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SPACs as lotteries: underperformance and the investor skewness preference

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ABSTRACT

Using IPOs as a benchmark, this paper examines the impact of the investor preference for skewness on the post-merger underperformance of SPACs, based on a comprehensive set of 166 merged SPACs and 1,462 IPOs between 2014 and 2021. This relative underperformance of SPACs vis-à-vis IPOs is referred to as the 'SPAC underperformance puzzle' and is surprising given their similar function in the going-public market. The puzzle is persistent across a wide array of measurements, adjustments, and time horizons. Whereas the existing literature ascribes this underperformance to differences in corporate governance structures and target heterogeneity, this paper proposes a behavioural explanation: the investor preference for skewness. In short, SPACs are found to be more positively skewed than IPOs which attracts skewness-preferring investors, resulting in overvaluation and lower subsequent returns. This skewness effect is stronger during periods of high retail sentiment and in the presence of a skewness-preferring clientele as proxied by the inverse of institutional ownership. Overall, the investor preference for skewness helps simultaneously explain the SPAC underperformance puzzle and the high retail demand for this underperforming asset class during the recent SPAC frenzy.

Keywords: Special Purpose Acquisition Company ('SPAC'), Initial Public Offering ('IPO'), Skewness preference, Lottery stocks, Post-merger performance

JEL classification: G12, G34, G41

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1. INTRODUCTION

In 2020 U.S. Special Purpose Acquisition Companies (SPACs) raised a combined $79.9 billion from a record 237 Initial Public Offerings (IPOs), more capital than in all is previous years combined (Sanghamitra, 2020). Nonetheless, there seems no halt to the ongoing SPAC frenzy, with the new record number already surpassed within the first quarter of 2021. Fuelled by soaring share prices of recent success stories such as Virgin Galactic, Nikola, and DraftKings, investor appetite for SPACs remains high. The raison d'être of a SPAC is to take a private firm public as an alternative to the traditional IPO route. Whereas an IPO can be simplified as a firm looking for money, a SPAC is the equivalent of money looking for a firm. The U.S. Securities and Exchange Commission (SEC) defines a SPAC as follows:

> *"A SPAC is a black-check company with no operations that offers securities for cash […] for the future use in an acquisition of a private operating company. Following its IPO, the SPAC will identify acquisition candidates and attempt to complete a business combination transaction after which the company will continue the operations of the acquired company as a public company."* (SEC, 2020)

However, investor seem to forget the flip side of these recent success stories amidst this SPAC bonanza. That is, firms that issue stock significantly underperform non-issuers ex-post. This phenomenon is referred to as the 'new issues puzzle' and is well-documented among IPOs (Ritter, 1991; Loughran and Ritter, 1995) and SPACs (Dimitrova, 2017; Kolb and Tykvová, 2016). However, the relative underperformance of SPACs vis-à-vis IPOs[1] is striking given their similar function in the going-public market (Kolb and Tykvová, 2016). This underperformance is persistent across specifications and time horizons, even after controlling for the size and book-to-market ratio effects. Henceforth, this phenomenon is referred to as the 'SPAC underperformance puzzle'.

Thus far, the literature has proposed several explanations for this puzzle ranging from share price dilution and misaligned sponsor incentives (Ganhg et al., 2021; Klausner et al., 2020;

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[1] Whereas SPAC targets become publicly traded upon the merger date, firms that follow the traditional IPO route becomes publicly traded on the IPO date. Hence, using the SPAC merger date and IPO date as the starting point allows for a fair comparison of SPAC and IPO returns.

Dimitrova, 2017) to target heterogeneity (Bai et al., 2021; Datar et al., 2012; Kolb and Tykvová, 2016). While the existing explanations are able to explain the existence of the mispricing, they are unable to explain why the mispricing is persistent. Without discrediting existing explanations[2], this paper proposes the investor preference for skewness as the behavioural mechanism behind the SPAC underperformance puzzle and its persistence.

Skewness measures the asymmetry surrounding the mean of a firm-specific return distribution. A positively (negatively) skewed return distribution realises frequent small losses (gains) and a few extreme gains (losses). Examples of positively skewed stocks are IPO stocks (Green and Hwang, 2012; Cho and Kim, 2019), penny stocks (Kumar, 2009), glamour stocks (Zhang, 2013), OTC stocks (Eraker and Ready, 2015), and stock options (Boyer and Vorkink, 2014). Following Cumulative Prospect Theory (CPT) by Tversky and Kahneman (1992), CPT investors overweight low probability events and prefer positively skewed stocks while avoiding negatively skewed stock. As a result, positively skewed stocks become overvalued and earn lower subsequent returns than negatively skewed stocks (Mitton and Vorkink, 2007; Kumar, 2009; Boyer et al., 2010, Bali et al., 2011, 2020; Barberis and Huang, 2008). Henceforth, this phenomenon is referred to as the investor preference for skewness. The mispricing is persistent due to investors' unwillingness to short stocks with a potentially extreme positive return (Barberis and Huang, 2008), pervasive short-sale constraints among positively-skewed stocks (Bris et al., 2007; Chang et al., 2007), and higher transactions costs that impedes arbitrage (Bergsma and Tayal, 2019).

When compared cross-sectionally, positively skewed stocks tend to be smaller, younger, and have lower book-to-market ratios than negatively skewed stocks (Jiang et al., 2019; Bali et al., 2011, 2020; Zhang, 2013). Similarly, the literature reports SPACs to be smaller, younger, and have lower book-to-market ratios than IPOs (Kolb and Tykvová, 2016; Datar et al., 2012; Bai et al. 2021). Given this parallel in cross-sectional differences, my conjecture is that SPACs are more positively skewed than IPOs which attracts skewness-preferring investors, resulting in overvaluation and lower subsequent returns. Taking the higher skewness of SPACs into consideration, one might wonder whether the investor preference for skewness causes the SPAC

[2] Obviously, the investor preference for skewness will not be the sole driver of SPAC underperformance vis-a-vis IPOs. Other factors are expected to contribute to this underperformance. In this study, I demonstrate that the investor preference for skewness is one of the economically important drivers behind the SPAC underperformance puzzle.

underperformance puzzle. This conjecture is synthesised in the following research question: "*What is the impact of the investor preference for skewness on the SPAC underperformance puzzle?*"

The SPAC underperformance puzzle is examined by comparing the Buy-and-Hold Abnormal Returns (BHARs) of 166 merged SPACs and 1,462 IPOs between 2014-2021. As expected, SPACs are found to underperform IPOs which confirms the puzzle's existence. The magnitude of the underperformance monotonically increases for extended holding periods and ranges from -10.8% for the one-month BHAR to -20.8% for the six-month BHAR. Using alternative Calendar-Time Abnormal Returns (CTARs), market or industry-adjusted returns, or a matched sample approach does not affect the size or significance of the puzzle.

This paper then examines the expected idiosyncratic skewness for both SPACs and IPOs. In line with expectations, SPACs are reported to exhibit 9.4% higher expected idiosyncratic skewness than IPOs after controlling for potential skewness proxies. Moreover, the individual return distributions of SPACs are found to be more positively skewed than IPOs. As a result, SPACs are more in demand among skewness-preferring investors, leading to overvaluation and lower subsequent returns. This conjecture is tested by sorting SPACs and IPOs into skewness terciles. Overall, firms in the high skewness tercile underperform firms in the low skewness tercile by -23.6% to -47.0%, depending on the holding period and issuing type. More specifically, a one-standard-deviation increase in idiosyncratic skewness decreases returns by -20.9% to -25.7% over holding periods up to six months. This evidence is consistent with the investor preference for skewness.

Given the lower expected returns of positively skewed stocks, the investor preference for skewness is likely driving the SPAC underperformance puzzle. This possibility is evaluated by examining the return differences between SPACs and IPOs within each skewness tercile. As expected, SPACs do no longer underperform their IPO counterparts within each skewness tercile. As a result, the SPAC underperformance puzzle disappears after controlling for the higher idiosyncratic skewness among SPACs. The results are robust across methodological approaches such as alternative calendar-time weighted portfolios, propensity scoring models and a regression approach. Hence, the difference in idiosyncratic skewness between SPACs and IPOs drives the SPAC underperformance puzzle which is consistent with the skewness preference explanation.

In the last part of this paper, the conjecture that the investor preference for skewness is the channel causing the SPAC underperformance puzzle is validated by examining the puzzle in two specific contexts: institutional ownership and retail sentiment. Both measures amplify the overvaluation of positively skewed stocks, albeit through different mechanisms. While higher retail demand increases the presence of the skewness preference, higher sentiment increases the strength of the preference.

When compared to institutional investors, retail investors are more susceptible to behavioural biases which translates into a preference for skewness (Kumar, 2009; Han and Kumar, 2013). This is commensurate with the higher retail demand for more positively skewed stocks as reported by Lin and Lui (2018). As a result, the SPAC underperformance puzzle should be stronger for stocks with higher retail ownership. Using institutional ownership as an inverse measure of retail investors, this study indeed finds the strongest SPAC underperformance of -17.8% when institutional ownership is low (i.e. high retail ownership). Moreover, the puzzle becomes insignificant for high institutional ownership, corresponding to lower mispricing in absence of a skewness-preferring clientele. This evidence based on institutional ownership is strongly consistent with the skewness preference explanation.

While institutional investors have stable risk preferences, retail investors have non-stationary risk preferences depending market on conditions (Malmendier and Nagel, 2011; Page et al., 2014). As a result, retail investors overweight small probabilities during high sentiment periods which increases their willingness to hold positively skewed stocks (Barberis and Huang, 2008; Green and Hwang, 2012; Blau, 2017). The SPAC underperformance puzzle should thus be the strongest during higher retail sentiment periods. In line with expectation, this study finds the strongest SPAC underperformance of -9.2% during high sentiment periods while becoming insignificant during low sentiment periods. This sentiment-based evidence based is strongly consistent with the skewness preference explanation.

Both retail sentiment and institutional ownership exacerbate the mispricing of positively skewed stocks, resulting in lower subsequent returns. Conversely, negatively skewed stocks remain unaffected by this skewness-related mispricing. Given this mispricing asymmetry between positively and negatively skewed stocks, institutional ownership is found to positively moderate the skewness-return relationship while retail sentiment negatively moderates the relationship. More specifically, for every one-standard-deviation increase in expected skewness, stocks in the low institutional ownership tercile (high retail sentiment tercile) underperform the other two terciles by an additional -3.3% (-6.5%). Hence, the investor preference for skewness is stronger during periods of high retail sentiment and in the presence of more skewness-preferring retail investors.

These findings contribute to several strands of literature. Firstly, this study sheds new light on the SPAC underperformance puzzle from a behavioural perspective. In so far, the limited literature has attempted to explain the puzzle through differences in target chracteristics (Howe and O'Brien, 2012; Dimitrova, 2017; Kolb and Tykvová, 2016; Datar et al., 2012) and corporate governance mechanisms (Gahng et al., 2021; Klausner et al., 2020). While these existing explanations are able to explain the existence of the mispricing, they are unable to explain why the mispricing is persistent. This study contributes to this strand by introducing the investor preference for skewness as a novel behavioural mechanism that links both the existence and the persistence of the SPAC underperformance puzzle.

Secondly, this paper contributes to the existing research on SPAC post-merger performance by introducing various measurements and adjustments. Prior SPAC research has mainly analysed buy-and-hold abnormal returns (Howe and O'Brien, 2012; Klausner et al., 2020; Dimitrova, 2017). However, this approach does not account for return autocorrelations (Fama, 1998; Mitchell and Stafford, 2000). Therefore, this study employs an additional six-factor regression model and a propensity scoring model to account for risk factor exposure, target heterogeneity, and return autocorrelations. Additionally, the sample period is extended and the number of observations is increased. While prior studies mainly focus on the period up till 2015, this study includes newer data from the period 2015-2021. Moreover, 166 merged SPACs and 1,462 IPOs are included whereas Kolb and Tykvová (2016), the study most closely related to this paper, includes only 127 SPACs and 1,128 IPOs.

Thirdly, this study extends the existing literature on the investor preference for skewness to a previously unexplored set of assets, namely SPACs. Prior studies have investigated the lottery-like characteristics of IPO stocks (Green and Hwang, 2012; Cho and Kim, 2019), penny stocks (Kumar, 2009), glamour stocks (Zhang, 2013), OTC stocks (Eraker and Ready, 2015), and stock options (Boyer and Vorkink, 2014). This paper identifies SPACs as another set of lottery-like stocks which earn more negative abnormal returns given their positive skewness (Mitton and Vorkink, 2007; Kumar, 2009; Boyer et al., 2010, Bali et al., 2011).

The remainder of this study is structured as follows. Section 2 reviews the relevant literature on the going public market and the investor skewness preference, after which the hypotheses and conceptual model are proposed. Section 3 describes the data sample, measurements and overall research methodology. Section 4 reports the results from the empirical analyses coupled with several robustness checks. Section 5 provides the conclusions and discusses the limitations and potential avenues for future research.

2. LITERATURE REVIEW

2.1 Dissecting the going-public market

The going-public market can be roughly segmented into SPACs and IPOs[3]. Whereas an IPO can be simplified as a firm looking for money, a SPAC is the equivalent of money looking for a firm. More specifically, a SPAC is a publicly-held investment vehicle created by a sponsor with the goal of acquiring an equity stake in a private firm within an 18 to 24-month timeframe. The sponsor raises this capital through an IPO and receives 20% of the post-IPO equity as compensation for finding a suitable target firm. Once a suitable target is identified, a mandatory shareholder vote is held which gives shareholders the option to vote in favour of the merger or redeem their shares. Gahng et al. (2021) found an average redemption of 68% of IPO proceeds over the period 2010-2018. If approved, the SPAC trades the cash raised from its IPO for a stake in the target firm and redistributes those shares among its investors who now own shares in the newly public firm. Upon the merger date, the SPAC changes its name and ticker to reflect the target firm which completes the SPAC process. Conversely, a traditional IPO can be thought of as a more direct way of raising capital without the need for a sponsor or shareholder vote. The firm cooperates with an underwriter who gauges investor interest for the firm's stock after which the IPO price is set and sold on a public exchange.

Taken together, both SPACs and IPOs offer a route to a public listing, albeit following different trajectories which tailor to different firms. Bai et al. (2021) develop a segmented model of the going-public market based on firm heterogeneity in terms of quality and riskiness. Firm quality is identified as either value-creating (i.e. good) or value-destroying (i.e. bad). In equilibrium, good firms are brought public while bad firms remain private. The riskiness of a firm depends on its probability of success and is identified as either safe or risky. Consequently, these

[3] Reverse mergers and direct listings are not taken into account due to their small share in the total going-public market.

different going-public firms cater to different investor preferences. Whereas safety-seeking investors prefer safe firms, yield-seeking investors prefer risky firms (Becker and Ivashina, 2014).

In the IPO market, the underwriter act as a certification intermediary and is liable for misstatements and omissions in projections and other forward-looking statements. Moreover, the underwriter's payoff depends on the IPO success which mitigates adverse selection (Chemmanur and Paeglis, 2005; Brau and Fawcett, 2006). As a result, safer firms enter the public market via an IPO while more risky firms are excluded (Bai et al., 2021). The SPAC market fills the market gap for more risky firms and caters to the needs of yield-seeking investors. Instead of the underwriter, the SPAC sponsor act as a certification intermediary in this market. SPACs enjoy a more lenient regulatory treatment than IPOs since they are regulated under merger rules rather than public offering rules (Klausner et al., 2020). This enables difficult-to-value private firms to enter the public market via a SPAC. Hence, SPACs form an alternative route to the public market for more risky firms that are excluded from the IPO market.

2.2 The costs of going public

Besides SPACs and IPOs catering to the needs of different firms and investors, both going-public vehicles differ in their cost structure. Overall, Gahng et al. (2021) find the median total costs as a percentage of IPO proceeds to be almost threefold for SPACs compared to the traditional IPO route at 14.1% and 4.8%, respectively. Whereas both going-public vehicles incur equal direct costs such as underwriter commissions, their indirect costs differ. IPOs incur structural underpricing costs while SPACs incur dilution costs.

The initial offer price of the IPO shares should closely reflect the intrinsic value of the firm to raise the maximum possible amount of equity (Jenkinson and Ljungqvist, 2001). However, the initial offer price is often set too low, resulting in underpricing or 'money left on the table'. This structural underpricing of IPOs is a well-known anomaly in the IPO literature and results in significantly higher returns on the first trading day (Beatty and Ritter 1986; Loughran and Ritter, 2004). This so-called IPO 'pop' has been 14.8% for the period 2001-2019 and is partially caused by the book-building setup of traditional IPOs (Ritter, 2021). This setup results in late offer price announcements which induce higher price uncertainty of the firm's intrinsic value, resulting in more severe underpricing (Ritter and Welch, 2002; Ljungqvist, 2007; Derrien, 2010). In contrast, SPACs offer a fixed minimum price upfront which reduces price uncertainty and underpricing.

While not incurring indirect costs related to underpricing, SPACs incur dilution costs that stem from two primary sources: promote shares held by sponsors and warrants held by shareholders. Firstly, promote shares are given to the SPAC sponsor as compensation for finding a suitable target to take public. Hence, the extend of dilution does not become effective until after the SPAC merger. This block of shares is commonly worth 20% of the post-IPO equity and hence only 80% of the existing shares are backed by cash. Lakicevic and Vulanovic (2013) underline this by observing that investors own 78.2% of SPAC equity but provide close to 97% of the cash. Klausner et al. (2020) report a net sponsor promote[4] of 7.7% as a percentage of post-merger equity.

Secondly, SPAC IPO investors receive a partial warrant for each share purchased (i.e. often ½ warrant). Simply put, if the shareholders decide to redeem their shares they are allowed to keep their warrants. These 'free' warrants are not backed by cash and dilute the share price by 4% as a percentage of post-merger equity (Klausner et al., 2020). In sum, the total indirect costs of SPACs amount to 11.7% which is roughly equal to the reported 14.1% as reported by Ganhg et al. (2021). When juxtaposed with the earlier noted 14.8% IPO pop, the direct and indirect costs of SPACs and IPOs are comparable in size.

2.3 The SPAC underperformance puzzle

Thus far, the literature agrees on SPACs and IPOs having the same function of bringing private firm and doing so at equal cost. Besides the structural underpricing of IPOs, the longer-term underperformance of IPOs is a well-documented phenomenon in the IPO literature underperformance (Ritter, 1991; Loughran and Ritter, 1995; Brav and Gompers, 1997). Moreover, this underperformance is documented outside the US in, for example, Latin America (Aggarwal et al., 1993), the United Kingdom (Levis, 1995) and Australia (Dimovski and Brook, 2004). However, SPACs suffer worse post-merger underperformance across different specifications and time horizons (Gahng et al., 2021; Klausner et al., 2020; Dimitrova, 2017; Kolb and Tykvová, 2016). This phenomenon of SPACs underperformance relative to IPOs is referred to as the SPAC underperformance puzzle.

[4] The net promote is used rather than the initial promote since sponsors are found to forfeit more than 30% of their compensation to other investors as inducements to complete the merger (Ganhg et al., 2021).

Howe and O'Brien (2012) document negative six-month median (mean) SPAC underperformance of -23.1% (-14.0%) across 87 SPACs that merged between 2003-2008. This negative median (mean) performance worsens to -43.4% (-32.5%) over twelve months and -64.2% (-53.8%) over 36 months. Klausner et al. (2020) compared 46 SPACs in the 2019-20 merger cohort and find a three-month median (mean) underperformance of SPACs compared to an IPO index of 32.8% (13.1%). This median (mean) underperformance worsen over longer horizons to 43.2% (33.0%) over six months and 56.5% (47.1%) over twelve months. Dimitrova (2017) examines 73 SPACs across 31 industries between 2004-2010 and reports median (mean) underperformance of SPACs vis-a-vis IPOs of 36.5% (23.8%) over twelve months post-merger which worsens to 64.7% (30.7%) over 24 months. Moreover, SPACs show comparable underperformance against industry- and size-matched firms as well as the Russel 2000. Similarly, Kolb and Tykvová (2016) examine 127 SPACs and 1,128 IPOs between 2003-2015 and find SPACs to underperform IPOs up to 60 months when matched on industry, firm size and book-to-market ratio. In sum, the SPAC underperformance puzzle is well documented across different horizons and specifications.

Hypothesis 1: SPACs underperform IPOs in the longer-term.

2.4 The investor preference for skewness

The traditional mean-variance framework by Markowitz (1952) is based on the expected utility theory as axiomatised by von Neumann and Morgenstern (1944). However, the growing field of behavioural finance has identified various flaws in this rational decision-making model. One such deviation from rational risk evaluation is the investor's preference for positively skewed assets. Skewness measures the asymmetry surrounding the mean of a return distribution and is not incorporated into the traditional mean-variance framework. A positively skewed return distribution realises frequent small losses and a few extreme gains. Examples of positively skewed stocks are IPO stocks (Green and Hwang, 2012; Cho and Kim, 2019), penny stocks (Kumar, 2009), glamour stocks (Zhang, 2013), OTC stocks (Eraker and Ready, 2015), and stock options (Boyer and Vorkink, 2014).

The context in which skewness is assessed matters. Kraus and Litzenberger (1976) and Harvey and Siddique (2000) argue that idiosyncratic skewness is irrelevant under the assumption of optimally diversified investors since diversification erodes skewness exposure. However, Simkowitz and Beedles (1978) and Conine and Tamarkin (1981) note that investors remain underdiversified when optimising under the three-moment framework of Kraus and Litzenberger (1976) as opposed to the traditional mean-variance framework. As a result, idiosyncratic skewness should be relevant in the presence of heterogeneous skewness preferences among investors.

Mitton and Vorkink (2007) provide theoretical evidence for this conjecture by developing a model of heterogeneous skewness preferences. Whereas traditional investors are mean-variance optimisers, skewness-preferring investors accept lower diversification (i.e. lower average returns) in exchange for higher skewness. Next to theoretical models, the heterogeneity of skewness preferences is well-documented in the empirical literature. When compared to the skewness aversion of institutional investors (Bali et al., 2020; Kumar, 2005; Alldredge, 2020), retail investors exhibit a preference for skewness (Kumar, 2009; Han and Kumar, 2013).

Replacing the traditional expected utility framework with non-standard preferences allows for a more accurate reflection of investors' risk attitude and yields new asset pricing implications. Following cumulative prospect theory (CPT) by Kahneman and Tversky (1992), CPT investors overweight low probability events that correspond to a positively-skewed payoff. Subsequently, CPT investors are willing to accept lower returns for stocks with higher idiosyncratic skewness. Barberis and Huang (2008) further extended this by developing a market model under CPT preferences. In this model, errors in the probability weighting cause investors to overvalue stocks with a small probability of a large positive return. On a market level, the skewness preference causes overvaluation and lower subsequent returns of positively skewed assets. Other theoretical papers explain the skewness preference by using more advanced utility functions (Brunnermeier and Parker, 2005; Brunnermeier et al., 2007; Barberis et al., 2020).

Next to theoretical models, the investor skewness preference is well-documented in the empirical literature across a various markets and timeframes (Boyer et al., 2010; Blau, 2018, Bali et al., 2011; Bali et al., 2020). Moreover, specific stock types have been examined for their positive skewness, such as IPO stocks (Green and Hwang, 2012; Cho and Kim, 2019), penny stocks (Kumar, 2009), glamour stocks (Zhang, 2013), OTC stocks (Eraker and Ready, 2015), and stock options (Boyer and Vorkink, 2014). In sum, the literature concurs on idiosyncratic skewness being priced in the market and forming a component of returns, albeit from different sets of assumptions. Hence, positively skewed stocks generate lower returns in the cross-section.

Hypothesis 2: Idiosyncratic skewness reduces longer-term returns.

While the investor preference for skewness is able to explain the existence of the mispricing, it also explains the persistence of the mispricing via limits to arbitrage. Firstly, many investors are unable or unwilling to exploiting an arbitrage opportunity that requires shorting positively skewed stock with a low probability of an extreme positive return (Barberis and Huang, 2008). Secondly, short-sale constraints tend to be more pronounced among positively-skewed stocks (Bris et al., 2007; Chang et al., 2007; Blau and Whitby, 2018). Thirdly, positively-skewed stocks tend to be smaller and more illiquid which raises transactions costs and impedes arbitrage (Bergsma and Tayal, 2019). In sum, the arbitrage risk increase for more positively skewed stocks which explains the persistence of the mispricing.

2.5 Skewness implications for SPACs and IPOs

IPOs have been extensively researched for their lottery-like characteristics. Green and Hwang (2012) examine 7,975 US IPOs over the 1975–2008 period and find lower returns of more positively skewed IPOs up to five years post-IPO. Cho and Kim (2019) provide additional empirical support for the lower returns of positively skewed stocks in an international setting by utilising a dataset of 17,051 IPOs from 23 countries over the 1990-2013 period. Moreover, Tang et al. (2018) examine 874 Chinese IPOs between 2009-2012 and report positively skewed IPOs underperforming less skewed IPOs over longer horizons ranging from six months up to five years. However, it remains an open-ended question whether the skewness preference is present in the context of SPACs.

When compared cross-sectionally, positively skewed stocks tend to be smaller, younger, and have lower book-to-market ratios than negatively skewed stocks (Jiang et al., 2019; Bali et al., 2011, 2020; Zhang, 2013). Similarly, the literature reports SPACs to be smaller, younger, and have lower book-to-market ratios than IPOs (Kolb and Tykvová, 2016; Datar et al., 2012; Bai et al. 2021). Given this parallel in cross-sectional differences, SPACs have increased exposure to various cross-sectional determinants of skewness relative to IPOs. Hence, SPACs are hypothesised to be more positively skewed than IPOs which attracts skewness-preferring investors. Recall that the skewness preference causes overvaluation and lower subsequent returns of positively skewed assets (Barberis and Huang, 2008). Conditional on SPACs being more positively skewed than IPOs, the SPAC underperformance puzzle should disappear when adjusted for differences in skewness. Put differently, SPACs are hypothesised to no longer underperform IPOs when adjusted for skewness.

Hypothesis 3: SPACs have higher idiosyncratic skewness than IPOs.

Hypothesis 4: SPACs do not underperform IPOs when adjusted for idiosyncratic skewness.

When compared to the skewness aversion of institutional investors (Bali et al., 2020; Kumar, 2005; Alldredge, 2020), retail investors exhibit a preference for skewness (Kumar, 2009; Han and Kumar, 2013). Retail demand should thus be higher among more positively skewed stocks, which amplifies the skewness-related mispricing. Put differently, a higher concentration of skewness-preferring retail investors exacerbates the mispricing of positively skewed stocks, resulting in lower subsequent returns. This interest from retail investors is proxied by the inverse of institutional ownership. Conversely, negatively skewed stocks remain unaffected by this skewness-related mispricing. Given this mispricing asymmetry, institutional ownership should positively moderate the skewness-return relationship.

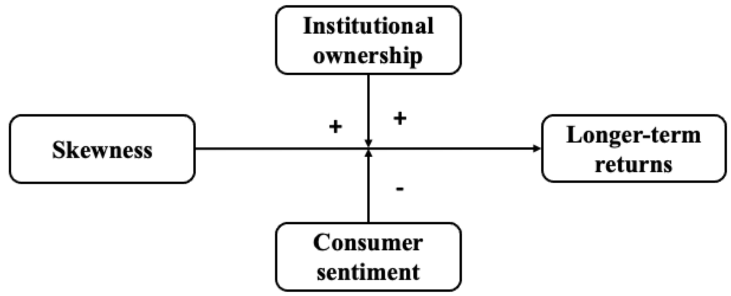
Hypothesis 5: Institutional ownership positively moderates the skewness-return relationship.

Ritter (1991) and Ritter and Welch (2002) suggest that retail sentiment may explain the underperformance of IPOs. Moreover, theoretical work on IPO underperformance due to over-optimistic investors by Derrien (2005) and Ljungqvist et al. (2006) has been substantiated with vast empirical support (Gao et al., 2016; Dorn, 2009; Cornelli et al., 2006; Kumar and Lee, 2006). Barber and Odean (2008) find institutional investors to exhibit stable risk preferences. Conversely, the risk preferences of retail investors vary with market conditions (Malmendier and Nagel, 2011; Page et al., 2014). More specifically, the skewness preference is amplified during high sentiment periods, which exacerbates the skewness-related mispricing of positively skewed stocks and lowers subsequent return (Green and Hwang, 2012; Blau, 2017). Conversely, negatively skewed stocks remain unaffected by this skewness-related mispricing. Given this mispricing asymmetry between positively and negatively skewed stocks, retail sentiment should negatively moderate the skewness-return relationship.

Hypothesis 6: Retail sentiment negatively moderates the skewness-return relationship.

After evaluating the relevant literature, four main hypotheses are proposed to examine the underperformance of SPACs vis-à-vis IPOs. Moreover, two additional hypotheses are proposed to examine the moderating effects of institutional ownership and retail sentiment on the skewness-performance relationship. These hypotheses are summarised below in *Figure 1.*

Figure 1: Conceptual model of the moderated skewness-performance relationship



3. DATA AND METHODOLOGY

3.1 Sample selection and data sources

The sample of this study consists of 166 merged SPACs and 1462 IPOs that traded on the NYSE or NASDAQ from January 2014 through May 2021. The *ThomsonOne (T1)* new issues database is used to extract the IPO and SPAC names, industry, IPO dates, and announcement dates. IPOs are required to be larger than $5 million and listed on the Field-Ritter dataset of IPO founding dates[5]. Moreover, closed-end funds and REITs are excluded. To ensure that only SPACs are included that have completed a merger, only the target firm must be publicly traded. The SEC *EDGAR* database is used to collect 13F (institutional ownership) filings to assess institutional ownership. Moreover, retail sentiment data is obtained from the *Federal Reserve Bank of St. Louis* and the *American Association of Individual Investors*. Financial statements and stock price data are obtained from the *Compustat* and *CRSP databases*, respectively. Regarding stock price data, only ordinary common shares (CRSP share code 10 or 11) and NYSE and NASDAQ stocks (CRSP exchange codes 11 or 14) are considered to ensure comparability. Moreover, returns are adjusted for dividends and stock splits.

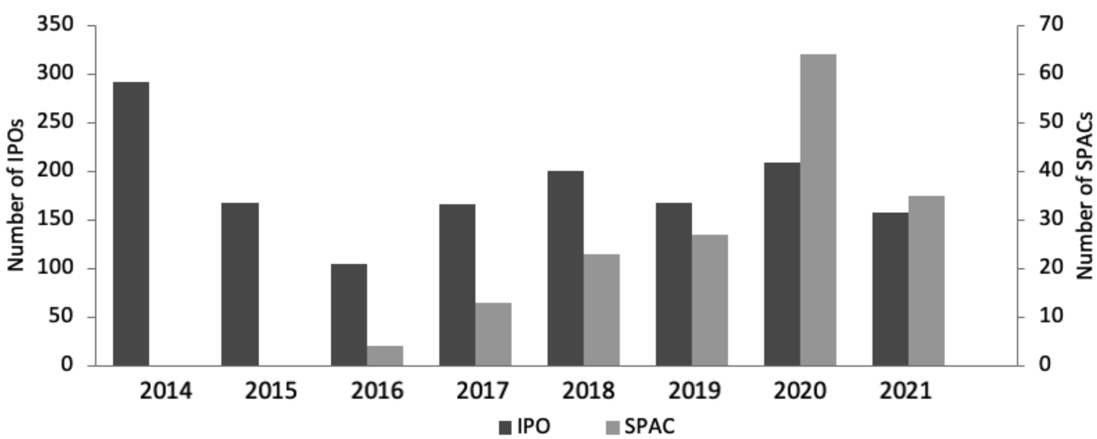
Figure 2 displays the number of completed SPACs and IPOs from 2014-2021 and underlines the recent trend of going public via a SPAC, with almost 40% of the SPAC sample merging within 2020 alone. In line with Helwege and Liang (2004), SPACs and IPOs are subject to time-varying clustering. While many more SPACs launched in 2020, only the number of completed SPAC matters since this study assesses post-merger SPAC returns instead of pre-

[5] See https://site.warrington.ufl.edu/ritter/files/founding-dates.pdf

merger returns. *Table 1* reports the distribution of SPACs and IPOs across the Fama-French 17 (FF17) industry classification as derived from their individual SIC codes. The table shows that the "Other" industry forms more than one-third of the total sample. However, the FF30 industry classification results in too many categories with only a few observations. This troubles the computation of *Expected skewness* since this measure is industry-based. Hence, the FF17 industry classification is chosen over the FF30 industry classification.

The SPACs and IPOs are also assigned to the low, medium or high expected skewness portfolio using the 33rd and 66th percentiles as breakpoints. *Table 1* reports the combined fractions of SPACs and IPOs per expected skewness portfolio for each industry. Whereas the FF17 industries differ in their distribution across the three expected skewness portfolios, all but one industry (i.e. Food) have at least 25% of SPACs and IPOs in their low skewness portfolio and 25% in their high skewness portfolio. Hence, the sample is balanced which is distorted by operationalising the FF30 industry classification.

Figure 2: Number of completed SPACs and IPOs from 2014-2021



Note: The number of completed SPACs is given rather the number of launched SPACs since this study looks at the post-merger performance as opposed to the pre-merger performance.

3.2 Measures

3.2.1 Return measure

Both an event-time and a calendar-time methodology are used to account for potential variation in the statistical power across methodologies (Brav and Gompers, 1997; Barber and Lyon, 1997). The event-time analysis formalises Buy-and-Hold Abnormal Returns (BHARs) as in Kothari and Warner (1997). Alternatively, the calendar-time portfolio measures Calendar-Time Abnormal

Table 1: Industry distribution of SPACs and IPOs from 2014-2021

FF17 industry	N	Percent	Expected skewness (%) Low	Medium	High
Food	26	1.73	69.23	11.54	19.23
Mining and Minerals	12	0.77	50.00	0.00	50.00
Oil and Petroleum Products	39	2.50	35.90	23.08	41.03
Textiles, Apparel & Footwear	3	0.26	33.33	33.33	33.33
Consumer Durables	20	1.28	40.00	20.00	40.00
Chemicals	16	1.03	25.00	37.50	37.50
Drugs, Soap, Parfums, Tobacco	334	21.81	25.00	37.50	37.50
Construction and Materials	26	1.67	40.12	30.24	29.64
Steel Works Etc	2	0.13	50.00	0.00	50.00
Fabricated Products	4	0.26	25.00	25.00	50.00
Machinery and Business Equip.	72	4.68	30.56	41.67	27.78
Automobiles	19	1.35	47.37	5.26	47.37
Transportation	33	2.12	30.30	27.27	42.42
Utilities	27	1.73	40.74	18.52	40.74
Retail Stores	67	4.49	28.36	22.39	49.25
Banks, Insurance Companies	202	13.15	37.13	28.22	34.65
Other	627	41.05	27.11	41.15	31.74
Total	*1529*	*100.00*	*510*	*511*	*508*

Note: SPACs and IPOs are classified according to the Fama-French 17 industry classification using their respective SIC codes. Subsequently, SPACs and IPO are assigned to the low, medium or high expected skewness portfolio using the 33rd and 66th percentiles as breakpoints. The combined fractions of SPACs and IPOs per expected skewness portfolio are shown for each industry.

Returns (CTARs) via a six-factor regression model (Fama, 1998; Mitchell and Stafford, 2000). An additional propensity scoring model is operationalised which matches SPACs and IPOs with similar size, book-to-market, and age.

Event-time approach: Buy-and-Hold Abnormal Returns

Buy-and-hold abnormal returns closely mimic the investor's experience and assume no rebalancing, hereby improving the implementation of this methodology (Lyon et al., 1999). The BHARs form the returns of an investor who purchases common stock in an IPO or SPAC at the end of the first trading day[6] (counted from the merger day for SPACs) and holds this stock for one, three, six, and twelve months, respectively. Subsequently, these returns are adjusted for (i) market returns or (ii) industry returns. If no return data exists for the complete holding periods, the available return data is used to eliminate potential survivorship bias. Additionally, BHARs are

[6] The first trading day is excluded in line with the existing literature (Loughran and Ritter, 1995; Brav and Gompers, 1997). Excluding the first trading day equals the playing field with regards to unincluded indirect costs such as IPO underpricing and SPAC dilution. Moreover, institutional investors receive the lion's share of the (SPAC) IPO allotment which troubles the implementation of a portfolio strategy which start at the first trading day.

computed for a matched sample of IPOs and SPACs based on size, age, and book-to-market ratio using a propensity score matching model as in Kolb and Tykvova (2016). This approach helps to adjust for different firm characteristics between SPACs and IPOs. The BHAR of firm *i* over holding period *T* is measured as follows:

$$BHAR_i = \prod_{t=1}^{T}(1 + R_{i,t}) - \prod_{t=1}^{T}(1 + R_{a,t}) \quad (1)$$

where T denotes the holding period in months or delisting date, whichever comes sooner, $R_{i,t}$ denotes the excess log return of SPAC or IPO *i* at time *t*, and $R_{i,t}$ represents the excess log return of benchmark a, at time *t* based the either of the two adjustments.

Calendar-time approach: Calendar-Time Abnormal Returns

The calendar-time approach accounts for the return autocorrelations unlike the event-time approach (Fama, 1998; Mitchell and Stafford, 2000). However, the calendar-time approach averages between periods of heavy event activity versus periods of light event activity (Dutta, 2015). This could be problematic given the time-varying clustering of SPACs as IPOs as visualized in *Figure 2* (Helwege and Liang, 2004). Monthly values for the Fama-French five factors (Fama and French, 2015) are retrieved from the Kenneth French data library and supplemented with the momentum factor (Carhart, 1997). Monthly calendar-time portfolios are formed which add all SPACs that merged in the month before the portfolio formation and drop all SPACs after a holding period of one, three, six, or twelve months. The number of firms in the sample is non-constant over time since the number of IPOs and SPAC mergers are not uniformly distributed over the sample period. The formed portfolios are monthly rebalanced and the equal-weighted portfolio log returns are computed. This process is repeated for IPOs. Thereafter, the monthly log returns of portfolio *i* are regressed on the six risk factors as follows:

$$R_{i,t} = \alpha_i + \beta_i R_{m,t} + \gamma_i SMB_t + \delta_i HML_t + \phi_i RMW_t + \psi_i CMA_t + \zeta_i MOM_t + \varepsilon_{i,t} \quad (2)$$

where $R_{i,t}$ denotes the monthly log return of portfolio i at month *t*, α denotes the regression intercept and forms the monthly log excess return of portfolio i at month *t*, $\{ \beta_i R_{m,t} + \gamma_i SMB_t + \delta_i HML_t + \phi_i RMW_t + \psi_i CMA_t + \zeta_i MOM_t \}$ represent the Fama-French market, size, book-to-market, profitability, investment factors and the Carhart momentum factor, $\varepsilon_{i,d}$ denotes the regression residual of portfolio *i* in month *t*. Additionally, CTARs are computed for a matched sample of IPOs and SPACs based on size, age, and book-to-market.

3.2.2 Expected skewness measure

Investors should only care about the expected skewness of the stock at the moment of purchase (i.e. first trading day for IPOs and merger day for SPACs). Ex-ante skewness is often used to proxy a stock's expected skewness. However, ex-ante skewness is by definition retrospective while expected skewness is forward-looking. More fundamentally, capturing ex-ante skewness requires a long return history which is by definition unavailable on the first trading day.

Zhang (2006) and Green and Hwang (2012) overcome this limitation by utilising recent returns from industry peers to measure *Expected skewness* at the first trading day. This industry sorting leverages the fact that firms within an industry share similar firm characteristics and are subject to the same technological and regulatory shocks. Hence, SPACs or IPOs from industries with high expected skewness are likely to have positively skewed returns. Additionally, this group approach better captures tail events by considering a larger stock universe and focusing on the tail of the distribution rather than the whole. Hence, this measure more accurately represents the skewness preference since investors use tail events to judge how 'lottery-like' a stock is. The *Expected skewness* of firm *i* at time *t* is measured as follows:

$$es_{i,t} = \frac{(P_{99} - P_{50}) - (P_{50} - P_1)}{(P_{99} - P_1)} \tag{3}$$

where P_j is the j^{th} percentile of the log monthly return distribution pooled across all stocks within the FF17 industry of firm *i* over three months preceding the month of the offering. Consequently, a positive expected skewness indicates a rightly skewed return distribution. The denominator controls for the dispersion of the distribution which is linked to the valuation uncertainty (Lowry et al., 2010). The firms are classified according to the Fama-French 17 industry classification. A finer industry partition increases intra-industry similarity but reduces the number of observations and hence the likelihood of capturing small probability events.

<u>*Measurement validation*</u>

The validity of the expected skewness measure is assessed by benchmarking it against a different measure of expected skewness as operationalised by Boyer et al. (2010). The validation follows a two-stage process. First, the *Idiosyncratic skewness* is computed as:

$$is_{i,t} = \frac{1}{N(t)-2} \frac{\sum_{d \in S(t)} \varepsilon_{i,d}^3}{iv_{i,t}^3} \tag{4}$$

$$iv_{i,t} = \left(\frac{1}{N(t)-1} \sum_{d \in S(t)} \varepsilon_{i,d}^2 \right)^{\frac{1}{2}} \tag{5}$$

where $iv_{i,t}$ denotes the idiosyncratic volatility of stock *i* at time *t*, and $is_{i,t}$ represents the idiosyncratic skewness of stock *i* at time *t*. Let *S(t)* denote the set of trading days from the first day of month *t* through the end of months 1, 3, 6, or 12, let *N(t)* denote the number of days in this set, let $\varepsilon_{i,d}$ denote the residual of firm *i* on day *d* from regressing daily excess returns on the daily Fama and French (1993) three factors over *S(t)*. The square of the market return is added to this regression as in Kraus and Litzenberger (1976) to control for return co-skewness. Subsequently, $\varepsilon_{i,d}$ is computed via the following regression:

$$R_{i,d} - R_{f,d} = \alpha_i + \beta_i (R_{m,d} - R_{f,d}) + \gamma_i SMB_d + \delta_i HML_d + \phi_i (R_{m,d} - \bar{R}_m)^2 + \varepsilon_{i,d} \tag{6}$$

where $R_{i,d} - R_{f,d}$ denotes the excess return of stock i on day d, $\{ \beta_i (R_{m,d} - R_{f,d}),\ \gamma_i SMB_d\ , \delta_i HML_d \}$ represent the Fama French market, size and book-to-market factors, on day d, $\phi_i (R_{m,d} - \bar{R}_m)^2$ denotes the co-skewness with $R_{m,d}$ being the market return on day *d* and $\bar{R}_m$ being the average market return of the full period, $\varepsilon_{i,d}$ denotes the residual of firm *i* on day *d*.

The second stage regresses the *Expected skewness* measure of Green and Hwang (2012) at *t-1* on the *Idiosyncratic skewness* at *t=0*. Thus, the expected skewness measure is analogous to using the fitted values from the predictive regression:

$$is_{i,t} = \alpha_i + \beta_i\ es_{i,t-1} + \lambda_t X_{i,t} + \ \varepsilon_{i,t} \tag{7}$$

where $is_{i,t}$ denotes the idiosyncratic skewness measure of Boyer et al. (2010) at time *t*, $\beta_i\ es_{i,t-1}$ denotes the expected skewness as in Green and Hwang (2012) at *t-1*, and $\lambda_t X_{i,t}$ denotes a vector of additional firm- and deal-specific variables to eliminate unobserved heterogeneity as further elaborated on in *Section 3.2.4*. Subsequently, the significance level of $\beta_i\ es_{i,t-1}$ points out whether the *Expected skewness* estimator at *t-1* is helpful in predicting the *Idiosyncratic skewness* at *t=0*.

Appendix A: Table 10 reports the regression results across one-, three-, six- and twelve-month holding periods. The *Expected skewness* coefficient at *t-1* is significant at the 1% level for the one-, three-, and six-month holding periods and hence accurately predict the *Idiosyncratic skewness* at *t=0*. However, *Expected skewness* is unable to reliably predict *Idiosyncratic skewness* for the twelve-month holding period, even at the 10% significance level. Accordingly, Singleton and Wingender (1986) report an insignificant relationship between current and future skewness. This means that positively-skewed assets are not likely to exhibit positive skewness in the next period and vice versa. Hence, skewness does not persist in the long-term and is sensitive to sample sizes and time periods (Fogler and Radcliffe, 1974; Adcock and Shutes, 2005).

Cross-sectional versus time-series validation

Harvey and Siddique (2000) note that skewness is non-stationary over time which troubles comparability. Hence, both the *Expected idiosyncratic skewness* and *Market expected skewness* are considered to account for cross-sectional and time-series variation in expected skewness. *Figure 3* displays the time-series dispersion between expected skewness terciles and reveals a particular large dispersion during 2019 and 2020. Since this study is interested in the cross-section of returns, *Expected skewness* should not solely be driven by this time-series variation. In other words, cross-sectional variation should remain significant when accounting for time-series variation. The *Market skewness* is computed to disentangle both sources of variation:

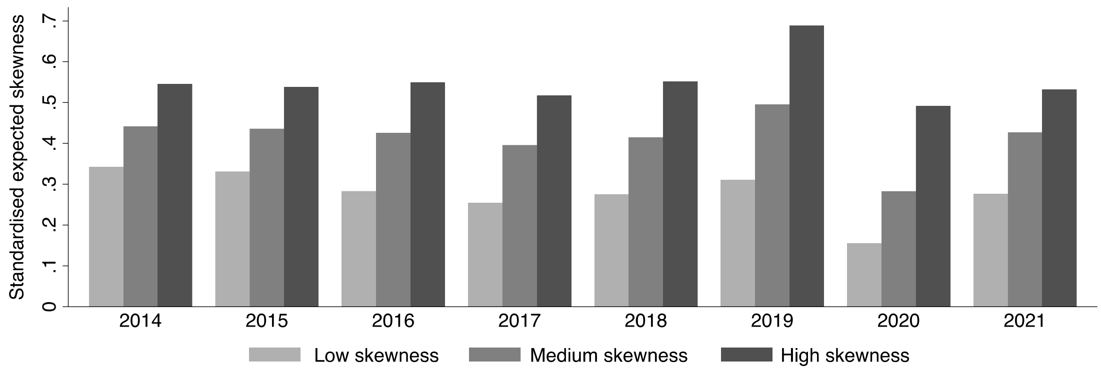
$$ms_t = \frac{(P_{99} - P_{50}) - (P_{50} - P_1)}{(P_{99} - P_1)} \quad (8)$$

where ms_t denotes the *Market skewness* of at time *t*, and P_j is the j^{th} percentile of the log monthly return distribution across all stocks over three months preceding the month of the offering.

Three double-sorted equally-weighted portfolios are formed based on *Expected skewness* and *Market skewness* to explore the marginal effects. *Table 2* reports the one-month BHARs for these double-sorted portfolios. Within each *Market skewness* tercile, returns decrease from low to high *Expected skewness*. For example, the low *Expected skewness* tercile outperforms the high tercile by 26.0% (t=3.62; p<0.01) in the lowest *Market skewness* tercile. This outperformance increases to 27.7% for the second tercile (t=6.71; p<0.01) and to 30.7% for the third tercile (t=5.93; p<0.01). Similarly, the low *Market skewness* portfolio outperforms the high *Market skewness* portfolio on average by 22.1% (t=3.62; p<0.01) for the lowest *Expected skewness* tercile and slightly increases for the second and third tercile.

Taken together, the one-month BHARs are impacted by cross-sectional variation in *Expected skewness* as well as time-series variation in *Market skewness*. Hence, cross-sectional variation in *Expected skewness* remains significant across *Market skewness* terciles. *Expected skewness* thus accurately captures the cross-section of returns. The results remain similar for the three- and six-month BHARs, while twelve-month BHARs are not significant.

Figure 3: Time-series dispersion of skewness portfolios



Note: The low, medium, and high skewness portfolios are sorted by year to reveal the time-series dispersion of the skewness portfolios. The expected skewness is standardised between zero and one to enhance visibility.

Table 2: Cross-sectional versus time-series variation in expected skewness

	Expected skewness			
Market skewness	Low	Medium	High	Δ Low - high
Low	0.269	0.080	0.009	0.260*** (3.623)
Medium	0.165	-0.086	-0.112	0.277*** (6.711)
High	0.048	-0.156	-0.259	0.307*** (5.932)
Δ Low - high	0.221*** (3.623)	0.236*** (3.992)	0.248*** (4.066)	

*Note: Three double-sorted equally-weighted portfolios are formed based on expected skewness and market skewness. SPACs and IPOs are assigned to low, medium, or high portfolio using the 33rd and 66th percentiles of expected skewness and market skewness as breakpoints. The differences between the highest and lowest terciles are reported with t-statistics in parentheses. Significance levels: *** 0.01, ** 0.05, * 0.10.*

3.2.3 Moderator measures

Institutional ownership is measured via 13F filings from the Edgar SEC system and expressed as the percentage of total shares held by institutional investors. These filings require institutional investors that hold more than $100 million in assets to disclose their holdings. The first 13F filing after the IPO or SPAC merger is used and is unaffected by the expiration of lock-up periods, ranging between 180 to 360 days for SPACs and IPOs.

Monthly data on the University of Michigan Consumer Sentiment Index (*UMCSENT*) from the Federal Reserve Bank of St. Louis is used to proxy retail sentiment at the IPO or merger date. This index is normalised to have a value of 100 in December 1966. Overall, values below (above) the 33rd (66th) percentile are identified as low (high) retail sentiment periods.

3.2.4 Control variables

Market and industry characteristics

Ritter (1984) and Beatty and Ritter (1986) find ex-ante uncertainty to influence IPO returns. Hence, multiple proxies for ex-ante uncertainty are included such as *Market/Industry return, Market/Industry volatility, Market/Industry momentum* and *Market sentiment*. Whereas the market measures are calculated for all stocks listed on the NYSE and NASDAQ, the industry measures are computed for the same stock set but split according to FF17 industry classification. *Market/Industry return* is computed as the average daily return over the month preceding going public. Additionally, the *Russel2000* is included as an alternative return index.

To account for *Market/Industry volatility*, the lagged one-month standard deviation of daily returns at the IPO or merger date is included. Moreover, the *Market/Industry momentum* is computed as the cumulative industry return from month *t-8* to *t-2*, with *t* being the IPO or merger date (Cho and Kim, 2019). *Market sentiment* proxies for underperformance with firms going public during hot issue periods underperforming firms that go public in cold periods (Helwege and Liang, 2004). The measure is based on the number of IPOs per quarter and defines the top two quartiles as a hot issue period (1) and the bottom two quartiles as cold issue period (0). Lastly, two sets of year and industry dummies are included to control for unobserved year or industry fixed effects.

Firm characteristics

Various characteristics are found to measure ex-ante uncertainty on the firm level. Log (*Age*) represents the natural lorgarithm number of years since incorporation until the IPO or merger date and proxies for uncertainty (Field and Karpoff, 2002; Loughran and Ritter, 2004; Megginson and Weiss, 1991; Llungqvist and Wilhelm, 2003). Moreover, the returns of young firms tend to be more positively skewed than the returns of older firms (Green and Hwang, 2012Log (*Size*) is included to account for smaller firms that are found to underperform (Ritter, 1991; Loughran and Ritter, 1995; Ibbotson et al., 1994). Log(*Size*) is computed as the natural logarithm of the number of outstanding shares multiplied by the closing price on the first trading day after the IPO or merger. *Book-to-market* is included to adjust for the higher book-to-market ratio of positively skewed stocks (Jiang et al., 2019; Bali et al., 2011). Book-to-market is measured by dividing the quarter-end book equity after the IPO or SPAC merger on the month-end market capitalisation. Furthermore, *SPAC* is included as a dummy variable which is equal to one if the firms went public via a SPAC and zero via an IPO. Lastly, an *Exchange* dummy variable is added which is equal to one for stocks on the NASDAQ and equal to zero for stocks on the NYSE.

Deal characteristics

Underwriter reputation reduces ex-ante uncertainty and is therefore included (Carter and Manaster, 1990; Loughran and Ritter, 2004). The Carter-Manaster rankings are adopted from Jay Ritters data library and adapted as in Loughran and Ritter (2004). Hence, each underwriter is ranked from zero (least prestigious) to nine (most prestigious). Only the lead underwriter is considered in the case of multiple underwriters. Second, Kolb and Tykvová (2016) find that VCs prefer IPOs over SPACs as judged by their higher stake in the former. To account for *VC involvement*, a dummy is included which is equal to one if the firm is backed by venture capital and zero otherwise. Lastly, the natural logarithm of *Proceeds* is added to account for the IPO size.

3.3 Research method

This paper's hypotheses are tested through a portfolio and regression approach. The portfolio approach assigns SPACs and IPOs separately into three equally-weighted portfolios using the 33rd and 66th percentiles of *Expected idiosyncratic skewness* as breakpoints. These portfolios are then held for one, three, six, or twelve months after which the return differences across the terciles are assessed. Additionally, separate yearly portfolios and matched portfolios are formed to eliminate time-varying clustering and differences in firm characteristics.

The hypotheses are re-tested through an OLS regression by adding firm-, deal-, market- and industry- characteristics to control for unobserved heterogeneity. Moreover, the moderating effects of *Institutional ownership* and *Retail sentiment* are assessed. The regressions are performed for the one-, three-, six-, and twelve-month holding periods and use Huber-White standard errors to account for heteroscedasticity (Wilcox, 1996). Finally, a set of regression diagnostics and robustness checks are conducted to ensure structural and methodological validity. The complete regression model, including the interaction terms, is depicted by the following formula:

$$BHAR_{i,t} = \alpha_{i,t} + \beta_1 Expected\ skewness_{i,t} + \beta_2 SPAC_{i,t} + \beta_3 (Expected\ skewness_{i,t} * SPAC_{i,t}) + \lambda_t X_{i,t} + \lambda_t Y_{i,t} + \lambda_t Z_{i,t} + \varepsilon_{i,t} \quad (9)$$

where $BHAR_{i,t}$ denotes the buy-and-hold return of firm *i* over holding period *t*, $\alpha_{i,t}$ denotes the intercept, β_1 till β_5 denote the coefficients of the main variables and interaction terms, $\lambda_t X_{i,t}$ denotes a vector of both moderating variables and interaction terms with the main variables, $\lambda_t Y_{i,t}$ denotes a vector of firm-, deal-, market- and industry-specific variables, $\lambda_t Z_{i,t}$ denotes a vector of year and industry fixed-effects variables, and $\varepsilon_{i,t}$ denotes the residual.

4. RESULTS

4.1 Descriptive statistics

Table 3 reports the cross-sectional averages for the full sample and split sample of SPACs and IPOs, whereas *Appendix: Table 11* displays the pairwise correlations across the full sample. Two-sample *t*-tests are performed to assess split-sample differences in characteristics. Moreover, alternative Mann–Whitney *z*-tests are performed to account for potential differences in skewness between SPACs and IPOs. While both SPACs and IPOs bring private firms public, they differ significantly across firm, deal, market, and industry characteristics.

Translated back to a non-logarithmic scale, firms that go public via a SPAC are on average 2.6 years younger (10.5 versus 13.1) than firms that follow the traditional IPO route. Moreover, SPACs have lower *Institutional ownership* (43% versus 51%), are smaller in Log(*Size*) ($1.34 billion versus $1.62 billion), and have a lower *Book-to-market* ratio (0.20 versus 0.24). These findings are in line with the existing literature and of similar magnitude (see Klausner et al., 2020; Kolb and Tykvová, 2016; Bai et al., 2021). Moreover, SPACs or IPOs are equally listed between the NYSE and NASDAQ, making for a balanced sample.

Deal characteristics also differ substantially between SPACs and IPOs. *Underwriter reputation* of SPAC deals is on average 6.85 on the Carter-Manaster rankings versus 7.71 for IPOs. This lower reputation of SPAC underwriters might be linked to SPACs catering to more risky firms. In turn, this increases potential reputation damage for more reputable underwriters. Contrary to popular belief, the log(*Proceeds*) for SPACs and IPOs are not significantly different (*z*=0.59). Moreover, *VC involvement* is lower for SPAC deals at 16% versus 26% of IPO deals. In line with Kolb and Tykvová (2016), VCs seem to prefer IPOs over SPACs.

Market and industry characteristics show other differences between the two going public vehicles. *Market momentum*, *Market volatility*, *Industry volatility*, and *Market skewness* are significantly lower on the first trading day of IPOs relative to SPACs. Together these four summary statistics paint a similar picture as in Bai et al. (2021), where IPOs cater to safety-seeking investors under more stable market conditions (i.e. lower momentum, volatility and skewness). Conversely, SPACs cater to yield-seeking investors under more volatile market conditions. No clear picture arises from the returns on the IPO day or SPAC merger day. Whereas the *Market return* is marginally higher on IPO days, *Industry return* is marginally higher on SPAC merger days, and *Russel 2000 returns* do not statistically differ between the two.

Table 3: Summary statistics per group

	Full sample			SPAC			IPO			MW-test	t-Test
	Mean	Stdev	*N*	Mean	Stdev	*N*	Mean	Stdev	*N*	*Z*-Value	*t*-Value
Firm characteristics											
Expected skewness	-0.09	0.19	1532	0.01	0.25	152	-0.09	0.18	1380	-4.40***	-5.99***
Log(Age)	2.61	0.76	1626	2.40	0.85	165	2.63	0.75	1461	3.84***	3.75***
Exchange	1.31	0.46	1596	0.29	0.46	131	0.31	0.46	1462	0.40	0.40
Institutional own.	0.51	0.32	1287	0.43	0.26	111	0.51	0.32	1176	2.17**	2.46 ***
Log(Size)	7.37	0.52	1536	7.19	0.49	152	7.39	0.52	1384	5.14***	4.29***
Book-to-market	0.24	0.01	1473	0.20	0.12	152	0.24	0.14	1321	14.75***	3.73***
Deal characteristics											
Underwriter rep.	7.61	1.85	1472	6.85	1.86	166	7.71	1.82	1306	6.39***	5.72***
Log(Proceeds)	5.23	0.92	1631	4.93	1.20	166	5.26	0.88	1465	0.59	4.45***
VC involvement	0.25	0.43	1621	0.16	0.37	166	0.26	0.44	1455	2.61***	2.61***
Market conditions											
Retail sentiment	91.42	8.15	1599	90.16	8.6	160	91.55	8.1	1439	1.71**	2.04**
Market sentiment	1.87	0.74	1631	1.63	0.71	166	1.90	0.74	1462	4.58***	4.54***
Market return	0.01	0.01	1583	0.01	0.00	160	0.01	0.00	1423	3.15***	1.83**
Russel 2000 return	0.01	0.01	1601	-0.01	0.02	160	0.01	0.01	1441	0.49	0.71
Market momentum	0.09	0.09	1307	0.12	0.01	160	0.09	0.01	1147	-4.24***	-5.02***
Market volatility	-0.04	0.01	1583	0.02	0.01	160	0.01	0.01	1423	-4.49***	-4.89***
Market skewness	0.01	0.14	1567	0.02	0.17	156	-0.05	0.13	1411	-5.86***	-5.75***
Industry conditions											
Industry return	0.01	0.00	1532	0.02	0.00	152	0.01	0.00	1380	-2.39**	-2.19**
Industry volatility	0.01	0.01	1532	0.02	0.00	152	0.01	0.00	1380	-7.04***	-9.30***

*Note: Summary statistics are given for the full sample and split-sample between SPACs and IPOs. Subsequently, a t-Test and a Mann-Whitney z-test are performed to assess whether the two groups are statistically different. Significance levels: *** 0.01, ** 0.05, * 0.10.*

4.2 The SPAC underperformance puzzle

This section investigates the SPAC underperformance puzzle by comparing the relative performance of SPACs and IPOs via buy-and-hold abnormal returns in *Table 4* and calendar-time abnormal returns in *Appendix: Table 12*. Subsequently, the returns are measured across several time horizons and undergo different adjustments and matching procedures to ensure robustness.

4.2.1 Buy-and-hold abnormal returns

Table 4 Panel A indicates significant SPAC underperformance relative to IPOs across holding periods of one, three, and six months. To illustrate by example, SPACs earn a negative abnormal one-month return of -7.7% while IPOs realise a positive abnormal return of 3.1%. The SPAC underperformance equals -10.8% which is significant following a pairwise *t*-test (t=-2.56; p<0.01) and an alternative Mann-Whitney *z*-test (z=-2.26; p<0.05). This underperformance monotonically increases to -13.8% and -20.8% for the three- and six-month holding periods, respectively. Moreover, the underperformance is robust when using market or industry returns.

Against expectations, the SPAC underperformance decreases is size and statistical significance across the twelve-month holding period (t=-1.33; p<0.10). Moreover, the underperformance is insignificant following the Mann-Whitney *z*-test. The insignificance is potentially caused by measurement problems of long-run performance (Barber and Lyon, 1997; Kothari and Warner, 1997), which are discussed in more detail in *Section 5.2*.

Section 4.1 reported significant differences in firm characteristics between SPACs and IPOs, potentially driving the observed SPAC underperformance. This concern is alleviated by operationalising a propensity scoring model that matches SPACs and IPOs with similar Log(*Size*), Log(*Age*) and *Book-to-market*. The matched sample coefficients in *Table 4 Panel B* confirms earlier results: SPACs underperform IPOs across adjustments and holding periods up to six months, albeit at slightly lower significance levels. Again, the SPAC underperformance monotonically increases from -7.8% for the one-month holding period (t=-1.93; p<0.05) to -18.5% for the six-month holding period (t=-2.82; p<0.01). Compared to the unmatched sample, the underperformance is slightly lower due to heterogeneity in firm characteristics.

In sum, the evidence in this section suggests that SPACs significantly underperform IPOs. This holds true for holding periods up to six months for the full sample as well as a matched sample. Moreover, the SPAC underperformance remains significant after adjusting for market or industry returns and across statistical tests. Hence, strong support is found for hypothesis 1, which states that SPACs underperform IPOs in the longer-term.

4.2.2 Calendar-time abnormal returns

This subsection employs an additional calendar-time approach to provide further evidence of the SPAC underperformance puzzle. This approach accounts for autocorrelations in returns which forms a limitation of the reported BHARs in *Section 4.2.1* (Fama, 1998; Mitchell and Stafford, 2000). Monthly calendar-time portfolios are formed, which add all SPACs that merge in the month before the portfolio formation and drop all SPACs after holding periods of one-, three-, six-, or twelve-month. *Appendix: Table 12 Panel A* reports the coefficients of a split-sample regression model that regresses monthly portfolio returns on six risk factors across different holding periods. The alpha from each regression forms the monthly calendar-time abnormal return.

Consistent with the BHAR analyses, SPACs realise significantly lower alphas relative to IPOs across holding periods of one to six months. To illustrate by example, SPACs earn a negative monthly alpha of -8.3% while IPOs realise a positive monthly alpha of 0.3%. The SPAC underperformance equals -8.6% (t=-96.23; p<0.01), slight lower than the reported 10.8% in the BHAR analysis. This underperformance monotonically increases to cumulative negative CTARs of -12.0% and -22.8% for the three- and six-month holding periods. Again, the magnitude of the underperformance corresponds to the reported BHARs of -13.8% and -20.8% over the same holding periods. Moreover, SPACs do not significantly underperform IPOs over the twelve-month holding periods (t=-0.83; p>0.10). In untabulated results, the industry and market-adjusted returns are used to form monthly calendar-time portfolios. The market-adjusted SPAC underperformance remains statistically significant at the 1% level and monotonically increases from -6.9% for the one-month holding period (t=-44.80; p<0.01) to -12.9% for the six-month holding period (t=-10.03; p<0.01). The results are similar for industry-adjusted returns.

The same propensity scoring model as in *Section 4.2.1* is operationalised, matching SPACs and IPOs with similar Log(*Size*), Log(*Age*) and *Book-to-market*. The matched sample coefficients in *Appendix: Table 12 Panel B* amount to CTARs of -7.9% , -10.2%, and -13.1% for holding periods of one, three, and six months, respectively. Consistent with earlier results, the twelve-month CTAR remains insignificant. Concluding, the evidence in this section suggests that SPACs significantly underperform IPOs. This holds true for holding periods up to six months for the full sample as well as a matched sample. Moreover, the magnitude of the underperformance is similar to the earlier reported BHARs. Hence, strong support is found for hypothesis 1 which states that SPACs underperform IPOs in the longer-term.

Table 4: Logarithmic buy-and-hold return differences across SPACs and IPOs

	Panel A: Full sample BHARs								Panel B: Matched sample BHARs					
	SPAC		IPO		Δ SPAC		t-test	MW-test	SPAC		Δ SPAC		t-test	MW-test
	Mean	N	Mean	N	− IPO	St. Error	*t*-Value	*z*-Value	Mean	N	− IPO	St. Error	*t*-Value	*z*-Value
BHAR 1m														
Unadjusted	-0.077	148	0.031	1145	-0.108	0.042	-2.555***	-2.259**	-0.049	148	-0.078	0.041	-1.933**	-2.357**
Market adj.	-0.099	137	0.011	937	-0.110	0.043	-2.582***	-2.505***	-0.068	137	-0.083	0.041	-2.035**	- 2.439**
Industry adj.	-0.076	138	0.019	953	-0.095	0.042	-2.253**	-2.098**	-0.042	138	-0.062	0.041	-1.488*	-1.985**
BHAR 3m														
Unadjusted	-0.149	134	-0.011	1099	-0.138	0.050	-2.779***	-2.429***	-0.117	134	-0.106	0.050	-2.115**	-1.706*
Market adj.	-0.191	124	-0.068	895	-0.123	0.051	-2.393***	-2.108**	-0.169	124	-0.115	0.050	-2.307**	-2.082**
Industry adj.	-0.191	125	-0.042	911	-0.149	0.051	-2.920***	-2.781***	-0.174	125	-0.132	0.052	-2.542***	-2.137**
BHAR 6m														
Unadjusted	-0.322	100	-0.114	1023	-0.208	0.061	-3.404***	-2.751***	-0.258	100	-0.144	0.063	-2.279**	-1.802*
Market adj.	-0.413	95	-0.206	830	-0.207	0.063	-3.295***	-2.862***	-0.350	95	-0.167	0.063	-2.662***	-1.762*
Industry adj.	-0.396	95	-0.150	845	-0.246	0.063	-3.899***	-3.517***	-0.335	95	-0.185	0.066	-2.824***	-1.976**
BHAR 12m														
Unadjusted	-0.468	70	-0.314	880	-0.154	0.116	-1.330*	-0.794	-0.330	70	-0.015	0.114	-0.140	-0.622
Market adj.	-0.591	66	-0.473	705	-0.118	0.120	-0.977	-1.101	-0.475	66	-0.025	0.116	-0.221	-0.730
Industry adj.	-0.553	66	-0.376	718	-0.177	0.120	-1.470*	-0.595	-0.403	66	-0.026	0.118	-0.222	-0.899

*Note: The logarithmic returns of SPACs and IPOs as well as the performance gap of SPACs vis-à-vis IPOs are reported across holding periods of one, three, six, and twelve months. These returns are further adjusted for market and industry returns. Moreover, a matched sample is determined via a propensity scoring model which matches SPACs and IPOs of similar size, age, and book-to-market. Subsequently, a pairwise t-test and an alternative Mann-Whitney test are performed for each return to assess whether the returns are significantly different across both going public vehicles. Significance levels: *** 0.01, ** 0.05, * 0.10.*

4.3 The relation between skewness and issuing type

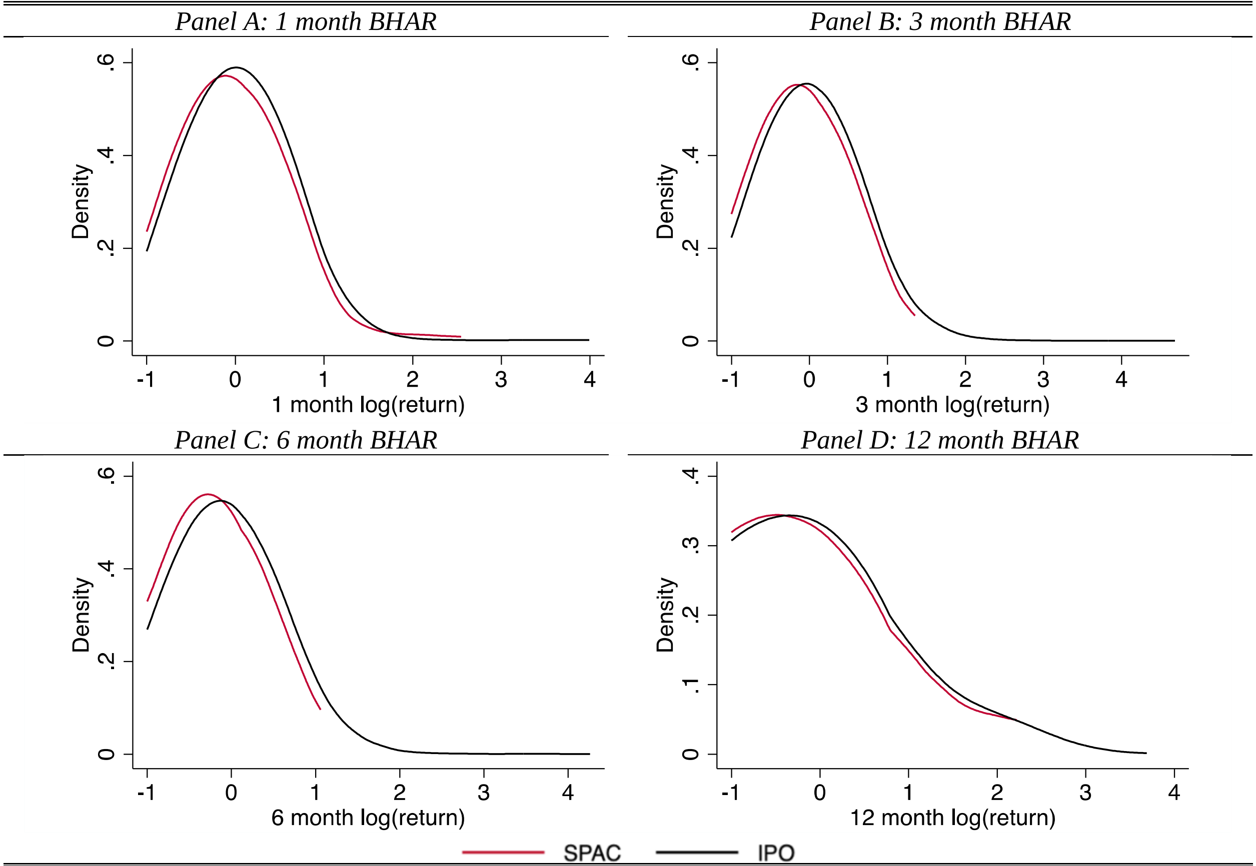
This subsection investigates the relation between expected idiosyncratic skewness and issuing type by examining the return density plots of SPACs and IPOs in *Figure 4* and performing a two-sample Kolmogorov-Smirnov test in *Appendix: Table 13*. This test separately quantifies the distance between the SPAC and IPO return distribution functions to assess whether the two samples are drawn from the same distribution. Moreover, *Table 5 Panel A* reports regression results of expected idiosyncratic skewness on SPAC dummy variable with or without skewness proxies. *Panel B* provides the percentage of SPACs within each idiosyncratic skewness quintile.

In line with the higher *Expected skewness* among SPACs as reported in *Section 4.1 Table 3*, *Panels A* till *D* of *Figure 4* indicate a more positively skewed return distribution of SPACs relative to IPOs across all holding periods. The Kolmogorov-Smirnov test in *Appendix: Table 13* strengthens the above evidence by reporting significantly positive coefficients for SPACs across holding periods of one month (0.10; $p<0.05$), three months (0.24; $p<0.01$), and six months (0.19; $p<0.01$). Notably, both coefficients are insignificant for the twelve-month holding period, indicating equal skewness among SPACs and IPOs.

Model 1 in *Table 5 Panel A* reports the results when only the SPAC dummy is included in the regression. The SPAC coefficient is significantly positive (0.09; $p<0.01$), suggesting that the *Expected idiosyncratic skewness* of SPACs is 9.4% higher relative to IPOs. Model 2 includes potential proxies for skewness as reported in the literature (Jiang et al., 2019; Bali et al., 2011, 2020; Zhang, 2013). The coefficients for Log(*Age*), and *Book-to-market* are insignificant, implying that both variables do not proxy for skewness in the sample. This corresponds with the weak correlations with *Expected skewness* as reported in *Appendix: Table 11*. Moreover, the Log(*Size*) coefficient is significantly negative (-0.03; $p<0.01$), signalling that smaller firms are more positively skewed. This result is consistent with size proxying for skewness as documented in Bali et al. (2011). The SPAC coefficient remains significantly positive (0.08; $p<0.01$), confirming that SPACs are more positively skewed than IPOs even after controlling for the size effect. Lastly, *Table 5 Panel B* reports that the percentage of SPACs monotonically increases from the lowest to the highest skewness quintile. This suggests once more the higher expected idiosyncratic skewness of SPACs relative to IPOs.

In sum, the evidence in this section suggests that SPACs exhibit significantly higher (i.e. more positive) expected idiosyncratic skewness than IPOs. This holds true for holding periods of one, three, and six months and remains significant after including potential skewness proxies. Hence, strong support is found for hypothesis 3, which states that SPACs have higher idiosyncratic skewness than IPOs.

Figure 4: Return density plots across holding periods



Note: Density plots for logarithmic buy-and-hold abnormal returns across the one-, three-, six-, and twelve-month holding periods split across SPACs and IPOs.

Table 5: The relationship between expected idiosyncratic skewness and issuing type

Panel A: The relationship between expected idiosyncratic skewness and issuing type

Model	SPAC	Log(Age)	Log(Size)	Book-to-market	Constant	N	Adj. R^2
1	0.094***				-0.094***	1,529	0.063
	(0.020)				(0.005)		
2	0.083***	-0.002	-0.027***	-0.037	0.122***	1,387	0.117
	(0.021)	(0.006)	(0.001)	(0.025)	(0.073)		

Panel B: The percentage of SPACs across expected idiosyncratic skewness quintiles

Skewness quintile	1	2	3	4	5
% of SPACs	4.3	7.5	7.8	10.1	20.1

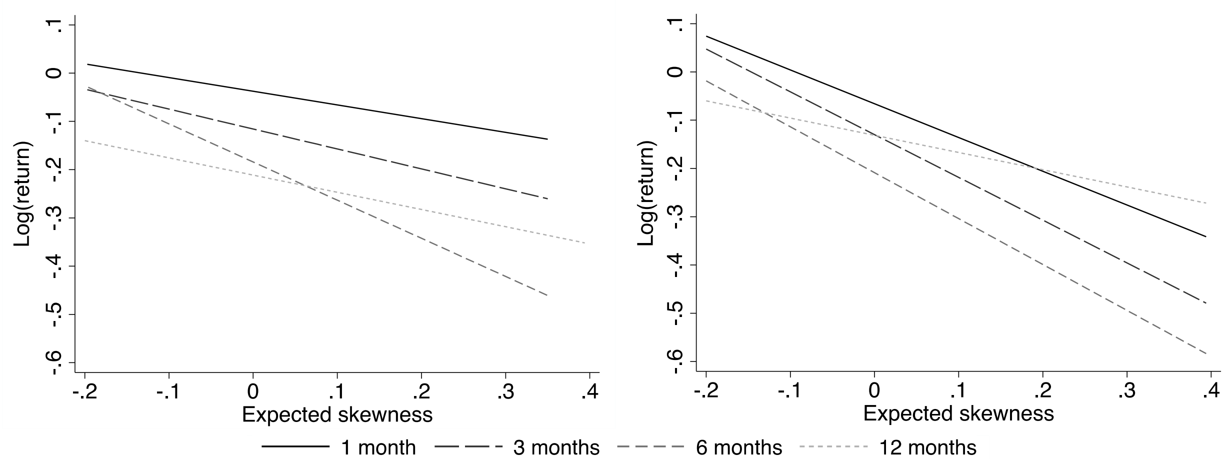
*Note: Panel A reports the regression coefficients of Expected idiosyncratic skewness on the SPAC dummy and several skewness proxies. Panel B provides the percentage of SPACs within each idiosyncratic skewness quintile. Huber-White standard errors are shown in parentheses. Significance levels: *** 0.01, ** 0.05, * 0.10.*

4.4 The relation between skewness and returns

Thus far, the previous subsections have individually examined the returns (*Section 4.2*) and expected idiosyncratic skewness (*Section 4.3*) of SPACs and IPOs. This subsection unifies both concepts by investigating the relationship between expected idiosyncratic skewness and returns, as plotted in *Figure 5*. The observed relationship is negative across all holding periods and issuing types, suggesting that stocks with high expected skewness earn lower average returns than stocks with low expected skewness. Moreover, the relationship steepens across SPACs and IPOs for the three- and six-month holding periods. This indicates an increased return gap in favour of stocks with low expected idiosyncratic skewness. Conversely, the skewness-return relationship flattens for the twelve-month holding period, potentially due to skewness not being persistent over longer horizons (Singleton and Wingender, 1986; Fogler and Radcliffe, 1974). This is commensurable with the insignificant relationship between *Expected skewness* and the twelve-month *Idiosyncratic skewness* in *Section 3.2.2*.

Figure 5: Expected skewness-return relationship split between SPACs and IPOs across holding periods

Panel A: SPACs | *Panel B: IPOs*



Note: The relationship between expected skewness and buy-and-hold abnormal returns is split between SPACs and IPOs and plotted for the one-, three-, six-, and twelve-month holding periods.

The skewness-return relationship is further examined by univariately sorting SPACs and IPOs into equally-weighted terciles based on expected idiosyncratic skewness terciles and held for one, three, six, or twelve months. *Table 6: Panel A* indicates that buy-and-hold returns monotonically decrease from the lowest to the highest skewness terciles. To illustrate by example, SPACs in the high skewness tercile realise a one-month BHAR of -13.2%, whereas the low skewness tercile realises -9.4%. This outperformance amounts to 23.6% (t=3.10; p<0.01) and monotonically increases up to 39.0% for the six-month holding periods (t=3.70; p<0.01). IPOs display similar significant outperformance of the lower skewness terciles across holding periods which ranges from 33.8% to 47.0%. Notably, the return differences are not significant for the twelve-month holding period across both sub-samples. Overall, the results are commensurate with empirical work on the skewness of IPO stocks (Green and Hwang, 2012; Cho and Kim, 2019).

Table 6: Panel B forms calendar-time weighted portfolios as opposed to the equally-weighted portfolios in *panel A* to account for potential time-varying clustering of SPACs and IPOs (Helwege and Liang, 2004). *Panel B* reports a similar return pattern from the lowest to the highest skewness terciles across holding periods and issuing types. For example, the low skewness SPAC portfolio realises a three-month BHAR of 5.5%, whereas the high skewness portfolio realises -26.5%. Overall, the outperformance of low versus high skewness tercile remains of similar statistical significance, suggesting that time-varying clustering thus does not drive the results.

Taken together, the evidence in this section suggests that SPACs and IPOs with higher expected idiosyncratic skewness earn lower average returns. This holds true for holding periods of one, three, and six months and remains significant after accounting for potential time-varying clustering. Hence, strong support is found for hypothesis 2, which states that negatively skewed stocks outperform positively skewed stocks.

4.5 The relation between skewness and the SPAC underperformance puzzle

Given the evidence from the previous subsections that SPACs are more positively skewed than IPOs, one might wonder whether the SPAC underperformance puzzle is simply a result of the higher expected idiosyncratic skewness among SPACs. To investigate this possibility, SPACs and IPOs are again separately sorted into equally-weighted skewness terciles as in *Table 6: Panel A*. However, rather than assessing the returns differences between the skewness terciles, the return differences between SPACs and IPOs within each skewness tercile are examined.

The buy-and-hold abnormal returns in *Table 6*: *Panel A* indicate no significant differences between SPACs and IPOs within each skewness tercile. To illustrate by example, SPACs in the high skewness tercile realise a one-month BHAR of -13.2%, whereas IPOs realises -14.2% with the difference being insignificant (t=0.84; p>0.10). This holds true across holding periods up to six months. SPACs only significantly underperform IPOs for the medium (t=-1.70; p<0.10) and high expected skewness terciles (t=-1.65; p<0.10) for the twelve-month holding period, albeit at the higher 10% significance level. Additional calendar-time weighted portfolios as reported in

Table 6: *Panel B* commensurate with the findings above and confirm that the results are not driven by time-varying clustering of SPACs and IPOs. Moreover, the return differences between SPACs and IPOs remain of similar statistical and economical significance.

Thus far, the evidence in this section points towards expected idiosyncratic skewness as a driver of the SPAC underperformance puzzle. This notion is further tested by operationalising a propensity scoring model which matches SPACs and IPOs with similar expected idiosyncratic skewness. *Table 6: Panel C* reports significant underperformance of SPACs vis-à-vis IPOs for the unmatched sample up to holding periods six months. On the other hand, SPACs do not underperform IPOs in the matched sample where returns are adjusted for differences in skewness. To illustrate by example, SPACs underperform IPOs by 10.8% for the unmatched sample over one month (t=-2.55; p<0.01) but do not significantly underperform for the matched sample (t=-0.31; p>0.10). This holds true when extending the holding periods to three months (t=-0.67; p>0.10) or six months (t=-0.57; p>0.10). Notably, neither the unmatched nor matched twelve-month BHAR difference is significant. Further inspection reveals that 100 out of 753 observations are off-support, which hints at an unbalanced sample.

In sum, the evidence in this section suggests that SPACs do not underperform their IPO counterparts once their returns are skewness-adjusted. Expected idiosyncratic skewness thus explains the SPAC underperformance puzzle, strongly supporting hypothesis 4. This holds true for holding periods up to six months and across skewness terciles.

4.6 Regression approach

Thus far, this paper has relied on univariate sorts to examine the relationship between skewness and the SPAC underperformance puzzle. This subsection employs a multi-stage regression approach to control for potentially confounding factors by including a batch of firm, deal, market, and industry characteristics. *Table 7* reports the regression coefficients across holding periods of one month (Model 1-3), three months (Model 4-6), and six months (Model 7-9).

In line with earlier findings, the SPAC underperformance puzzle disappears for the twelve-month holding period. Moreover, the corresponding F-test of significance is rejected (F=1.29; p>0.10) and the AIC (BIC) of 1316 (1574) is significantly higher compared to shorter holding periods, indicating a lower model fit. Hence, no further interpretation of the twelve-month holding period will be given. Nonetheless, *Section 5.2* discusses the potential measurement issues that cause the insignificant SPAC underperformance puzzle across the twelve-month holding period.

Table 6: Return differences between SPACs and IPOs across expected skewness portfolios and (un)matched samples

Panel A: Equally-weighted portfolios

Expected skewness	1 month BHAR			3 month BHAR			6 month BHAR			12 month BHAR		
	SPAC	IPO	Δ SPAC – IPO	SPAC	IPO	Δ SPAC – IPO	SPAC	IPO	Δ SPAC – IPO	SPAC	IPO	Δ SPAC – IPO
Low	0.094	0.205	-0.111	0.034	0.215	-0.181	0.008	0.146	-0.137	-0.135	-0.243	-0.108
			(-1.372)			(-1.629)			(-0.711)			(-0.777)
Medium	-0.071	-0.007	-0.064	-0.125	-0.054	-0.071	-0.158	-0.136	-0.022	0.049	-0.181	0.232*
			(-0.055)			(-0.398)			(-0.681)			(1.701)
High	-0.132	-0.142	0.010	-0.245	-0.226	-0.019	-0.381	-0.323	-0.058	-0.349	-0.255	-0.096*
			(0.835)			(-0.481)			(-0.804)			(-1.645)
Δ Low – high	0.236***	0.338***		0.281***	0.442***		0.390***	0.470***		0.214	0.012	
	(3.104)	(11.777)		(3.047)	(12.077)		(3.696)	(12.583)		(0.979)	(1.411)	

Panel B: Calendar-time weighted portfolios

Expected skewness	1 month BHAR			3 month BHAR			6 month BHAR			12 month BHAR		
	SPAC	IPO	Δ SPAC – IPO	SPAC	IPO	Δ SPAC – IPO	SPAC	IPO	Δ SPAC – IPO	SPAC	IPO	Δ SPAC - IPO
Low	0.123	0.202	-0.079	0.055	0.211	-0.156	0.098	0.140	-0.041	-0.181	-0.195	-0.014
			(-0.873)			(-1.165)			(-0.068)			(-0.251)
Medium	0.038	0.033	0.005	-0.016	-0.012	-0.004	-0.074	-0.113	0.038	-0.117	-0.244	0.127
			(0.692)			(-0.082)			(0.751)			(0.942)
High	-0.166	-0.183	0.017	-0.265	-0.283	0.018	-0.387	-0.362	-0.026	-0.366	-0.250	-0.116
			(0.152)			(0.357)			(-0.526)			(-1.428)
Δ Low - high	0.289***	0.385***		0.320***	0.494***		0.486***	0.502***		0.185	0.056	
	(3.307)	(13.665)		(3.047)	(13.699)		(3.420)	(13.478)		(1.106)	(0.998)	

Panel C: Matching approach

Expected skewness	1 month BHAR			3 month BHAR			6 month BHAR			12 month BHAR		
	SPAC	IPO	Δ SPAC – IPO	SPAC	IPO	Δ SPAC – IPO	SPAC	IPO	Δ SPAC – IPO	SPAC	IPO	Δ SPAC - IPO
Unmatched	-0.077	0.031	-0.108***	-0.149	-0.011	-0.138***	-0.322	-0.114	-0.208***	-0.468	-0.314	-0.154
			(-2.555)			(-2.779)			(-2.751)			(-1.330)
Matched	-0.040	-0.022	-0.018	-0.125	-0.066	-0.059	-0.231	-0.144	-0.087	-0.331	-0.181	-0.150
			(-0.310)			(-0.670)			(-0.570)			(-0.550)

*Note: Panel A utilises a portfolio approach that splits the sample between SPACs and IPOs which are assigned to a low, medium, or high expected skewness portfolio using the 33rd and 66th percentiles as breakpoints. Subsequently, the buy-and-hold returns of each portfolio are reported across holding periods of one, three, six, and twelve months. Panel B follows the same approach as panel A, but separately forms these portfolios for each year rather than pooling all years together to address potential time-varying clustering. Panel C matches SPACs and IPOs based on expected skewness and reports buy-and-hold returns of the matched sample. t-statistics are given in parentheses. Significance levels: *** 0.01, ** 0.05, * 0.10.*

4.6.1 Main hypotheses

Table 7 Model 1 report the results when only the *SPAC* dummy is included in the regression with the control variables. The significantly negative *SPAC* coefficient of -0.080 (t=-2.01; p<0.05) suggests that SPACs underperform IPOs by an average -8.0% for the one-month holding period. This result is consistent with the SPAC underperformance puzzle as reported in previous sections. The slightly lower effect size compared to -10.8% one-month BHAR in *Section 4.2.1* can be ascribed to the inclusion of the control variables. Nonetheless, strong support is found for hypothesis 1. Model 2 includes only *Expected skewness* in the regression with the controls. The *Expected skewness* coefficient of -1.035 is significantly negative (t=-13.2; p<0.01), confirming the negative skewness-return relation as stated by hypothesis 2. To put into context, a one-standard-deviation increase in *Expected skewness* results in a -20.9% decrease in the one-month BHAR.

The *SPAC* dummy, *Expected skewness*, and the interaction term between these two variables are included in Model 3. If the investor preference for skewness drives the SPAC underperformance puzzle, one would expect the puzzle to disappear once controlled for skewness. The significantly negative *Expected skewness* coefficient of -1.066 (t=-12.62; p<0.01) remains nearly identical compared to Model 2. Moreover, the *SPAC* coefficient becomes insignificant (t=-0.52; p>0.10), implying that the SPAC underperformance disappears once *Expected skewness* is controlled for. In other words, the investor preference for skewness explains the SPAC underperformance puzzle, which serves as strong support for hypothesis 4. Finally, the interaction term between *SPAC* and *Expected skewness* is insignificant (t=-0.43; p>0.10). This indicates a similar skewness-return relationship between SPACs and IPOs.

The reported effect remains of similar statistical significance but slightly increase in size for extended holding periods of three (Model 4-6) and six months (Model 7-9). Firstly, SPAC underperformance monotonically increases to -9.9% and -13.9% over three and six months. Secondly, a one-standard-deviation increase in *Expected skewness* results in a -25.0% and -25.7% return decrease over three-, and six-month, rather than -20.9% over one month. Similarly to Model 3, the SPAC underperformance disappears once *Expected skewness* is controlled for.

Table 7: Multivariate regression approach across different holding periods

	BHAR 1m			BHAR 3m			BHAR 6m		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
SPAC	-0.080**		-0.044	-0.099**		-0.051	-0.139**		-0.046
	(0.045)		(0.042)	(0.056)		(0.054)	(0.070)		(0.066)
Expected skewness		-1.035***	-1.066***		-1.228***	-1.348***		-1.285***	-1.329***
		(0.078)	(0.084)		(0.099)	(0.109)		(0.109)	(0.117)
SPAC * Expected skewness			0.078			0.103			0.166
			(0.149)			(0.175)			(0.245)
Exchange	-0.012	-0.012	-0.015	-0.020	-0.023	-0.024	-0.046	-0.051	-0.051
	(0.033)	(0.030)	(0.030)	(0.043)	(0.039)	(0.039)	(0.048)	(0.043)	(0.043)
Underwriter reputation	0.038***	0.038***	0.039***	0.026**	0.025**	0.029***	0.016	0.015	0.017
	(0.009)	(0.008)	(0.008)	(0.012)	(0.011)	(0.011)	(0.013)	(0.012)	(0.012)
Log(Age)	0.035*	0.018	0.018	0.051**	0.031	0.030	0.024	-0.002	-0.002
	(0.018)	(0.016)	(0.016)	(0.023)	(0.021)	(0.021)	(0.026)	(0.023)	(0.023)
Log(Size)	0.022	0.040	0.044*	0.059	0.072**	0.082**	0.037	0.064**	0.068**
	(0.029)	(0.026)	(0.026)	(0.036)	(0.032)	(0.033)	(0.040)	(0.036)	(0.036)
Book-to-market	-0.034	-0.060	-0.055	-0.075	-0.096	-0.088	0.035	0.013	0.015
	(0.079)	(0.071)	(0.071)	(0.098)	(0.089)	(0.089)	(0.106)	(0.096)	(0.096)
Log(Proceeds)	0.012	0.004	0.006	0.048**	0.036*	0.036*	0.041	0.031	0.031
	(0.018)	(0.017)	(0.017)	(0.024)	(0.021)	(0.022)	(0.027)	(0.025)	(0.025)
VC involvement	0.097***	0.069**	0.070**	0.094***	0.057	0.055	0.116**	0.075	0.074
	(0.036)	(0.032)	(0.032)	(0.046)	(0.042)	(0.042)	(0.051)	(0.047)	(0.047)
Market sentiment	0.123***	-0.087**	-0.084**	0.166***	-0.075	-0.066	0.183***	-0.043	-0.040
	(0.034)	(0.035)	(0.035)	(0.047)	(0.047)	(0.047)	(0.050)	(0.049)	(0.049)
Market return	11.924	8.692	7.754	13.806	0.600	-0.950	-12.194	-22.799	-23.248
	(13.469)	(12.191)	(12.237)	(18.408)	(16.765)	(16.712)	(20.742)	(18.839)	(18.876)
Russel 2000 return	1.001	0.890	0.926	2.452*	1.842	2.055	-0.580	-0.913	-0.870
	(1.002)	(0.906)	(0.908)	(1.392)	(1.264)	(1.262)	(1.497)	(1.360)	(1.361)
Market momentum	0.130	-0.200	-0.219	0.334	-0.076	-0.097	-0.147	-0.608**	-0.607**
	(0.177)	(0.160)	(0.163)	(2.19)	(0.200)	(0.204)	(0.270)	(0.247)	(0.251)
Market volatility	-2.740	1.319	2.063	10.857	15.37*	16.433*	1.248	3.850	4.628
	(7.190)	(6.479)	(6.525)	(9.507)	(8.614)	(8.627)	(10.624)	(9.625)	(9.665)
Industry return	1.432	-12.427	0.044	-8.776	-18.656	-16.868	-1.320	-14.083	-13.506
	(10.399)	(9.477)	(9.554)	(14.718)	(13.402)	(13.392)	(17.091)	(15.554)	(15.577)
Industry volatility	1.517	-0.036	-1.066	3.812	1.883	0.442	3.866	2.991	2.117
	(6.484)	(5.804)	(5.893)	(9.593)	(8.684)	(8.692)	(10.947)	(9.901)	(9.953)
Constant	-0.518**	-0.680***	-0.724***	-1.103***	-1.238***	-1.357***	-0.749***	-1.025***	-1.074***
	(0.228)	(0.203)	(0.207)	(0.288)	(0.256)	(0.261)	(0.319)	(0.109)	(0.066)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	814	814	814	752	752	752	669	669	669
Adj. R^2	0.123	0.281	0.292	0.150	0.298	0.305	0.143	0.293	0.314
AIC	714	552	544	972	829	821	922	793	771
BIC	878	717	711	1134	991	974	1074	946	935

*Note: Result of linear multivariate models where the dependent variables are the buy-and-hold returns for holding periods of one (Model 1-3), three (Model 4-6) and six months (Model 7-9). Huber-White standard errors are used to account for heteroscedasticity and are shown in parentheses. Significance levels: *** 0.01, ** 0.05, * 0.10.*

4.6.2 Post-estimations

A set of regression diagnostics is conducted to ensure that no OLS regression assumptions are violated. Firstly, the linearity assumption is tested by plotting the augmented partial residuals of each independent variable against the dependent variable in *Appendix: Figure 8*. Overall, the smoothed line is close to the OLS regression line across all plots, indicating no substantial non-linearities in the data. The kernel density plot in *Appendix: Figure 9 Panel A* shows that the residuals are normally distributed, as required for OLS regressions. Moreover, the standardized normal probability plot in *Panel B* shows no substantial non-linearity in the middle range while the quantile-quantile plot in *Panel C* only slightly deviates from normality in the upper tail. Subsequently, these five observations are removed from the final regression models. Potential heteroskedasticity in the sample is assessed via the White's test which reports *P*-values of 0.38, 0.27, and 0.48 for Model 3, 6, and 9. Hence, the variance of the residuals is homogenous across specifications and no further adjustments of the independent variables are deemed necessary. *Appendix: Table 16* reports the variance inflation factors (VIFs) to identify potential multicollinearity. Upon inspection, all independent variables display VIF values ranging from 1.07 to 8.60 across Model 3, 6, and 9. These variables do not merit further investigation, given the rule of thumb that only VIF values greater than ten merit further inspection.

As a final check, the leverage against normalized squared residuals of each observation is plotted in *Appendix: Figure 9 Panel D* to identify outliers in the sample. The vertical line represents the average normalized squared residuals, while the horizontal red line represents the average leverage. Observations with high leverage strongly affect the slope of the regression line, whereas observations with a large squared residual have a large difference between the predicted and observed value. Subsequently, the most extreme outliers are removed from the regression and are found to moderately improve the R^2 across all specifications.

4.7 Institutional ownership

Thus far, the analyses in previous sections indicate the investor preference for skewness is likely the channel that causes the relative underperformance of SPACs vis-à-vis IPOs. This section conducts two additional tests to rule out alternative explanations and validate the investor skewness preference as the main channel. When compared to institutional investors, retail investors are more susceptible to behavioural biases and have a preference for skewness (Kumar, 2009; Han and Kumar, 2013). Retail demand should thus be higher among more positively skewed stocks, which amplifies the skewness-related mispricing. This interest from retail investors is measured as the inverse of institutional ownership. If the investor preference for skewness drives the SPAC underperformance puzzle, one would expect the puzzle to be stronger for stocks with low institutional ownership.

4.7.1 Institutional ownership and the SPAC underperformance puzzle

Table 8 reports the returns differences between SPACs and IPOs within each institutional ownership tercile across different holding periods. As expected, the SPAC underperformance puzzle is the strongest in the low institutional ownership tercile. This underperformance amounts to -23.4% across the one-month holding period (t=3.46; p<0.01) and becomes insignificant in the medium (t=-0.64; p>0.10) and high terciles (t=-0.48; p>0.10). Extending the holding period up to six months reveals the same pattern.

The conjecture is retested within a regression context with the regression coefficients across different holding periods reported in *Appendix: Table 14*. The regressions include additional indicator variables for the low and high institutional ownership terciles and the interaction terms with the *SPAC* dummy. In Model 10, the *Low institutional ownership* coefficient of -0.084 is significantly negative (t=-2.81; p<0.01), suggesting -8.4% lower returns for stocks in the low tercile. Conversely, the *High institutional ownership* coefficient is insignificant, implying equal performance. The interaction term between *Low institutional ownership* and *SPAC* is significantly negative (t=-3.56; p<0.01), which equals a SPAC underperformance of -17.8% within the low tercile. Moreover, the interaction term between *High institutional ownership* and *SPAC* is insignificant (t=0.58; p>0.10), implying no SPAC underperformance in the high tercile. Taken together, the SPAC underperformance puzzle is present in the tercile dominated by skewness-preferring retail investors and disappears in the high tercile. The evidence in this subsection is consistent with the investor skewness preference explanation and is robust up to a six-month holding period.

Table 8: Return differences between SPACs and IPOs across institutional ownership terciles

	1 month BHAR			3 month BHAR			6 month BHAR		
Institutional ownership	SPAC	IPO	Δ SPAC – IPO	SPAC	IPO	Δ SPAC – IPO	SPAC	IPO	Δ SPAC – IPO
Low	-0.298	-0.064	-0.234*** (-3.464)	-0.393	-0.111	-0.282*** (-3.421)	-0.389	-0.203	-0.186** (-2.096)
Medium	-0.089	0.018	-0.107 (-0.638)	-0.109	0.006	-0.115 (-0.575)	-0.131	-0.097	-0.034 (-0.399)
High	0.147	0.196	-0.049 (-0.475)	0.149	0.226	-0.077 (-0.460)	-0.029	0.059	-0.088 (-0.425)
Δ Low – high	-0.445*** (-2.436)	-0.260*** (-4.560)		-0.542*** (-4.246)	-0.387*** (-5.418)		-0.360*** (-2.007)	-0.262*** (-5.312)	

Note: SPACs and IPOs are assigned to a low, medium, or high institutional ownership portfolio using the 33rd and 66th percentiles as breakpoints. Subsequently, the buy-and-hold returns of each portfolio are reported across holding periods of one, three, and six months.

4.7.2 The moderating effect of institutional ownership

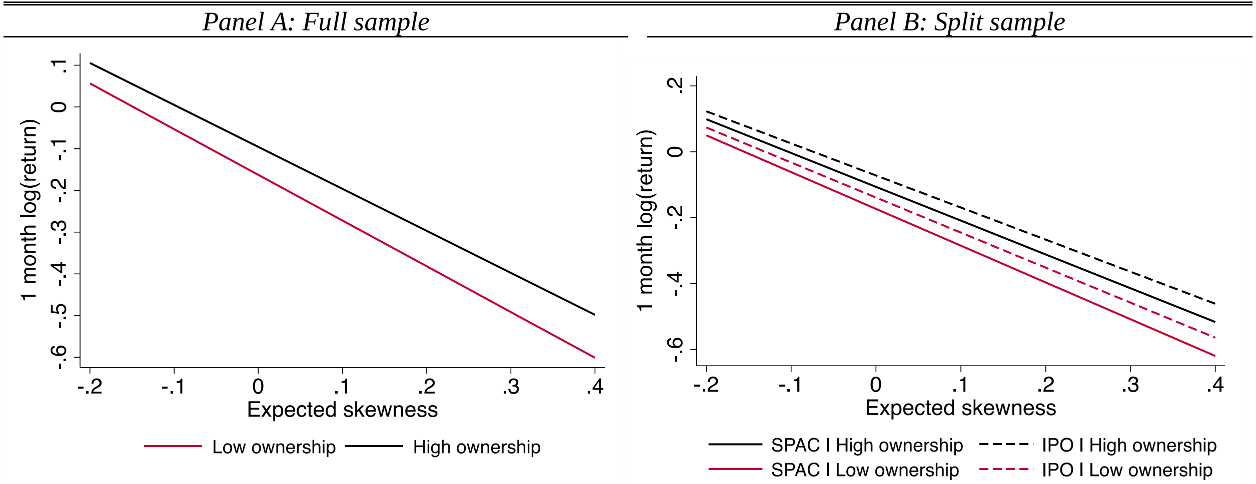
Following *Table 8*, SPACs (IPOs) in the low institutional ownership tercile underperform the high tercile by -44.5% (-26.0) at the 1% significance level. The higher concentration of skewness-preferring retail investors in this lower tercile exacerbates the mispricing of positively skewed stocks, resulting in lower subsequent returns. Conversely, negatively skewed stocks remain unaffected by this skewness-related mispricing. Given this mispricing asymmetry between positively and negatively skewed stocks, institutional ownership should positively moderate the skewness-return relationship.

This moderation effect is examined by adding the interactions terms between *Low* (*High*) *institutional ownership* and *Expected skewness* to the regression. *Appendix: Table 14* reports the regression coefficients. Compared to *Model 10* in *Section 4.7.1*, the *Expected skewness,* (*Low*) *High institutional ownership*, and the interaction terms with the *SPAC* dummy remain of equal magnitude and statistical significance. Hence, SPACs only underperform in the low tercile, whereas the skewness-return relationship is equally negative among SPACs and IPOs.

More importantly, the interaction terms between *Low institutional ownership* and *Expected skewness* is significantly negative at -0.175 (t=-2.16; p<0.05). Conversely, the interaction term for the high tercile is insignificant (t=0.01; p>0.10). This suggests that the negative skewness-return relationship steepens in the low tercile while remaining equal in the high tercile. Hence, institutional ownership positively moderates the skewness-return relationship, as visualised in *Panel A* of *Figure 6*. To put into context, for every one-standard-deviation increase in expected skewness, stocks in the low tercile underperform the other two terciles by an additional -3.3%.

If the investor preference for skewness drives the SPAC underperformance in the low tercile, the underperformance should disappear when controlled for skewness. This conjecture is tested by including the *Low institutional ownership* × *Expected skewness* × *SPAC* interaction term. In untablulated results, the coefficient of the three-way interaction term is insignificant (t=0.08; p>0.10). This implies an equal moderating effect of institutional ownership among SPACs and IPOs as visualised in *Panel B* of *Figure 6*. Moreover, the *Low institutional ownership* × *SPAC* interaction term becomes insignificant (t=-0.61; p>0.10), indicating no SPAC underperformance in the low tercile once controlled for skewness. Taken together, the evidence in this section is consistent with the investor skewness preference explanation and is robust up to holdings periods of six months. Moreover, strong support is found for hypothesis 5, which states that institutional ownership positively moderates the skewness-return relationship.

Figure 6: Moderating effect of institutional ownership on the expected skewness-return relationship



Note: Panel A plots the predicted values from regression Model 10 and assesses the expected skewness-return relationship for low and high institutional ownership. Panel B plots the predicted values from regression Model 13 and assesses the expected skewness-return relationship for low and high institutional ownership across SPACs and IPOs.

4.8 Retail sentiment

This section conducts two additional tests to validate the investor skewness preference as the main channel that causes the SPAC underperformance puzzle. When compared to the stable risk preferences of institutional investors (Barber and Odean, 2008), retail investors' risk preferences vary with market conditions (Malmendier and Nagel, 2011; Page et al., 2014). As a result, the skewness preference is amplified during high sentiment periods which increases the overvaluation of positively skewed stocks (Green and Hwang, 2012; Blau, 2017). Hence, SPACs should experience stronger mispricing during high retail sentiment periods, given their more positive skewness vis-à-vis IPOs. If the investor preference for skewness drives the SPAC underperformance puzzle, one would expect the puzzle to be stronger during periods of high retail sentiment.

4.8.1 Retail sentiment and the SPAC underperformance puzzle

Table 9 reports the returns differences between SPACs and IPOs within each sentiment tercile across different holding periods. As expected, the SPAC underperformance puzzle is the strongest in the high retail sentiment tercile at -12.9% for the one-month holding period (t=2.90; p<0.01). The magnitude of the puzzle decreases to -9.7% (t=-1.43; p<0.10) in the medium terciles and becomes insignificant in the low tercile (*t*=-0.42; *p*>0.10). Extending the holding period up to six months reveals roughly the same pattern. The puzzle remains the strongest in the high tercile, whereas both the medium and low terciles turn insignificant. Hence, the SPAC underperformance puzzle is present in the high sentiment tercile while disappearing in the medium and low terciles.

The conjecture is retested within a regression context with the regression coefficients across different holding periods reported in *Appendix: Table 15*. The regressions include additional indicator variables for the low and high retail sentiment terciles and the interaction terms with the *SPAC* dummy. In Model 16, the coefficients for *Low retail sentiment* and *High retail sentiment* are significant at the 1% level but of opposing signs. While the low tercile outperforms the other two by 21.7% (*t*=6.25; *p*<0.01), the high tercile underperforms by -13.2% (*t*=-3.96; *p*<0.01). The interaction term between *High retail sentiment* and *SPAC* is negative and significant (*t*=-2.03; *p*<0.05). This indicates a SPAC underperformance of -9.2% within the *High retail sentiment* tercile, which is slightly lower than the -12.9% as reported in *Table 9*. Moreover, the interaction term between *Low retail sentiment* and *SPAC* is insignificant (*t*=-0.98; *p*>0.10), implying no SPAC underperformance within the low tercile. Taken together, the SPAC underperformance puzzle is present in the high sentiment tercile and disappears in the low sentiment tercile. The evidence in this subsection is consistent with the investor skewness preference explanation and is robust up to a six-month holding period. Moreover, strong support is found for hypothesis 6, which states that retail sentiment negatively moderates the skewness-return relationship.

Table 9: Return differences between SPACs and IPOs across retail sentiment terciles

	1 month BHAR			3 month BHAR			6 month BHAR		
Retail sentiment	SPAC	IPO	Δ SPAC – IPO	SPAC	IPO	Δ SPAC – IPO	SPAC	IPO	Δ SPAC – IPO
Low	0.178	0.244	-0.066 (-0.416)	0.162	0.205	-0.043 (-0.321)	0.218	0.262	-0.044 (-0.103)
Medium	-0.021	0.076	-0.097* (-1.425)	-0.041	0.029	-0.070 (-0.960)	-0.132	-0.063	-0.069 (-0.885)
High	-0.283	-0.154	-0.129*** (-2.899)	-0.336	-0.172	-0.164*** (-3.225)	-0.436	-0.258	-0.178*** (-3.130)
Δ High - Low	-0.461*** (-4.955)	-0.398*** (-10.994)		-0.498*** (-4.836)	-0.377*** (-8.769)		-0.654*** (-2.498)	-0.520*** (-10.284)	

Note: Note: SPACs and IPOs are assigned to a low, medium, or high institutional ownership portfolio using the 33rd and 66th percentiles as breakpoints. Subsequently, the buy-and-hold returns of each portfolio are reported across holding periods of one, three, and six months.

4.8.2 The moderating effect of retail sentiment

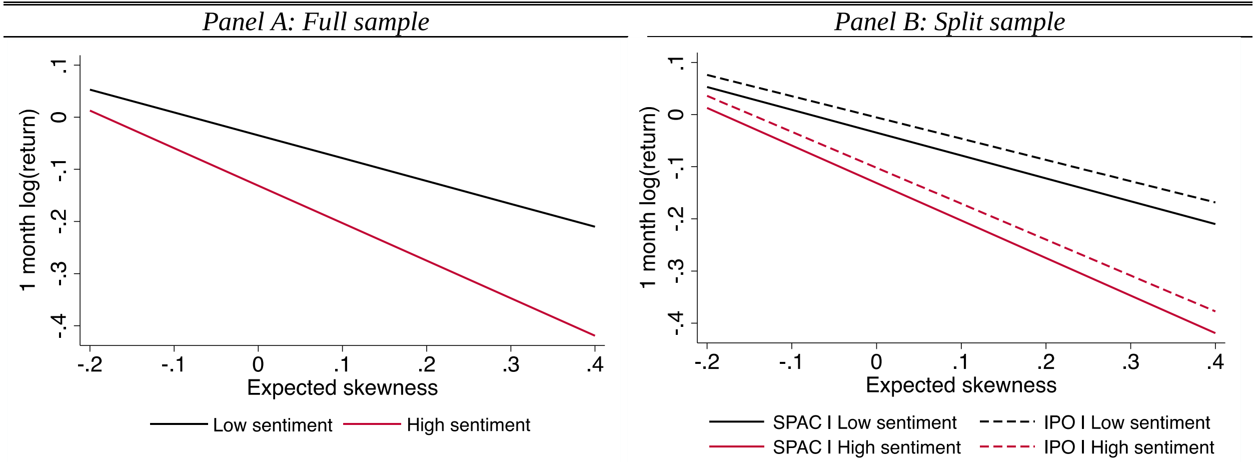
Following *Table 9*, SPACs (IPOs) in the high retail sentiment tercile underperform the low tercile by -46.1% (-39.8%) at the 1% significance level. The amplified skewness preference during high sentiment periods increases the overvaluation of positively skewed stocks, resulting in lower subsequent returns. Conversely, negatively skewed stocks remain unaffected by this skewness-related mispricing. Given this mispricing asymmetry between positively and negatively skewed stocks, retail sentiment should negatively moderate the skewness-return relationship.

This moderation effect is examined by adding the interactions terms between *Low* (*High*) *institutional ownership* and *Expected skewness* to the regression. *Appendix: Table 15* reports the regression coefficients. Compared to Model 16 in *Section 4.8.1*, the *Expected skewness,* (*Low*) *High retail sentiment*, and the interaction terms with the *SPAC* dummy remain of equal magnitude and statistical significance. Hence, SPACs only underperform in the high sentiment tercile whereas, the skewness-return relationship is equally negative among SPACs and IPOs.

More importantly, the interaction terms between *High retail sentiment* and *Expected skewness* is significantly negative at -0.247 (t=-1.74; p<0.05). Conversely, the interaction term for the low tercile is insignificant (t=0.33; p>0.10). This suggests that the negative skewness-return relationship steepens in the high tercile while remaining equal in the low tercile. Hence, retail sentiment negatively moderates the skewness-return relationship as visualised in *Panel A* of *Figure 7*. To put into context, for every one-standard-deviation increase in expected skewness, stocks in the high tercile underperform by an additional -6.5%.

If the investor preference for skewness drives the SPAC underperformance in the high tercile, the underperformance should disappear when controlled for skewness. This conjecture is tested by including the *High retail sentiment* × *Expected skewness* × *SPAC* interaction term. In untablulated results, the coefficient of the three-way interaction term is insignificant (t=0.74; p>0.10). This implies an equal moderating effect of retail sentiment among SPACs and IPOs, as visualised in *Panel B* of *Figure 7*. Moreover, the *High retail sentiment* × *SPAC* interaction term becomes insignificant (t=-1.03; p>0.10), indicating no SPAC underperformance in the low tercile once controlled for skewness. Taken together, the evidence in this section is consistent with the investor skewness preference explanation and is robust up to the six-month holding period.

Figure 7: Moderating effect of institutional ownership on the expected skewness-return relationship



Note: Panel A plots the predicted values from regression Model 16 and assesses the expected skewness-return relationship for low and high retail sentiment periods. Panel B plots the predicted values from regression Model 16 and assesses the expected skewness-return relationship for low and high retail sentiment periods across SPACs and IPOs.

4.9 Robustness checks

Several robustness checks are performed to verify the structural validity of the moderated regressions by comparing the regression coefficients to the coefficients for plausible alternative regression specifications. Firstly, the *Expected skewness* measure is adjusted by using the 95th and 5th percentiles rather than the 99th and 1st percentiles of the three-month industry-pooled return distribution. Using a more narrow return distribution eliminates small probability events at both tails, which should decrease the strength and explanatory power of *Expected skewness*. Secondly, *Expected skewness* is measured over the six months preceding the month of the offering rather than three months. This increases the probability of capturing tail events at the expense of underweighting more recent price information. Hence, *Expected skewness* should be of similar strength and explanatory power. Separately re-running the regressions with both adjustments does not change the regression results in terms of significance. As expected, allowing for a narrower return distribution decreases the one-, three-, and six-month BHARs by 4.3%, 3.3%, and 3.9%, respectively. Moreover, extending the measurement period does not significantly alter the predicted BHARs, which underlines the robustness of the *Expected skewness* measure.

The squared and cubic *Expected skewness* terms are individually included in the regression to test whether the expected skewness-return relationship is potentially U- or S-shaped. Both the squared and cubic terms are not significant at the 10% level across all holding periods, ruling out the squared and cubic specifications. Moreover, the dependent variables (i.e. one-, three-, and six-month BHARs) are independently adjusted for market and industry returns as in *Section 4.2.1*. Subsequently, separately re-running the regressions with both adjustments does not change the regression results in terms of significance nor the moderation effects.

The robustness of both moderation effects is assessed by using the more extreme moderator quintiles rather than terciles. As expected, the moderation effects increase in economic magnitude and remain statistically significant. For example, a one-standard-deviation increase in expected skewness increases the underperformance of the *Low institutional ownership* tercile by an additional -3.3% and -3.7% for the quintile.

An alternative dataset is used to assess whether the moderating effect of *Retail sentiment* is driven by measurement differences. Weekly sentiment survey data (*AAIISENT*) from the American Association of Individual Investors is used to provide a more fine-grained view on Retail sentiment rather than the monthly data on the University of Michigan Consumer Sentiment Index (*UMCSENT*). The *AAIISENT* measures the percentage of individual investors who are bullish, bearish, and neutral on the stock market in the short term. Re-running the regression specifications with the *AAIISENT* measure does not change the significance of the moderation effect, but does slightly improve the economic magnitude. Moreover, the *AAIISENT* models display an improved AIC and BIC, which underlines the better fitting of the more fine-grained sentiment data.

5. DISCUSSION AND CONCLUSION

5.1 Main findings

This paper examines the impact of the investor preference for skewness on the SPAC underperformance puzzle, based on a comprehensive set of 166 merged SPACs and 1,462 IPOs between 2014 and 2021. This relative underperformance of SPACs vis-à-vis IPOs is surprising given their similar function in the going-public market. The existing literature ascribes this underperformance to differences in corporate governance structures (Ganhg et al., 2021; Klausner et al., 2020; Dimitrova, 2017) and target heterogeneity (Bai et al., 2021; Datar et al., 2012; Kolb and Tykvová, 2016). However, this paper identifies the investor preference for skewness as the channel causing the SPAC underperformance puzzle. In short, SPACs are more positively skewed than IPOs which attracts skewness-preferring investors, resulting in overvaluation and lower subsequent returns. This conjecture is tested via four main hypotheses.

The first hypothesis tests whether SPACs underperform IPOs in the longer-term in order to confirms the puzzle's existence. In favour of the hypothesis, SPACs significantly underperform IPOs over holding periods of one, three, and six months using an event-time (i.e. BHAR) as well as a calendar-time (CTAR) approach. The magnitude of the underperformance ranges from -10.8% for the one-month BHAR to -20.8% for the six-month BHAR. Moreover, the SPAC underperformance puzzle remains robust when adjusting for market or industry returns or when operationalising a propensity scoring model to control for firm heterogeneity. Notably, the puzzle remains insignificant for the twelve-month holding period. This can be ascribed to the reduced SPAC sub-sample and general measurement problems of long-run buy-and-hold returns (Barber and Lyon, 1997; Kothari and Warner, 1997). In sum, SPACs underperform IPOs up to six months across measurements, adjustments and statistical tests. Hence, the first hypothesis is accepted.

The second hypothesis tests whether idiosyncratic skewness reduces longer-term returns in order to confirm the effect of the skewness preference. More specifically, positively skewed stocks become overpriced and earn lower subsequent returns (Kumar, 2009; Bali et al., 2011). In favour of the hypothesis, firms with high idiosyncratic skewness underperform firms with low idiosyncratic skewness using sorted portfolios as well as a regression approach. More specifically, a one-standard-deviation increase in idiosyncratic skewness decreases returns by -20.9% to -25.7% over holding periods up to six months. This effect remains robust when using separate yearly portfolios to eliminate time-varying clustering or when regressing market- or industry-adjusted returns. Surprisingly, the skewness-return relationship is insignificant for the twelve-month holding period. This is potentially due to skewness not being persistent over longer horizons (Singleton and Wingender; 1986; Fogler and Radcliffe, 1974). Moreover, time-varying volatility is more pronounced among longer-horizon returns resulting in a departure from the normality assumption which is required for many statistical tests (Eckbo, 2008). Taken together, idiosyncratic skewness reduces longer-term returns up to six months across different methodologies and adjustments. This serves as acceptance of hypothesis two and is in line with the skewness preference.

The third hypothesis tests whether SPACs have higher idiosyncratic skewness than IPOs. In favour of the hypothesis, SPACs are reported to exhibit 9.4% higher expected idiosyncratic skewness than IPOs after controlling for potential skewness proxies. The literature identifies age, book-to-market ratio and size as cross-sectional determinants of skewness (Jiang et al., 2019; Bali et al., 2011, 2020; Zhang, 2013). However, this study is only able to confirm the latter. Additionally, the SPAC return distributions are more positively skewed than those of IPOs up to six months. The twelve-month return distributions are therefore equal, potentially due to the mean-reversion over time. Taken together, SPACs have higher idiosyncratic skewness than IPOs which serves as acceptance of hypotheses three.

The fourth hypothesis tests whether the difference in idiosyncratic skewness between SPACs and IPOs drives the SPAC underperformance puzzle. In favour of the hypothesis, SPACs do no longer underperform their IPO counterparts within each skewness tercile. Put differently, the SPAC underperformance puzzle disappears after controlling for the higher idiosyncratic skewness among SPACs. This result is robust across holding periods up to six months and across methodological approaches such as alternative calendar-time weighted portfolios, propensity scoring models and a regression approach. Hence, the fourth hypothesis is accepted and is in line with the investor preference for skewness as the channel causing the SPAC underperformance puzzle.

The last part of this paper rules out alternative explanations and validates the skewness preference as the channel causing the SPAC underperformance puzzle by examining the puzzle in two specific contexts: institutional ownership and retail sentiment. When compared to institutional investors, retail investors have a preference for skewness (Kumar, 2009; Han and Kumar, 2013). Using institutional ownership as an inverse measure of retail investors, this study finds the strongest SPAC underperformance of -17.8% when institutional ownership is low (i.e. high retail ownership). Moreover, the puzzle becomes insignificant for high institutional ownership, corresponding to lower mispricing in absence of a skewness-preferring clientele. This evidence based on institutional ownership is strongly consistent with the skewness preference explanation.

When compared to the stable risk preferences of institutional investors, retail investors overweight small probabilities during high sentiment periods, which increases their skewness preference (Barberis and Huang, 2008; Green and Hwang, 2012; Blau, 2017). In line with expectation, this study finds the strongest SPAC underperformance of -9.2% during high retail sentiment periods while becoming insignificant during low sentiment periods. This sentiment-based evidence based is strongly consistent with the skewness preference explanation.

The fifth and sixth hypotheses test whether institutional ownership and retail sentiment moderate the skewness-return relationship. Both institutional ownership and retail sentiment exacerbate the mispricing of positively skewed. However, negatively skewed stocks remain unaffected by this skewness-related mispricing. Given this mispricing asymmetry between positively and negatively skewed stocks, institutional ownership is found to positively moderate the skewness-return relationship while retail sentiment negatively moderates the relationship. More specifically, for every one-standard-deviation increase in expected skewness, stocks in the low institutional ownership tercile (high retail sentiment tercile) underperform the other two terciles by an additional -3.3% (-6.5%). Hence, the investor preference for skewness is stronger during periods of high retail sentiment and in the presence of more skewness-preferring retail investors. This serves as acceptance of hypotheses 5 and 6.

5.2 Limitations and future research

This paper provides strong evidence that the investor preference for skewness is the channel causing the mispricing of positively skewed stocks and hence the SPAC underperformance puzzle. However, only theoretical evidence of limits to arbitrage is given to explain why the mispricing is persistent. Providing direct evidence of the persistence of the mispricing is important to strengthen the conclusions of this paper. Hence, future research could examine the relation between limits to arbitrage and the SPAC underperformance puzzle. In particular, more pervasive short-sale constraints among positively-skewed stocks might help to explain the persistence of the puzzle (Bris et al., 2007; Chang et al., 2007; Blau and Whitby, 2018).

This study employs both an event-time and a calendar-time methodology to measure the size of the SPAC underperformance puzzle. While the event-time methodology does not account for return autocorrelations, the calendar-time methodology does not adjust for time-varying clustering of events (Fama, 1998; Mitchell and Stafford, 2000; Dutta, 2015). Hence, there is potential variation in the statistical power across methodologies (Brav and Gompers, 1997; Barber and Lyon, 1997). The main regression analyses in this paper use buy-and-hold abnormal returns rather than calendar-time abnormal returns, given the more extreme time-varying clustering of SPAC as visualised in *Figure 2*. However, one could argue that return autocorrelations constitute a larger methodological problem. Subsequently, future research could address this limitation by conducting Fama-MacBeth (1973) cross-sectional regressions or a Standardized Calendar-Time Approach (SCTA) as proposed by Dutta (2015). Additionally, while this study uses Huber-White standard errors to account for heteroscedasticity, the statistical validity could be further enhanced through more sophisticated methods such as bootstrapping.

Against expectation, the expected skewness-return relationship is insignificant across the twelve month periods, potentially due to measurement issues. Firstly, expected skewness is unable to reliably predict idiosyncratic skewness for the twelve-month holding period. This corresponds to Singleton and Wingender (1986) who report an insignificant relationship between current and future skewness. Hence, skewness is not persistent in the long-term and is sensitive to sample sizes and time periods (Fogler and Radcliffe, 1974; Adcock and Shutes, 2005). Secondly, time-varying volatility is more pronounced among longer-horizon returns which is not captured by this study's cross-sectional approach. Subsequently, this results in a departure from the normality assumption, which is required for many statistical tests (Eckbo, 2008). Thirdly, the event-time methodology used in this paper is prone to misspecifications and an inflated rejection rate due to higher variance across longer holding periods (Barber and Lyon, 1997; Kohtari and Warner, 1997). Future research could overcome the above limitations by using more sophisticated methods to examine the SPAC underperformance puzzle over longer horizons. Examples include the Standardized Calendar-Time Approach by Dutta (2015) and bootstrapping.

Ex-ante skewness is often used to proxy a stock's expected skewness. However, capturing ex-ante skewness requires a long return history which is by definition unavailable on the first trading day of IPOs (merger day for SPACs). This study operationalises the expected skewness measure by Zhang (2006) and Green and Hwang (2012) that overcomes this limitation by using recent returns from industry peers. While this measure is robust to using narrower or wider industry-pooled return distribution, it remains an approximation of a firm's true expected skewness. Future studies could improve on capturing the true expected skewness in two distinct ways.

Firstly, this study classifies firms according to the Fama-French 17 industry classification. Using a finer industry partition (e.g. FF30 classification) increases intra-industry similarities to better approximate a firm's true expected skewness, but reduces the number of observations and thus the likelihood of capturing small probability events. Future research should aim to replicate these results on a more granular level by using a finer industry partition, conditional on using larger sample. This should be feasible given the record number of SPACs that went public in 2021 but did not have a long enough return history to be included in this study's sample. Additionally, extending the measurement periods leaves room for future papers to examine the long-term SPAC underperformance puzzle rather than this paper's longer-term focus (i.e. up to one year).

Secondly, future research could operationalise and compare different skewness measures to derive at a closer approximation of the firm's true expected skewness. Potential candidates are jackpot probability (Conrad et al., 2014), lottery index (Kumar et al., 2016), maximum daily return (Bali et al., 2011), excess tail probability (Jiang et al., 2020), and expected (idiosyncratic) skewness (Boyer et al., 2010). Another way of doing this is to construct a lottery factor by combining multiple dimensions, as in Jiang et al. (2021).

Finally, Kumar et al. (2019) and Barberis and Huang (2020) show that the investor preference for skewness is a common driver of mispricing across a wide range of market anomalies. Hence, future research could test whether the investor preference for skewness might help to explain other equity puzzles. A logical starting point are other positively skewed assets such as penny stocks, distressed stocks, OTC stocks and stock options.

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7. APPENDIX

Table 10: Regression models of expected skewness on idiosyncratic skewness over time

	Idiosyncratic skewness 1m	Idiosyncratic skewness 3m	Idiosyncratic skewness 6m	Idiosyncratic skewness 12m
	(1)	(2)	(3)	(4)
Expected skewness	0.369***	0.629***	0.322***	0.212
	(0.095)	(0.157)	(0.103)	(0.181)
Institutional ownership	-0.042	-0.142	-0.083	-0.119
	(-0.053)	(0.087)	(0.056)	(0.096)
SPAC	0.097	0.205*	0.178	0.395***
	(0.065)	(0.107)	(0.076)	(0.144)
Exchange	-0.037	-0.203***	-0.069	-0.137*
	(0.044)	(0.071)	(0.046)	(0.078)
Underwriter reputation	-0.013	0.014	-0.005	-0.004
	(0.011)	(0.018)	(0.012)	(0.002)
Log(Age)	-0.041*	-0.038	-0.053**	-0.057
	(-0.023)	(0.038)	(0.076)	(0.044)
Log(Size)	-0.027	-0.023	-0.035**	-0.190***
	(0.037)	(0.071)	(0.041)	(0.071)
Book-to-market	-0.185	-0.775	-0.903	-0.375
	(0.379)	(0.618)	(0.401	(0.697)
Log(Proceeds)	0.052**	0.018	0.019	0.030
	(0.024)	(0.04)	(0.027)	(0.047)
VC involvement	-0.005	0.054	0.045	0.151*
	(0.042)	(0.070)	(0.046)	(0.081)
Constant	0.599**	1.049**	0.953***	2.174***
	(0.301)	(0.496)	(0.338)	(0.594)
Industry fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
N	823	646	585	486
Adj. R^2	0.052	0.058	0.052	0.045
AIC	1076	1811	981	1456
BIC	1236	1971	1137	1607

*Note: Result of linear multivariate models where the dependent variables are the idiosyncratic skewness for holding periods of one (1), three (2), six (3), and twelve (4) months. Huber-White standard errors are used to account for heteroscedasticity and are shown in parentheses. Significance levels: *** 0.01, ** 0.05, * 0.10.*

Table 11: Pairwise correlations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
Firm characteristics																			
(1) Expected skewness	1.00																		
(2) Log(Age)	-0.04	1.00																	
(3) SPAC	0.15	-0.09	1.00																
(4) Exchange	0.07	0.13	-0.01	1.00															
(5) Institutional own.	-0.08	0.04	-0.07	0.05	1.00														
(6) Log(Size)	-0.09	0.11	-0.11	0.26	0.10	1.00													
(7) Book-to-market	-0.05	0.06	-0.10	0.13	0.04	0.12	1.00												
Deal characteristics																			
(8) Underwriter rep.	-0.01	0.03	-0.15	0.29	0.02	0.15	0.03	1.00											
(9) Log(Proceeds)	-0.09	-0.01	-0.11	0.40	0.07	0.27	0.06	0.57	1.00										
(10) Venture capital	-0.09	-0.12	-0.06	-0.01	0.11	0.45	-0.02	0.06	0.13	1.00									
Market conditions																			
(11) Retail sentiment	0.30	0.00	-0.05	0.05	0.13	-0.06	0.01	0.00	-0.09	-0.07	1.00								
(12) Market sentiment	0.21	0.06	-0.11	0.07	0.03	-0.10	0.03	0.05	-0.04	-0.09	0.59	1.00							
(13) Market return	-0.29	-0.06	0.05	-0.06	0.00	0.08	0.00	0.01	0.07	0.09	-0.23	-0.14	1.00						
(14) Russel 2000 return	-0.06	-0.03	-0.02	-0.05	0.04	0.02	-0.01	-0.04	0.00	-0.05	-0.02	-0.03	0.03	1.00					
(15) Market momentum	-0.21	-0.09	0.14	0.00	0.03	0.11	-0.02	-0.04	0.08	0.15	-0.20	-0.19	0.07	0.04	1.00				
(16) Market volatility	0.01	-0.10	0.12	-0.11	-0.02	0.01	-0.03	-0.07	-0.01	0.08	-0.36	-0.33	-0.23	0.02	0.04	1.00			
(17) Market skewness	0.29	-0.10	0.07	-0.01	-0.08	-0.06	-0.02	0.06	0.03	0.02	0.28	0.29	0.12	0.05	-0.37	-0.31	1.00		
Industry conditions																			
(18) Industry return	-0.24	-0.04	0.06	-0.03	0.00	0.10	0.04	0.02	0.07	0.10	-0.18	-0.12	0.80	0.03	0.05	-0.17	0.09	1.00	
(19) Industry volatility	0.02	-0.10	0.23	-0.04	-0.03	0.05	0.00	-0.08	0.02	0.07	-0.28	-0.28	-0.17	0.01	0.10	0.85	-0.27	-0.05	1.00

Note: Pairwise correlations are shown for the sample of N=1628.

Table 12: Logarithmic calendar-time return differences across SPACs and IPOs

Panel A: Full sample

	1 month CTAR			3 month CTAR			6 month CTAR			12 month CTAR		
	SPAC	IPO	SPAC - IPO	SPAC	IPO	SPAC - IPO	SPAC	IPO	SPAC - IPO	SPAC	IPO	SPAC - IPO
Intercept	-0.083***	0.003***	-0.086***	-0.049***	-0.009***	-0.040***	-0.055***	-0.019***	-0.038***	-0.039***	-0.029***	-0.010
	(0.003)	(0.001)	(0.001)	(0.004)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
$R_m R_f$	1.044***	0.133***	1.162***	0.013***	0.555***	0.822***	0.388***	0.144***	0.246***	0.116**	0.218***	-0.067***
	(0.084)	(0.013)	(0.024)	(0.013)	(0.011)	(0.030)	(0.065)	(0.0119)	(0.002)	(0.056)	(0.016)	(0.015)
SMB	1.025***	-0.156***	3.100***	0.577***	0.525***	-0.491***	0.961***	0.817***	-0.549***	1.425***	0.986***	-1.151***
	(0.123)	(0.018)	(0.004)	(0.021)	(0.018)	(0.041)	(0.114)	(0.020)	(0.002)	(0.986)	(0.258)	(0.020)
HML	0.584***	0.576***	0.844***	-0.157*	-0.383***	1.496***	-0.751***	-0.071***	0.029***	-1.010***	-0.171***	0.326***
	(0.142)	(0.021)	(0.042)	(0.018)	(0.015)	(0.051)	(0.086)	(0.016)	(0.002)	(0.746)	(0.021)	(0.025)
RMW	0.670***	0.923***	0.992***	0.924**	-1.649***	1.409***	-0.635***	-1.243***	0.742***	0.017	0.261***	-0.318
	(0.200)	(0.031)	(0.060)	(0.031)	(0.027)	(0.073)	(0.158)	(0.029)	(0.002)	(0.136)	(0.369)	(0.036)
CMA	-0.881***	-1.282***	-1.398***	-1.281***	-0.084***	1.551***	0.835***	-0.526***	1.326***	0.212*	-0.764***	0.825**
	(0.171)	(0.028)	(0.054)	(0.0279)	(0.024)	(0.065)	(0.136)	(0.262)	(0.002)	(0.117)	(0.033)	(0.032)
MOM	0.956***	-0.080***	1.891***	-0.080***	0.326***	1.379***	0.405***	0.121***	0.262***	-0.070	0.349***	-0.362*
	(0.093)	(0.014)	(0.042)	(0.014)	(0.012)	(0.033)	(0.072)	(0.013)	(0.002)	(0.062)	(0.017)	(0.016)
Adj. R^2	0.204	0.387	0.311	0.251	0.472	0.356	0.272	0.611	0.489	0.297	0.269	0.336

Panel B: Matched sample

	1 month CTAR	3 month CTAR	6 month CTAR	12 month CTAR
Intercept	-0.079***	-0.034***	-0.022***	-0.004
	(0.001)	(0.001)	(0.001)	(0.001)
Adj. R^2	0.109	0.179	0.150	0.081

*Note: Monthly calendar-time portfolios are formed which add all SPACs or IPOs that merger in the month before the portfolio formation and drop all SPACs or IPOs after a holding period of 1, 3, 6 or 12 months. The monthly portfolio returns are regressed on the six risk factors to obtain the monthly CTAR which is given by the intercept. Panel A reports the CTARs for SPACs and IPOs individually as well as the return difference between both portfolios. Panel B reports the CTARs of a matched sample which matches SPACs and IPOs with similar size, age, and book-to-market. Huber-White standard errors are given in parentheses. Significance levels: *** 0.01, ** 0.05, * 0.10.*

Table 13: Two-sample Kolmogorov-Smirnov test for SPACs vis-à-vis IPOs

Positive skewness	1 month BHAR	3 month BHAR	6 month BHAR	12 month BHAR
SPAC	0.099**	0.237***	0.186***	0.125
	(0.025)	(0.001)	(0.003)	(0.133)
IPO	0.017	-0.001	-0.002	-0.046
	(0.931)	(0.997)	(0.999)	(0.765)

*Note: The Kolmogorov-Smirnov test quantifies a distance between the buy-and-hold abnormal return distributions of SPACs and IPOs across one-, three-, six-, and twelve-month holding periods and assesses whether the distributions are equal or not. A positive difference indicates a more positively (left) skewed distribution whereas a negative difference indicates a more negatively (right) skewed distribution. P-values are given in parentheses. Significance levels: *** 0.01, ** 0.05, * 0.10.*

Table 14: Moderated regression with institutional ownership as moderator

	BHAR 1m	BHAR 3m	BHAR 6m	BHAR 1m	BHAR 3m	BHAR 6m
	(10)	(11)	(12)	(13)	(14)	(15)
SPAC	-0.031	-0.046	-0.038	-0.036	-0.049	-0.030
	(0.058)	(0.072)	(0.090)	(0.059)	(0.068)	(0.086)
Expected skewness	-1.058***	-1.348***	-1.325***	-1.017***	-1.461***	-1.227***
	(0.084)	(0.108)	(0.117)	(0.109)	(0.135)	(0.151)
SPAC * Expected	0.200	0.621	0.210	0.265	0.522	0.197
skewness	(0.160)	(0.200)	(0.260)	(0.232)	(0.199)	(0.026)
Inst. ownership (low)	-0.084***	-0.094***	-0.118***	-0.081***	-0.087***	-0.111***
	(0.029)	(0.041)	(0.044)	(0.036)	(0.042)	(0.046)
Inst. ownership (high)	0.031	0.041	0.006	0.032	0.046	0.025
	(0.032)	(0.040)	(0.044)	(0.040)	(0.056)	(0.060)
Inst. ownership (low)	-0.178***	-0.251***	-0.226***	-0.194***	-0.239***	-0.218***
* SPAC	(0.062)	(0.089)	(0.074)	(0.062)	(0.094)	(0.086)
Inst. ownership (high)	-0.019	-0.046	-0.039	-0.017	-0.062	-0.052
* SPAC	(0.079)	(0.102)	(0.135)	(0.086)	(0.198)	(0.214)
Inst. ownership (low)				-0.175**	-0.191**	-0.154*
* Expected skewness				(0.059)	(0.074)	(0.088)
Inst. ownership (high)				0.101	0.103	0.116
* Expected skewness				(0.162)	(0.231)	(0.252)
Exchange	-0.024	-0.032	-0.060	-0.024	-0.016	-0.047
	(0.030)	(0.039)	(0.043)	(0.031)	(0.038)	(0.043)
Underwriter reputation	0.038***	0.026**	0.014	0.037***	0.028**	0.016
	(0.008)	(0.011)	(0.012)	(0.008)	(0.018)	(0.012)
Log(Age)	0.019	0.032	0.000	0.021	0.028	-0.008
	(0.016)	(0.021)	(0.023)	(0.012)	(0.021)	(0.023)
Log(Size)	0.043	0.081**	0.066*	0.039	0.078**	0.059*
	(0.026)	(0.032)	(0.036)	(0.027)	(0.032)	(0.036)
Book-to-market	-0.064	-0.100	0.004	-0.063	-0.107	0.014
	(0.071)	(0.088)	(0.096)	(0.071)	(0.088)	(0.096)
Log(Proceeds)	0.002	0.026	0.022	0.001	0.022	0.018
	(0.017)	(0.022)	(0.025)	(0.057)	(0.022)	(0.025)
VC involvement	0.070**	0.046	0.066	0.069**	0.052	0.066
	(0.033)	(0.042)	(0.0947	(0.033)	(0.041)	(0.047)
Market sentiment	-0.089**	-0.075	-0.050	-0.091***	0.072	0.043
	(0.035)	(0.046)	(0.049)	(0.035)	(0.046)	(0.049)
Market return	9.212	1.047	-21.215	8.259	2.393	-19.751
	(12.229)	(16.540)	(18.752)	(12.313)	(16.610)	(18.854)
Russel 2000 return	0.834	1.472	-1.032	0.743	2.011	-1.07
	(0.907)	(1.257)	(1.355)	(0.909)	(1.258)	(1.365)
Market momentum	-0.225	-0.115	-0.611**	-0.225	-0.122	-0.597**
	(0.163)	(0.202)	(0.249)	(0.164)	(0.202)	(0.251)
Market volatility	2.543	17.081**	5.160	2.290	17.036**	3.326
	(6.529)	(8.548)	(9.611)	(6.554)	(8.627)	(9.735
Industry return	-11.899	-17.198	-14.334	-11.111	-18.340	-17.173
	(9.543)	(13.249)	(15.484)	(9.580)	(13.335)	(15.594
Industry volatility	-0.76	0.281	1.412	-0.403	0.236	3.280
	(5.908)	(8.627)	(9.916)	(5.919)	(8.718)	(10.073)
Constant	-0.672***	-1.228***	-0.935***	-0.670***	-1.265***	-0.934***
	(0.209)	(0.261)	(0.293)	(0.210)	(0.265)	(0.298)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	814	752	669	814	752	669
Adj. R^2	0.288	0.324	0.309	0.292	0.326	0.312
AIC	555	812	790	560	813	794
BIC	748	1001	971	771	1012	984

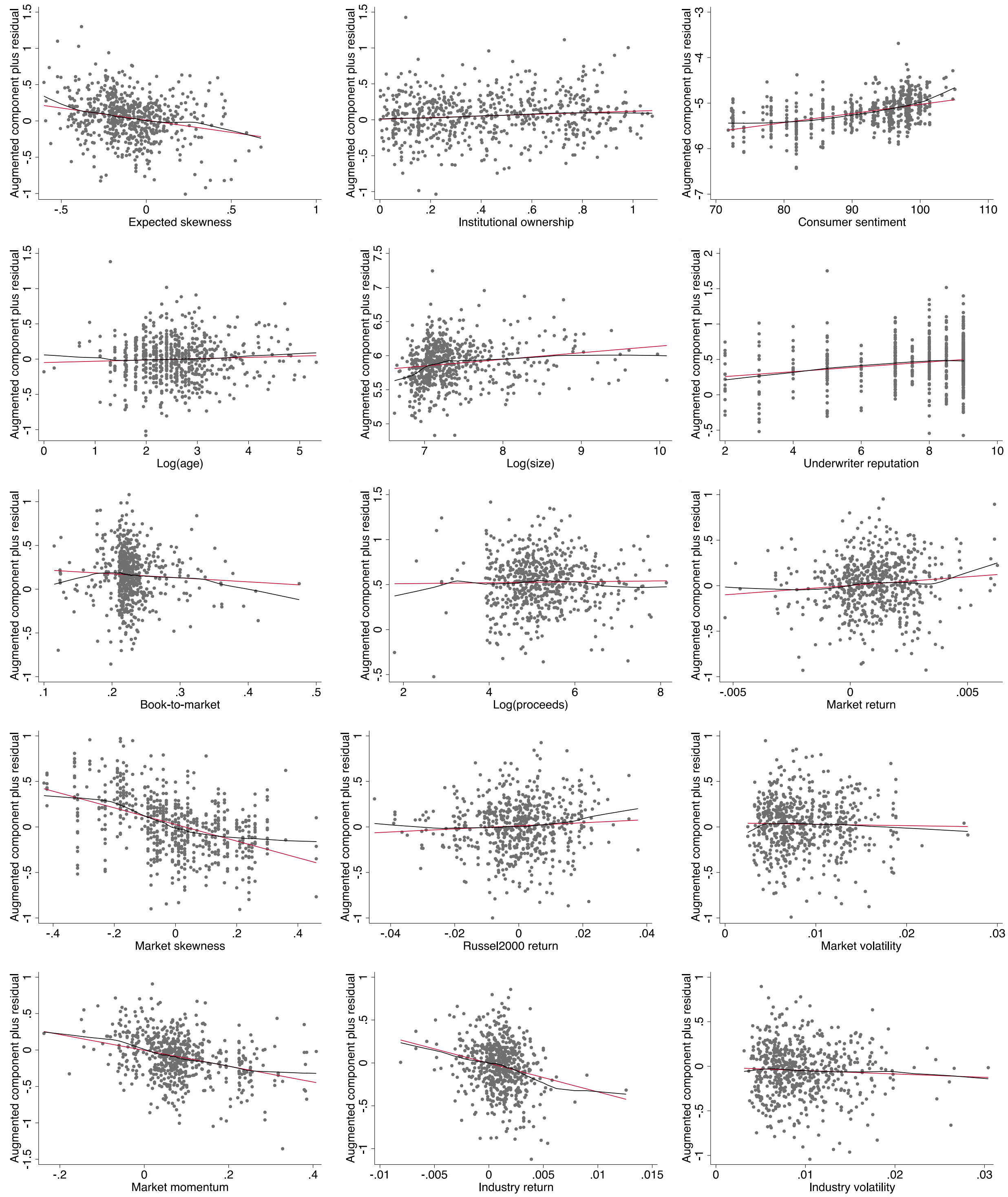
*Note: Result of linear multivariate models where the dependent variables are the buy-and-hold returns for holding periods of one (Model 10, 13), three (Model 11, 14) and six months (Model 12,15). Huber-White standard errors are used to account for heteroscedasticity and are shown in parentheses. Significance levels: *** 0.01, ** 0.05, * 0.10.*

Table 15: Moderated regression with retail sentiment as moderator

	BHAR 1m	BHAR 3m	BHAR 6m	BHAR 1m	BHAR 3m	BHAR 6m
	(16)	(17)	(18)	(19)	(20)	(21)
SPAC	-0.027	-0.051	-0.019	-0.040	-0.048	-0.027
	(0.057)	(0.078)	(0.099)	(0.067)	(0.091)	(0.105)
Expected skewness	-0.800***	-1.037***	-1.074***	-0.684***	-1.052***	-1.001***
	(0.093)	(0.125)	(0.0135)	(0.136)	(0.179)	(0.192)
SPAC * Expected	0.101	0.217	0.117	0.130	0.103	-0.140
skewness	(0.197)	(0.280)	(0.332)	(0.180)	(0.253)	(0.310)
Retail sentiment (low)	0.217***	0.280***	0.350***	0.173***	0.224***	0.312***
	(0.043)	(0.061)	(0.077)	(0.064)	(0.050)	(0.059)
Retail sentiment (high)	-0.132***	-0.140***	-0.093***	-0.114***	-0.171***	-0.089***
	(0.033)	(0.043)	(0.045)	(0.036)	(0.047)	(0.049)
Retail sentiment (low)	-0.044	-0.051	-0.026	-0.032	-0.044	-0.039
* SPAC	(0.106)	(0.098)	(0.078)	(0.090)	(0.124)	(0.095)
Retail sentiment (high)	0.092**	0.103**	0.114**	0.096**	0.119**	0.078**
* SPAC	(0.095)	(0.083)	(0.092)	(0.096)	(0.070)	(0.094)
Retail sentiment (low)				0.055	0.039	0.062
* Expected skewness				(0.165)	(0.137)	(0.175)
Retail sentiment (high)				-0.347**	-0.312**	-0.366**
* Expected skewness				(0.151)	(0.118)	(0.148)
Exchange	-0.022	-0.027	-0.056	-0.025	-0.026	-0.052
	(0.029)	(0.038)	(0.042)	(0.029)	(0.037)	(0.042)
Underwriter reputation	0.039***	0.030***	0.019	0.038***	0.028***	0.014
	(0.008)	(0.010)	(0.011)	(0.008)	(0.010)	(0.011)
Log(Age)	0.026*	0.035*	0.002	0.030*	0.038*	0.005
	(0.016)	(0.020)	(0.023)	(0.015)	(0.020)	(0.023)
Log(Size)	0.040	0.075**	0.064*	0.042*	0.083***	0.068*
	(0.025)	(0.032)	(0.036)	(0.025)	(0.031)	(0.035)
Book-to-market	-0.021	-0.051	0.050	-0.005	-0.034	0.070
	(0.069)	(0.088)	(0.095)	(0.068)	(0.086)	(0.093)
Log(Proceeds)	0.005	0.032	0.027	0.001	0.026	0.026
	(0.016)	(0.021)	(0.024)	(0.016)	(0.021)	(0.024)
VC involvement	0.061*	0.055	0.065	0.061*	0.052	0.055
	(0.031)	(0.041)	(0.046)	(0.031)	(0.041)	(0.045)
Market sentiment	-0.086**	-0.072	-0.047	0.099***	0.087*	0.065
	(0.034)	(0.046)	(0.049)	(0.033)	(0.046)	(0.048)
Market return	10.126*	2.569	-17.884	10.283	4.125	-14.289
	(11.984)	(16.548)	(18.587)	(11.718)	(16.186)	(18.198)
Russel 2000 return	1.060	2.030	-0.703	0.916	2.035*	-0.766
	(0.878)	(1.242)	(1.338)	(0.859	(1.218)	(1.310)
Market momentum	-0.423***	-0.279	-0.655***	-0.475***	-0.352*	-0.670***
	(0.161)	(0.204)	(0.250)	(0.159)	(0.203)	(0.250)
Market volatility	4.365	18.214**	7.152	3.117	18.035**	9.427
	(6.506)	(8.547)	(0.9514)	(6.266)	(8.359)	(9.337)
Industry return	-16.886	-22.192*	-20.899	-20.504**	-24.479*	-20.896
	(9.383)	(13.269)	(15.419)	(9.143)	(13.009)	(15.122)
Industry volatility	-2.371	0.813	0.096	-0.862	1.696	-1.002
	(5.765)	(8.585)	(9.825)	(5.637)	(8.401)	(9.624)
Constant	-0.632***	-1.245***	-1.001***	-0.697***	-1.343***	-1.126***
	(0.201)	(0.258)	(0.288)	(0.205)	(0.257)	(0.285)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	814	752	669	814	752	669
Adj. R^2	0.334	0.335	0.325	0.365	0.363	0.355
AIC	502	799	774	467	772	748
BIC	695	989	955	670	970	937

*Note: Result of linear multivariate models where the dependent variables are the buy-and-hold returns for holding periods of one (model 10), three (model 11) and six months (model 12). Huber-White standard errors are used to account for heteroscedasticity and are shown in parentheses. Significance levels: *** 0.01, ** 0.05, * 0.10.*

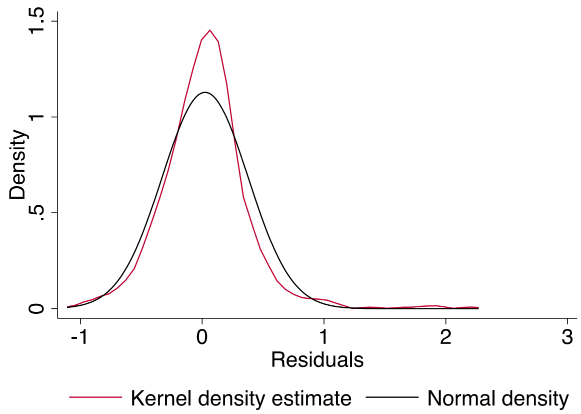
Figure 8: Augmented component plus residuals plots



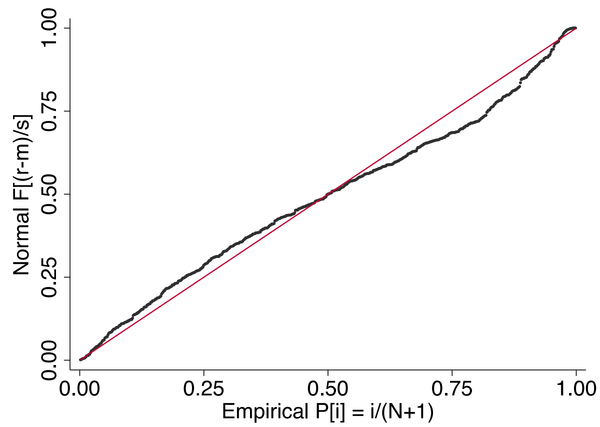
Note: Augmented component plus residuals plots for all included control variables. The smoothed line in given in black whereas the regression line in given in red to test linearity assumption. Large deviations from this regression line indicate potential nonlinearity.

Figure 9: Post-estimation plots

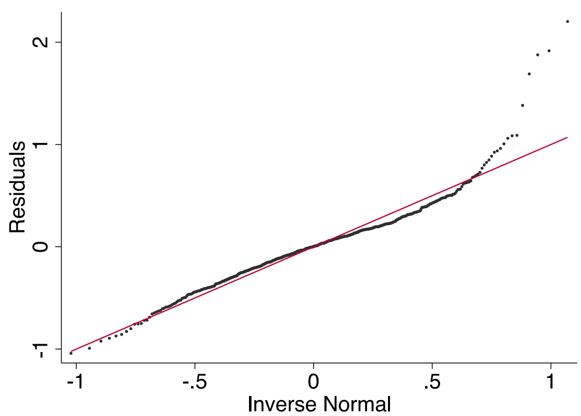
Panel A: Kernel density plot of residuals



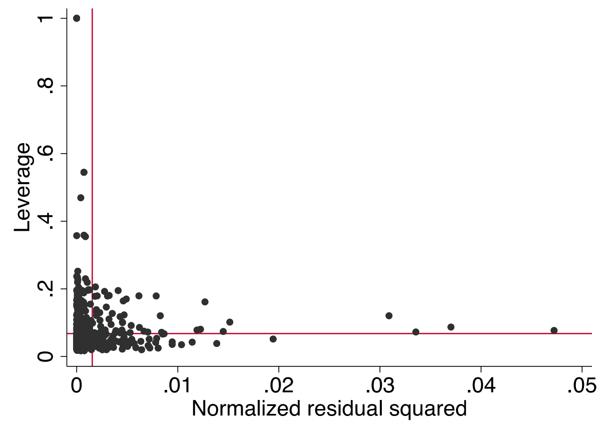
Panel B: Standardized normal probability



Panel C: Quantile-quantile plot



Panel D: Leverage versus normalized residual squared plot



Note: Kernel density plot of residuals, standardized normal probability, quantile-quantile plot to test normality assumption.

Table 16: Variance inflation factors

	BHAR 1m	BHAR 3m	BHAR 6m
	(1)	(2)	(3)
Expected skewness	6.620	6.830	7.050
SPAC	1.570	1.530	1.510
Expected skewness * SPAC	3.160	3.140	3.150
Exchange	1.380	1.370	1.380
Underwriter reputation	1.730	1.750	1.710
Log(Age)	1.210	1.190	1.170
Log(Size)	1.550	1.510	1.480
Book-to-market	1.280	1.280	1.310
Log(Proceeds)	1.890	1.890	1.870
VC involvement	1.500	1.460	1.450
Market skewness	2.420	2.460	2.610
Market sentiment	5.790	5.810	4.640
Market return	3.500	3.940	4.000
Russel 2000 return	1.080	1.090	1.090
Market momentum	1.920	1.810	1.390
Market volatility	7.700	8.180	8.600
Industry return	3.070	3.640	3.650
Industry volatility	7.960	8.280	8.310

Note: Variance inflation factors of al variables included in regression Model 3, 6, and 9 to identify multicollinearity.