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The Performance of SPACs

An empirical study of the performance of SPAC stocks and warrants in the deSPAC period.

Gardar Fridriksson and Erik Solbakken

Supervisor: Karin S. Thorburn

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NORWEGIAN SCHOOL OF ECONOMICS

Preface

This master thesis was written as a part of our Master of Science in Economics and Business Administration at the Norwegian School of Economics (NHH).

We want to express gratitude to our supervisor, Professor Karin S. Thorburn, for sharing her expertise in finance and the broader realm of M&A. During the spring of 2021, we had the pleasure of taking her course in Mergers & Acquisitions at NHH, and became intrigued by the increasing popularity of SPACs in the M&A sector. Since then, we have had several conversations with Professor Thorburn. We feel honored, and it has truly been a privilege to discuss hypotheses, finance, and the general processes with her. We would also like to thank Professor Thore Johnsen for valuable conversations on the topic of option theory and Benjamin Samuels and Kristin Zimmerman of Morgan Stanley for additional insights into the SPAC world.

We hope this thesis adds to existing research and inspires further examination of SPACs. Due to the high increase in the number of listed SPACs, we believe this field of research needs more attention and investigation.

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Gardar J. R. F. Fridriksson

Erik A. Solbakken

Abstract

In this master thesis, we examine the performance of 130 SPAC stocks and warrants in the deSPAC period from 2012 to 2021. We find buy-and-hold returns for stocks and warrants coherent with current literature. Measured over 12 months, the average stock return is -10,4% and the average warrant return is 22,8%. We measure excess return by the Fama French three-factor model. We find no evidence of risk-adjusted excess stock return when looking at rolling calendar-time portfolios for stocks, implying that the market prices the stocks correctly at the time a SPAC merges with a target company. In contrast, we find sufficient evidence to conclude that the warrants of the respective stocks provide a positive risk-adjusted excess return when examined through the same framework. To our knowledge, we are the first to evaluate the risk-adjusted excess return on warrants. By cross-sectional analyses, we find that the excess return is driven by the redemption ratio that a SPAC encounters upon its merger. This may be explained by the fact that many SPACs see large redemption ratios due to redemptions from investors who are solely invested for the SPAC period, and redeem their shares regardless of the proposed merger's quality. Consequently, the market misinterprets these redemptions as signals of bad-quality mergers, and undervalue the warrants at the merger date.

Contents

1. Introduction

The history of Special Purpose Acquisition Companies (SPACs) began in August 2003, with the listing of Millstream Acquisition Corporation (Riva and Provasi, 2019). Over the past decade, the registrations of SPACs have increased dramatically across the world, particularly in the United States. The SPAC initial public offer (IPO) volume in the U.S. has gone from \$1.1 billion in 2011 to \$138.1 billion raised in 2021 as of the 28th of October[1]. For comparison, the traditional IPO volume in the U.S. was \$76.3 billion in 2020 (Rudden, 2021).

A traditional SPAC is a blank-check company that goes public through an IPO with the sole purpose of merging with a private operating company, thereby taking the target company public. A company merging with a SPAC can thus be considered an alternative to a traditional IPO. SPACs are not allowed to have a specific target company before listing, although they commonly disclose an industry of interest. SPACs are required to close a transaction within a certain amount of time, usually two years with an option to extend with an additional three to six months. If the SPAC is unable to consummate a merger within the specified timeframe, the company in its whole is liquidated. In a situation where a SPAC is liquidated, all paid-in capital by investors is returned in full.

We present a more thorough explanation of the structure of SPACs in Section 2.

In this paper, we take a closer look at the return on SPAC warrants in the period after the company has merged with a target company, commonly referred to as the deSPAC period. We also examine the performance of the stocks in the deSPAC period. We obtain data from the last 11 years, given the structural changes that were made to SPACs in 2010[2]. Ritter et. al. (2021) find that common SPAC stocks yield an average return of -7,3% when pursuing a one-year buy-and-hold (BAHR) strategy, while the return on its corresponding warrants

[1] We refer to Appendix 1 for more descriptive statistics on the evolvement of SPACs.

[2] In late 2010, the NYSE Amex adopted a number of SPAC-specific listing standards which forced the structure of the SPACs to change. The changes enabled the SPACs to list on stock exchanges if the companies met certain listing requirements. Amongst these new changes were the requirement of the cash raised in the IPO to put into an escrow account (fund) and the redemption rights of investors. (https://www.corporatesecuritieslawblog.com)

averaged 64,4% when implementing a similar strategy. Lakicevic and Vulanovic (2013) show that seven days after the business combination, SPAC stocks yield a -9,59% cumulative abnormal return (CAR), while the warrants yield a 7,36% CAR. Consequently, we observe deviating returns between the two instruments in the extant literature. In our sample of US-listed SPACs, we find a one-year BAHR of -15,4% for stocks and 26,2% for warrants, confirming the earlier results for our expanded sample.

We contribute to the current literature in three ways. First, we expand the data sample used to estimate the deSPAC period return by nine months, hence also the number of observations. This might seem modest. However, because of the high SPAC activity, the additional SPAC mergers during the last quarter of 2020 and the first half of 2021 increase the sample by a considerable number of observations. Second, we implement a Fama French framework to determine whether the returns can be fully explained by the traditional risk factors; market, size, and value. In other words, we analyze the existence of potential risk-adjusted excess return. To our knowledge, the Fama French framework has not been used in analyzing the returns on SPAC warrants. Third, we explain our findings from the Fama French regressions on warrants by examining potential drivers for the unexplained returns. We do this by running cross-sectional analyses, introducing explanatory variables hitherto untested.

We create separate rolling calendar-time portfolios for stocks and warrants over 12- and 36 months. Our Fama French regressions for stocks show no significant risk-adjusted excess return, implying that the market prices the stocks efficiently at the time of the merger. Through our similar regressions of the warrants, we find risk-adjusted excess return in the deSPAC period, significant at the 5% level. Our significant results range from 0,8% to 1,3% weekly. This is interesting, as it implies that the return on stocks can be fully attributed to the risk factors in the Fama French model, while its derivatives are driven by other factors, not accounted for in the model.

Through our cross-sectional analyses, we find significant results, suggesting that the risk-adjusted excess returns on SPAC warrants are driven by the redemption ratio. Higher redemption ratios affect the risk-adjusted excess warrant returns positively. This may be explained by investor behavior and the maturity of the SPAC market in general. Seeing large redemption ratios caused by investment funds that invest solely for the risk-free SPAC period, the market may misinterpret high redemption ratios as signals of bad-quality mergers. Consequently, this should drive the warrant prices down at the time of the merger. The prices are then adjusted correctly once the true quality of the combined company is revealed. While the market's expectations of the company value increase, so will the return on the warrants.

We also find significant evidence that the risk-adjusted excess return on warrants is driven by risk-adjusted excess return on the underlying stocks. This aligns with traditional option theory, suggesting that the expected return on a call option will increase as the expected return of its underlying asset increases.

This paper is organized as follows: Section 2 describes the structure of SPACs. Section 3 reviews current literature on the performance of SPACs as well as some of the variables that might explain this performance. Section 4 presents the hypotheses tested in our analysis. Section 5 presents the data sample used in this paper and how this is provided. Section 6 explains the methodology used for the analyses. Section 7 examines the empirical results of this research. Section 8 evaluates the empirical strength of the inference made in the empirical section. Section 9 concludes this paper in addition to suggesting further research.

2. The structure of SPACs

The SPAC is initiated by a group of *Sponsors* who serve as the company's management team and is often comprised of industry professionals and high-profile investors. In recent years, a various number of "celebrities" have been included as SPAC sponsors as well, with the sole purpose of attracting attention to the SPAC. Sponsors are rewarded with 20% ownership in the SPAC, meaning that if there are issued 80 million shares in the IPO, the sponsors receive 20 million shares, normally referred to as "the promote".

In addition, sponsors are entitled to purchase additional warrants at $1,50 each, and they commonly contribute with cash this way. This enables the SPAC to cover any expenses the company may encounter pre-merger. These funds are also used to pay underwriters in the IPO. Underwriters typically charge 5,5% of the total SPAC IPO value. Only the first 2% are paid once the SPAC is listed initially, and the remaining 3,5% once the SPAC closes its merger.

During the IPO process, most SPACs issue bundled units for $10. A unit consists of one share and a fraction of a warrant (an out-of-the-money call option), both trading separately on the stock exchange once the IPO process is completed. The proceeds from the IPO are put into an escrow account, and upon a potential merger with a target company, *investors* can redeem their shares in return for their initial amount of invested cash, including accrued interest. The sponsors' 20% ownership of the SPAC does not give them access to any of the money in the trust upon a merger. This makes the SPAC investment 100% risk-free in the SPAC period. Investors who choose to redeem their shares keep their warrants, hence suggesting that the warrants are given to investors for free. This, in turn, makes the risk-free SPAC investment very attractive; the investors get a risk-free return on the $10, as the fund is invested in AAA-rated bonds, plus an additional free warrant that can be sold in the open market.

Being aware that the sponsors are entitled to the SPAC value once a merger takes place, the common investors will see dilution directly thereafter. The dilution in question arises from the fact that once the trust money has been spent to merge with another company, the investors and sponsors share the ownership of the new company according to their respective ownership stakes. This implies that the sponsors now are entitled to what used to be the investor exclusive trust. For example, if a SPAC raised $1 billion in its proceeds at a unit price of $10, each investor share would reflect $10 of value in the trust upon merger. If no investors applied their right to redeem their shares upon the merger, the $1 billion in the trust are no longer only of the investors' property; the sponsors now own 20% of the trust, resulting in a situation where the company's value equals $8 per share, a 20% dilution overnight.[3]

Given the redemption possibilities that come with SPACs, combined with the sponsors' compensation of 20% ownership, incumbent SPAC investors may see even more dilution. Building on the example above, but with a redemption ratio of 50% instead of zero, each share will only hold $6,67 of cash in the trust.[4] Hence, the higher the redemption ratio, the more dilution.

To ensure that the investors aren't faced with too much dilution, many SPACs invite a handful of investors to make private placements in the public equity (PIPE). This, in turn, ensures that the trust value remains at a level that ensures enough cash for the merger to go through, in addition, to diluting the incumbent shareholders less. Sponsors often make special arrangements with PIPE investors to have them stay on for a certain amount of time, and are often compensated by buying in at a lower price than $10 per share, or in the form of side payments.[5] The SPACs issue new equity to the PIPE investors and their paid-in amounts are added to the escrow fund just before the merger.

Interestingly, Klausner et. al. (2021) refers to interviews with SPAC industry professionals who mention a group known colloquially as the "SPAC Mafia". More a phenomenon than a specific group, it is comprised of investment funds that invest in SPACs at the IPO state, with the sole purpose of redeeming their shares pre-merger and selling the warrants that they

[3] At IPO: 125 million shares in total, 80% (100m) sold in the IPO, and 20% (25m) retained for sponsors. Trust value of $1 billion, value per investor share of $10 ($1 billion / 100 million shares).
Post-merger (given no redemption): Trust value of $1 billion divided by all shares, 125 million, implies a new share value of $8 per share.

[4] At IPO: 125 million shares in total, 80% (100m) sold in the IPO, and 20% (25m) retained for sponsors. Trust value of $1 billion, value per investor share of $10 ($1 billion / 100 million shares).
Post-merger (50% redemption): Trust value of $500 million ($1 billion x 0,5) divided by all shares, 75 million (100m x 0,5 + 25m), implies a new share value of $6,67 per share ($500 million / 75 million shares).

[5] Klausner et. al. (2021) provide a thorough elaboration on the structure of PIPE deals, as well as SPAC structure in general.

are given for “free”. Both referred to by Klausner et. al. (2021) and confirmed in our own conversations with practitioners, many suggest that this is one of the main reasons why some SPACs see very large redemption ratios.

However, more potential dilution is on the horizon of the SPAC once one takes into account the effect of the outstanding warrants of the company. Once warrant holders exercise their warrants in return for stocks, the overall pie (the company value) increases while each piece (i.e. each share) decreases in value. Combined with high redemption, especially in cases with little or no PIPE investments, common SPAC investors are subject to high redemption.
SPAC warrants are typically exercisable at a strike price of $11,5 within five years after the completion of the new business combination. In most cases, the companies are entitled to force warrant holders to exercise their warrants at the strike price of $11,5 prematurely. To force such an early exercise, the stock of the new company has to close above $18 on 20 days over a period of 30 consecutive days. Warrant holders that fail to exercise within a certain time, are only entitled to receive a redemption price of $0,01 per warrant.[6]

In the next section, we review the current literature on SPACs.

[6] The example above is the common way of structure, however, each SPAC designs their own structure and disclose this in the registration statement, S-1 form.

3. Literature review

In this section, we review relevant literature on SPACs. As a result of being a somewhat "new" phenomenon, the current research on SPACs is rather limited. There are, however, several good studies providing interesting findings. Since the main purpose of this master thesis is to examine and understand drivers of SPAC warrant returns, we review the extant literature on the performance of SPACs concerning both warrants and stocks. We focus on the different frameworks, periods, and methods previous research has used to measure performance. The literature on drivers of warrant return is meager. Hence, we move on to discuss articles that focus on identifying variables that could affect stock return performance. This includes liquidity, redemption ratio, and days between the IPO and the merger.

3.1 The performance of SPACs

The first SPAC was listed on a publicly-traded exchange in August 2003. Jog and Sun (2007) are the first to investigate the performance of SPACs. Analyzing a sample of 42 SPACs between 2003 and 2006, they found that sponsors earned an annualized return of 1,9%, while investors faced an annual return of -3%. From 2003 and until today, the growth of listed SPACs has been exponential. No studies have found positive average stock returns for investors in the deSPAC period. This is quite noteworthy, given the extensive investor interest for and growth of the SPAC sector.

When Stefan Lewellen (2009) measures the monthly excess return for stocks and warrants, he divides the different SPACs into four different categories; "No target", "Target found", "Acquisition completed" and "Withdrawn". He measures monthly BAHR from 2003 to 2008 and derives "excess return" by subtracting the risk-free rate and market risk premium from the BAHR. The companies are reassigned to their suitable category daily. The returns are measured depending on how many days they spend in each category. Those that have *found* targets receive an annualized excess return of 11%, while the SPACs that have *merged* with a target company, receive an annualized excess return of -36,5%. The return for warrants is closely linked to the stock, yielding 3,44% for SPACs that have found a target and -4,41% for those that have merged with another company. We report his results from the "Acquisition completed" group separately since our sample consists solely of SPACs that have completed mergers.

Lewellen (2009) creates a four-factor Fama-French model (market; SMB; HML; momentum) with both equally weighted and value-weighted portfolios to measure monthly excess return for stocks. In the equally weighted portfolio, SPACs that have completed the merger, receive -2,24% monthly excess return, significant at a 5% level. For the value-weighted portfolios, the observed alphas are insignificant from zero.

As Lewellen (2009) investigates the drivers of the stock return, he controls for liquidity using Amihud (2002). Amihud presents different methods to estimate liquidity on stocks. Lewellen (2009) shows that the liquidity measure has no material impact on any of the results above. This is interesting, as Rodrigues and Stegemoller (2021) stress that SPACs are highly illiquid as an investment vehicle. From the literature studying how liquidity affects general stock return, we know that investors holding illiquid securities require an additional risk premium for their positions (Amihud, 2008). We will take a closer look at liquidity later in our literature review.

Jenkinson and Sousa (2011) study a sample of 58 SPACs, using a sample period from 2003 to 2009. They divide the companies into "bad SPACs" and "good SPACs", and conclude that the market can identify which SPACs are bad investments and which ones are good investments; bad SPACs trade below trust value on the day of voting, and the good SPACs trade above trust value. Overall, investors experience a six-month average cumulative return of -24% and a one-year average return of -55%. Jenkinson and Sousa (2011) argue that these returns are mainly driven by the bad group, as they yield a six-month CAR of -39% and a -79% one-year CAR. For the good group, investors see a six-month CAR close to zero, and a one-year CAR of -6,2%. Based on this, Jenkinson and Sousa (2011) suggest that investors should vote against a merger when the SPAC trades below trust value, and redeem their shares to avoid these negative returns. This is interesting, as the market appears to be able to predict which SPACs that will yield bad results in the deSPAC period. We will take a closer look at redemption later in this section.

In 2013, Lakicevic and Vulanovic analyze 161 SPACs in the period 2003 to 2009. They separate the different securities in the issued unit at IPO and find differences in returns, especially between stocks and warrants. Using CAR to measure the performance of stocks, they find significant CAR from one to seven days after the merger at the 1% level. The one-day CAR shows an average of -5,35% and the seven-day CAR shows -9,59%. However, measuring the CAR for the *units* post-merger, the one-day CAR is significant at the 10% level, showing 9,87%. No other CARs are significant. Although not measuring CAR for warrants, the one-day CAR of the units shows that the warrants pull in the opposite direction of the stock. In their attempt to do the same for warrants, they have only eight observations and fail to reach significance.

Reviewing some of the early studies on SPAC performance, the literature is one-sided; the return on SPAC stocks in the deSPAC period is negative. When reviewing more recent studies, the results are much the same.

Geerken et. al. (2021) are the first to investigate the short-term stock performance on SPACs going public after 2010, using CAR. Their sample consists of 50 SPACs going public in the period 2016-2021. Initially, they identified 83 SPACs, but the sample was reduced to 50 SPACs when imposing different criteria.

Geerken et.al. (2021) focus on two key events in the SPACs lifetime; the announcement of the merger and the completion of the merger. Additionally, they create a taxonomy with four different clusters; “the good”, “the bad”, “the ugly” and “the others”. The SPACs are allocated to a suitable group based on three factors. The first factor concerns the number of days the SPAC uses to merge with a target company after its IPO. The second concerns the volatility of the stock price from the IPO date to the merger completion. The third factor is solely the difference between the IPO price and the price of June 17th, 2021. After clustering the SPACs, 58% are "good", 12% "bad", 20% "ugly" and the remaining 10% "other". On a general note, “good” SPACs have low volatility and announce their target within a year from the IPO. As the volatility and days until the merger increase, the SPACs are distributed to “the bad”, “the ugly” and “the others”. SPACs characterized as “others” do not meet the criteria for any of the other groups, and are to be seen as a group of leftover companies rather than the worst performers.

Geerken et. al. (2021) show significant results when measuring CAR around the merger announcement date. In the period “three days before merger announcement to three days after”, they report a 1,98% CAR, significant at a 5% level. When doing the same around the merger completion date, they report a CAR of -5,12%, significant at a 5% level.

Expanding on the previous research done by Jenkinson and Sousa (2011), Geerken et. al. (2021) find through their taxonomy of SPACs that the ones categorized as "ugly" are the main drivers for the negative short-term returns observed for the second event. This is consistent with Jenkinson and Sousa's (2021) findings, where their group of "bad SPACs" was shown to be the main driver for the negative returns observed.

Ritter et. al. (2021) conduct thorough research on 114 SPACs that consummated mergers between January 2010 and September 2020. When analyzing returns for both stocks and warrants, they first use a simple BAHR strategy for one- and three years. They find that the one-year BAHR for stocks is -7,9%, on average, while the three-year BAHR yields an average of -0,7%. However, for the same period and companies, the one-year BAHR for warrants was 64,4% on average. The three-year BAHR was 113% on average. They note that this much deviation between stocks and their corresponding call options is quite puzzling. However, we notice that the medians of warrant returns are -10,5% and -5,9% for one-year and three-year BAHR, respectively.

Ritter et. al. (2021) also use the Fama French three-factor model to measure the stock return. They find a monthly alpha of -2% for the three-year value-weighted portfolio, significant at the 5% level. The coefficient for the market is significant at a 1% level for both one-year and three-year equally- and value-weighted portfolios. The SMB variable is significant at a 5% level for the three-year equally weighted portfolio. Only one of four models provided significant alphas.

The prior research on SPACs shows negative performance in the deSPAC period for stocks. The most recent literature shows positive returns for warrants. Next, we review how extant research explains what drives the poor performance of SPAC stocks.

3.2 Drivers of SPAC performance

Chong et. al. (2021) develop, based on trading volume as a variable, an optimal trading strategy for SPACs. Their sample consists of 122 SPACs listed in the period between 2018 and 2020. First, they divide the SPACs into different sectors and use CAPM and the Fama-French three-factor model to measure abnormal returns. They find that SPACs in the financial sector yield positive returns on average for the CAPM model when excluding the SPACs that have not merged with another company. However, when including those SPACs, none of the sectors yield positive average returns for the 3-month, 6-month, and 12-month periods.

Chong et. al. (2021) suggest buying SPACs when their trading volume is four times larger than the 20-days moving average trading volumes. Moreover, the average trading volume should exceed one million shares, and the changes in the SPAC's stock price on the purchase day must be greater than 3%. Then; their advised strategy would be to hold the stock for ten days, or sell it sooner if the position yields a loss by more than 15%.

Chong et. al. (2021) implement this strategy on a back-test. This sample consists of listed SPACs in the period between 2018 and 2021. They observe a cumulative return of 281,68% over that period, while the S&P 500 has a cumulative return of 53,38% for the same period. Chong et. al. (2021) then run regression analyses using CAPM and the Fama French three-factor model, to see if their trading strategy yields any significant excess return. They find a daily 0,02% excess return for the period, significant at a 10% level for both models.

However, since no SPACs fit the criteria for the trading strategy until 2020, they also test the trading strategy for the period 2020 to 2021 alone. Then, the daily excess return increases to 0,6% in the CAPM, and 0,5% in the Fama French model, both significant at a 10% level.

As we explained in Section 2, SPACs come with the feature of redemption rights. Klausner et. al. (2021) found, in a sample of 49 SPACs, an average redemption ratio of 58% among the 2019-2020 merger cohort and a median of 73%. SPACs then have to seek capital from third-party investors and sponsors, primarily to replace the capital lost due to the redemption of shares. Klausner et. al. (2021) show that the median SPAC holds $5,7 in net cash per share before the merger, and not $10 as the initial trust value per share would suggest. The

$5,7 per share is after potential PIPE investments. Klausner et. al. (2021) argue that SPAC redemptions amplify the effects of dilution and dissipation of cash on a per-share basis.[7]

Klausner et. al. (2021) also documents that more than 92% of the shareholders in the SPAC period, identified from 13-F filings[8], exit before the deSPAC period. This implies that only 8% of the initial SPAC investors, stay on through the merger. Based on their findings, Ritter et. al. (2021) suggest an optimal redemption strategy. They found that most of the return in the SPAC period is realized right after the announcement of the merger. Hence, their optimal redemption strategy is to sell the shares if the redemption value is lower than the market prices, and redeem the shares if the redemption value is higher than the market price.

This strategy is consistent with the findings in the literature reviewed above, as the positive realized return arises, on average, from the SPAC period, while the negative return derives from the deSPAC period. Ritter et.al. (2021) also mentions that after several conversations with practitioners in the SPAC sector, this is a strategy often used. They also test the impact of redemption on the deSPAC performance. They find that deals with a 5% redemption ratio will have a 40,7% better one-year return than a deal with a redemption ratio equal to 95%.

Knowing that sponsors are strongly incentivized to complete a merger (to receive value from their shares), Dimitrova (2012) investigates how the amount of time used to announce a target affects the stock performance of SPACs. She finds evidence for inverted U-shaped correlation, meaning that sponsors who spend a too short or too long time to disclose and merge with a target, has a negative effect on stock prices. This indicates that rushing an announcement or announcing a target at the last minute is not perceived as an optimal strategy in terms of shareholder returns.

In the next section, we present the hypotheses on which this master thesis is based.

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[7] Klausner et. al (2021) also lists underwriter fees, advisory fees, and other fees related to the merger. In addition, recent guidance from the SEC on warrants, warrants should be treated as a liability rather than an equity instrument, which is accounted for in Klausner et. al. (2021)'s calculations.

[8] The Securities and Exchange Commission's (SEC) Form 13-F is a quarterly report that is required to be filed by all institutional investment managers with at least $100 million in assets under management.

4. Hypotheses

We want to understand what drives the return on SPAC stocks and warrants. We know from previous literature that stocks, on average, yield negative BAHR in the deSPAC period, while their corresponding warrants yield positive BAHR. Ritter et. al. (2021) find negative risk-adjusted excess stock returns, significant in one of four models of Fama French regressions. However, no one has analyzed the risk-adjusted excess return on warrants in the deSPAC period.

To thoroughly investigate SPAC stock- and warrant returns in the deSPAC period, we form three hypotheses. The first regards the risk-adjusted excess return on stocks, while the others concern the risk-adjusted excess return on warrants. We develop the following hypotheses:

4.1 Hypothesis 1

$H_{0.1}$: SPAC stocks have no risk-adjusted excess return in the deSPAC period.

$H_{1.1}$: SPAC stocks have risk-adjusted excess return in the deSPAC period.

We test this hypothesis on a calendar-time portfolio basis, where the stocks are introduced and excluded based on different criteria. Given the increase of SPACs in our sample (130) compared to the Ritter et. al. (2021) sample (114), and also nine additional months of trading data, we want to see whether the results remain consistent. The findings of previous literature on the field suggest that the economic theory of efficient market pricing holds up in three of four models.

Stocks, in general, are often expected to co-move with the market, and we would consequently expect significant coefficients for the market risk factor. Also, knowing that SPACs often remain small-cap companies after they merge, we would expect to see significant coefficients with respect to the SMB-factor as well.

4.2 Hypothesis 2

$H_{0.2}$: SPAC warrants have no risk-adjusted excess return in the deSPAC period.

$H_{1.2}$: SPAC warrants have risk-adjusted excess return in the deSPAC period.

No literature has examined if there exists risk-adjusted excess return on SPAC warrants. The nature of derivatives suggests that the expected return on warrants should be driven by the expected return on the underlying stock. This means that if we do not observe any risk-adjusted excess return on the stock, we should not expect to observe this on the warrants either. Additionally, we should expect the warrants to load on the same risk factors as their underlying stocks. The return of a call option is simply the future value of the stock subtracted by the strike price. Hence, what drives the expected return on the stock should explain the expected return on the warrant.

However, looking at the findings of Ritter et. al. (2021) where they find negative stock BAHR and positive warrant BAHR, we want to examine whether the warrants actually are priced efficiently in the market, or if there exists any risk-adjusted excess return on them. Given the differences we observe from the BAHR calculations, we suspect that there may exist such risk-adjusted excess returns on warrants and that the market consistently fails to price the warrants correctly at the time a SPAC merges with its target company.

As with the stocks, we test this hypothesis by implementing a Fama French three-factor model, running the regressions on a calendar-time portfolio basis.

4.3 Hypothesis 3

$H_{0.3}$: Redemption ratio does not affect the risk-adjusted excess return on warrants.

$H_{1.3}$: Redemption ratio affects risk-adjusted excess return on warrants.

If our suspicions of risk-adjusted excess return on warrants prove to be true, consequently allowing us to reject $H_{0.2}$ it would be interesting to examine any underlying drivers for this. Considering the insights from Section 2 on how large investment funds, the “SPAC Mafia”, use SPACs as an investment vehicle to park funds temporarily, the redemption ratio of a SPAC may explain why the market fails to price the warrants efficiently.

Higher redemption ratios upon a merger may signalize to investors that the proposed merger is of low quality. However, knowing that investment funds intend to redeem their shares upon a merger, in any case, large redemption ratios may falsely signalize that a merger is of bad quality. Taking the youth of the SPAC phenomenon into account, common investors may misinterpret the high redemption ratio as a signal of a bad merger, despite the proposed merger being of high quality. This should in turn affect the price of the warrants negatively. However, once the merger goes through, and the merger quality subsequently is revealed, the return on warrants with higher SPAC redemptions should be higher than those of lower redemptions.

We test this hypothesis by running cross-sectional analyses.

5. Data gathering and sample construction

The data sample comprising the base for this master thesis consists of 130 SPACs that went public in the period between the 1st of January 2010 and the 30th of June 2021. We exclude SPACs that went public in earlier years due to the changes in SPAC regulations- and structure that occurred in January 2010. Our SPAC sample contains blank check companies with American domicile, that went public through IPOs on the New York Stock Exchange or NASDAQ. All SPACs that trade Over-the-Counter (OTC) are excluded from the sample to obtain the most accurate pricing- and volume data.[9]

We limit our sample to the United States to have companies facing similar regulations and jurisdiction. Of the companies that went public in our sample, all have consummated mergers. As this paper seeks to study the stock and warrant returns in the deSPAC period, our sample is limited to SPACs that have completed mergers and trade as the new entity. We exclude SPACs that don't include warrants in their IPO units and SPACs whose warrants trade in the OTC markets. Another event that eliminates a SPAC from our sample is whenever its warrants are redeemed for cash or other types of payment (stock) during the merger process with the target company[10].

To our knowledge, our final sample contains more US-warrant observations than any other study, despite having stricter requirements and only US observations. We recognize that the sample is relatively small compared to research done on other areas where the datasets can be considerably larger. That being said, the nature of the SPAC evolvement, and its somewhat short history, limit our possibilities to construct a larger sample that meets our criteria.

We collect data from multiple sources. From the Refinitiv database (Securities Data Company (SDC Platinum)), we obtain static company information such as IPO date, volume and price, stock exchange listing, and nationality.

[9] OTC markets are less liquid than stock exchange markets, causing the price observations to be fewer and more volatile. Also, the requirements to list in the OTC market are less comprehensive than for a stock exchange IPO, and by excluding the OTC companies, we avoid potential structural differences between companies within our sample.

[10] We refer to Appendix 1 for more descriptive statistics on the evolvement of SPACs.

We merge this data with information from SPAC Research (https://www.spacresearch.com) on when which companies consummated mergers, and who their targets were. Also, SPAC Research provides information on shareholder redemption, NewCo tickers and corresponding warrant tickers, warrant structure, sector of business, and when the transactions are consummated. Based on their data, we can extract information on how many days each SPAC used before closing a merger candidate. We access Gritstone Asset Management's SPAC Data (https://gritstoneam.com/spacdata) to verify the status of SPACs that lack data points from our other sources, especially for companies that faced liquidation while still being in the SPAC period.

Whenever our three sources of static data were unable to provide sufficient data of various sorts, or in cases of irregularities, we reference EDGAR for further details. The database is provided by the US Securities and Exchange Commission, SEC, and provides free public access to corporate information. Especially companies that made IPO offerings before 2015 required examination of EDGAR filings to fill in the missing data.

For our sample of SPACs, we extract daily and weekly stock- and warrant prices from the Thomson Reuters Eikon DataStream terminal. We obtain prices after the first merger was completed in 2012 (Universal Business Payment Solutions merging with JetPay). In addition to pricing information, we also use the DataStream terminal to obtain data on transaction volume, market capitalization, and dividend payments for the same SPAC securities over the same period. We require each stock and warrant to have at least three full months of trading, meaning that all SPACs and their corresponding warrants that merge after the 30th of June 2021 are left out of our sample.

Seven of the SPACs in our original sample had missing information on trading volume and prices for its warrants, and are eliminated from the sample. Furthermore, we exclude three SPACs with missing data on redemption ratio from the regressions examining the drivers of warrant return.

A total of 972 SPACs went public in the United States between January 2010 and October 2021. Our selection criteria leave us with a sample of 130 American SPACs that consummated business combinations, all having stocks, and warrants traded on American stock exchanges.

To run Fama French regressions, we obtain weekly Fama French factors at Kenneth F. French's website (http://mba.tuck.dartmouth.edu). The factors obtained from Kenneth French's website are noted as percentages and not decimals, and we convert the values to decimals to make correct inferences in Section 7 of this master thesis. To account for the relatively low trading activity, we use weekly portfolio returns, limiting our number of portfolios with zero return.

6. Methodology

To compare our findings with previous studies, we first employ the BAHR strategy of Ritter et. al (2021) for both stocks and warrants. Next, we examine whether there is risk-adjusted excess return on the stocks and warrants when put into rolling calendar-time portfolios (hereby: all portfolio periods referred to are on a calendar-time basis). We use the Fama French three-factor model to examine any excess return. Then, we repeat the Fama French regressions for each individual stock and warrant to compute company-specific alphas. Once we have computed company-specific alphas, we run cross-sectional analyses to investigate the warrant return further.

6.1 Buy-and-hold return

We calculate the BAHR for the deSPAC period, on each stock and warrant for 3-, 12-, and 36 months. For a direct comparison with the rolling portfolios in the Fama French models, we assume that the investor purchases the security on the first day of the next month after the merger is completed and sells the security on the last day of the holding period. We calculate the return from the respective period accordingly. Given liquidation, delisting, or redemption, we use the last day of trading in the period as our sell price. To exemplify, if a SPAC merges with a target on July 16th, 2019, and we are looking at 12-month returns, we would buy the warrant on August 1st, 2019, and sell it on July 31st, 2020. If the company's underlying stock were to trade above $18 over 20 days (depending on the initial IPO document), and the company uses its right to redeem the warrants on April 19th, 2020, we calculate the 12-month return from August 1st, 2019 to April 19th, 2020.

Specifically, the BAHR for any given warrant in the deSPAC period is computed as

$$BAHRW_{i,t} = \frac{P_i\_min(T, delist)}{P_i\_deSPAC\_date} - 1$$

Where $P_i\_min(T, delist)$ is the price for warrant i at the end of the respective interval T (3, 12, or 36 months), or the delisting date of the warrant, whichever comes first. $P_i\_deSPAC\_date$ expresses the price of the warrant on the first day of the coming month after the merger has taken place.

Given that stocks may pay a dividend during our intervals of observation, we compute the stock returns as for the warrant, but with an additional component for potential dividend payments in the numerator. Hence, our specific model for the BAHR on any given stock in the deSPAC period is computed as

$$BAHRS_{i,t} = \frac{P_i\_min(T, delist) + \sum Dividend_{i,t}}{P_i\_deSPAC\_date} - 1$$

Where $P_i\_min(T, delist)$ is the stock price *i* at the end of the respective interval T (3, 12, or 36 months), or the delisting date of the stock, whichever comes first. $Dividend_{i,t}$ is the dividend paid for company *i* at time *t*. $P_i\_deSPAC\_date$ expresses the price of the stock on the first day of the coming month after the merger has taken place.

We compute the arithmetic average and median for the different periods. The stocks and warrants are kept separate when computing averages and medians.

6.2 Fama French regressions

To further investigate the findings from our BAHR analysis, we run Fama French regressions on both security types. The Fama French model is a three-factor pricing model. It builds on the capital asset pricing model (CAPM), which computes the required rate of return for a security, given its volatility (beta). In addition to the market factor that the CAPM derives from, the Fama French model also evaluates how a security or portfolio loads on two other factors; firm size, and firm value. The intersection from the regression, alpha, expresses the additional risk-adjusted return a security yields due to good (poor) management and private information. While it is interesting to comment on all of the factors in the model, the alpha factor is the most interesting to interpret because it denotes any return that cannot be attributed to the market, size, or value.

Our starting point is to create rolling portfolios. The securities are added to the portfolio on the first day of the coming month *after* the merger has been completed. The security is then kept in the portfolio for either 12 or 36 months, depending on which timeframe we assess. We form our first portfolio when there are two companies in the deSPAC period, giving us our first portfolio on August 1st in 2015. Securities are introduced and excluded from the portfolio on a continuously rolling basis. Given our decision to have at least three months of observations for each security, we derive a total of 74 monthly portfolios for both the 12 and 36 months intervals.

The Fama French regressions are run in two different ways in terms of *weights*. First, our regressions are based on equally weighted portfolios where the sum of returns in the portfolio is divided by the number of assets in the respective portfolio. Second, we run regressions of the same portfolios, but with a value-weighted approach based on the market capitalization of the underlying security at the merger date. This implies that securities of high value make up a larger fraction of the portfolio than those of lower market capitalization. The different weighting strategies yield different portfolio returns, causing the Fama French regression to give significantly different outcomes. Our specific Fama French model is defined as

$$R_{p,t} - R_{f,t} = a + b * (R_{m,t} - R_{f,t}) + c * SMB_t + d * HML_t + e_{p,t}$$

Where $R_{p,t}$ is the weekly return for a portfolio, either equally or value-weighted, in week t; $R_{m,t}$ is the market return on the value-weighted CRSP index in week t (Kenneth French); $R_{f,t}$ is the one week T-bill in week t; SMB_t is the return on small firms minus big firms in week t, and HML_t is the return on high book-to-market firms minus low book-to-market firms in week t.

We do the same estimation for each individual warrant. As for the portfolios, we begin the interval of calculations on the first of the coming month after the company merger and estimate for 12 months for each warrant. Similar to our portfolio one, our company-specific model is defined as

$$R_{i,t} - R_{f,t} = a + b * (R_{m,t} - R_{f,t}) + c * SMB_t + d * HML_t + e_{i,t}$$

where $R_{i,t}$ is the weekly return for a warrant *i;* all other factors being identical to those above.

6.3 Cross-sectional analyses

To explain what may affect the risk-adjusted excess return on warrants, we regress the warrant-specific alphas on a set of explanatory variables, running traditional ordinary least square (OLS) regressions. Considering our reflections regarding $H_{0.3}$, our main explanatory variable is the Redemption ratio. Additionally, we identify several control variables that we include in our regression models for more robust inference.

Our control variables are company-specific stock alpha, the number of days between IPO date and the merger date, warrant liquidity, stock volatility, and target sector.

Our regression model is defined as

$$Warrant\ Alpha = a + b_1 * x_1 + b_2 * x_2 + \cdots + b_n * x_n \ + e$$

where b_n is the coefficient of the independent variable x_n. The independent explanatory- and control variables are the following:

6.3.1 Redemption ratio

The redemption ratio represents the percentage of shareholders who exercised their redemption rights in the pre-merger process. We obtain this variable directly from SPAC Research.[11] The variable is expressed as *Redemption.*

6.3.2 Company-specific stock alpha

The calculations of company-specific stock alphas are identical to those of the warrant ones and give an expression of risk-adjusted excess return on each stock, measured over one year. The variable is expressed as *One-year stock alpha.*

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[11] We refer to Appendix 1e for more statistics on SPAC redemptions.

Specifically, our model is the following

$$R_{i,t} - R_{f,t} = a + b * (R_{m,t} - R_{f,t}) + c * SMB_t + d * HML_t + e_{i,t}$$

where $R_{i,t}$ is the weekly return for a stock *i* in week t; $R_{m,t}$ is the market return on the value-weighted CRSP index in week t (Kenneth French); $R_{f,t}$ is the one week T-bill in week t; SMB_t is the return on small firms minus big firms in week t; and HML_t is the return on high book-to-market firms minus low book-to-market firms in week t.

6.3.3 Days until merger

This variable is defined as the number of days between the initial IPO and the consummation of a merger with a target company. We estimate this variable simply by counting the days between the two events.[12] The variable is expressed as DAYS.

6.3.4 Warrant liquidity

To get a representative figure for the liquidity, we aggregate the total trades done within 12 months, or the time period available, and divide it by the number of trading days in the corresponding period. This yields the number of trades per day. Next, we divide this number by the number of warrants outstanding (due to difficulties in obtaining data on the exact amount of outstanding warrants, we use the number of warrants issued in the SPAC IPO). In turn, we get a percentage representation of each warrant's daily turnover (trades per day), i.e. how many times it has been sold, on average, each day. The liquidity is derived from the time period that we apply for the respective alpha calculation. Hence, both the dependent and independent variables are both derived from corresponding periods, thus being directly comparable. The variable is expressed as *Warrant liquidity.*

[12] We refer to Appendix 1f for more statistics on days spent for a SPAC to merge with a target.

6.3.5 Stock volatility

We derive the volatility from the same period that we use to estimate the excess return. The volatility is calculated using the daily prices on each security. The variable is expressed as *Stock Volatility.* Specifically, we derive the volatility by

$$VAR(X) = \frac{\sum(X_i - \bar{X})}{n-1}$$

where X_i is the price of stock X at the time i, and $\bar{X}$ is the average price of the stock in the period. n refers to the number of observations in the sample.

6.3.6 Sector

The SPACs in our sample are allocated to different sectors. To examine whether there are sector differences, we create a binomial dummy variable for each of them but one. The sectors we derive from SPAC Research are "Automotive", "Cannabis", "Consumer", "Energy", "Financial", "Food", "Healthcare", "Industrial", "Materials", "Media & Entertainment", "Real Estate", "Technology" and "Travel & Hospitality". We create dummies for all but "Automotive".

6.3.7 Robustness of regression models

To validate that we make a robust inference, we evaluate our explanatory variables by running correlation tests between all the respective variables. We do this to avoid any problems related to multicollinearity, one of the assumptions of running OLS regressions. Additionally, we evaluate that all other assumptions required to conduct OLS regressions are met.[13]

[13] We refer to Appendix 2 for correlation matrixes and Appendix 3 for OLS assumptions.

7. Empirical analysis

Our empirical analyses aim to test the hypotheses from Section 4. We have structured the analysis into three sub-sections. First, we present our analyses from the BAHR strategies to control that our results are consistent with previous research. Second, we present our results from the Fama French models. Third, we run cross-sectional analyses on the individual warrant alphas using the redemption ratio as the explanatory variable. Additionally, we include several control variables. We test our hypotheses $H_{0.1}$ to $H_{0.3}$ in progressive order.

7.1 Buy-and-hold return

Previous literature has used CAR to measure short-term performance, and BAHR to measure long-term performance. We measure the 3-months, 12-months, and 36-months BAHR in the deSPAC period to validate our implemented method towards previous findings. We estimate returns for both stocks and warrants. For consistency, we use the same time periods for both our Fama French and BAHR approaches. Section 6 describes the calculations.

7.1.1 Stocks in the deSPAC period

Merger year	n	3 months BAHR	12 months BAHR	36 months BAHR
2012	1	-17,80 %	-54,73 %	-40,22 %
2013	0	0,00 %	0,00 %	0,00 %
2014	0	0,00 %	0,00 %	0,00 %
2015	2	-19,53 %	-26,43 %	-8,31 %
2016	2	21,47 %	21,30 %	-35,18 %
2017	2	8,65 %	21,60 %	-35,62 %
2018	7	-4,99 %	-28,88 %	37,31 %
2019	11	-2,77 %	-11,46 %	26,79 %
2020	52	6,38 %	4,75 %	-0,28 %
2021	53	-14,92 %	-23,45 %	-23,45 %
Average	130	-4,0 %	-10,4 %	-6,9 %
Median	130	-9,6 %	-19,3 %	-18,6 %
Min	130	-70,2 %	-87,6 %	-90,9 %
Max	130	154,5 %	323,4 %	271,8 %

Table 1: Buy-and-hold return on stocks for the deSPAC period.

For stocks, we find an average of -4% and a median of -9,6% for the 3-months BAHR. Expanding the deSPAC period to a 12-months period, we find an average of -10,4% and a median of -19,3%. This indicates that even after the merged company has operated for over a year, the current price is way lower than the price on the merger date. Expanding our estimation period to 36-months, we find an average of -6,9%, which is somewhat lower than in the 12-months period. The median of -18,6% is much the same as the 12-months period. It seems that the SPACs face a huge drop in the stock price in the first year. Then, after one year as operating companies, the stock prices appear to stabilize.

Vulanovic (2016) investigates the market value of SPACs that have completed mergers. He claims that the market spends some time evaluating the combined company after the merger, going from a blank-check company to a fully operational one. He states that the combined company often is overvalued at the time of the merger and that this usually takes one year to stabilize. Eckbo and Norli (2004) argue that using BAHR to measure return for IPO firms in the period from one to five years after the IPO is misguiding. They argue that IPO firms tend to be more liquid in terms of turnover and are less leveraged. This means that the low return observed in the period from one to five years after the IPO is commensurable. If the IPO firm faces lower risk in terms of liquidity and leverage, the expected return should be lower. By including a liquidity risk factor in the original Fama French three-factor model, they prove that the expected return should be lower in this period, due to higher turnover and less leverage. This means that IPO firms are less exposed to systematic risk in this period.

As we derive from this table, the highest observed returns are quite high, the 12-month BAHR being 323,4%. The lowest observed return is -90,9% and is derived from the 36-months holding period.

Expanding the sample size and -period compared to current literature, our results show consistency with previous studies in the case of negative deSPAC period BAHR for stocks. Ritter et. al. (2021) find a 12-months average of -7,3%, with a median of -21,4%. For the 36-months period, they find an average of 3.3%, actually showing a positive return. However, the median for the same period was -18,5%.

7.1.2 Warrants in the deSPAC period

Merger year	n	3 months BAHR	12 months BAHR	36 months BAHR
2012	1	0,00 %	0,00 %	0,00 %
2013	0	0,00 %	0,00 %	0,00 %
2014	0	0,00 %	0,00 %	0,00 %
2015	2	-24,97 %	-38,93 %	-28,03 %
2016	2	25,71 %	11,43 %	-8,86 %
2017	2	-52,83 %	0,71 %	-44,34 %
2018	7	-7,39 %	-30,30 %	89,07 %
2019	11	20,19 %	6,85 %	41,36 %
2020	52	65,43 %	81,14 %	72,48 %
2021	53	-9,48 %	-20,09 %	-20,09 %
Average	130	22,8 %	22,8 %	27,8 %
Median	130	-9,3 %	-14,5 %	-14,5 %
Min	130	-100,0 %	98,9 %	-98,9 %
Max	130	744,4 %	1177,8 %	764,6 %

Table 2:Buy-and-hold return on warrants for the deSPAC period.

Moving on to measure the BAHR for SPAC warrants, we start by analyzing the 3-months return, also for the portfolio period. We find an average of 22,8%, and a median of -9,3%. So, even if the average warrant return deviates from the average stock return, we still see that the median is negative. The highest observation in this period is 744,4%. Expanding the period to 12-months, the average BAHR remains at 22,8%. The median remains negative, showing a return of -14,5%. The highest observed return for this period is 1177,8%. When we analyze the 36-months BAHR, the average increases to 27,8%, while the median remains unchanged at -14,5%. The highest observed return is 764,6%.

As for stocks, the results for warrants are consistent with previous research when the sample size is increased, and the period from which we derive prices is extended. Ritter et. al. (2021) find a 12-months average of 64,4%, with a median of -10,5%. For the 36-months BAHR, they find an average of 113% and a median of -5,9%.

The average returns for stocks consistently come out negative, while the averages for the warrants show positive returns. However, looking at the median returns, both stocks and warrants show negative returns for all the respective periods. The downside of return is limited to -100% while the upside can be infinite, which explains higher averages than medians.

Knowing the rationale from Eckbo and Norli (2004) and the inherent problems of following a BAHR approach to evaluate the performance of both stocks and warrants, we continue our further investigations by employing the Fama French three-factor model to examine any potential risk-adjusted excess return.

7.2 Fama French portfolio regressions

The results from our Fama French portfolio regressions on stocks are consistent with Ritter et. al (2021). While their research finds a significant alpha in one of four models at the 5% significance level, our results reach the 10% significance level in one model. This meager significance supports theories of efficient pricing at the time when a SPAC consummates a merger; the market has priced the asset correctly. To our knowledge, no current literature investigates warrant return in a Fama French framework. As we employ this framework on the SPAC warrants, we reach significance at the 5% level in two of four models, and at 10% in one model. All the significant alphas show positive coefficients, meaning that the market is undervaluing the warrants at the time of the merger, despite our controls for the Fama French risk factors. Reaching such significance levels in three of four models should be sufficient evidence to conclude that there indeed is risk-adjusted excess return on SPAC warrants.

As pointed out in Section 6, we have four price observations per stock or warrant in each monthly portfolio, beginning once two or more companies have consummated mergers. The model output should consequently be understood on a weekly basis. For the 12-month portfolios, there appear to be four consecutive months (August 2016 until December 2016) that don’t meet the criteria of having at least two companies in the portfolio. Consequently, we remove the 16 observations composing the respective portfolios in our 12-month models. The following seeks to answer the hypothesis of no risk-adjusted excess return on SPAC stocks, $H_{0.1}$.

7.2.1 Stock portfolios

	Equally weighted		Value-weighted	
	12 months	36 months	12 months	36 months
	(1)	(2)	(3)	(4)
Alpha	-0,003	-0,003(*)	-0,001	-0,003
Market - Rf	0,892(***)	0,868(***)	0,898(***)	0,878(***)
SMB	0,821(***)	0,803(***)	0,917(***)	0,865(***)
HML	0,003	0,045	-0,156	-0,145
N. Observations	304	321	304	321
Adj. R-squared	0,321	0,401	0,288	0,358

Table 3: Fama French three-factor regressions of stock returns in portfolios, models 1 to 4.
** p<0,10, ** p<0,05, *** p<0,01.*

Our equally weighted model for 12 months, model (1), shows weekly significant and positive coefficients for both the market variable and the SMB variable, with values of 0,89 and 0,82, respectively. The p-values are significant at a 1% level for both. This implies that the portfolios load positively on the market as well as the SMB portfolio. In other words; if the return on the market portfolio increases, one would have an increase in the expected return of the SPAC portfolio as well. Given that the coefficient is lower than 1, it implies that the portfolio moves less than the market. The same rationale applies to small-cap companies; the portfolio co-moves with small-cap firms.

The intersect, alpha, fails to reach significance on conventional levels. The understandings from this must be that the market prices the stocks efficiently at the time of the merger, given that we do not find any risk-adjusted excess return for this model. This coincides with the standard economic theory of the market being able to set correct prices. In terms of determination (adjusted), model (1) reaches 32,1% which can be said to be relatively good compared to 15,4% in Ritter's similar model.

The equally weighted model for 36 months, model (2), also shows weekly significant and positive coefficients for the market- and SMB variables. In this case, the coefficients are 0,87 and 0,80, respectively. Their p-values are significant at the 1% level. When examining the alpha coefficient of this model, we observe a coefficient of -0,3%, significant at a 10% level.

The now significant alpha suggests that the market fails to price the stocks correctly at the time of the merger. The negative coefficient means that the stocks are priced too high at the merger completion, despite controlling for the Fama French risk factors. The adjusted degree of explanation in model (2) is 40,1%, approximately 8 percentage points better than comparable studies.

Interpreting the value-weighted regressions for 12 months, model (3), we observe weekly significant and positive coefficients for both the market- and SMB factors, 0,90 and 0,92, respectively. Their corresponding p-values are both significant at a 1% level. The alpha fails to reach significance at conventional levels. The adjusted coefficient of determination descends marginally from the comparable model (1), and amounts to 28,8%. In comparison to previous studies, we should expect to see higher degrees of explanation from the value-weighted models. However, the differences are small.

In the last model for stocks, model (4), the value-weighted portfolios over 36 months, we observe yet another outcome of significant and positively loaded market- and SMB factors, with the respective coefficients being 0,88 and 0,86. The levels of significance remain at the higher 1% level. The alpha of this model is insignificant at conventional levels. When Ritter et al. (2021) applied the same model to their sample, model (4) was the only one to provide a significant alpha, in their case at the 5% level. Assessing the adjusted determination coefficient from this model, we obtain a value of 35,8%. Again, slightly lower than the corresponding equally weighted portfolio.

On a general note, we observe significant and positive coefficients for the market- and SMB factors in all of our models (1 to 4). The significant market factors are both expected as well as coherent given that stocks, in general, are expected to move with the market. As for the SMB factors, it appears reasonable to observe significant observations here too, knowing that most of our sample companies are of small size. Comparing the average market capitalization for our sample companies with the S&P500, we find our sample to average just below $1,9 billion, while the S&P500 averages just below $80 billion. As for the HML factors, none came out significant, not even at the 10% level. Similarly, only one of the alpha coefficients for stocks came out significant, although only at 10%.

Conclusively, the evidence is not considered sufficient enough to argue that SPAC stocks provide a risk-adjusted excess return in the deSPAC period, and we fail to reject our null hypothesis, $H_{0.1}$. This echoes both previous findings and economic theory that suggests that the market is able to price securities efficiently.

The following seeks to answer the hypothesis of no risk-adjusted excess return on SPAC warrants, $H_{0.2}$.

7.2.2 Warrant portfolios

	Equally weighted		Value-weighted	
	12 months	36 months	12 months	36 months
	(5)	(6)	(7)	(8)
Alpha	0,013(**)	0,01(**)	0,008(*)	0,005
Market - Rf	0,905(***)	0,851(***)	1,268(***)	1,038(***)
SMB	0,881(*)	0,716(**)	1,048(***)	0,945(***)
HML	0,118	-0,211	-0,157	-0,268
N. Observations	304	321	304	321
Adj. R-squared	0,054	0,085	0,172	0,192

Table 4: Fama French three-factor regressions of warrant returns in portfolios, models 5 to 8.
** p<0,10, ** p<0,05, *** p<0,01.*

Model (5), comprised of the equally weighted portfolios over 12 months, shows positive coefficients for all of the model's variables. Specifically, the market and SMB variables are

0,91 and 0,88, respectively. The market variable is significant at a 1% level, while the SMB factor is significant at a 10% level. The intersecting alpha of the model is positive at 1,3% weekly, significant on a 5% level. Interestingly, this suggests that the market prices the SPAC warrants too low at the time of a SPAC merger, contrary to its correct pricing of the stocks. The risk-adjusted excess returns an investor gains by purchasing a warrant at the time a SPAC merges is quite notable.

The understanding from this is that a significant part of the movement we see in the warrant portfolios is not captured by the Fama French risk factors. The significance observed with respect to the market- and SMB factors should be noted to be rationale even for warrants, given that their underlying stocks are the ones analyzed (and significant) in the stock section. Knowing that the positive average BAHR for warrants may be driven by a few outliers, we want to control for their effect by excluding the best- and worst-performing warrants from the regressions. The alpha remains positive, still significant.[14] Consequently, we continue to include all warrants.

When we expand the time in which the warrants are held in each portfolio to 36 months, still equally weighted, our model (6) shows lower coefficients for all of the models' three variables. The market- and SMB variables show 0,85 and 0,72, respectively. The significance levels remain unchanged from model (5), except for the SMB coefficient which increases its significance to the 5% level. The interpretation remains similar to the one above. Looking at the alpha, we derive a result significant at a 5% level, with a coefficient of 0,96%. The lower alpha, compared to model (5), implies that more of the risk-adjusted excess return on warrants stem from the first year in the deSPAC period than in the two last, controlling over three years. Followingly, the market seems to price warrants more correctly as the merged company gets more time to operate.

Moving over to the value-weighted portfolios, we first inspect the 12-month results from model (7). The coefficient for the market variable shows a weekly positive coefficient of 1,27, significant at a 1% level. The SMB coefficient is 1,05 at a 1% significance level. Model (7)'s alpha is significant at a 90% level, with its coefficient being 0,78%. Seeing

[14] We refer to Appendix 4 for a presentation of the 12-month equally weighted portfolio, best- and worst-performing warrant excluded.

lower risk-adjusted excess return from the value-weighted portfolios implies that the warrants of larger companies provide less excess return than smaller companies.

In our last Fama French regression, model (8), with the value-weighted portfolios in which each warrant was kept for 36 months, we make the weakest inference for warrants. The coefficients for the market and SMB variables show values of 1,04 and 0,96, respectively. Assessing the p-values, the corresponding levels are conclusive at the 1% for the two. The alpha coefficient is insignificant at conventional levels, and this model is the only one to provide an insignificant alpha.

The results from our Fama French regressions on warrants are unanimous in their direction; SPACs who have entered the deSPAC period see positive warrant alphas on a portfolio basis, contrary to the observed results from the stock examinations. Three of our four tested models provide sufficient evidence to reach such conclusions. Given the nature of derivatives, this conflicts with the intuition of warrants correlating positively with their respective underlying stocks. Our Fama French models suggest that the market manage to efficiently price the stocks at the time of the merger, while the warrants seem to be undervalued at the time a SPAC consummates its merger.

As a result, we reject the null hypothesis of no excess return on warrants, $H_{0.2}$, and conclude that there is positive risk-adjusted excess return on SPAC warrants in the deSPAC period.

For a further examination of the risk-adjusted excess return, we estimate company-specific warrant alphas by running Fama French regressions on each individual warrant.[15] The company-specific alphas will serve as the dependent variable in cross-sectional analyses, which provide a framework that enables us to analyze explanations for the excess return and answer hypothesis $H_{0.3}$.

[15] We refer to Appendix 5 for outputs of company-specific warrant alphas.

7.3 Cross-sectional analyses

In this section, we continue to examine the risk-adjusted excess return we find on SPAC warrants. We do this by conduction cross-sectional analyses. Despite not finding risk-adjusted excess return on the SPAC stocks, we conduct cross-sectional analyses on stocks for control purposes.

7.3.1 Warrant analyses

As we find sufficient evidence to conclude that warrants on SPACs provide risk-adjusted excess returns in the deSPAC period. Our cross-sectional regressions below seek to provide more understandings of what drives the risk-adjusted excess return on SPAC warrants, particularly by testing our third hypothesis, $H_{0.3}$. In order to make a robust inference, we include several control variables in our regressions.

	1-yr W.alpha	1-yr W.alpha	1-yr W.alpha	1-yr W.alpha	1-yr W.alpha
	(9)	(10)	(11)	(12)	(13)
Redemption	0,023(***)		0,016(*)	0,013	0,022(***)
One-year stock alpha	1,355(***)	1,362(***)	1,370(***)		1,354(***)
DAYS		0,000(***)	0,000	0,000	
Warrant liquidity	0,040	-0,009	0,021	0,000	
Stock volatility	0,000	0,000	0,000	-0,020	
N. Observations	127	127	127	127	127
Adj. R-squared	0,473	0,469	0,480	-0,009	0,481

*Table 5: Multiple regressions of one-year company-specific warrant alpha for the deSPAC period, models 9 to 13. * p<0,10, ** p<0,05, *** p<0,01.*

We begin our cross-sectional analyses by running correlation tests on the variables and note the correlation between *Redemption* and *DAYS* of 0,46.[16] Consequently, we run models (9) and (10) where we keep the two variables separate. Both models provide coefficients of the respective variables at the 1% level. When we include both *Redemption* and *DAYS* in model (11), *DAYS* loses its significance, while *Redemption* reaches significance at the 10% level.

The positive correlation between *Redemption* and *DAYS* is not surprising. Previous research, Dimitrova (2021), Klausner et. al. (2021), and Ritter et. al. (2021), argue that the redemption ratio increases as the time spent to merge with a target increases. Knowing the sponsors' incentives to merge instead of liquidating the SPAC, last-minute mergers are often perceived to be of low quality. The number of days may therefore cause the redemption to be high, but the redemption may also be high despite a merger being completed early in the SPAC period.

Observing positive coefficients for *Redemption*, significant at the 1% level in models (9) and (13), we reject $H_{0.3}$ and conclude that the positive risk-adjusted excess return on SPAC warrants is driven by the redemption ratio a SPAC encounters upon its merger. The positive coefficient suggests that an increase in redemption will give a higher risk-adjusted excess return on the warrants in the deSPAC period.

Knowing the trading strategy of certain shareholders in SPACs[17], especially with respect to the "SPAC Mafia", our suspicions of the market misinterpreting large redemption ratios are confirmed. Acknowledging the fact that the "SPAC Mafia" seeks to redeem their shares nonetheless, large redemption ratios serve as a false signal of a low-quality merger. When the market fails to acknowledge the way SPACs are used by the "SPAC Mafia", companies who encounter high redemption ratios suffer in terms of low warrant prices at the time of the merger. When the quality of the merger later is revealed, the same warrant prices will increase in value, hence also providing higher returns than the warrants of SPACs that saw lower redemption ratios.

[16] We refer to Appendix 2 for correlation matrixes.

[17] We refer to the rationale from Klausner et. al (2021), discussed in Section 2.

The only control variable to reach significance is the company-specific stock alpha. From model (13), we obtain a positive coefficient of 1,354, significant at the 1% level. This implies that the risk-adjusted excess returns for warrants are affected by some of the expected returns on SPAC stocks. From option theory, we know that the expected return on the underlying stock affects the expected return on the option.[18] For call options, the expected return will increase when the expected return on the underlying stock increases. The expected return for a call option equals the expected return on the underlying stock minus the strike price and the option premium. Thus, reaching significance on this variable is expected.

As for all other control variables, we fail to reach significance on any conventional levels. We refer to Appendix 6 for discussions on those.

7.3.2 Stock analyses

	1-yr S.alpha	1-yr S.alpha	1-yr S.alpha	1-yr S.alpha
	(14)	(15)	(16)	(17)
Redemption	-0,002	-0,004		-0,004
DAYS	0,000		0,000	
Stock liquidity	0,000	0,000	0,000	
Stock volatility	0,000	0,000	0,000	
N. Observations	127	127	127	127
Adj. R-squared	-0,019	-0,017	-0,011	-0,002

*Table 6: Multiple regressions of one-year company-specific stock alpha for the deSPAC period, models 14 to 17. * p<0,10, ** p<0,05, *** p<0,01.*

[18] In conversations with Thore Johnsen, professor at the Norwegian School of Economics (NHH), he confirms that the expected return on the underlying stock should affect the expected return on the derivative.

Despite failing to reach significant alphas in all but one of the Fama French portfolio regressions of the stocks, we run cross-sectional analyses on the individual stocks' risk-adjusted excess return. As for warrants, we use the individual company alpha as the dependent variable for these analyses. Our explanatory- and control variables remain similar to the warrant regressions. However, we substitute *warrant* liquidity with *stock* liquidity. The latter is derived exactly like the former, using stock trades and volumes instead of warrant trades and volumes[19].

Our results from Table 6 coincide with our expectations. As we are unable to conclude that there is sufficient evidence of risk-adjusted excess return on the portfolio basis, we would not expect to see any significant drivers of the same return on a company-specific level. We fail to reach significance in any of the models above; no coefficients are able to explain any risk-adjusted excess return on the stocks in the deSPAC period. Previous literature has found the redemption ratio and days until merger to affect the BAHR on SPAC stocks in the deSPAC period. We refer to Section 3 for these findings. However, we are unable to prove that the same factors affect risk-adjusted excess returns in our sample.

[19] We refer to Section 6.3.4 for how the liquidity factor is derived.

8. The analysis: a critical point of view

The SPAC phenomenon started in 2003, and both the SPAC sector and the field of research are still under development. Despite presenting a larger sample than previous research, we acknowledge elements that may limit and weaken our analyses. In this section, we elaborate more in detail on those.

8.1 Sample

Some of the most current literature does analyze the return on warrants, but the sizes of their samples are modest. Lakicevic and Vulanovic (2013) were able to only analyze eight different warrants, while Lewellen (2009) had data on 79 warrants for SPACs that had merged with a target. Ritter et. al. (2021) conducted their research based on 105 warrants. We have managed to expand the number of observed stocks and warrants to 130, but also extended the data period of trades. Despite the sample expansion, we recognize that our sample is of limited size. Low sample size may bias the analyses to a certain extent, but given that previous literature finds their sample sizes sufficient to make inferences, we believe that our analyses are based on adequate data.

8.2 Period of measurement

We measure the performance from 2013 to 2021, with a substantial amount of the SPACs merging in 2020 and 2021. This overlaps with the COVID-19 pandemic, which could make our results affected by unusual times in the financial market. In times of high uncertainty, as it is during a pandemic, investors tend to place investments in assets with lower risk. Investing in a SPAC should, in principle, be risk-free as the investor has the option of redeeming the shares. This implies that investors should be more willing to invest in the SPAC period only, and redeem/sell their positions before the merger goes through. Seeing our BAHR and Fama French portfolio results coinciding with previous findings, we don't believe that our results have been influenced much by the COVID-19 pandemic.

8.3 Variables

We employ only one key explanatory variable, although numerous control variables. Our explanatory variable, *Redemption*, reached significance in multiple models. One of our control variables, *One-year stock alpha*, reached significant levels in all models. We have included variables that have been tested in the previous literature in an attempt to explain drivers for the returns on SPAC stocks. Seeing the deviating returns on stocks and warrants, we find it interesting to see whether the drivers that affect returns on stocks also can explain the risk-adjusted excess returns on the warrants. This is proved to be the case for the redemption ratio

The Fama French framework can be expanded to include more risk factors. We have adapted the three-factor model with the purpose of comparing our results with previous research as time has gone by and the sample size has increased. To further investigate risk-adjusted excess return, the models could be expanded to include factors for momentum, quality, and low volatility.

8.4 The landscape of SPACs

As we have seen from the SPACs that have entered into the deSPAC period by now, the results in the deSPAC period have been destructive for common shareholders. Despite this, the SPAC market grows exponentially, and the amount of SPACs in search of targets today is just below 600 in the US alone[20]. Based both on current literature and conversations with practitioners, there is little doubt that the landscape of SPACs is changing and adapting as the market gets more mature and investors get better understandings of the benefits and problems that SPACs bring today. Practitioners suggest that the SPAC phenomenon is diversifying the public market. They argue that the deSPAC period as of today is to be seen as a long-term investment and that investors must withstand poor returns short term when invested in SPACs. Further, they claim that more private companies want to go public. SPACs provide these companies with an easy and fast way of entering the public markets.

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[20] Gritstone Asset Management LLC: https://www.gritstoneam.com/spacdata

Knowing the time spent on, as well as the strict regulations of, traditional IPOs, the SPAC phenomenon is here to stay; they open the public market to more companies.[21]

With the misalignment between sponsors and investors that we see today, many believe that there will be structural changes and regulations that may ensure better investor protection in the deSPAC period. Additionally, seeing the exponential growth of SPACs, the competition for finding potentially good targets will tighten. This should help the SPAC sector self-regulate in terms of investor- and sponsor compensation.

Our results from this master thesis are based on the current situation in the sector. However, knowing that the sector continuously is being formed to meet the demands of the market, future research may find different answers due to regulatory- and structural changes.

In the next and final section of this paper, we summarize key findings and present some concluding remarks. We also reflect on what future research may aim its focus at.

[21] In conversation with Benjamin Samuels and Kristin Zimmerman of Morgan Stanley we learned about their perceptions of the SPAC market today, as well as how it may develop in the years to come. This coincides to a great extent with Klausner et. al. (2021).

9. Conclusion

In this paper, we analyze the return on SPAC stocks and warrants in the deSPAC period and suggest an explanation of why SPAC warrants provide a risk-adjusted excess return. We have extended the sample compared to previous literature and collected data on 130 different SPACs. All companies are listed on either NYSE or NASDAQ and are registered in the United States of America. Given the scope of our period, all SPACs that are included in our sample have successfully completed a business combination with a target company.

Our findings show consistency with respect to current literature (Ritter et. al., 2021). We examine the returns of SPAC stocks and warrants through a simple buy-and-hold strategy (BAHR) and find the average return on warrants to be positive, regardless of the time period applied to the sample. For the corresponding stocks, the average BAHR is negative. When measured over one year, the average BAHR on warrants is 22,8%, while the stocks' average BAHR is -10,4%. When comparing the medians of the two, they are both negative with returns of -19,3% and -9,3%, respectively. Finding positive BAHR for warrants and negative BAHR for stocks, we examine the returns by implementing the Fama French three-factor model.

From our Fama French portfolio regressions, we conclude that SPAC stocks do not provide a risk-adjusted excess return in the deSPAC period, also consistent with Ritter et. al. (2021). Our analysis of the warrant return, however, provides sufficient evidence to conclude that warrants provide a risk-adjusted excess return in the deSPAC period. This implies that the stocks are priced correctly at the time of the merger, while the warrants are undervalued. The undervaluation of the warrants is interesting, and we run cross-sectional analyses to find explanations for this.

The cross-sectional analyses provide sufficient evidence to conclude that the risk-adjusted excess return on SPAC warrants is driven by the redemption ratio its company encounters upon merging with a target. We find that as the ratio of redemption increases, so does the return on the warrants. This coincides with the section in Klausner et. al. (2021) that explains how a large fraction of SPAC shareholders, the "SPAC Mafia", is invested solely in the SPAC period to get a risk-free investment and plan on redeeming their positions in any case. The market might misinterpret the following large redemption ratios as bad-quality mergers, which in turn drives the warrant prices down at the time of the merger. Subsequently, once the true quality of the merger is revealed, the warrants may see an increase in value, ultimately providing their investors with higher returns. We also find that risk-adjusted excess return on warrants is linked to the risk-adjusted excess return on its stocks. This confirms that the expected return on a derivative is positively affected by the expected return on its underlying asset.

In the future, when the SPAC sector has matured and more SPACs have entered the deSPAC period, our analyses would be interesting to repeat. First, it would be interesting to see whether the results remain constant once the sample size is increased. Second, it would be interesting to see whether the market learns to acknowledge that the warrants are underpriced at the time of the merger, and corrects the inefficient pricing. In terms of testing, future research may include additional risk factors in the examination of excess return to see whether momentum, quality, and volatility affect the returns of SPAC stocks and warrants.

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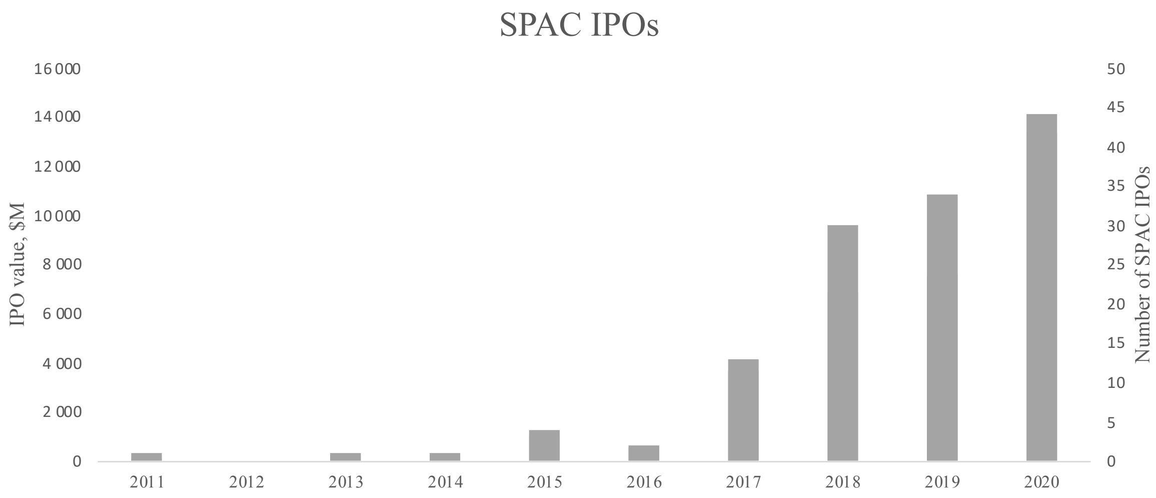
Appendix

In this appendix, we provide insights and further information that we did not find room to include in the main thesis. The content is to be seen as a supplement to the research above, and not to be interpreted on its own.

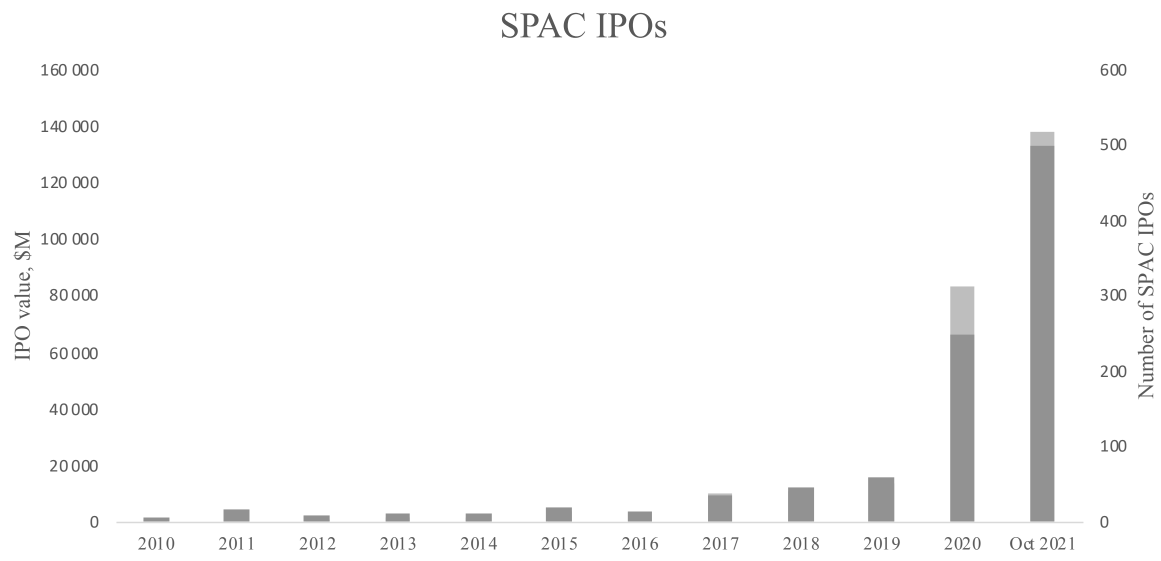
Appendix 1

We provide some basic descriptive statistics of our sample in appendix 1. The total sample consists of 130 SPACs. All have listed the initial SPAC after 2010 and consummated a merger within the 30th of June 2021. All companies in our sample have both the common stock as well as the corresponding warrant trading on either NYSE or Nasdaq. Of the 130 SPACs included in our sample, 3 lack an accurate measure of redemption and are consequently left out during the regressions of warrant return drivers.



Appendix 1a: Number of SPACs going public and their aggregated IPO value in $M, our sample.

As we can derive from Appendix 1a, the number of SPACs going public has increased to a great extent over the following years. Appendix 1b presents the total SPACs listed since 2010, while 1a only presents the sample used for this master thesis.



Appendix 1b: Number of SPACs going public and their aggregated IPO value in $M, United States.

From Appendix 1b we observe an explosive trend in the listing of new SPACs in the United States. The total IPO value in 2021 has surpassed the value of traditional IPOs. The big differences between Appendix 1a and 1b arise from the fact that most of the newly listed SPACs still are in the SPAC period, thus not qualifying for our sample.

Number of SPAC mergers

Year	Amount
2012	1
2013	0
2014	0
2015	2
2016	2
2017	2
2018	7
2019	11
2020	52
2021 (by end of June)	53

Appendix 1c: Number of SPACs completing mergers between 2012 and 30th June 2021, our sample.

Appendix 1c gives a record of how many mergers there have been in the different years. As a result of more listings, the number of merging SPACs increases over the years. No SPACs that met our criteria consummated business combinations in 2013 and 2014.

Sector of operations, target

Sector	Amount
Automotive	17
Cannabis	3
Consumer	7
Energy	11
Financial	17
Food	7
Healthcare	21
Industrial	18
Materials	3
Media & Entertainment	6
Real Estate	4
Technology	12
Travel & Hospitality	4

Appendix 1d: Sectors where the SPACs found their target, our sample.

Appendix 1d presents an overview in which sectors the different SPACs found their target companies. As we derive from the table, the most frequent sectors from which targets are found are healthcare, industrial, automotive, financial, and technology.

Redemption ratio

	Ratio
Average	28,0 %
Median	7,0 %
Min	0,0 %
Max	99,7 %

Appendix 1e: Sectors where SPACs found their targets.

Appendix 1e shows how the redemption varies across the sample. The lowest observed redemption is 0,0% while the highest redemption is 99,7%.

Days between SPAC IPO and merger date	Days
Average	506
Median	478
Min	145
Max	1 281

Appendix 1f: Days between SPAC IPO and the merger with the target company, our sample.

Appendix 1f gives a record of how many days the SPACs encountered in the SPAC period before consummating a merger with a target company and entering the deSPAC period.

Warrant structure in SPAC units

Warrant structure	Amount
1	33
1/2	38
1/3	47
1/4	4
1/5	2
3/4	6

Appendix 1g: Fraction of warrant included in the SPAC Unit at IPO, our sample.

Appendix 1g shows what fraction of a warrant is included in the unit sold at the IPO of the SPAC. The most frequent fractions are one whole warrant, one half of a warrant, and one-third of a warrant.

Appendix 2

	Redemption	DAYS	Stock Volatility	Stock Alpha	Warrant Liquidity
Redemption	1				
DAYS	0,462	1			
Stock Volatility	-0,142	-0,145	1		
Stock Alpha	-0,076	-0,108	0,047	1	
Warrant Liquidity	-0,125	0,052	0,034	-0,039	1

Appendix 2: Correlation matrixes on independent variables used in cross-sectional analyses.

To not make regressions with variables that correlate at levels that are too high, we run correlation tests to disclose any improper variable matches. Given the correlation between DAYS and Redemption, we avoid regressions with both as independent variables.

Appendix 3

Assumptions for linear models:

Linearity in parameters

The relationship between the dependent variables and the independent variables should be linear.

Random Sampling

The sample should be randomly drawn from the population, if not the sample can result in biased estimators.

No perfect collinearity

There should be no perfect collinearity between the independent variables meaning that the following should not exist:

- One variable is a constant multiple of another
- Logs are used inappropriately
  - One variable is a linear function of two or more other variables

Zero conditional mean

The expected values of the residual are equal to zero. This implies no endogenous regressors. If this assumption is invalidated one could receive omitted variable bias. The assumption is formulated as follows:

$$E[\in|x_i] = 0 \; \forall \; i$$

Homoscedastic residuals

The residuals should be homoscedastic, meaning that the variance should be constant across the observations. The assumption is formulated as follows:

$$Var[\in|x_i] = \sigma_{\in}^2 \; \forall \; i$$

Appendix 4

	Equally weighted 12 months
	(5b)
Alpha	0,012(*)
Market - Rf	0,900(***)
SMB	0,918(*)
HML	0,090
N. Observations	304
Adj. R-squared	0,055

Appendix 4: Fama French three-factor regression of the equally weighted warrant portfolios, model 5b. Best- and worst-performing warrant excluded.

Appendix 4 displays the results from the Fama French three-factor regressions of the equally weighted warrant portfolios. The highest observed return on the warrants in this period was twice as high as the second-highest return. The p-value increases marginally from 0,048 to 0,057. The alpha coefficient remains almost identical. For the cross-sectional analyses, we excluded the same warrants and derived the exact same results. We believe this supports keeping all observations in the sample.

Appendix 5

Company-specific warrant alphas

NewCo	SPAC	1-yr FF-alpha	P-value
180 Life Sciences	KBL Merger Corp IV	0,029629	0,319241
23andMe	Vg Acquisition Corp	-0,015151	0,688218
Accel Entertainment	TPG Pace Holdings Corp	0,015262	0,396257
Advantage Solutions	Conyers Pk II Acq Corp	0,006842	0,702446
Advent Technologies	AMCI Acquisition Corp	0,005973	0,869013
AerSale	Monocle Acq Corp	0,027851	0,224892
Aeva	InterPrivate Acquisition Corp	0,009044	0,803830
AGROFRESH SOLUTIONS, INC. (XNAS:AGFS)	Boulevard Acquisition Corp	-0,012861	0,521037
Akerna	Mtech Acq Corp	-0,008033	0,763748
Alta	B Riley Principal Merger Corp	0,012962	0,539291
AppHarvest	Novus Capital Corp	-0,009563	0,792439
ARKO Holdings	Haymaker Acquisition Corp II	0,018867	0,396528
Arrival	CIIG Merger Corp	-0,000005	0,000251
AST SpaceMobile	New Providence Acquisition	0,017545	0,616050
Astra	Holicity Inc	-0,047635	0,564841
ATI Physical Therapy	Fortress Value Acq Corp Ii	-0,088778	0,265166
Atlas Technical Consultants	Boxwood Merger Corp	0,020947	0,320256
BankMobile	Megalith Financial Acquisition	0,008967	0,825521
BARK	Northern Star Acquisition Corp	-0,030534	0,300145
Beachbody	Forest Road Acquisition Corp	-0,060348	0,070867
Billtrust	South Mountain Merger Corp	-0,007383	0,759481
Bioceres	Union Acq Corp	-0,003858	0,899019
BioMx	Chardan Healthcare Acq Corp	-0,003761	0,883480
Blade	Experience Investment Corp	0,063787	0,075472
Broadmark	Trinity Merger Corp	0,008794	0,628309
Butterfly Network	Longview Acquisition Corp	-0,015069	0,562827
Cano Health	Jaws Acquisition Corp	0,044293	0,310996
Canoo	Hennessy Capital Acquisition	-0,003296	0,907201
CareMax Medical Group, IMC Medical Group Holdings	Deerfield Healthcare Tech	-0,019768	0,639351
CarLotz	Acamar Partners Acq Corp	-0,015743	0,499899
Centennial Resource Dev	Silver Run Acquisition Corp	-0,000138	0,000000
Cerevel Therapeutics	Arya Sciences Acquisition II	0,059274	0,261201
ChargePoint	Switchback Energy Acq Corp	0,061079	0,197058
Cision	Capitol Acquisition Corp III	0,000719	0,863724
Clarivate	Churchill Capital Corp	0,009835	0,472632
Clever Leaves	Schultze Special Purpose Acq	0,011171	0,841940
Clover Health	Social Capital Hedosophia III	0,019608	0,682737
CuriosityStream	Software Acq Grp Inc	0,025221	0,484173
Danimer Scientific	Live Oak Acquisition Corp	0,044333	0,269111
Daseke	Hennessy Capital Acq Corp II	0,007210	0,584576
Desktop Metal	Trine Acquisition Corp	0,014010	0,671929
DraftKings	Diamond Eagle Acquisition Corp	0,032781	0,139142

Appendix 5a: Overview of 1-year company-specific warrant alphas, calculated using the Fama French three-factor model. Part a.

Company-specific warrant alphas

NewCo	SPAC	1-yr FF-alpha	P-value
E2open	CC Neuberger Principal Hldg I	0,034272	0,216577
Electric Last Mile	Forum Merger Iii Corp	-0,017716	0,581133
EnerVest	TPG Pace Energy Holdings Corp	0,007166	0,559549
Eos Energy Storage	B Riley Principal Merger II	0,018521	0,597930
Falcon Minerals	Osprey Energy Acquisition Corp	-0,004959	0,804891
Finance of America	Replay Acquisition Corp	-0,027803	0,318562
Fisker	Spartan Energy Acquisition	0,032991	0,383407
Fusion Fuel	Hl Acqs Corp	0,005163	0,866444
GCM Grosvenor	CF Finance Acquisition Corp	0,036351	0,250416
Genius Sports	Dmy Technology Group Inc Ii	0,002843	0,937933
Global Blue	Far Point Acquisition Corp	-0,002080	0,942898
Golden Nugget Online Gaming	Landcadia Holdings Ii Inc	-0,042324	0,021863
Grid Dynamics	Chaserg Tech Acq Corp	0,017738	0,370622
HighPeak Energy	Pure Acquisition Corp	0,059378	0,182006
Hims	Oaktree Acquisition Corp	-0,022223	0,541675
HOF Village	Gordon Pointe Acq Corp.	0,004643	0,893684
Hostess Brands	Gores Holdings Inc	-0,001923	0,878427
Hycroft Mining	Mudrick Capital Acquisition	-0,004663	0,810243
HydraFacial	Vesper Healthcare Acq Corp	0,080806	0,128858
Hyliion	Tortoise Acquisition Corp	-0,007605	0,638339
IEA	M III Acquisition Corp	-0,014336	0,390854
IGI	Tiberius Acq Corp	0,032178	0,191623
Immatics Biotech	Arya Sciences Acquisition Corp	0,013869	0,513653
indie Semiconductor	Thunder Bridge Acquisition II	0,055022	0,341474
Innoviz Technologies	Collective Growth Corp	-0,026267	0,402678
Janus International Group	Juniper Industrial Hldg Inc	-0,016975	0,618949
JetPay	Universal Business Payment	0,000000	0,000000
Kaleyra	Gigcapital Inc	0,018814	0,463314
Katapult	Finserv Acq Corp	0,089743	0,492159
Landsea Homes	LF Capital Acquisition Corp	0,011581	0,644662
Latch	TS Innovation Acqs Corp	0,076482	0,106089
Lightning eMotors	Gigcapital3 Inc	0,028542	0,628925
Lindblad Expeditions Holding, Inc.	Capitol Acquisition Corp II	0,000051	0,996645
Lion Electric	Northern Genesis Acq Corp	-0,013571	0,720463
Lion Financial	Proficient Alpha Acq Corp.	0,016955	0,757634
LiveVox	Crescent Acquisition Corp	0,033476	0,431916
Metromile	INSU Acquisition Corp II	-0,016074	0,644988
MP Materials	Fortress Value Acquisition	0,037080	0,130083
MultiPlan	Churchill Capital Corp III	0,012566	0,494155
Nesco	Capitol Investment Corp IV	0,010340	0,740423
NeuroRx	Big Rock Partners Acq Corp	-0,098625	0,678629
Nikola	VectoIQ Acquisition Corp	-0,010017	0,950274
NPS	Natl Energy Svcs Reunited Corp	-0,008423	0,585945
NRC Group	Hennessy Capital Acq Corp III	0,028426	0,238588
Nuvation Bio	Panacea Acquisition Corp	0,035484	0,389024

Appendix 5b: Overview of 1-year company-specific warrant alphas, calculated using the Fama French three-factor model. Part b.

Company-specific warrant alphas

NewCo	SPAC	1-yr FF-alpha	P-value
Origin Materials	Artius Acq Inc	-0,023352	0,521528
Ouster	Colonnade Acquisition Corp	-0,019155	0,557782
Owl Rock Capital Group, Dyal Capital Partners	Altimar Acquisition Corp	0,062179	0,143898
PAE	Gores Holdings Iii Inc	-0,006777	0,643679
Paya	Fintech Acquisition Corp III	-0,000754	0,958800
Payoneer	FTAC Olympus Acquisition Corp	0,006566	0,847731
Paysafe	Foley Trasimene Acq Corp II	-0,025589	0,324390
Perella Weinberg Partners	Fintech Acquisition Corp IV	0,000530	0,978343
PLAYSTUDIOS	Acies Acquisition Corp	-0,020006	0,504818
Porch.com	PropTech Acquisition Corp	0,003463	0,921347
Proterra	ArcLight Clean Transition Corp	-0,037409	0,195485
PureCycle Technologies	Roth CH Acquisition I Co	-0,009459	0,830907
Purple Innovation	Global Partner Acq Corp	0,174201	0,067627
Quantum-Si	Highcape Capital Acq Corp	-0,024814	0,588739
QuantumScape	Kensington Capital Acq Corp	0,008706	0,764946
Ranpak	One Madison Corp	0,008414	0,553152
Reviva Pharma	Tenzing Acquisition Corp	-0,003467	0,888691
Romeo Power	RMG Acquisition Corp	-0,030749	0,739651
Rush Street Interactive	dMY Technology Group Inc	-0,012792	0,626018
Shift	Insurance Acquisition Corp	-0,003140	0,784096
Skillsoft and Global Knowledge	Churchill Capital Corp Ii	0,035226	0,440486
Skillz	Flying Eagle Acq Corp	-0,031296	0,546889
SOC Telemed	Healthcare Merger Corp	-0,025673	0,176018
SoFi	Social Capital Hedosophia V	0,016183	0,675566
Stem, Inc.	Star Peak Energy Transition	0,039219	0,367322
Stratos Management Systems	Pensare Acquisition Corp	0,099607	0,116126
Talkspace	Hudson Executive Invest Corp	-0,043031	0,241610
Target Hospitality	Platinum Eagle Acq Corp	0,233732	0,258059
Tattooed Chef	Forum Merger Ii Corp	0,021440	0,246306
Triterras Fintech	Netfin Acquisition Corp	-0,011934	0,715940
U.S. Well Services	Matlin & Partners Acq Corp	-0,007843	0,827774
Ucommune	Orisun Acquisition Corp	-0,020388	0,676284
UpHealth, Cloudbreak Health	Gigcapital2 Inc	-0,030940	0,054182
Utz	Collier Creek Holdings	0,015138	0,153891
Velodyne Lidar	Graf Industrial Corp	-0,019762	0,356837
Vertiv	GS Acquisition Holdings Corp	0,010685	0,443042
View	CF Finance Acquisition Corp II	0,001284	0,964598
Vincera Pharma	Lifesci Acq Corp	-0,008044	0,731049
Virgin Galactic	Social Capital Hedosophia	0,032114	0,287985
Vivint	Mosaic Acq Corp	0,040241	0,246498
Weedmaps	Silver Spike Acq Corp.	-0,010022	0,553177
Whole Earth Brands	Act II Global Acquisition Corp	0,000802	0,963143
XL Fleet	Pivotal Investment Corp II	-0,032859	0,055231

Appendix 5c: Overview of 1-year company-specific warrant alphas, calculated using the Fama French three-factor model. Part c.

Appendix 6

Appendix 6a shows the results from the cross-sectional analysis including all our control variables, excluding *DAYS*. Appendix 6b shows the results from the cross-sectional analyses using sectors as dummy variables.

	1-yr W.alpha	1-yr W.alpha	1-yr W.alpha	1-yr W.alpha	1-yr W.alpha
	(9)	(10)	(11)	(12)	(13)
Redemption	0,023(***)		0,016(*)	0,013	0,022(***)
One-year stock alpha	1,355(***)	1,362(***)	1,370(***)		1,354(***)
DAYS		0,000(***)	0,000	0,000	
Warrant liquidity	0,040	-0,009	0,021	0,000	
Stock volatility	0,000	0,000	0,000	-0,020	
N. Observations	127	127	127	127	127
Adj. R-squared	0,473	0,469	0,480	-0,009	0,481

*Appendix 6a: Table 7: Multiple regressions of one-year company-specific warrant alpha for the deSPAC period, models 9 to 13. * p<0,10, ** p<0,05, *** p<0,01.*

Appendix 6a provides no significant evidence that warrant liquidity or stock volatility affects the risk-adjusted excess return on SPAC warrants. In general, warrants' liquidity should be expected to affect the bid/ask spread, but not the risk-adjusted excess return. This is consistent with our findings. As for stock volatility, one should expect the expected volatility of the underlying stock to affect the return of the option. When we try to use the average volatility of the stock, measured over the one-year period we also measure the risk-adjusted excess return for warrants over, we find no significant evidence to suggest that this is true for our sample.

	1-yr W.alpha	1-yr W.alpha
	(18)	(19)
Redemption		0,019(**)
One-year stock alpha		1,340(***)
Cannabis	-0,006	-0,013
Consumer	0,013	0,012
Energy	0,004	-0,004
Financial	0,007	-0,002
Food	0,000	-0,010
Healthcare	-0,009	-0,003
Industrial	0,000	-0,009
Materials	-0,001	-0,013
Media & Entertainment	-0,008	-0,014
Real Estate	0,013	0,006
Technology	0,021	0,000
Travel & Hospitality	0,086(***)	0,069(***)
Constant	0,004	0,013(*)
N. Observations	127	127
Adj. R-squared	0,062	0,537

*Appendix 6b: Multiple regressions of one-year company-specific warrant alpha for the deSPAC period, models 18 to 19. * p<0,10, ** p<0,05, *** p<0,01.*

Appendix 6b provides significant evidence that SPACs that have merged with a company in the “Travel & Hospitality” sector and the “Automotive” sector affect the risk-adjusted excess return on warrants positively. “Travel & Hospitality” shows a positive coefficient, significant at the 1% level. “Automotive”, represented by the *Constant* shows a positive coefficient, significant at a 10% level.

A plausible reason for why “Travel & Hospitality” provides significant results, is linked with the COVID-19 pandemic. This sector suffered large cuts in terms of demand and income after the first quarter of 2019 and during 2020 in which restrictions on both domestic and foreign traveling were fact. However, during 2021, vaccines have been distributed and a lot of the restrictions have been revoked. Hence, one could argue that the warrants in this sector had low prices due to low expectations of future value. As the restrictions have been revoked, investors have increased the expectations of future value. Hence, the expected return of warrants has increased due to rapid changes in the sector. This is also consistent with option theory, as sudden changes in variables that affect the expected volatility of the underlying stock, should affect the return on options.

As for the sector “Automotive”, an article published by McKinsey & Company (2021) argues that despite seeing a decrease in income at the beginning of the pandemic, this sector has accelerated out of the turn. This is due to increased technology in the sales platforms, indicating that the sector quickly managed to adapt to the new environment. This may have caused the same rationale as for the sector “Travel & Hospitality”. Investors underpriced the warrants at the beginning of the pandemic, but seeing that the merged companies were able to maintain high sales, the market corrected the valuation of the warrants.