“Performance analysis of healthcare-focused special purpose acquisition companies”

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ARTICLE INFO	Gimede Gigante and Daniele Notarnicola (2021). Performance analysis of healthcare-focused special purpose acquisition companies. *Investment Management and Financial Innovations*, *18*(4), 150-165. doi:10.21511/imfi.18(4).2021.14
DOI	http://dx.doi.org/10.21511/imfi.18(4).2021.14
RELEASED ON	Tuesday, 09 November 2021
RECEIVED ON	Friday, 01 October 2021
ACCEPTED ON	Tuesday, 02 November 2021

JOURNAL	"Investment Management and Financial Innovations"
ISSN PRINT	1810-4967
ISSN ONLINE	1812-9358
PUBLISHER	LLC “Consulting Publishing Company “Business Perspectives”
FOUNDER	LLC “Consulting Publishing Company “Business Perspectives”

NUMBER OF REFERENCES	NUMBER OF FIGURES	NUMBER OF TABLES
59	1	6

BUSINESS PERSPECTIVES

LLC "CPC "Business Perspectives"
Hryhorii Skovoroda lane, 10,
Sumy, 40022, Ukraine

www.businessperspectives.org

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PERFORMANCE ANALYSIS OF HEALTHCARE-FOCUSED SPECIAL PURPOSE ACQUISITION COMPANIES

Abstract

The Covid-19 pandemic has accelerated some structural changes in the healthcare industry, and several health-tech start-ups thrived by providing innovative solutions to the challenges imposed by the pandemic. To finance their growth, many of these companies went through mergers with Special Purpose Acquisition Companies (SPACs). The paper investigates the market performance of healthcare-focused US-listed SPACs. The study aims to analyze the returns that healthcare SPACs offer to their investors and ascertain the determinants that drive these returns over a sample of 33 SPACs that merged with a healthcare firm between 2018 and 2021. Linear regression is employed to identify the drivers of SPACs' market performance. Portfolio analysis is also performed and compared against the Russell 2000 and the S&P500 Healthcare Indexes.

The first outcome accomplished by the analysis is that a portfolio made of healthcare-SPACs underperforms small-cap firms by 2.14% and the healthcare industry by 6.72% over a two-year period, even if the difference in the returns of the healthcare SPACs portfolio and the two benchmarks is not statistically significant. Moreover, a high level of redemptions, the presence of serial SPAC sponsors, cross-border deals, private equity and venture capital funds as sellers, and a high percentage of boutique investment banks among the sell-side advisors seem to negatively affect the returns of healthcare-focused SPACs with a significance level of at least 10%. Instead, a larger number of buy-side advisors appears to be beneficial for healthcare-focused SPACs' market performance.

Keywords mergers and acquisitions, IPO, financial innovation, US, market returns

JEL Classification G12, G14, G24, G32, G34

Received on: 1st of October, 2021
Accepted on: 2nd of November, 2021
Published on: 9th of November, 202

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Conflict of interest statement:
Author(s) reported no conflict of interest

INTRODUCTION

During 2020, capital markets worldwide were characterized by high volatility and instability due to the outbreak of the Covid-19 pandemic. The disruption and great uncertainty of financial markets made it more difficult to find the right "IPO window" for private firms aiming to become public companies to raise capital and finance their expansion. In response to this challenge, market operators, mainly in the United States, brush up a backdoor way to access public markets: the Special Purpose Acquisition Companies (SPACs). Indeed, US SPAC offerings skyrocketed in 2020, raising more than $83.2 billion in 248 IPOs. In the first half of 2021, the volumes increased even more, overtaking the traditional IPO funding in terms of gross proceeds raised.

Concurrently, healthcare start-ups have experienced rapid growth due to the Covid-19 pandemic, and valuations of health-tech companies were at all-time highs because the pandemic made necessary the shift to digital healthcare solutions. However, to keep growing these companies need to access public markets capital and scale up. These high-growth start-ups may have difficulties raising funds in public markets

http://dx.doi.org/10.21511/imfi.18(4).2021.14

because of their short history and complex and innovative business. Indeed, in the last two years, an increasing number of healthcare companies went public through a SPAC deal as well as more and more SPACs are claiming in their prospectus to seek targets in the healthcare industry, thus revealing a sort of symbiosis between this investment vehicle and the industry. The choice of SPACs is due to the numerous advantages that they can give to high-growth healthcare companies, including speediness of the process, more deal certainty, and the possibility of showing projects and making forward-looking statements.

Because of the high suitability of healthcare companies as SPAC targets and the relevance of the healthcare industry in the global economy, this study poses the attention to investigating the market performance of SPACs that completed a business combination with healthcare companies. In particular, the study aims to analyze the returns that healthcare SPACs offer to their investors and ascertain the determinants that drive these returns. The paper is carried out on SPACs listed on the US Stock Exchanges since the US is the leading market for these vehicles and provides a solid database for the analysis.

The significance of the topic derives from the recent popularization of SPACs in the financial markets worldwide (even if they interest mainly the US) and their tight connection with innovation in the healthcare sector, an industry with an estimated value of more than $8 trillion (Dealroom, 2021) and expected to grow at a 3.9% compound annual growth rate (CAGR) between 2020 and 2024 (Deloitte, 2021a).

1. LITERATURE REVIEW AND HYPOTHESES

Academic literature on SPACs started to develop only recently due to the newness of these investment vehicles and focuses mainly on the US market since SPACs are primarily a US phenomenon. The first contributions on SPACs emerged in 2007 and examined both the legal and financial aspects of the vehicles. Hale (2007), Heyman (2007), Riemer (2007), Davidoff (2008), and Sjostrom (2008) explored the SPAC structure from the legal and accounting standpoints, describing the main characteristics of SPACs, their differences compared to the blank-check companies active in the 1990s, their advantages and drawbacks for prospective investors, but without executing any empirical analysis.

The first empirical analyses on SPACs' structural and market data were conducted by Jog and Sun (2007), and Boyer and Baigent (2008). Jog and Sun (2007) highlighted a possible conflict of interest between SPAC sponsors and investors, as they found that the former realized annualized returns of 1,900%, while the latter experienced a negative annual return of 3%, over a sample of 62 SPACs over the period 2003–2006. Instead, Boyer and Baigent (2008) and Kolb and Tykvová (2016) found that SPACs offer a less costly and faster route to public markets, especially in periods of low IPO activity. However, the relative cheapness of the SPAC process compared to traditional IPOs is still a debated issue in the literature. Indeed, Klausner and Ohlrogge (2020) came to the opposite conclusion, arguing that SPACs are more expensive than traditional IPOs and average SPAC returns are lower than the ones of companies listed through conventional IPOs. In particular, the authors examined SPAC performance at three, six, and twelve months after the business combination completion, finding median returns to be negative and worsening over time (–14.5%, –23.8%, and –65.3%, respectively). Gahng et al. (2021) also analyzed SPAC returns over their life cycle, breaking them down into pre-merger period and post-merger period. They reported an average annualized for the pre-merger period of 9.3%, while the average one-year return after the merger was –15.6%. Notwithstanding the different periods of the analysis, these results are in line with those of Jenkinson and Sousa (2009), who found that six months after the merge, SPAC investors experience an average cumulative return of –24%. The same conclusions are reached by Floros and Sapp (2011), who reported that SPACs exhibit significant post-acquisition negative returns and perform worse than typical reverse mergers. Lakicevic and

Vulanovic (2013) confirmed the previous findings, reporting a –28.00% return to unitholders based on a sample of 66 SPACs that completed a business combination. Datar et al. (2012) investigated the SPACs' long-term performance finding that the operational performance of SPACs is inferior to industry peers. A thorough analysis of SPAC returns over their life cycle is provided by Gigante et al. (2020), who focused on the Italian SPAC market and concluded that SPACs create value mainly for early investors.

Regression models are also often employed in the literature on SPACs. In particular, Lewellen (2009) applied a Fama-French four-factor model on the returns of a portfolio of SPACs, concluding that SPACs have a market beta close to one. Cumming et al. (2014) used logistic regression to investigate the probability of a SPAC to complete a business combination, finding that younger management teams have a higher degree of acquisition approvals. The qualities of SPACs' management team were also examined by Kim (2009), Collins (2012), and Blomkvist et al. (2021). It was concluded that having managers with longer industry experience has a positive impact on the attraction of investors. Through a logistic regression model, Vulanovic (2016) demonstrated the interconnection between SPACs targeting foreign companies and higher liquidation likelihood. Conversely, Gigante and Guidotti (2021), through logistic regression, found that US SPACs focused on the Chinese firms have a higher likelihood to complete a business combination. Logistic regression was also employed by Dimic et al. (2020) to examine the determinants of SPAC IPOs withdrawals. Instead, Dimitrova (2017) regressed the four-year post-IPO buy-and-hold abnormal return of a portfolio of SPACs over several variables related to the SPACs' characteristics, bringing evidence of an inverted U-shaped relationship between the time from the IPO to the acquisition of a target and SPAC performance. Kim et al. (2021) performed a cross-sectional regression on the SPAC post-merger returns, concluding that larger offering size and the presence of venture capital funds decrease SPAC returns.

Although SPACs' market returns have been extensively analyzed by the academic literature, no previous studies focused specifically on analyzing the performance of SPACs that completed a business combination with healthcare companies. Hence, the purpose of this study is to investigate the stock returns that healthcare SPACs deliver to an investor, appraise whether the market performance of a portfolio of healthcare SPACs significantly differs from those of small-cap US companies and established healthcare firms, and ascertain the factors determining the returns. In particular, two tests of hypothesis are performed to compare the performance of the SPAC portfolio against two benchmarks. The hypotheses for both tests are the following:

H_0: *Healthcare SPAC portfolio returns do not significantly differ from the returns of the benchmark.*

H_1: *Healthcare SPAC portfolio returns significantly differ from the returns of the benchmark.*

Moreover, the innovative approach of this study lies in the fact that the regression analysis centers on the value created during the de-Spacing phase and takes into consideration variables that were never taken into account, such as the number of financial advisors to the merger and the percentage of boutique investment banking firms among them.

2. METHODOLOGY

The main data on SPACs features and relevant dates were retrieved from SPAC Research, and the data were cross-checked with SPAC Track and SPAC Insider. Mergermarket was also employed to get data about the business combinations. Further information was obtained from the company's press releases, Business Wire, PR Newswire, and GlobeNewsWire. Moreover, the SEC filings in the Electronic Data Gathering, Analysis, and Retrieval (EDGAR) system were consulted when the other sources provided conflicting information. Stock price data, instead, were obtained from Refinitiv and checked with Bloomberg. The sample comprises 33 SPACs that completed a business combination with a healthcare company in the period December 2018–July 2021. To get a sense of the characteristics of the sample SPACs, Table 1 reports the statistics on the main features of these firms.

http://dx.doi.org/10.21511/imfi.18(4).2021.14

Table 1. Overview of SPAC characteristics

Source: Authors' elaboration.

SPAC Characteristics	Mean	Min	25th Percentile	Median	75th Percentile	Max	St. Dev
IPO Gross Proceeds ($ Million)	267.8	46.0	120.8	172.5	345.0	1,100.0	235.1
Cash Held in Trust (% of IPO Proceeds)	100.48%	100.00%	100.00%	100.00%	100.00%	113.30%	2.32%
Redemptions (% of IPO Proceeds)	35.86%	0.00%	0.00%	10.27%	79.35%	100.00%	39.56%
PIPE investments (% IPO Proceeds)	91.03%	0.00%	29.68%	50.00%	117.00%	395.65%	100.88%
Total Cash Delivered to Target ($ Million)	455.0	14.1	115.0	247.8	555.0	3,613.1	659.8
Cash to Target (% IPO Proceeds)	155.58%	12.25%	69.35%	123.10%	178.47%	508.95%	119.91%
Deal Value ($ Million)	1,506.3	61.6	525.1	905.4	1,440.0	11,138.0	2,073.8
Deal Value (as multiple of IPO Proceeds)	5.1x	0.4x	2.5x	4.7x	7.1x	11.8x	3.1x
Deal Value (as multiple of Cash to Target)	5.3x	1.1x	2.0x	3.1x	6.3x	5.1x	6.1x

2.1. Portfolio construction

The portfolio analysis is performed to assess healthcare SPACs as an asset class where to invest and to identify whether they over- or underperformed selected market benchmarks.

The portfolio is built as a continuously rebalancing equally-weighted portfolio, i.e., the healthcare-focused SPACs have all the same weights, and every day the portfolio is rebalanced to keep the weights equal to the previous day. This approach was adopted because it is believed to be the more unbiased since no firm is over- or underweighted compared to others. Therefore, it offers a fair picture of the returns of the healthcare-focus SPAC segment. The ending date of the portfolio is July 31, 2021, while the start date is July 31, 2019, so to have at least two years of returns. On July 31, 2019, thirteen of the 33 sample SPACs were already listed. Looking at returns before this date means having a portfolio excessively concentrated on a few SPACs (less than thirteen).

To get the daily portfolio returns, the single SPAC daily return is computed according to the following formula:

$$Daily\ \text{Re}turn_t = \frac{Closing\ Price_t - Closing\ Price_{t-1}}{Closing\ Price_{t-1}}. \quad (1)$$

Then, the returns is aggregated at portfolio levels according to the following formula:

$$r_P = \frac{r_1 + r_2 + r_3 + \ldots + r_N}{N}, \quad (2)$$

where r_P is the daily portfolio return, r_i is the daily return of each SPAC in the portfolio and N is the number of SPACs in the portfolio.

Returns computed according to Formula 1 are linear returns and, thanks to their properties, it is possible to compute portfolio returns as a simple or weighted average of its components' linear returns. As a new sample SPAC goes public and data are available, it is added to the portfolio, and the daily portfolio return can be still computed according to Formula 2 with no changes needed: the return of the new SPAC will be added to the numerator, and the number of SPACs in the portfolio (at the denominator) will increase by one.

The benchmarks selected to compare the healthcare SPAC portfolio returns are the Russell 2000 Index and the S&P 500 Healthcare Sector Index. The Russell 2000 Index measures the performance of the small-cap segment of the US equity universe and provides a comprehensive and unbiased small-cap barometer. It was picked as a benchmark for the healthcare SPAC portfolio since the vast majority of healthcare firms acquired by the sample SPACs are small-cap companies, thus comparability is ensured. The S&P 500 Healthcare Sector Index comprises those companies included in the S&P 500 that are classified as members of the GICS healthcare sector and offers an overview of the market performance of the US healthcare industry. Hence, it is an appropriate benchmark for a portfolio of US SPACs that acquired healthcare firms. Besides belonging to the same sector and geographies, S&P 500 companies and healthcare SPAC portfolio companies differ in dimensions, being S&P 500 companies established large-cap companies. However, this does not hinder the comparability of the two portfolios since the aim, in this case, is to view the healthcare SPAC portfolio performance in comparison with the broad healthcare industry, and not with same size companies (for this purpose, Russell 2000 Index is already employed as the benchmark).

To examine trends and differences over time the analysis was performed over four different timeframes: 3 months, 6 months, 1 year, and 2 years, having as reference date the portfolio ending date (July 31, 2021). When cumulative linear returns are computed starting from the daily linear returns, the following formula is employed:

$$Cumulative\ Return_{t_0,t_n} = \\ = \left(1+r_{t_0}\right)\cdot\left(1+r_{t_1}\right)\cdot\ldots\cdot\left(1+r_{t_n}\right)-1. \quad (3)$$

Finally, two *t*-tests are executed to ascertain whether the two-year daily returns of the healthcare SPAC portfolio significantly differ from the returns of the two selected benchmarks. Precisely, two-sample t-tests assuming unequal variances are performed.

The hypotheses for both tests are the following:

H_0: *Healthcare SPAC portfolio returns do not significantly differ from the returns of the benchmark.*

H_1: *Healthcare SPAC portfolio returns significantly differ from the returns of the benchmark.*

The *t*-statistics are computed according to the following formula:

$$t = \frac{\overline{r}_{Portolio} - \overline{r}_{Benchmark}}{\sqrt{\frac{\sigma^2_{Portolio} - \sigma^2_{Benchmark}}{n}}}, \quad (4)$$

where $\overline{r}$ is the mean return, σ is the standard deviation of the returns, and n is the sample size (which is the same for both samples).

2.2. Regression model

Linear regression is employed to understand what are the significant variables that explain the returns of healthcare-focused SPACs. In particular, the dependent variable is the cumulative stock return (CSR) of the SPACs from the day before the business combination announcement to fifteen days after the transaction closing. This cumulative return is computed as follow:

$$Cumulative\ Return = \frac{Closing\ Price_{15d\ post\ merger} - Closing\ Price_{1d\ before\ announc}}{Closing\ Price_{1d\ before\ announc}}. \quad (5)$$

The choice of this time frame comes from the fact that the focus of the analysis is on the value creation of the business combination as the market perceives it. Indeed, the selected time window encompasses the total duration of the merger process, and many of the regressors presented below relate to the business combination's characteristics. Any SPAC stock price variation before the merger announcement is due either to an investment in the sponsor's reputation or to pure speculation since the fair value of a pre-announcement SPAC should be equal to the amount of cash it holds in the trust account. Hence, these fluctuations are independent of the value creation delivered from the merger, therefore, are excluded from the analysis. Similarly, choosing the fifteenth day after the merger completion as the ending date is functional to give the market some time to absorb the information on the target that becomes available upon closing, while not going too far in time, when other factors than the features of the merger process become relevant.

For the aim of the model, several independent variables were identified. The first variable is the base ten logarithms of the gross proceeds raised at IPO (*IPO_Proc*) to account for the dimension of the SPACs. This has the role of control variable and three variables are adjusted for the value of IPO proceeds. The logarithmic transformation performed on the IPO size is useful to transform a highly skewed variable into a more normalized one, and it is also helpful to handle any potentially non-linear relationship with the independent variable. The second variable is the amount of SPAC share redemptions (*Redemptions*) as a percentage of the IPO proceeds. It is expected that high redemption levels will lead to poor market performance because they signal low confidence by SPAC shareholders in the acquired target. The third variable is the proceeds raised through PIPE investments (*PIPE_Proc*) as a percentage of the IPO proceeds. The fourth variable is the business combination deal value (*Deal_Value*) as a percentage of the IPO proceeds. The fifth, sixth, and seventh variables are related to the management team of the

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SPAC, and these are respectively the number of officers managing the SPAC (*N_of_Officers*), the percentage of officers that have healthcare expertise (*Healthcare_Exp*), and their previous experience as SPAC sponsor (*Serial_Sponsor*). The last two mentioned variables are defined as dummy variables that equal 1 if the officers have healthcare expertise or have previously sponsored another SPAC and 0 otherwise. These variables are relevant since SPACs rely heavily on their sponsors' experience and network, which can be put at the target service after the business combination. As such, the percentage of officers with healthcare experience should positively impact the combined entity's returns. A SPAC officer is considered to have healthcare expertise if he or she has sat in the Board of Directors of at least two healthcare companies and/or has experience in healthcare investing through working in Investment Banking, Private Equity, or Hedge Funds with a focus on the healthcare industry, and/or is graduated in healthcare science and working in the healthcare sector (like doctors, clinical researchers, or surgeons). A SPAC sponsor is deemed to be a serial sponsor if it has launched at least another SPAC before the IPO of the SPAC in question. The eighth variable is relative to the initial acquisition focus of the SPAC (*Healthcare_Focus*) and is described as a dummy variable that takes a value of 1 if the initial focus is the healthcare industry and 0 otherwise. This variable will be helpful to understand whether having an initial focus on healthcare and then actually merging with a healthcare firm has an impact on the market returns. The ninth variable is the time to acquisition (*Time_to_Acq*), computed as the base-ten logarithm of the number of days between the SPAC IPO date and the business combination completion day. This variable will allow understanding whether for healthcare-focused SPACs is beneficial to do a more prolonged search for the right target or it is better to soon close a transaction to avoid having pressure in the late stages of the SPAC life. The tenth variable is related to the country of incorporation of the target company (*Cross_Border*). It is described as a dummy variable that takes a value of 1 if the target is incorporated outside the US, resulting in a cross-border business combination, and 0 otherwise. The eleventh variable is to assess whether the target sale represents an exit strategy for private equity or venture capital investors (*PEVC_Exit*). It is described as a dummy variable that equals 1 if the target company was owned by PE or VC funds previous to the acquisition and 0 otherwise. From twelfth to fifteenth, the last variables revolve around the financial advisors appointed for the business combination transaction. In particular, these variables are the number of buy-side advisors (*N_of_Buy_Adv*), the percentage of investment banking boutiques among the buy-side advisors (*Boutique_Buy_Adv*), the number of sell-side advisors (*N_of_Sell_Adv*), and the percentage of investment banking boutiques among the sell-side advisors (*Boutique_Sell_Adv*). An investment bank is deemed to be a boutique if it provides few specialized services, or it focuses on a specific market segment, or, even if it provides full-services and does not serve a specific segment, it is not in the top fifty advisors of the last three-year league tables for all the services it offers (M&A, Equity, Debt, Loans).

The cross-sectional multiple linear regression model is, then, described as follows:

$$\begin{aligned} CSR_i = {} & \alpha + \beta_1 IPO\_Proc_i + \\ & + \beta_2 Redemptions_i + \beta_3 PIPE\_Proc_i + \\ & + \beta_4 Deal\_Value_i + \beta_5 N\_of\_Officers_i + \\ & + \beta_6 Healthcare\_Exp_i + \beta_7 Serial\_Sponsor_i + \\ & + \beta_8 Healthcare\_Focus_i + \beta_9 Time\_to\_Acq_i + \\ & + \beta_{10} Cross\_Border_i + \beta_{11} PEVC\_Exit_i + \\ & + \beta_{12} N\_of\_Buy\_Adv_i + \\ & + \beta_{13} Boutique\_Buy\_Adv_i + \\ & + \beta_{14} N\_of\_Sell\_Adv_i + \\ & + \beta_{15} Boutique\_Sell\_Adv_i + \varepsilon_i. \end{aligned} \quad (6)$$

The regressors of the model were also checked for multicollinearity through the computation of the variance inflation factor (*VIF*) according to the following formula:

$$VIF_i = \frac{1}{1 - R_i^2}, \quad (7)$$

where VIF_i is the variance inflation factor for the regressor i, and R_i^2 is the *R*-squared of the regressor i.

3. RESULTS AND DISCUSSION

3.1. Portfolio analysis

The last two years' healthcare SPAC portfolio performances are plotted against the benchmarks in Chart 1. The portfolio and the benchmarks have been rescaled to a nominal value of 100 on July 31, 2019.

As can be noticed from Figure 1, until the outbreak of the Covid-19 pandemic, the three portfolios followed a similar trend and delivered comparable returns. However, the pandemic deeply affected US small-cap companies, and indeed the Russell 2000 index plummeted in March 2020: at the bottom, the index was down by 37.05% compared to the initial value of July 2019. Instead, the drop of the healthcare SPAC portfolio and S&P 500 Healthcare index was smaller (at the bottom, they were losing 7.18% and 17.37%, respectively), and their recovery was faster. Indeed, the healthcare SPAC portfolio returned to pre-Covid levels already in May 2020, while the Russell 2000 index recovered completely only in November 2020. From December 2020, the healthcare SPAC portfolio began growing fast, reaching a peak of +83.19% over the inception value in February 2021, leaving behind both benchmarks. The outstanding growth of the portfolio was due to the "new normality" imposed by the Covid-19 pandemic that boosted the valuation of innovative life sciences and biotech firms to record highs. Moreover, between December 2020 and March 2021, twelve sample SPACs announced their business combinations, triggering an incredible market reaction. However, after the boom upon the deal announcement, SPAC prices start to deflate. In fact, in the last three months of observation, the value of the healthcare SPAC portfolio dropped dramatically and closed below both benchmarks. To better assess the differences in the returns between the healthcare SPAC portfolio and the benchmarks, Table 2 reports more detailed return statistics.

In the last six months, the healthcare SPAC portfolio considerably underperformed both benchmarks, registering an extra return of –17.79% compared to small-cap firms and –25.17% against the US healthcare industry, together with higher daily volatility (2.04%). The wide fluctuations in the portfolio value are caused again by the wave business combination announcements that occurred in the first quarter of 2021, which created instability in the sample SPAC prices. Focusing on longer timeframes, the picture gets better for the healthcare SPAC portfolio. Indeed, over the last year, the portfolio delivered a 20.92% cumulative return, even if still lower than the one provided by the US healthcare industry (underper-

Source: Authors' elaboration.

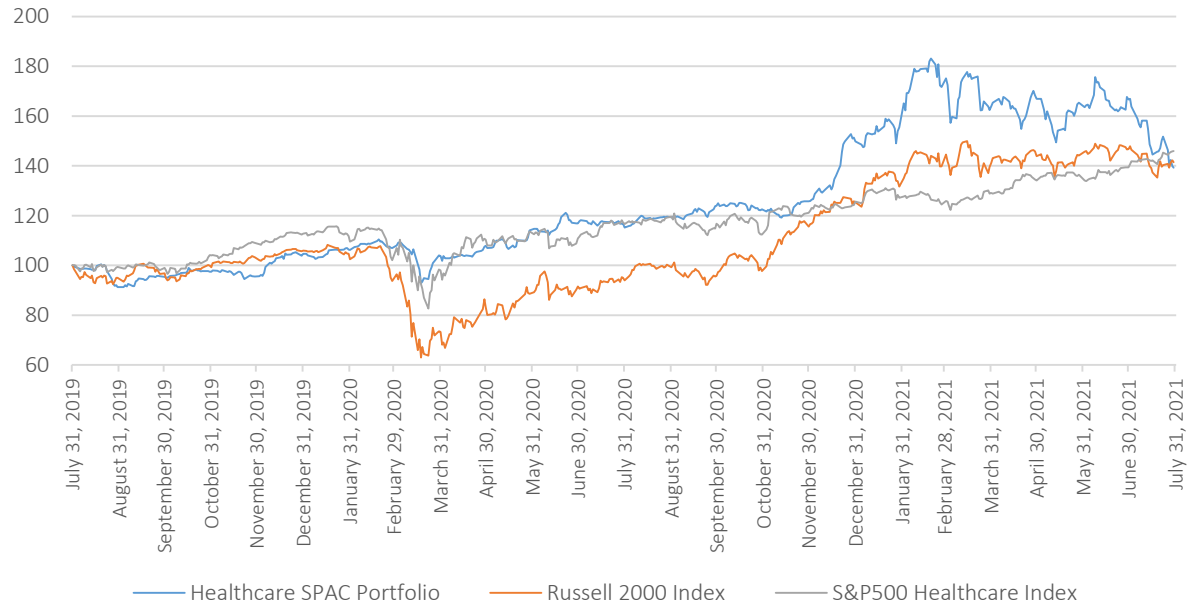

Figure 1. Healthcare SPAC portfolio performance versus benchmarks

http://dx.doi.org/10.21511/imfi.18(4).2021.14

Table 2. Healthcare SPAC portfolio returns versus benchmarks

Source: Authors' elaboration.

Time Horizon		Healthcare SPAC Portfolio	Russell 2000 Index	S&P 500 Healthcare Index
3 Months Statistics	3M-Cumulative Returns	–16.60%	–1.77%	8.89%
	3M-Extra Cumulative Return	/	–14.83%	–25.50%
	3M-Daily Volatility	1.79%	1.26%	0.64%
6 Months Statistics	6M-Cumulative Returns	–10.43%	7.36%	14.74%
	6M-Extra Cumulative Return	/	–17.79%	–25.17%
	6M-Daily Volatility	2.04%	1.46%	0.68%
1 Year Statistics	1Y-Cumulative Returns	20.92%	50.38%	25.23%
	1Y-Extra Cumulative Return	/	–29.46%	–4.32%
	1Y-Daily Volatility	1.63%	1.43%	0.88%
2 Years Statistics	2Y-Cumulative Returns	39.25%	41.38%	45.97%
	2Y-Extra Cumulative Return	/	–2.14%	–6.72%
	2Y-Daily Volatility	1.35%	2.10%	1.47%
2 Years Annualized Statistics	2Y-Annualized Return	18.00%	18.91%	20.82%
	2Y-Annual Volatility	21.35%	33.25%	23.32%
	2Y-Annual Sharpe Ratio	0.83	0.56	0.88

formance of 4.32%). The extra return over the Russell 2000 is meager (–29.46%). However, the comparison is biased because the small-cap index was still well below pre-pandemic levels one year ago and recovered thereafter. Over the two years' timeframe, the healthcare SPAC portfolio slightly underperformed the Russell 2000 index (extra return of –2.14%) and was also beat by the S&P 500 Healthcare index (extra return of –6.72%). However, the portfolio returns were more stable than the benchmarks' ones. Indeed, despite delivering similar returns over the two years, the prices of the healthcare SPACs included in the portfolio were less volatile than the ones of US small-cap firms. Looking at the two-year annualized figures, the healthcare SPAC portfolio offered a better risk-adjusted return than the Russell 2000 based on the Sharpe Ratio (0.83 versus 0.56). However, the S&P 500 healthcare index beats the portfolio also on this synthetic risk-adjusted-performance

Table 3. *T*-tests outcomes

Source: Authors' elaboration.

Panel A	Healthcare SPAC Portfolio	Russell 2000 Index
Observations	504	504
Mean	0.0007481	0.0009115
Std. Error	0.0006014	0.0009366
Std. Deviation	0.0135015	0.0210271
Skewness	–0.0467209	–1.0062142
Kurtosis	3.9692628	9.1010104
[95 % Conf.Interval]	–0.0004335	–0.0009287
	0.0019297	0.0027517
t = –0.1468		
Pr(|T|>|t|) = 0.8834		
Panel B	**Healthcare SPAC Portfolio**	**S&P 500 Healthcare Index**
Observations	504	504
Mean	0.0007481	0.0008596
Std. Error	0.0006014	0.0006570
Std. Deviation	0.0135015	0.0147499
Skewness	–0.0467209	–0.2065239
Kurtosis	3.9692628	10.3624129
[95 % Conf.Interval]	–0.0004335	–0.0004312
	0.0019297	0.0021504
t = –0.1251		
Pr(|T|>|t|) = 0.9004		

indicator (0.83 versus 0.88) because US healthcare companies were able to deliver higher returns with a similar level of volatility.

Finally, two *t*-tests were performed to determine whether the differences observed in the 2-year returns of the healthcare SPAC portfolio and the benchmarks are relevant or are only due to chance. Table 3 displays the outcomes of both *t*-tests.

The *p*-values of both tests are substantially higher than the 10% threshold, and the null hypotheses cannot be rejected. Therefore, it is possible to conclude that there is no statistical evidence that the returns of the healthcare SPAC portfolio differ from those of the benchmarks at any significance level.

3.2. Regression analysis

The multiple linear regression was performed through the Stata software. Table 4 reports the regression outputs and the significance of each variable. The low *p*-value for the *F*-test (0.0029) and a high Adjusted R-squared (0.5997) support the statistical significance of the model.

Before discussing the regression outputs, it is compulsory to note that a sample size of only 33 observations limits the power of the results obtained and the precision of the regression coefficient estimates. Nevertheless, the selected sample is still representative of the healthcare-focused SPACs' population that completed a business combination to date. There was no way to expand the sample because SPACs have gained popularity only recently, and there is a limited number of them to observe. However, in 2020 and 2021, a massive amount of SPACs went public, and they will complete a business combination in the next 12-24 months. Hence, the number of SPACs that successfully merged with a healthcare firm is doomed to increase significantly in the next few years.

Moving on to the discussion of the regression outputs, the first result yielded by the regression is the negative impact that the percentage of share redemptions (*Redemptions*) has on healthcare SPACs' market return with a significance of 1% (*p*-value = 0.000), consistently with previous literature. This result was expected since high levels of redemption communicate to the market that a large number of SPAC shareholders consider the target to be of poor qual-

Table 4. Multiple linear regression output

Source: Authors' elaboration.

Cumulative Stock Return	Coeffic.	Std Error	t	*P*> |*t*|	[95 % Conf.Interval]		Significance
IPO_Proc	–0.142	0.245	–0.580	0.569	–0.658	0.374	
Redemptions	–1.209	0.226	–5.340	0.000	–1.686	–0.731	***
PIPE_Proc	–0.091	0.078	–1.160	0.260	–0.256	0.074	
Deal_Value	–0.007	0.026	–0.270	0.788	–0.061	0.047	
N_of_Officers	0.030	0.038	0.790	0.442	–0.051	0.111	
Healthcare_Exp	0.279	0.299	0.930	0.363	–0.351	0.910	
Serial_Sponsor	–0.640	0.139	–4.600	0.000	–0.933	–0.346	***
Healthcare_Focus	–0.128	0.210	–0.610	0.551	–0.572	0.316	
Time_to_Acq	0.467	0.402	1.160	0.260	–0.380	1.315	
Cross_Border	–0.583	0.192	–3.030	0.007	–0.989	–0.178	***
PEVC_Exit	–0.247	0.126	–1.970	0.066	–0.512	0.018	*
N_of_Buy_Adv	0.180	0.079	2.280	0.036	0.013	0.346	**
Boutique_Buy_Adv	0.003	0.150	0.020	0.984	–0.313	0.319	
N_of_Sell_Adv	0.008	0.061	0.130	0.902	–0.121	0.136	
Boutique_Sell_Adv	–0.430	0.198	–2.170	0.045	–0.847	–0.012	**
_cons	–0.358	1.451	–0.250	0.808	–3.419	2.702	
Number of Observations	=	33					
F (15, 17)	=	4.20					
Probability > *F*	=	0.0029					
R-squared	=	0.7873					
Adjusted *R*-squared	=	0.5997					
Root MSE	=	0.2682					

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

http://dx.doi.org/10.21511/imfi.18(4).2021.14

ity. Moreover, redemptions increase the dilution of remaining SPAC and target shareholders due to the sponsor's promotion. Even if the result was expected, the coefficient is notably high (–1.209), underlining the intense negative impact of redemptions on stock returns. The value of this coefficient suggests that, on average, a 1% increase in the share redemption will generate a drop of 1.21% in the cumulative stock return.

An outcome that may seem counterintuitive is the negative effect that serial SPAC sponsors (*Serial_Sponsor*) have on stock returns with a 1% significance (p-value = 0.000). One can think that being backed by a serial sponsor may be beneficial because of the sponsor's experience in SPAC transactions that may lead to a smoother de-SPAC process and higher performance. While this is true to a certain extent, there are several possible explanations for the negative coefficient of the regression. The first is that serial sponsors, with their ability in negotiating SPAC mergers, favor SPAC shareholders over target shareholders. Therefore, the terms and conditions of the merger agreement could be unfavorable to the target, which may affect the merged entity's stock returns from the announcement to the post-merger. Moreover, if the serial sponsor has listed more than one SPAC in a short period, it will have to split among all the sponsored SPACs its time and efforts to search for an appealing target, conduct proper due diligence, and so on. This lower focus, especially in a complex and specialized industry as the healthcare one, may result in the selection of a poor quality target delivering weak market performance. Finally, even if the expertise and network of a serial sponsor may be pretty extended, they are still limited and perhaps not suitable for every target it is acquiring. Indeed, different targets require different expertise and diverse networks, particularly if they belong to different industries. Another interesting result is the negative impact of a cross-border deal (*Cross_Border*) on stock returns, which is significant at 1% (p-value = 0.007). This was fairly predictable because cross-border transactions have additional layers of complexity in terms of due diligence, regulation, and legal agreements. Furthermore, the disclosure of information and the delicate due diligence process, which are paramount to developing a fair valuation for an innovative healthcare company, can be more challenging for cross-border business combinations. Vulanovic (2016) found that targeting foreign companies hampers the likelihood of completing a business combination. Additionally, this study found that when a business combination is completed with foreign healthcare targets, the returns are lower than for SPACs acquiring domestic healthcare companies.

A SPAC deal as a PE or VC exit strategy (*PEVC_Exit*) seems to negatively affect stock returns at a 10% level of significance (p-value = 0.066), similarly to what has been found by Kim et al. (2021). A possible explanation can be that firms previously owned by PE or VC funds have already had the opportunity to work together with experienced professionals with an extended financial and industrial network and have already gone through rationalization processes to increase efficiency. Hence, the target will benefit less from collaborating with SPAC sponsors that have similar expertise and networks to PE or VC general partners.

Concerning the financial advisors to the M&A deal, the number of buy-side advisors (*N_of_Buy_Adv*) appears to be beneficial for the merged entity's market returns with a 5% significance (p-value = 0.036). This may hint that more financial advisors for the SPAC allow getting a better valuation for volatile innovative life science and biotech targets, resulting in solid post-merger market performance. Conversely, a high percentage of investment banking boutiques among the sell-side advisors (*Boutique_Sell_Adv*) may harm stock returns at a 5% level of significance (p-value = 0.045). This is quite a surprising result since boutiques tend to provide independent financial and strategic advice to their clients and do not put pressure on the target to close an unfavorable deal. Hence, it was expected to have a positive impact of this variable on market returns. A probable cause for this unanticipated outcome may be that the market still has some doubts concerning SPACs due to their association with the infamous blank-check companies of the 1980s. Hence, investors feel reassured only when a consistent number of established bulge bracket investment banking firms get involved in SPAC deals. Moreover, being SPACs a relatively new investment vehicle, it can be the case that among the boutiques offering advising services for SPAC transactions, there are still few elite boutiques able to deliver higher quality performances.

Finally, having a higher percentage of officers with healthcare expertise (*Healthcare_Exp*) seems to be

beneficial for stock returns even if it is not significant according to the regression model. In addition, being initially focused on healthcare (*Healthcare_Focus*) is not statistically significant, but the limited number of observations might have compromised the precision of the estimate.

CONCLUSION

The objective of the study was to analyze the market performance of SPACs that completed a business combination with healthcare companies to understand whether SPACs could represent a sustainable source of financing for innovative healthcare companies, or they are destined to disappear because they do not provide compelling returns to shareholders. In particular, this paper compared the returns of a portfolio of healthcare SPACs against small-cap firms and healthcare companies and investigated the factors affecting the market performance of healthcare-focused SPACs.

Overall, it has been found that healthcare SPACs deliver highly negative returns in the short term and substantially underperforms small-cap firms and healthcare companies. However, healthcare SPACs provide comparable returns to small-cap firms and healthcare companies over the long run and are also less volatile. The performed *t*-tests confirm that the difference in the returns of healthcare SPACs and both small-cap and healthcare companies is not statistically significant.

Interesting outcomes were also delivered by the regression analysis performed on the cumulative returns generated from the day before the business combination announcement to fifteen days after the merger completion. A high level of share redemptions has a significant and strong negative impact on the returns of the combined entity. Serial SPAC sponsors have also been found to be detrimental for healthcare SPAC returns, probably because of their lower focus due to the plurality of vehicles they manage. Additionally, the analysis has brought evidence that cross-border deals and the presence of PE or VC funds among the target's sellers negatively affect healthcare SPACs returns, which is in line with the findings of the previous literature on SPACs. As regards the financial advisors involved in the business combination transactions, a high number of buy-side advisors have been identified to be significantly beneficial for SPACs' returns in a positive way, while having a high percentage of boutique investment banking firms among the sell-side advisors appears to be unfavorable for healthcare SPAC market performance.

Given the valuable results yielded by the analysis, the study can be deemed satisfactory, as it expands the current knowledge on healthcare SPACs, their returns, and the determinants of the performances. However, the study also has some critical limitations. As already pointed out, the restricted sample size limits the potential of the results obtained, the precision of the regression coefficient estimates and does not allow to generalize the findings and make a robust inference.

Looking forward, the main limitation of this paper may be easily overcome since there are 87 healthcare-focused SPACs actively seeking a target to date, and they structurally have to complete a business combination in the next couple of years. Hence, the number of SPACs that successfully merged with a healthcare firm is doomed to increase significantly, providing a larger sample for future analysis. Thus, building on the helpful methodology and innovative approach outlined in this paper and on the significant results achieved, future research could be performed on larger samples while considering both shares, warrants, and rights to deliver a comprehensive analysis on healthcare SPACs total returns. Moreover, as time passes, more data points on earlier healthcare firms that merged with SPACs will become available, and it will be possible to examine this subsample from further angles and over longer timeframes.

http://dx.doi.org/10.21511/imfi.18(4).2021.14

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APPENDIX A

Table A1. Regressors' correlation matrix

Source: Authors' elaboration.

Regressors	IPO_Proc	Redemptions	PIPE_Proc	Deal_Value	N_of_Officers	Healthcare_Exp	Serial_Sponsor	Healthcare_Focus	Time_to_Acq	Cross_Border	PEVC_Exit	N_of_Buy_Adv	Boutique_Buy_Adv	N_of_Sell_Adv	Boutique_Sell_Adv
IPO_Proc	1														
Redemptions	−0.16	1													
PIPE_Proc	0.06	−0.29	1												
Deal_Value	0.09	−0.21	0.44	1											
N_of_Officers	0.01	−0.30	0.03	0.14	1										
Healthcare_Exp	−0.39	−0.18	0.11	−0.45	−0.13	1									
Serial_Sponsor	0.20	−0.27	0.21	0.16	0.24	0.01	1								
Healthcare_Focus	−0.27	−0.16	0.19	−0.46	−0.14	0.84	−0.09	1							
Time_to_Acq	−0.30	0.74	−0.42	−0.19	−0.20	−0.24	−0.15	−0.32	1						
Cross_Border	−0.17	−0.22	−0.15	−0.15	−0.06	0.32	−0.21	0.13	0.04	1					
PEVC_Exit	0.46	−0.29	0.09	0.11	0.07	−0.04	0.06	0.01	−0.45	0.13	1				
N_of_Buy_Adv	0.21	0.02	0.11	0.11	0.03	0.03	0.30	−0.10	0.04	−0.07	0.08	1			
Boutique_Buy_Adv	−0.39	0.25	−0.12	−0.06	−0.12	−0.13	−0.40	−0.02	0.25	−0.04	−0.17	−0.27	1		
N_of_Sell_Adv	0.13	−0.19	0.49	0.21	0.30	−0.13	0.10	−0.07	−0.13	−0.02	0.22	0.07	0.10	1	
Boutique_Sell_Adv	−0.57	−0.12	−0.03	0.05	−0.01	0.36	−0.03	0.14	0.15	0.29	−0.26	0.07	0.15	−0.08	1

Note: Table A1 displays the one-to-one correlations between the regression variables. All the one-to-one correlations are lower than 0.5 in absolute value, except for the correlation between the IPO gross proceeds (*IPO_Proc*) and the percentage of investment banking boutiques among the sell-side advisors (*Boutique_Sell_Adv*); the percentage of share redemptions (*Redemptions*) and the time to acquisition (*Time_to_Acq*); and the percentage of SPAC officers that have healthcare expertise (*Healthcare_Exp*) and the initial acquisition focus of the SPAC (*Healthcare_Focus*).

http://dx.doi.org/10.21511/imfi.18(4).2021.14

Table A2. Variance inflation factors to detect multicollinearity

Source: Authors' elaboration.

Variable	VIF	SQRT VIF	Tolerance	*R*-Squared
IPO_Proc	3.02	1.74	0.3311	0.6689
Redemptions	3.57	1.89	0.2805	0.7195
PIPE_Proc	2.77	1.66	0.3613	0.6387
Deal_Value	2.74	1.66	0.365	0.635
N_of_Officers	1.48	1.22	0.6774	0.3226
Healthcare_Exp	6.78	2.6	0.1474	0.8526
Serial_Sponsor	1.63	1.28	0.613	0.387
Healthcare_Focus	4.96	2.23	0.2018	0.7982
Time_to_Acq	4.98	2.23	0.2007	0.7993
Cross_Border	1.81	1.34	0.5534	0.4466
PEVC_Exit	1.77	1.33	0.5663	0.4337
N_of_Buy_Adv	1.35	1.16	0.7398	0.2602
Boutique_Buy_Adv	1.74	1.32	0.574	0.426
N_of_Sell_Adv	1.95	1.4	0.5133	0.4867
Boutique_Sell_Adv	2.11	1.45	0.4743	0.5257
Mean VIF	=	2.84		

Note: Table A2 reports the Variance Inflation Factors (VIF) for each regressor employed in the model. The VIF of a variable is the quotient between the variance of a model containing only that variable versus the variance of a model that includes all the variables and it is used to check for multicollinearity. The higher the VIF, the more correlated a regressor is with the other regressors. As a rule of thumb, a VIF is acceptable if it is lower than the maximum between 10 and $1/(1-R^2_{\mathrm{mod}\,el})$, which equals 4.70 for the regression model of this study. As can be noticed from Table A2, all the variables of the model have a VIF well below 10; thus, it is possible to conclude that the model has no multicollinearity.