to rise and fall with the business cycle, it may be the case that certain macroeconomic factors should be included to bolster the predictive power of these models.

With that said, exploration of the significant variables and their coefficients can proceed. Beginning with the first model which predicts SPAC returns up to the point in time at which a deal is announced, only the size of the gross offering in the IPO is significant at the 5% level. Considering that this is the point in time where the SPAC is still mostly shapeless, it stands to reason that any returns generated are based on investor optimism and sentiment, but not around any company fundamentals or news. The 2% bump in the rate of return that companies receive for each additional \$100 million in the IPO suggests that the market responds positively to a larger SPAC. As hypothesized before, more money raised in the IPO enables the SPAC to pursue larger companies and broadens the scope of possible investment, which, while this may not make the IPO itself more successful than any counterparts, may command a premium on the secondary market post-IPO. The regressor that captured the time to announce a deal is significant only at the 10% level. It is perhaps unsurprising that this variable is significant, but surprising that it is not more so, as it suggests that investors are not much more optimistic about a SPAC that announces a deal with a target within a handful of months post-IPO than they are about a deal that takes more than a year to announce.

Only a single regressor is significant at the 5% level in the second model, the years to complete a deal. The coefficient suggests that an additional year spent completing a deal reduces the annualized logarithmic rate of return by 12% at the time the deal is completed. This may well reflect concerns around sponsor desperation to receive their promote and questions around the target's fundamentals, or possibly concerns around the involvement (which is often limited) of a sponsor who is perceived as inefficient in the management of the now-public firm. This variable is significant at the 5% or 1% levels in the following models with coefficients that are even more negative. Returns in these models should price in the post-merger behavior of the de-SPAC companies and offers some confirmation of this theory. Put plainly, the longer a deal takes to happen, the worse the post-merger firm performs. Interestingly, in the 60-day and 180-day returns models, there is a significant offsetting effect from the "time to announce" variable. This undercuts any real economic meaning from these

variables and suggests instead that there is likely some confounding effect that has not been uncovered, perhaps from an omitted variable, or else acts to just tamp down the magnitude of the coefficients on the “time to deal” variable.

Lastly, it is interesting to note that none of the industry dummies have any statistical significance, nor do the time-based dummies. This implies that SPACs do not outperform their peers based on the industry they enter into or when they complete their deals, which would otherwise be significant factors that determine a company’s returns within the relatively short windows used in the models. A Deloitte white paper published in 2016 surveyed around 3,000 private company executives and polled respondents on their biggest concerns in preparing for an IPO, to which one-third of respondents cited market timing.⁵⁴ Despite this, the models suggest that SPACs didn’t perform any worse during the COVID pandemic than they did during the market surge that followed. The most likely explanation for this lies in fact that all de-SPAC returns are low. When very few SPACs are performing well and the average SPAC suffers a loss on investment, there may be very little to differentiate them. In summary, while the data shows that SPACs perform worse the longer an investor in the IPO holds on to their shares, it is not entirely clear what drives these poor returns based on the regression models.

V. Conclusion

A. Summarizing SPAC Performance and Outlook

Through the lens of retrospection, the mainstream popularity that SPACs achieved is confusing. While they are certainly an attractive undertaking for sponsors and, to some degree, the PIPE financiers who help push a merger deal over the finish line, the incentives they offer are, at best, murky for target firms and in the case of public investors, nearly nonexistent. Given the complex and conflicting nature of SPACs, it is likewise difficult to conclude that they constitute a superior method of going public to that of a standard IPO.

The speed and underpricing benefits to target firms cited by advocates of SPACs are very real. The SPAC structure does enable target firms to go public in a much shorter period than a standard IPO. The data suggests an average period of 193 days, or roughly 6.5 months,

⁵⁴ *Private company IPOs: Is timing everything?* Deloitte, 2016.
<https://www2.deloitte.com/content/dam/Deloitte/us/Documents/audit/us-audit-private-company-ipos-is-timing-everything.pdf>

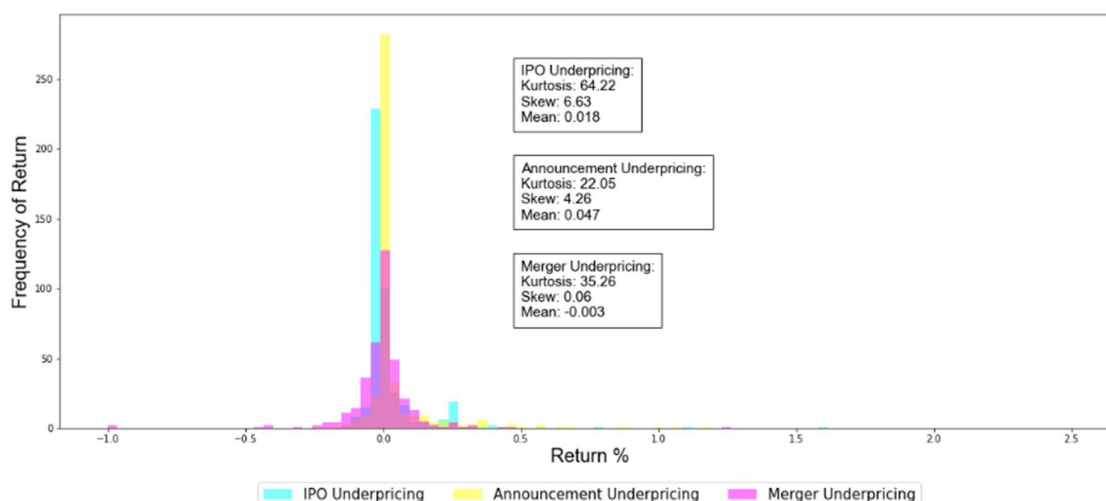
between the announcement of a SPAC merger deal and its completion, in contrast with no less than one year that a standard IPO typically requires.

Characterizing the relative benefits of reduced underpricing is less straightforward, as the underlying structures and timing differ vastly between standard IPOs and SPAC mergers. In a standard IPO, the initial price for the security on offer is effectively determined by investors during the book-building process, after which the underwriter begins allocating shares based on orders received. The secondary market plays no role in pricing the security until the offering has been completed, at which point underpricing of the public company can be determined as a simple function of the market price at closing and the offering price. Contrast this with the SPAC process, where, by the time any merger deal is announced, the SPAC itself is already publicly traded and any subsequent price changes may reflect market sentiment around the target. While the target company's shares are not actually trading at this point, market participants are effectively beginning to price in the eventuality. However, the price of the SPAC still includes the right to a pro-rata share of the trust account, and so the magnitude of underpricing, as it pertains to the true market value of the target company, is difficult to decipher.

Alternatively, consider SPAC underpricing as a function of the first day of trading for the now-public post-merger entity, which aligns concepts more closely with a traditional IPO. There are no confounding effects from the rights to the trust account, as redemption rights disappear after the merger has been completed. The key difference, however, is that the secondary market has already been pricing the SPAC's equity, as discussed above, from the time the merger deal was announced. In theory, this could reduce underpricing, as the market has already decided the value of the target firm and has started trading closer to this value.

In any event, SPACs seem to deliver on their promise of fairer valuations. An analysis of 439 SPACs reveals an average first-day return of just 2% after the SPAC IPO. Then, when comparing the equity price on the day before the SPAC's merger announcement and at the end of the day of the announcement, average first day returns for a sample of 423 SPACs is only 4.7%. Lastly, for 366 SPACs, the average return when comparing the closing price on the deal completion date to the day prior is -0.3%, which indicates slight overpricing of the security. The shrinking sample size is simply due to inconsistencies within the CRSP data.

Figure 25: Distribution of first-day SPAC returns



Again, contrast this with the average IPO underpricing cited in figure 4, which was rarely below 10%. In this sense, SPACs categorically provide better first-day returns than traditional IPOs and minimize the problem of leaving money on the table.

However, the longer-term returns for SPACs provide a clear reflection of their shortcomings. It is apparent that, at best, SPACs provide public investors with a risk-free rate of return and the roughly 50-50 chance that their warrants become in-the-money for a short period of time, while at worst yielding significant losses on investment. Investors must be willing to ask themselves if their capital is better deployed in a market index fund or, at the very least, in a handful of targeted investments based on company fundamentals or industry growth, such as what is happening in the artificial intelligence space currently.⁵⁵ Various ETFs have popped up that aim to invest in SPACs in various capacities and provide a means of direct comparison to these other popular investment vehicles.

⁵⁵ Goodkind, N. *The AI boom is here. Is it too late to invest?* CNN Business, 2023. <https://edition.cnn.com/2023/06/12/investing/premarket-stocks-trading/index.html>

Figure 26: SPAC ETF performance

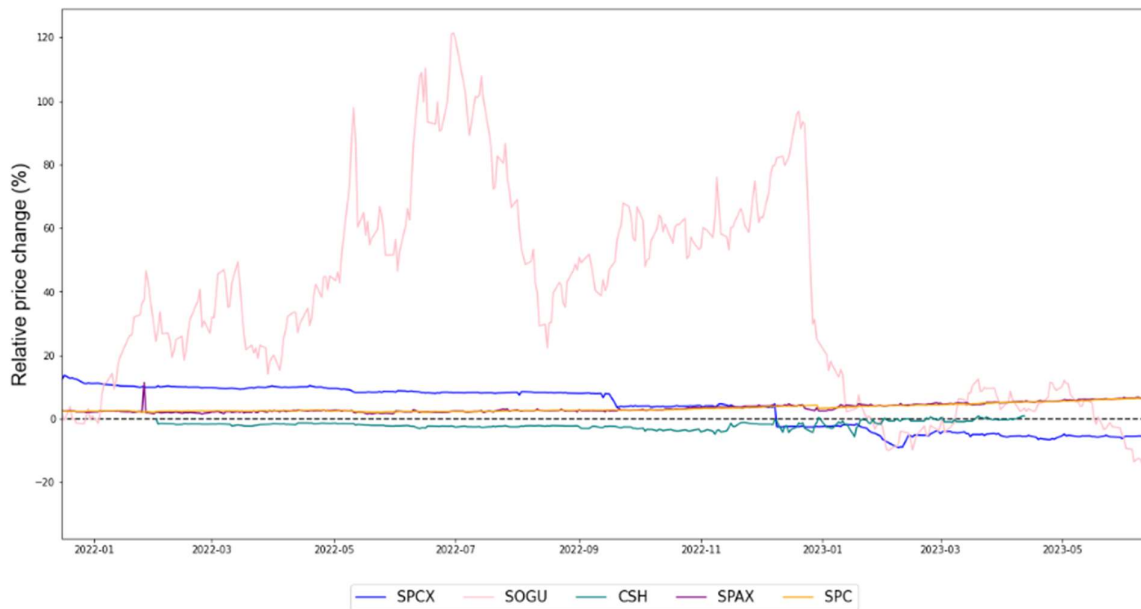


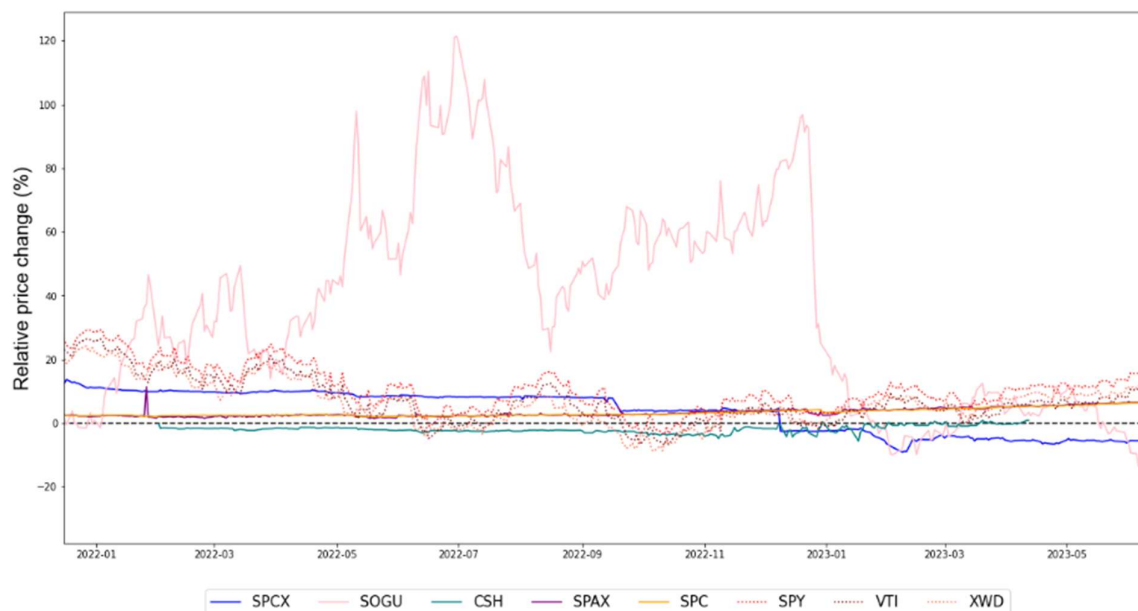
Figure 26 plots the relative price performance of five SPAC ETFs from mid-December 2021 through the present or through the point in time when the ETF was liquidated. Descriptions of the funds and their relative performance over this time period are given in the table below. Descriptions are taken from each ETF’s initial prospectus.

Ticker	Name	Description	Inception	Relative Price Change
SPCX	Collaborative Investment Series Trust - The SPAC and NEW Issue ETF	In pursuing the Fund’s investment objective, the Fund will at least 80% of its net assets (plus any borrowings for investment purposes) in units and shares of Special Purpose Acquisitions Corporations (“SPACs”) that have a minimum capitalization of \$100 million and companies that completed an initial public offering (“IPO”) within the last year.	December 15, 2020	-5.37%
SOGU	Investment Managers Series Trust II - AXS Short De-SPAC Daily ETF	The Fund seeks to provide investment results that are approximately the inverse of, before fees and expenses, to the price and yield performance of the [De-SPAC] Index.	May 17, 2021	-16.43%
CSH	Listed Funds Trust - Morgan Creek-Exos Active SPAC Arbitrage ETF	The Fund has adopted a non-fundamental investment policy to invest, under normal circumstances, at least 80% of its net assets (plus the amount of any borrowing for investment purposes) in Pre-Combination SPACs.	February 1, 2022	0.88%

SPAX	Tidal ETF Trust - Robinson Alternative Yield Pre-Merger SPAC ETF	The Fund will invest at least 80% of its net assets (plus any borrowings for investment purposes) in equity securities, specifically units and shares of common stock and warrants, of U.S.-listed Special Purpose Acquisition Companies (“SPACs”). The Fund expects to invest the majority of its assets in SPACs which are small capitalization companies.	June 22, 2021	6.44%
SPC	Trust for Professional Managers - CrossingBridge Pre-Merger SPAC ETF	The Fund seeks to invest in publicly-traded SPACs that at the time of purchase are trading at or below the SPAC’s pro rata trust account value.	September 20, 2021	6.39%

Most of the ETFs have a relatively straightforward investment objective, while the SOGU ETF looks to create an inverse return of the De-SPAC Index ETF (DSPC, now liquidated). SOGU’s peak performance was well beyond the other ETFs, achieving a 124.10% return relative to the 2021 end-of-year price by the following June. Interestingly this suggests that the best strategy for those investing in SPACs is to short sell them, rather than hold any sort of long position, as the returns on the other ETFs were negative or low and rarely offered any significant upside volatility. Contrast the performance of these ETFs with that of three market indices: SPCY, the well-known SPDR S&P 500 ETF; VTI, a very popular Vanguard market ETF; and XWD, a broader BlackRock MSCI World Index ETF.

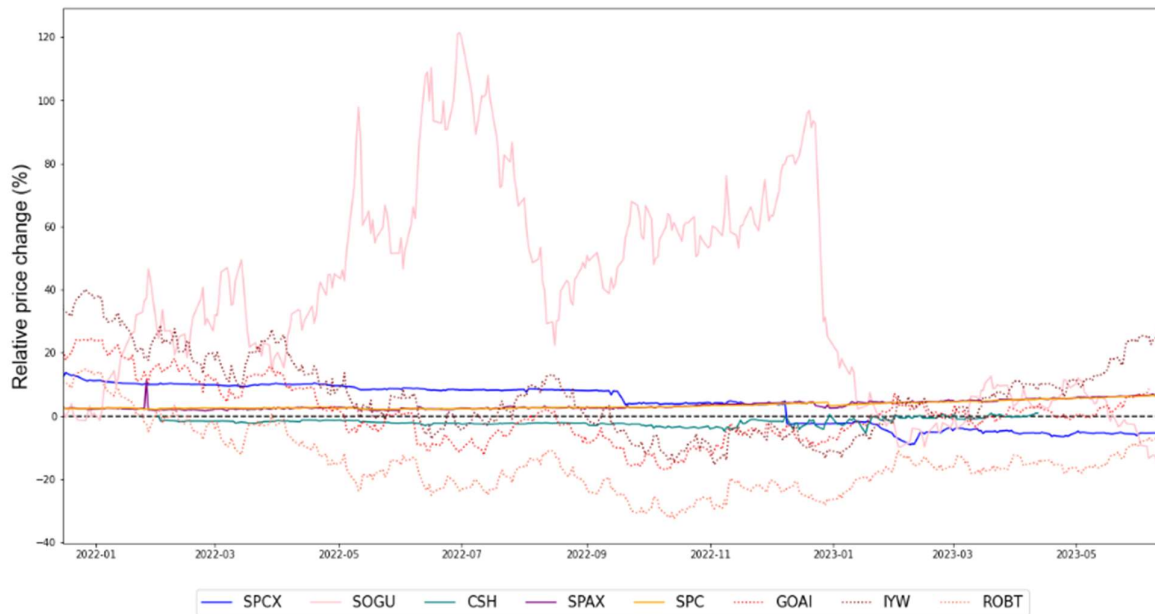
Figure 27: SPAC ETF vs. market index ETF performance



The three market index funds finished the same period with returns of 17.37%, 12.28%, and 12.55% respectively. While these funds did not outpace the SOGU fund at its peak, they provided higher returns than the other SPAC ETFs with relatively low volatility. These returns also exceed the 11.6% average annualized return netted by redeeming SPAC IPO investors,⁵⁶ and certainly outpace the annualized returns from holding SPAC equity directly.

Likewise, the SPAC ETFs are compared to ETFs that are more targeted towards investment in the rapidly growing artificial intelligence (AI) industry. The AI funds plotted in figure 28 are: GOAI, an Amundi AI STOXX Global AI index tracking fund with investment in companies positively exposed to the adoption of AI; IYW, a BlackRock fund with significant exposure to U.S. technology companies; and ROBT, a Nasdaq AI and robotics ETF. These funds had a more mixed performance, with IYW leaping 27.10% during the given timeframe, but with ROBT dropping -5.9%. The technology funds generally trailed the SPAC ETFs, but surged late as positive news broke throughout the industry and bolstered returns.

Figure 28: SPAC ETF vs AI/tech ETF performance



This all suggests that investors have a number of strategies worth pursuing that beat a simple buy-and-hold strategy for SPACs. Whether they elect to short SPAC stocks, invest in

⁵⁶ Klausner, M., Ohlrogge, M., & Ruan, E. *A Sober Look at SPACs*

the market, or follow the news coverage and bet on a hot industry, investors will often do better than if they hang on to SPAC equity.

Target companies must also consider the long-term performance prospects of going public with a SPAC. The speed and valuation benefits have already been discussed, but SPAC equities seem to only depreciate after the merger deal is complete, with 80% of the SPACs in the sample losing value 180 days after the initial business combination and an average 180-day post-merger price that is 44% lower than the value of the stock at the time of the deal. Such prospects make the idea of an equity consideration for the merger much less attractive, unless, of course, target shareholders are prepared to sell off their stock immediately, which then brings into question company ownership and organization moving forward. Such an exit ramp may not be palatable to target shareholders. Boston Consulting Group has published a roadmap for considerations target companies should take when considering a SPAC merger. The list includes planning to manage the expectations of both existing and new shareholders and preparing to counter disappointing post-merger stock performance.⁵⁷ The authors recommend that companies prepare a strategy to retain and attract shareholders, but trying to sell sinking equity may be no small feat. Even if a lower post-merger stock price is a truer reflection of the company's market value, this doesn't soften the blow to target shareholders who could have exited earlier and reaped the benefits of the inflated price at the time of the business combination.

SPAC data from 2022 already suggests that the future for SPACs is grim, with a significant drop off in the frequency of such IPOs and in the average size of the offering. Beyond the empirics already discussed, the shortcomings of SPACs are plainly borne out in their mechanics. As covered before, the fact the SPAC structure creates significant shareholder dilution, with the sponsor, PIPE financiers, and the IPO underwriters all taking a chunk out of the value of a given share. The drag that this dilution creates on returns is the focus of a follow-up paper by Michael Klausner and Michael Ohlrogge to their 2020 study, in which they confirm a relationship between the pre-merger net cash remaining per share, after dilutive effects are accounted for, and SPAC returns. They conclude that the precipitous decline in SPAC popularity was predictable given the significant impact of dilution on shareholders.⁵⁸ Additionally, they find that the misalignment of sponsor, PIPE financier, and

⁵⁷ Kengelbach, J. et. al. *The SPAC Bust Could Be a Boon for Targets*. Boston Consulting Group, 2023, <https://www.bcg.com/publications/2023/blank-check-bust-could-benefit-spac-merger-targets>

⁵⁸ Klausner, M. & Ohlrogge, M. *Was the SPAC Crash Predictable?* Yale Journal on Regulation Bulletin, 2023

shareholder incentives creates a significant wedge between the parties, with shareholders bearing the burden. Sophisticated shareholder redemptions create a financing vacuum for PIPE financiers to fill. Because they and the sponsor both benefit from the completion of any deal whatsoever, and because PIPE financiers may be capable of adopting more complex hedging strategies, the investors who remain behind will have their votes overshadowed, opening the door to a deal with sub-par targets.⁵⁹

These problems have invited significant discussion and investigation from the SEC, as mentioned. Proposed regulations seek to increase the regulatory burden on SPAC sponsors, increase the liability of the underwriter during de-SPAC transactions⁶⁰, and increase the transparency of dilution information to investors. While such laws would encourage investor protections and even the playing field between sponsors, underwriters, and investors, so to speak, they would reduce any incentive for forming and creating the public offering for the SPAC in the first place. Some SPAC advocates have argued against these regulations by claiming that they create undue burden on some parties and could “facilitate a chilling effect on the SPAC market and thereby undermine one of the SEC’s core missions of capital foundation.”⁶¹ Others seek to allay heavier regulation by arguing that changes aimed at protecting investors aren’t warranted, as retail investors are hardly impacted. They claim that institutional investors provide the majority of capital, typically redeem shares rather than sell them on the secondary market, and that retail investor participation is altogether limited.⁶² However, both arguments appear founded on the premise that continued capital creation should be the primary goal and should take priority over the wild asymmetries that may harm less sophisticated investors, an idea that is not likely to win over regulators. While balance is always important, the suggestion that increased transparency into the dilutive mechanisms inherent in SPACs creates a burden that undermines the fundamental benefits of SPACs highlights exactly what is wrong with the SPAC structure. When investors have more information, the sponsors stand to lose.

⁵⁹ Klausner, M. & Ohlrogge, M. *Was the SPAC Crash Predictable?* pp.108-109

⁶⁰ White & Case, LLP, comments to SEC proposed regulations, June 17, 2022, <https://www.sec.gov/comments/s7-13-22/s71322-20132359-302926.pdf>

⁶¹ *SEC Proposes Rules to Regulate SPACs*. White & Case, 2022. <https://www.whitecase.com/insight-alert/sec-proposes-rules-regulate-spacs>

⁶² Committee on Capital Markets Regulation. *Nothing But The Facts: Retail Investors and Special Purpose Acquisition Companies*. 2021. <https://capmksreg.org/wp-content/uploads/2021/10/CCMR-NBTF-SPACs-Retail-Investors.pdf>

Ultimately, the market provides the best indication whether or not SPACs are here to stay. Black Spade Acquisition Co., a Hong-Kong based SPAC that launched in July 2021, announced a merger with VinFast Auto Pte. Ltd., a Vietnamese electric vehicle manufacturer, in May 2023.⁶³ The 8-K filing cites a \$27 billion valuation for VinFast, which would make the de-SPAC transaction the third largest in history. However, this deal is yet to be completed, and business journalists suggest that the valuation could drop, citing a lack of valuation transparency in the investor presentation deck, poor product reviews, and the absence of any PIPE involvement. Meanwhile, the previously mentioned Pershing Square Tontine SPAC, the largest SPAC ever formed, was forced to liquidate its trust account after failed negotiations with a variety of targets, from Universal Music Group to French media company Vivendi to Airbnb.⁶⁴ Such developments suggest that the market for SPACs has come and gone, even in the absence of heightened SEC regulation.

Indeed, it appears that the SPAC market constituted a bubble which has now burst. Through regulatory gamification, SPACs presented themselves as shortcuts for private firms, whereby offering costs could be minimized and public capital could be tapped into faster than ever before. A frenzy, perhaps fueled by investor irrationality, soon formed as capital markets became inundated with blank check companies. With investors drawn in by free options and, perhaps, by celebrity endorsement, SPAC IPOs continued to flourish and grew bigger and bigger. Simultaneously, a media echo chamber formed, with many major media outlets proclaiming, “SPACs are here to stay!”⁶⁵ In reality, on the basis of what the SEC has seemingly characterized as deliberate vagueness, SPACs rode out retail investor losses and target shareholder headaches to deliver a payday to the sponsors, underwriters, and their peers in institutional investment. In response, the SEC sought to tighten the noose around SPACs, while investors were already beginning to exit the game. As it stands, SPACs may be forced to adapt or go extinct. While the latter outcome seems probable, the former outcome certainly seems possible. Following his Pershing Square Tontine failure, Bill Ackman has formed a new type of entity, the SPARC, or special purpose acquisition rights company, in which investors acquire warrants in the post-merger company and are only required to

⁶³ Bryant, C. *\$27 Billion Electric Vehicle Deal Shows SPAC Silliness is Back*. The Washington Post, 2023

⁶⁴ Deveau, S., Hytha, M. *Bill Ackman liquidates largest SPAC ever and returns \$4 billion to investors as blank-check era fades*. Fortune, 2022. <https://fortune.com/2022/07/12/bill-ackman-liquidates-largest-spac-ever-returns-4-billion-investors-blank-check-era-fades/>

⁶⁵ Referencing search engine results of the quoted phrase, which returns article after article, from names such as Morningstar, Forbes, Harvard Business Review, TechCrunch, and interviews with Gary Cohn, former National Economic Council Director, amongst other sources, that all affirm the permanence of SPACs.

provide any capital when the warrant is exercised and not prior.⁶⁶ While it remains to be seen if such a vehicle can pass SEC regulators, the development of the SPARC suggests that sponsors may be seeking different approaches. But most importantly, the data bears out the plain conclusion: with an 86% drop in SPAC IPO volume from 2021 to 2022, a trend that has continued into 2023, the SPAC, as we know it, is a thing of the past.

B. Limitations and Future Research

This study does have some limitations and weaknesses. First, the S&P Capital IQ data was inconsistently populated, especially for transactions from 2015 and prior. Similarly, the CRSP pricing data was not available beyond the end of June 2022. As such, the influence of both older and newer data elements is, in some cases, omitted from the analysis. Given the relative unpopularity of SPACs in these time periods, it stands to reason that there had not been many marquee SPAC mergers to create or fuel the SPAC boom, and so the returns calculated in the paper may have been even worse when accounting for the missing data.

Somewhat related, this paper was not entirely successful in achieving its goal of covering the SPAC landscape holistically. As mentioned in the abstract, other leading papers covering SPACs suffer from relatively small data samples. Zhang, Ritter, and Gahng cover only 1,071 SPAC IPOs, roughly half the size of the IPO data sample in this paper, and a comparable 458 SPACs for analysis of returns, but only from December 2020 and prior. Klausner, Ohlrogge, and Ruan primarily rely on data from the third-party aggregator website SPACInsider.com, which tracks roughly 1,400 SPACs. However, the actual study mainly addresses 47 SPACs from a year-and-a-half long window spanning from early 2019 through mid-2020. There is some coverage of the post-COVID time period that follows. When forming the research approach for this study, the initial desire was that SEC filings would form the entire foundation for SPAC registration, offering terms and fees, and merger terms, which would have eliminated the need for S&P Capital IQ altogether. Pricing data would still be retrieved from CRSP. However, SEC filings lack any degree of uniformity in how they are formatted, an issue which extends to the metadata as well, making a programmatic approach to data retrieval a near-impossibility. The aforementioned authors of the other studies also cite manageability of data as a reason for smaller datasets and reliance on third-party services.

⁶⁶ Curry, R. *SPARC vs SPAC: Different Financial Instruments With a Similar Goal*. MarketRealist.com, 2021. <https://marketrealist.com/p/what-is-a-sparc-vs-spac/>

Additionally, this study did not incorporate any macroeconomic influences into the various regression models, aside from the influence inherent in the time-fixed effect and industry dummy variables. While the comparison of SPAC ETFs to market funds provides some idea of the relative performance of SPAC equities under the same market conditions, it would be more useful from a model goodness-of-fit perspective to have incorporated these elements and obtain more reliable estimates. Given what is already known about the oscillating nature of IPO and M&A markets, this would help account for what stage in the business cycle the market was in as each SPAC attempted a merger. The influence of macroeconomic factors and regulations on SPAC activity provides an opportunity for future research. The majority of SPAC activity occurred in a post-COVID bull market; it would be interesting to see how SPACs perform during what appears to be a looming bear market and with high interest rates. Additionally, the SEC regulations discussed in the paper provide an opportunity to track SPAC development in an age of heightened scrutiny. New research can tackle whether greater disclosure transparency fosters a healthier system or if was a toothless endeavor.

Lastly, the scarcity of the SPARC structure does not yet make it a viable object for study; however, should this new formation begin to grow, it would warrant further examination. Its emphasis on investor protection may wash away many of the shortcomings of the SPAC and provide a new route for investment.

Appendix A: Regression Diagnostic Plots and Tests

To ensure proper specification of the selected models and the calculation of unbiased, consistent coefficients that allow for accurate interpretability, a slate of diagnostic tests was conducted. This section will outline the purpose of each test and provide test data, including data visualizations, test statistics, p-values, and economic interpretation, where applicable. In addition, any potential shortcomings of the given model will be acknowledged, as well as information on attempts to mitigate these issues.

Models for IPO outcomes

Logistic regression of binary success/termination outcomes for SPAC IPOs on various factors

Multicollinearity:

To ensure proper model and regressor specification, regressor correlations are first tested. Including regressors with high correlation can create confusion around the model's economic interpretations or cause issues with coefficient sensitivity. For the purposes of this model, a correlation coefficient should be no larger than 0.9 (using the absolute value).

Figure 29: IPO logistic regression model variable correlation matrix

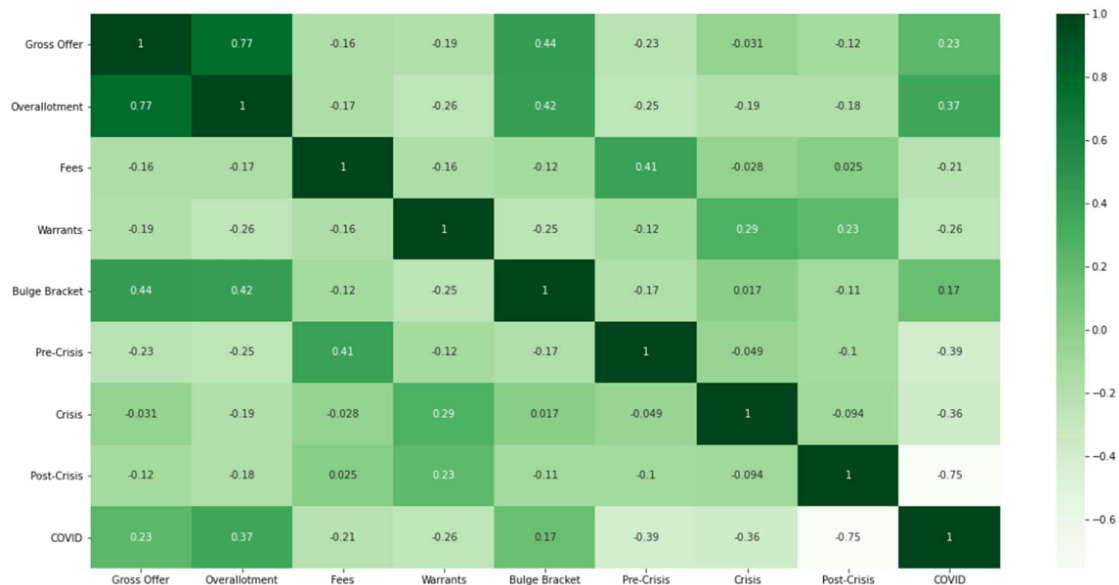


Figure 14 demonstrates no multicollinearity concerns amongst the model's specified regressors. The highest observed correlation is between the gross offer and overallotment

variables, which comes as little surprise; as the size of the IPO scales up, the additional shares made available to the underwriter also tend to scale up.

In addition, we check the Variance Inflation Factors for each regressor. As expected, the size of the gross offering and the size of the overallotment for the IPO have relatively large VIFs:

	feature	VIF
0	Gross_Offer	6.201229
1	Overallotment_Available	6.942102
2	Total_Fees	1.016201
3	Warrant Num	3.715594
4	Bulge Bracket	2.349636
5	Mortgage Crisis	1.548352
6	Post Mortgage Crisis	2.106290
7	Post Covid	5.371134

However, as the VIF statistics are less than 10, no corrective efforts are required.⁶⁷ The overallotment variable could be left out to reduce potential unreliability in the estimate of the regressors' coefficients, but it will remain in use for the purpose of its economic meaning, whereby the success of an IPO can be gauged by what sort of incentive additional shares for purchase offer.

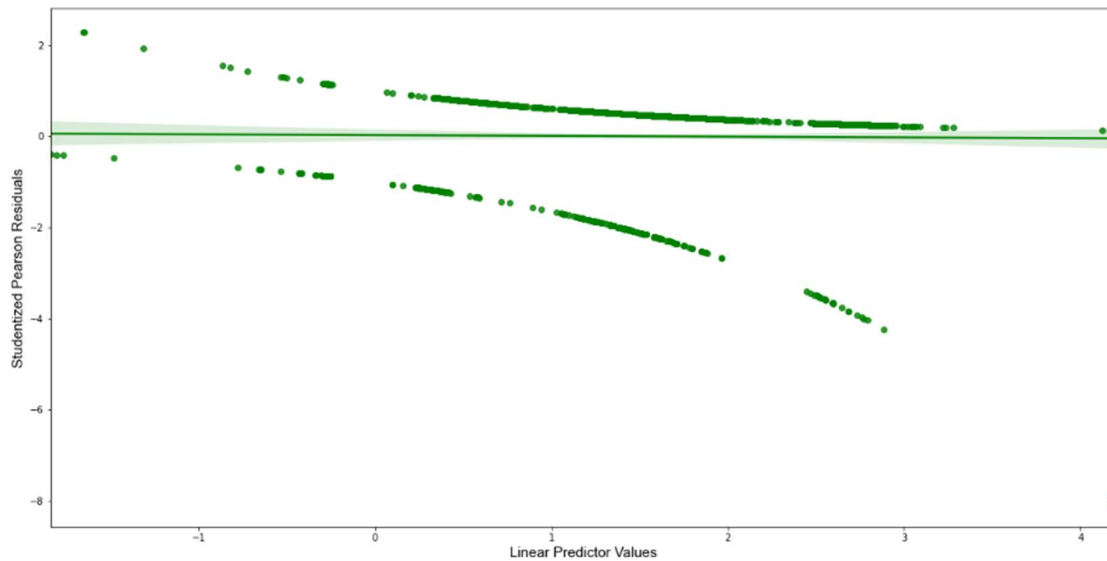
Residual plot:

With an OLS regression, it is considered useful to check the distribution of residuals to ensure normality. With a logistic regression, the distribution of residuals will not be normal, nor will the distribution be known, given the binary nature of the dependent variable. To check the residuals and ensure a proper model fit, the residuals are plotted against the fitted values, with a locally-weighted scatterplot smoothing function (LOWESS). For a good model fit, the LOWESS line should approximate a horizontal line with an intercept of zero.⁶⁸

Applied to the model, the LOWESS line behaves as desired.

⁶⁷ "Variance Inflation Factor", Corporate Finance Institute, June 2, 2020, <https://corporatefinanceinstitute.com/resources/data-science/variance-inflation-factor-vif/>

⁶⁸ <https://www.pythonfordatascience.org/logistic-regression-python/>. Article citations point to Kutner, M.H., Nachtsheim, C.J., & Neter, J. "Applied Linear Regression Models", 2004.

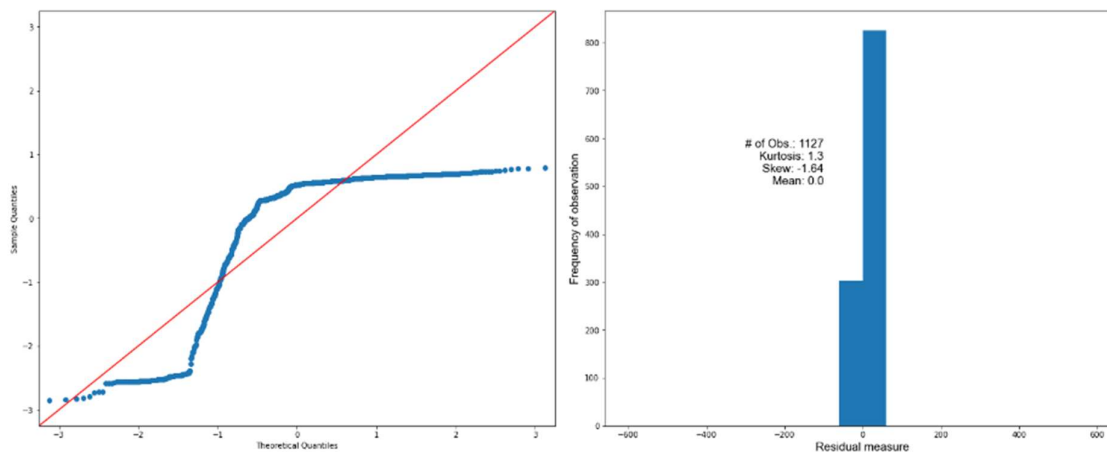


OLS regression of overallotment exercised on various factors

Residual distribution:

First, checks are made regarding the distribution of the residuals and the sample mean, as this distribution is a key assumption for hypothesis tests and for coefficients in an OLS model. A failure to meet these assumptions may indicate that the model has outliers or follows a different distribution, in which case a linear regression may not be suitable, or at the very least, a transformation of the data or some of the regressors may be needed.

Regarding the residual mean, this is a straight-forward calculation. Under the specified model, the mean is $7.6208e^{-16}$, which can be treated as zero in this instance. Regarding the distribution of the residuals, visualizations in the form of a QQ plot and a histogram do not suggest normality:



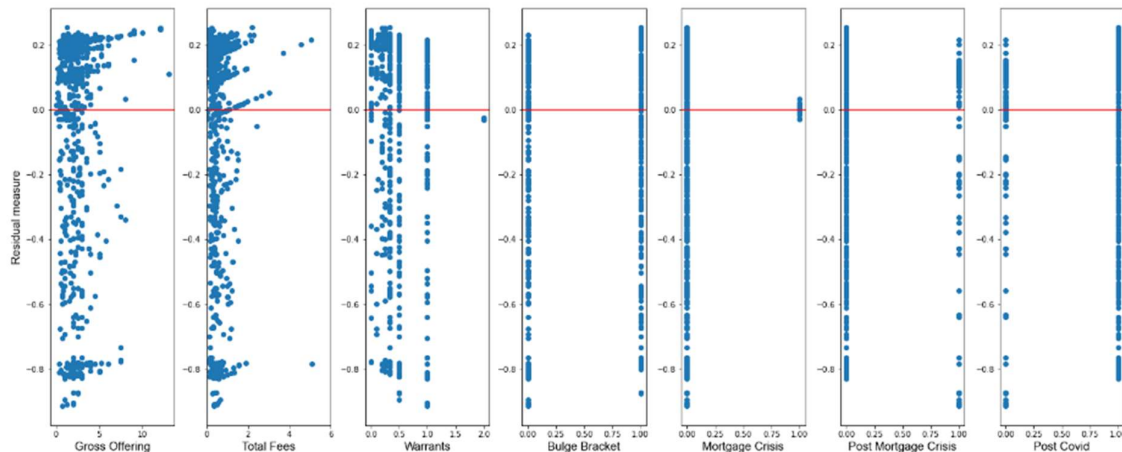
This is especially pronounced in the QQ plot, where the overwhelming majority of residuals do not lie near the plotted line. This can be formalized through implementation of a Shapiro-Wilk test, which tests null hypothesis that the data was drawn from a normal distribution. The test statistic produced by the sample data is 0.6809, with a corresponding p-value of 1.1192, which allows us to accept the null hypothesis of normality. This may be more readily understood in the context of the histogram, in which the overwhelming majority of observations lie in the bin nearest to 0 and virtually no kurtosis is evident.

Residual autocorrelation:

Testing on residual autocorrelation is not included in this model, as it pertains more to time-series data. The data for this paper is organized as time-agnostic cross-sectional data.

Residual correlation with regressors:

Correlation between the regressors and the residuals generally suggests that the model may be incomplete, insofar as additional variables may be needed to better parse out the difference between residuals and predictions. To visualize these relationships, the residuals are plotted against each regressor.

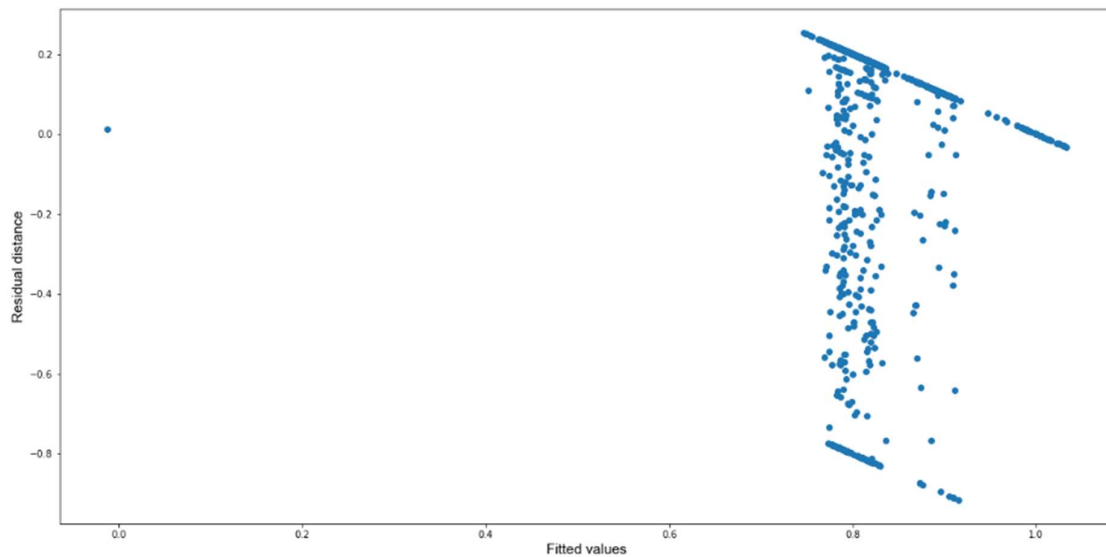


The red line is just plotted at 0 on the y-axis and signifies the point around which residuals should be evenly scattered. In general, there is no discernable pattern in the residuals, barring a few possible points in the total fees plot which appear to have some linear upward trend.

While the magnitude of the residuals is not the same on both sides of zero, there do appear to be an even number of observations on both sides. From a visual inspection standpoint, it will be assumed that no relationship exists between the regressors and the residuals.

Homoskedasticity:

The presence of heteroskedastic errors in a model may suggest that estimates of the standard error are biased and may diminish the significance of additional diagnostic test results. To determine if the model's residuals are heteroskedastic, both a visual and statistical check and performed.



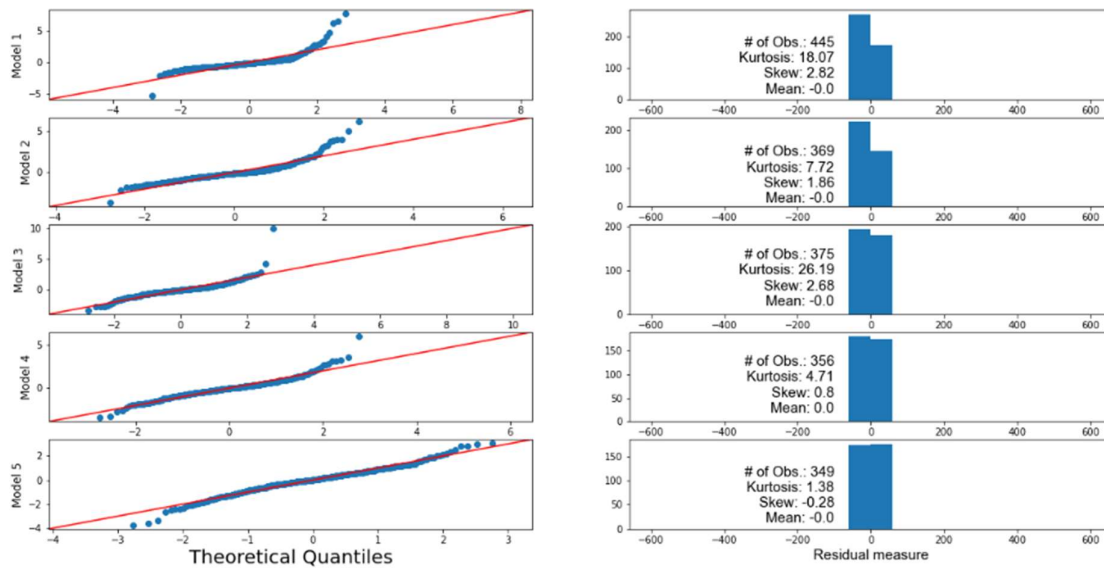
The errors are not weighted evenly on either side of zero, as there appear to be considerably more observations on the negative side. However, the residuals do appear to be distributed somewhat randomly, with the exception of two linear swaths on either side. This suggests that heteroskedasticity may be a real concern. To confirm this, a Breusch-Pagan test is performed, which produces a Lagrange multiplier statistic of 25.3168 with a corresponding p-value of $0.6667e^{-4}$, which is virtually zero. As such, the test's null hypothesis of homoskedasticity can be rejected, and it can be concluded that the model suffers from heteroskedasticity. A logarithmic transformation is a common way to address this issue. Unfortunately, as the y matrix possesses zeroes in some instances, this is not possible.

Models for SPAC returns

OLS regression of annualized logarithmic rate of return on various factors

The same tests were applied for each of the five models.

Residual distribution:

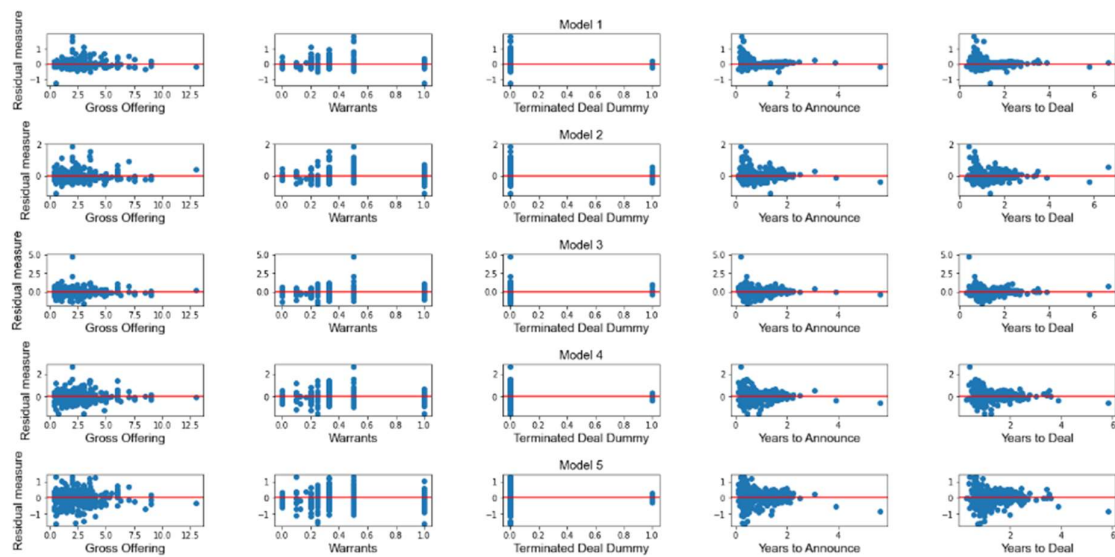


The QQ plots show fairly strict adherence to the line of normality, with some deviation at the upper end in the first two models. However, all histograms show a mean value of 0, which is a good indication of normality. This is again confirmed with Shapiro-Wilk tests. The test statistics and p-values for each model are as follows:

	Test statistic	p-value
Model 1 (@ announcement)	0.7274	2.4478e^{-26}
Model 2 (@ deal completion)	0.8517	3.3005e^{-18}
Model 3 (30-day post-merger returns)	0.8213	4.3180e^{-20}
Model 4 (60-day post-merger returns)	0.9398	7.8899e^{-11}
Model 5 (180-day post-merger returns)	0.9794	6.9584e^{-05}

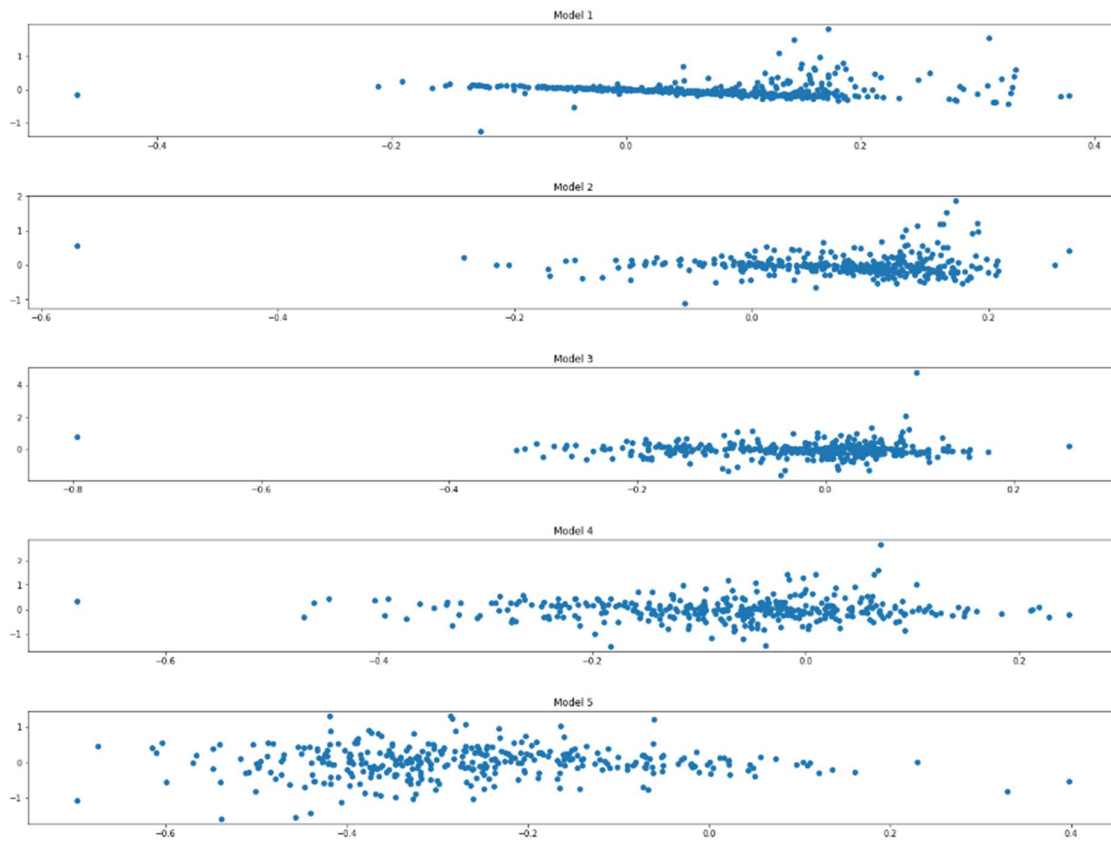
These statistics confirm the normal distribution for the models' residuals.

Residual correlation with regressors:



The time-fixed effects and industry dummy variables were omitted. In general, each regressor exhibits a fairly randomized relationship with the residuals. In the first two models, the years to deal and years to announce regressors perhaps have a non-random scattering, but this appears to diminish in the post-merger models. Ultimately, transformations of both the dependent variable and these regressors did not yield superior results, so the models were left as specified.

Homoskedasticity:



The scatterplot does not appear cone-shaped, as most visual tests for heteroskedasticity prescribe. The first two models do suggest that perhaps a different model specification may be better suited to the data, but the Breusch-Pagan tests are first applied. Test statistics and p-values for each model are as follows:

	Test statistic	p-value
Model 1 (@ announcement)	23.8423	0.1603
Model 2 (@ deal completion)	16.5808	0.5521
Model 3 (30-day post-merger returns)	7.9776	0.9790
Model 4 (60-day post-merger returns)	24.4426	0.1411
Model 5 (180-day post-merger returns)	27.3986	0.0718

The p-values produced by the test in all models exceed 0.05 and so the null hypothesis of homoskedasticity cannot be rejected.

Appendix B: Mathematical Definitions

Return measures:

The derivation of various returns discussed in this paper are as follows:

- *Simple return* = $\left(\frac{\text{Price at time } t}{\text{Offering price}}\right) - 1$
- *Logarithmic return* = $\ln\left(\frac{\text{Price at time } t}{\text{Offering price}}\right)$
- *Logarithmic rate of return* = $\frac{\ln\left(\frac{\text{Price at time } t}{\text{Offering price}}\right)}{\left(\frac{\text{Days held}}{\text{Days in period}}\right)}$

The logarithmic rate of return formula is typically applied in a 365-day period annualized format:

- *Annualized logarithmic rate of return* = $\frac{\ln\left(\frac{\text{Price at time } t}{\text{Offering price}}\right)}{\left(\frac{\text{Days held}}{365}\right)}$

Example: a SPAC has its IPO on June 1, 2021 with an offering price of \$10. A merger is completed on December 15th, 2021. 30 days later, on January 14, 2022, the de-SPAC company's price is \$6.75. With 227 days between the IPO and the 30-day post-merger cutoff, the annualized logarithmic rate of return for the 30-day post-merger holding period is calculated as:

$$\text{Annualized logarithmic rate of return} = \frac{\ln\left(\frac{6.75}{10}\right)}{\left(\frac{227}{365}\right)}$$

Which yields -0.6320, or -63.20%.

Logit model interpretation:

Logarithmic models express coefficients as the average change in the log odds of the response variable. These can be expressed as plain odds by applying the inverse formula, which is the exponential transformation. In order to express the coefficients even more intuitively, in the form of probabilities, consider that if:

- *probability of event* = $\frac{\text{odds of event occurring}}{1 + \text{odds of event occurring}}$

And we have our coefficients provided as log odds, then the probability can be calculated as:

- $probability\ of\ event = \frac{e^{\log odds\ of\ event\ occurring}}{1 + e^{\log odds\ of\ event\ occurring}}$

With this in mind, the economic interpretation of the logistic regression model is expressed in probabilities.⁶⁹

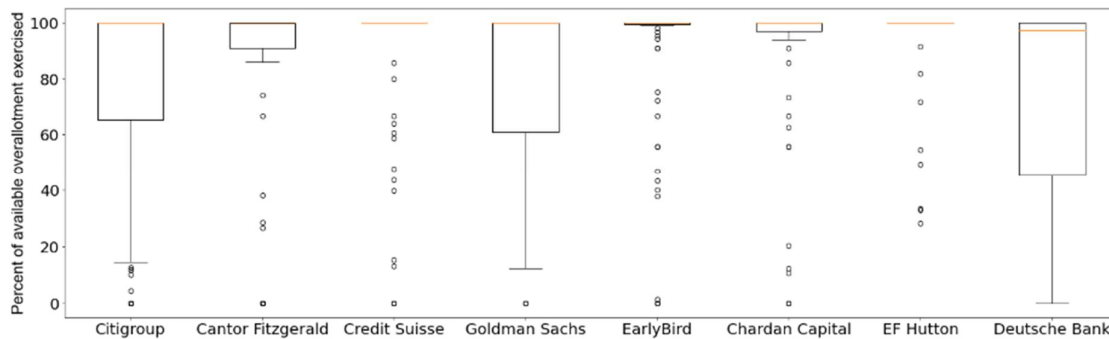
Example: IPO success is regressed on the size of IPO offering, expressed in units of \$1 million. The model produces a coefficient of 1.5 on the regressor. Then, the odds of an IPO succeeding are $e^{1.5}$, or 4.48 times better for every \$1 million raised in the IPO. In turn, this implies that the probability of IPO success goes up by $\frac{e^{1.5}}{1 + e^{1.5}}$, or 81.76%.

⁶⁹ Rotella, J., “*Probability, log-odds, and odds*”, Montana State University, https://www.montana.edu/rotella/documents/502/Prob_odds_log-odds.pdf

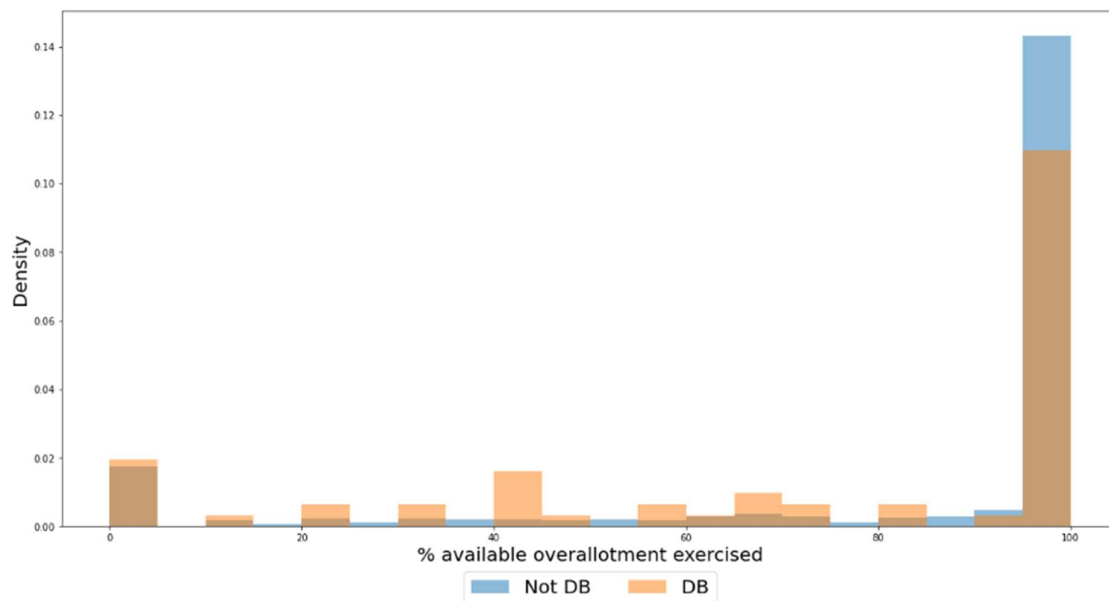
Appendix C: Population Tests

Deutsche Bank vs. other banks, portion of overallotments exercised

Deutsche Bank's portion of available overallotments was determined to have a smaller mean than that of all other banks together. This idea was first conceived through visual inspection of a boxplot that looked at major underwriters independently. While these plots show the median, the assumption was that all distributions had significant negative skew, implying that the mean for Deutsche Bank would be even lower than that of the others.



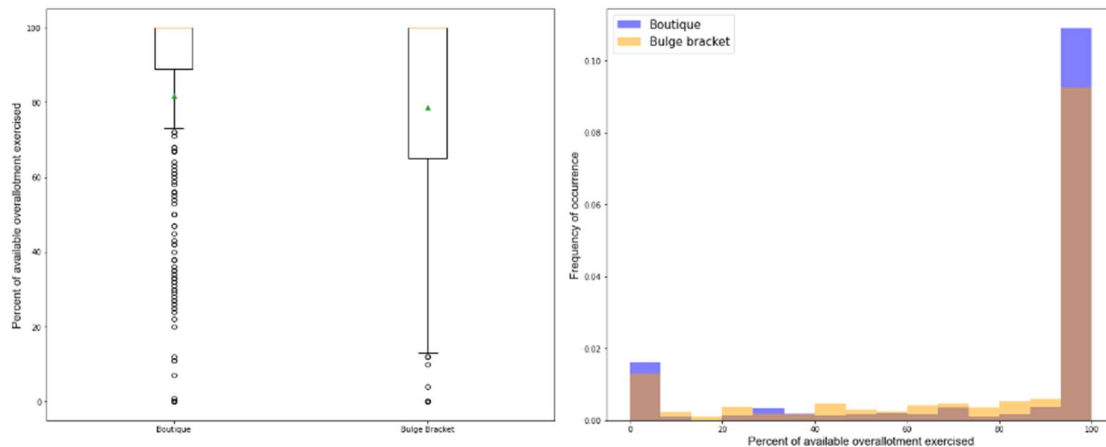
However, given differences in the number of observations for each underwriter, a density histogram is also employed to better understand how the frequency of given observations related to each underwriter group. In this case, Deutsche Bank was plotted against all other underwriters:



The Deutsche Bank histogram showed less of their total distribution towards the top, with more density towards the middle values. To formally test whether or not Deutsche Bank was associated with a smaller portion of available overallocments being exercised, a Wilcoxon rank-sum test was employed. This test was selected rather than a t-test or unequal variance t-test due to differences in the sample variances and the lack of normality in the data. The mean for the Deutsche Bank population was 73.44%, while the mean for other banks was 82.87%. The rank-sum test alternative hypothesis was two-tailed, simply testing whether or not one of the distributions is stochastically greater than the other. The t-statistic produced was -2.4811, which yielded a p-value of 0.0131, which, as it is less than .05, we will take to reject the null hypothesis and confirm that the distribution for Deutsche Bank produces values that are lower than their counterparts.

Bulge bracket banks vs. boutique banks, portion of overallocments exercised

The same process as above was followed for a comparison of these distributions. The mean is demonstrated in the boxplot as a green triangular marker.



Again, population differences were tested using a two-tailed Wilcoxon rank-sum test. The t-statistic was -2.5858 with a p-value of 0.0097, implying again that the values in the boutique population are more likely to be larger than those of the bulge bracket banks.

One hypothesis for this behavior is that overallocments may be exercised as a price-stabilization function and not as a function of excess demand from the market. If a bulge bracket bank underwriting an IPO signals to the market that the investment is safer, and the market isn't pricing any noise into the SPAC's equity during the overallocment period, than there may be less price volatility that requires stabilization efforts. Meanwhile, IPOs

underwritten by a boutique bank may be seen as a more speculative investment that produces greater volatility in the secondary market during the overallotment phase.

Mean returns across different holding periods

Figures 17, 19, and 20 present the distribution for the annualized logarithmic rate of returns for SPACs across different holding periods, all beginning with the initial IPO. Here, a two-tailed Wilcoxon rank-sum test is again performed for each pairing of distributions to determine if the returns are, essentially, statistically distinct from one another or not. The p-values for each test are displayed below, with the test statistics in parentheses.

	Returns @ IBC	30-day returns	60-day returns	180-day returns
Returns @ announcement	0.7788 (0.2808)	1.7602e ⁻⁰⁸ (5.6341)	8.6551e ⁻¹³ (7.1504)	9.6344e ⁻³⁴ (12.1075)
Returns @ IBC		5.4429e ⁻⁰⁶ (4.5469)	4.2933e ⁻⁰⁹ (5.8725)	3.3003e ⁻²⁸ (11.0132)
30-day returns			0.1745 (1.3580)	1.9107e ⁻¹¹ (6.7127)
60-day returns				1.6102e ⁻⁰⁷ (5.2395)

The negligible p-values in most tests confirm that the null hypothesis is rejected; the returns produced by SPACs across different holding periods are, generally, statistically distinct. The null hypothesis is not rejected for two pairs of distributions: returns at announcement versus returns at initial business combination and 30-day returns versus 60-day returns. This is not surprising given the economic meaning behind these comparisons. Between the time a deal is announced and when it is completed, investors have already formed opinions on the future of the SPAC. At the same time, the SPAC still is not producing any cash flows. As such, it makes sense that the returns produced by the SPAC at these two points in time reflect optimism around the forthcoming deal, but even more so, the value to investors of the pro-rata share of the trust account, which is relatively meager. As such, the two distributions yield the same mean return. Regarding the second pairing, this implies that 30-day returns may not necessarily yield any better returns than the 60-day returns; however, both distributions have a negative mean, and so conclusions about the post-merger performance of a SPAC are valid. There may simply be some price inelasticity for the first two months, which dissolves entirely by the sixth month post-merger, where returns are overwhelmingly negative.

The paired samples t-test is also implemented to compare returns distributions and may be more relevant because, in many instances, data for the same SPAC is available in each holding period. Again, p-values and test statistics can be found below.

	Returns @ IBC	30-day returns	60-day returns	180-day returns
Returns @ announcement	0.4031 (0.8370)	1.5134e ⁻⁰⁵ (4.3851)	8.5569e ⁻¹⁰ (6.3071)	1.2643e ⁻³¹ (12.9784)
Returns @ IBC		1.3728e ⁻⁰⁷ (5.3718)	9.7655e ⁻¹⁵ (8.0870)	3.2364e ⁻⁴² (15.6610)
30-day returns			2.9958e ⁻⁰⁵ (4.2286)	2.3993e ⁻²⁶ (11.5512)
60-day returns				1.8931e ⁻²⁶ (11.5794)

The results are very similar to the Wilcoxon rank-sum test, with the exception that the 30-day and 60-day distributions now yield rejection of the null hypothesis, which in the case of the paired samples t-test, is that the true mean difference is equal to zero. This finding would, then, support the idea that SPAC returns do progressively deteriorate with each successive holding period.

Appendix D: Bibliography

- Arora, K. *The Rise of the Retail Investor*. Forbes.com, 2022.
<https://www.forbes.com/sites/forbesagencycouncil/2022/11/04/the-rise-of-the-retail-investor/?sh=66357a4a1755>
- Banerjee, S. & Szydlowski, M. *Harnessing the Overconfidence of the Crowd: A Theory of SPACs*. 2021, SSRN working paper.
https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3930346
- Bazerman, M. & Patel, P. *SPACs: What You Need to Know*. Harvard Business Review, 2021.
<https://hbr.org/2021/07/spacs-what-you-need-to-know>
- Bryant, C. *\$27 Billion Electric Vehicle Deal Shows SPAC Silliness Is Back*. The Washington Post, 2021. https://www.washingtonpost.com/business/2023/05/15/-27-billion-electric-vehicle-vinfast-deal-shows-spac-silliness-is-back/2deee61c-f303-11ed-918d-012572d64930_story.html
- Bujang, M., Sa'at, N., Sidik, T., & Joo, L. *Sample Size Guidelines for Logistic Regression from Observational Studies with Large Population: Emphasis on the Accuracy Between Statistics and Parameters Based on Real Life Clinical Data*. Malaysian Journal of Medical Sciences, Vol. 25, No. 4, pp. 122-130, 2018.
- Bulley, D. & Bennett, D. *The Use of Cayman Islands Structure for SPAC IPOs*. Appleby Global, 2020. <https://www.applebyglobal.com/publications/the-use-of-cayman-islands-structures-for-spac-ipos/>
- Chauviere, K., Green, A., & Tan, T. *Earning the premium: A recipe for long-term SPAC success*. McKinsey & Company, 2020.
- Curry, R. *SPARC versus SPAC: Different Financial Instruments With a Similar Goal*. MarketRealist.com, 2021. <https://marketrealist.com/p/what-is-a-sparc-vs-spac/>
- Davis, D. *SPACs are so hot even Jay-Z is partnering with one. He's set to be the 'chief visionary officer' for California's largest cannabis firm*. BusinessInsider.com, 2020.
<https://www.businessinsider.com/jay-zs-roc-nation-enters-into-partnership-top-cannabis-spac-2020-11>

Deveau, S. & Hytha, M. *Bill Ackman liquidates largest SPAC ever and returns \$4 billion to investors as blank-check era fades*. Fortune, 2022. <https://fortune.com/2022/07/12/bill-ackman-liquidates-largest-spac-ever-returns-4-billion-investors-blank-check-era-fades/>

Dissanayake, M. & Gates, H. *Private company IPOs: Is timing everything?* Deloitte, 2016. <https://www2.deloitte.com/content/dam/Deloitte/us/Documents/audit/us-audit-private-company-ipos-is-timing-everything.pdf>

Goldstein, M. *SPACs Were All the Rage. Now, Not So Much*. The New York Times, 2022. <https://www.nytimes.com/2022/06/02/business/spacs-inflation-regulation.html>

Goodkind, N. *The AI boom is here. Is it too late to invest?* CNN Business, 2023. <https://edition.cnn.com/2023/06/12/investing/premarket-stocks-trading/index.html>

Hackbarth, D. & Morellec, E. *Stock Returns in Mergers and Acquisitions*. The Journal of Finance, Vol. 63, No. 3, June 2008.

Haddad, M. *Tailwind Acquisition Corp. (TWND) Closes NUBURU Deal*. SPACInsider.com, 2023. <https://www.spacinsider.com/news/mhaddad/tailwind-closes-nuburu-deal>

Heyman, D. *From Blank Check to SPAC: the Regulator's Response to the Market, and the Market's Response to the Regulation*. Entrepreneurial Business Law Journal, Vol. 2, No. 1, 2007.

Hu, H. & Black, B. *The New Vote Buying: Empty Voting and Hidden (Morphable) Ownership*. Southern California Law Review, Vol. 79, pp. 811-908, 2006.

Kengelbach, J., Pot, L., Bennerholm, O., Degen, D., & Endter, T. *The SPAC Bust Could Be a Boon for Targets*. Boston Consulting Group, 2023. <https://www.bcg.com/publications/2023/blank-check-bust-could-benefit-spac-merger-targets>

Klausner, M. & Ohlrogge, M. *Was the SPAC Crash Predictable?* Yale Journal on Regulation Bulletin, 2023.

Klausner, M., Ohlrogge, M., & Ruan, E. *A Sober Look at SPACs*. Yale Journal on Regulation, Vol. 39, No. 1, 2022.

Kunthara, S. *Athletes and Celebrities Join the SPAC Boom, SEC Takes Notice*. Crunchbase News, 2021. <https://news.crunchbase.com/public/athletes-and-celebrities-join-the-spac-boom-sec-takes-notice/>

- Lambert, J. *Why so many companies are choosing SPACs over IPOs*. KPMG, 2021.
<https://advisory.kpmg.us/articles/2021/why-choosing-spac-over-ipo.html>
- Langa, P. *Underwriting Your Underwriter (IPO)*. Forbes.com, 2023.
<https://www.forbes.com/sites/forbesfinancecouncil/2023/04/20/underwriting-your-underwriter-ipo/?sh=68d6e62c4e34>
- Li, Y. *SPAC market hits a wall as issuance dries up and valuation bubble bursts*. CNBC.com, 2022. <https://www.cnbc.com/2022/08/03/spac-market-hits-a-wall-as-issuance-dries-up-and-valuation-bubble-bursts.html>
- Loughran, T. & Ritter, J. *Why Has IPO Underpricing Changed Over Time?* Financial Management, Vol. 33, No. 3, pp. 5-37, 2004.
- Miao, H. & Macheel, T. *S&P 500 ends 2021 with a nearly 27% gain, but dips in final trading day*. CNBC.com, 2021. <https://www.cnbc.com/2021/12/30/stock-market-futures-open-to-close-news.html>
- Milstein, E. & Wessel, D. *What did the Fed do in response to the COVID-19 crisis?* The Brookings Institution, 2020. <https://www.brookings.edu/research/fed-response-to-covid19/>
- Nasr, T. *Robinhood Statistics 2023: Assets Under Management (AUM), Number of Users, Revenue, & More*. Investing in the Web, 2023.
- Nothing But The Facts: Retail Investors and Special Purpose Acquisition Companies*. Committee on Capital Markets Regulation, 2021. <https://capmksreg.org/wp-content/uploads/2021/10/CCMR-NBTF-SPACs-Retail-Investors.pdf>
- Pastor, L. & Veronesi, P. *Rational IPO Waves*. The Journal of Finance, Vol. 60, No. 4, pp. 1713-1757, 2005.
- Rainey, C. & McCaskey, K. *Estimating logit models with small samples*. Political Science Research and Methods, Vol. 9, pp. 549-564, 2021.
- Rodrigues, U. & Stegemoller, M. *Disclosure's Limits*. Yale Journal on Regulation Bulletin, 2022. <https://www.yalejreg.com/bulletin/disclosures-limits/>
- Ritter, J. *Initial Public Offerings: Underpricing*. 2023.
<https://site.warrington.ufl.edu/ritter/files/IPOs-Underpricing.pdf>

Spamann, H. & Guo, H. *The SPAC Trap: How SPACs Disable Indirect Investor Protection*. Yale Journal on Regulation, Vol. 40, No. 75, 2022.

Stankiewicz, K. *Indoor farming start-up with Martha Stewart on its board joins the SPAC craze to go public*. CNBC.com, 2020. <https://www.cnbc.com/2020/09/29/indoor-farming-start-up-appharvest-joins-the-spac-craze-to-go-public.html>

Sullivan, K. *Nebula Acquisition Corporation, Sponsored by True Wind Capital, Announces Closing of Initial Public Offering*. PR Newswire, 2018. <https://www.prnewswire.com/news-releases/nebula-acquisition-corporation-sponsored-by-true-wind-capital-announces-closing-of-initial-public-offering-300582397.html>

CF Disclosure Guidance: Topic No. 11. United States Securities and Exchange Commission. 2020. <https://www.sec.gov/corpfin/disclosure-special-purpose-acquisition-companies>

Release Nos. 33-11048; 34-94546; IC-34549; File No. S7-13-22. United States Securities and Exchange Commission. 2022. <https://www.sec.gov/rules/proposed/2022/33-11048.pdf>

White & Case LLP, comments to SEC proposed regulations, June 17, 2022, <https://www.sec.gov/comments/s7-13-22/s71322-20132359-302926.pdf>

White & Case LLP, *SEC Proposes Rules to Regulate SPACs*. Whitecase.com, 2022. <https://www.whitecase.com/insight-alert/sec-proposes-rules-regulate-spacs>

Zhang, D., Ritter, J., & Gahng, M. *SPACs*. The Review of Financial Studies, 2021.