BI Norwegian Business School - campus Oslo

GRA 19703

Master Thesis

Thesis Master of Science

Internet IPOs & the DotCom Bubble: Determinants of Post-Issue Performance

Navn:	Frieder Michael Vollmer, Gianpietro Di Vincenzo

Start:	15.01.2020 09.00
Finish:	01.09.2020 12.00

BI Norwegian Business School
Master of Science in Finance

Supervisor: Tatyana Marchuk
Date of submission: 1st of September 2020

Internet IPOs & the DotCom Bubble: Determinants of Post-Issue Performance

Master Thesis

Frieder Michael Vollmer ***Gianpietro Di Vincenzo***

Abstract

This paper investigates the short-term and long-term performance of initial public offerings (IPO) within the internet industry using a sample of 596 and 572 US listings from 1996 until 2016, respectively. Internet companies exhibit a particular degree of underpricing compared to the average IPO. Besides, they tend to underperform in the long term. Whereas first-day abnormal returns are amplified for listings during the DotCom bubble, a clear effect of the event on long-term performance could not be established. Eventually, we determine different IPO characteristics to determine post-issue performance over time through continuous adjustments of the information asymmetry between issuing companies, underwriters, and investors.

Keywords: IPO, Underpricing, Short-term Performance, Long-term Performance, Internet Industry, DotCom Bubble, Information Asymmetry, Private Equity, Venture Capital, Buyout

---

Acknowledgement: *We would like to thank our supervisor, Tatyana Marchuk, for the continuous and valuable input during the research process. We would further like to thank Sigrid Noer Gimse for granting us access to the Thomson Reuters Eikon database during the global COVID-19 pandemic.*

List of Abbreviations

A comprehensive list of acronyms used throughout this paper and the respective page indication of their first appearance

Acronym	*Meaning*	*Page*
IPO	Initial Public Offering	1
SEC	Securities and Exchange Commission	4
PE	Private Equity	16
BO	Buyout	16
LBO	Leveraged Buyout	16
VC	Venture Capital	16
USD	United States Dollar ($)	25
AR	Abnormal Return	36
OLS	Ordinary Least Squares	40
VIF	Variance Inflation Factor	45
CAR	Cumulative Abnormal Return	46
BHAR	Buy-and-Hold Abnormal Return	46

Note: This thesis derives from a previous collaboration between Gianpietro Di Vincenzo and Ana Beatriz Rêgo de Sá Barreto. As a result, textual similarities might occur from a mutual version preceding the preliminary thesis.

Table of Contents

1. Introduction & Motivation

1.1. Introduction

In the early 1990s, market excitement and government incentives joined to build the path to a digital and seemingly utopian future. With the rise of the internet, a global marketplace and revolutionary changes to business, communication, and everyday life emerged. Due to its commercialisation, the markets witnessed an enormous shift from the tangible-asset-heavy companies of the 19th and 20th centuries to intangible-asset-intensive firms such as Google, Facebook, and Uber. However, an enthusiastic wave of investments in internet stocks culminated in what is widely known as the DotCom bubble. Following exponential growth, its burst ultimately caused panic among investors and resulted in steep value losses of technology stocks and the subsequent bankruptcies of many companies within the industry in the early 2000s.

Nonetheless, the emergence of this innovative technological context has continued to attract a vast amount of investments and has drawn increasing attention to so called unicorn companies, private start-ups with a valuation exceeding $1 billion. According to CB Insight (2020), a growing number of venture capital-backed tech start-ups target unicorn status before going public. However, there is a rising concern about the overvaluation of these companies and their ability to deliver results that will not undermine investors' expectations.

Although some investors worry that a new internet bubble is on the rise following the vast amounts tech unicorns have been receiving from venture capitals before going public, it seems that these start-ups are no exception to previous research regarding initial public offerings (IPO). Empirical evidence shows that there are two main patterns: Short-run underpricing and long-run underperformance (e.g., Stoll & Curley, 1970; Ritter, 1991; Ljungqvist & Wilhelm, 2003). From 1980 to 2001, the number of companies going public in the US exceeded one per business day. At the end of the first trading day, their shares traded on average at 18.8% above the initial listing price. For an investor buying shares at the first-day closing price and holding them for three years, IPOs returned to 22.6%. Yet, over three years, the average IPO underperformed the market by 23.4% and seasoned companies with the same market capitalisation and book-to-market ratio by 5.1% (Ritter & Welch, 2002).

The discrepancy between the valuation a company had agreed upon with private investors and how the public market values them appears to hold within the technology sector, too. Square Inc., a mobile-payment unicorn, went public in November 2015 at $9 per share. However, during their last round of private funding, investors bought shares at $15.5. Uncertainty surrounding an IPO is alleged to explain why some companies experience underpricing (e.g., Ritter, 1984; Beatty & Ritter, 1986; Rock, 1986). Moreover, evidence regarding a relationship between underpricing and ensuing subpar long-term returns has emerged (Michaely & Shaw, 1995; Carter, Dark, & Singh, 1998; Teoh, Welch, & Wong, 1998b; Levis, 2011). Research indicates specific IPO characteristics, which may influence the performance of these companies, such as offering size, underwriters involved, or financial sponsorship, among others (e.g., Benveniste & Spindt, 1989; Megginson & Weiss, 1991; Corwin & Schultz, 2005).

This general tendency raises the question if internet stocks conform and experience initial underpricing and subsequent underperformance following their IPO. The analysis is carried out over three distinct time intervals concerning before, during, and after the DotCom bubble, which allows examining potential similarities or dissimilarities surrounding this particular event of interest. Specifically, the effect of certain IPO attributes on these phenomena becomes the focus of attention. Therefore, the research question of this study is:

'Which characteristics influence Internet IPOs' short-term and long-term performance?'

Our results show that internet stocks are particularly impacted by post-issue underpricing and long-run underperformance compared to the average US IPO. While we observe higher first-day abnormal returns for listings during the DotCom bubble, a clear effect of the latter on long-term performance could not be established. We identify higher proceeds, a larger syndicate size, and periods of high IPO activity to affect both short-term and long-term performance of internet IPOs. Venture capital, a common form of financial sponsorship within the technology sector, further influences underpricing, presumably due to venture capitalists' preference for riskier investments in growing industries. However, this effect on performance wears off over time.

The paper is organised as follows. Section 2 defines the standard IPO processes and takes a retrospective view on IPOs within the internet industry, including the effect of the DotCom bubble. Besides, it reviews the existing research literature on IPO underpricing and long-term performance. Section 3 further contrives the central research question and presents the hypotheses underlying this study. Section 4 elaborates on the dataset used for the analysis. Next, section 5 presents the methodology applied and discusses the results. First, the extent of internet IPO underpricing and long-run returns is estimated. Second, main corporate characteristics, which may influence the post-issue performance of internet companies are discussed. Section 6 concludes the findings. Finally, section 7 prompts further areas of interest to be investigated following our analysis.

1.2. Motivation

One event particularly marked the financial history of the internet industry when looking back at the late 1990s and early 2000s: The DotCom bubble. Although many investors incurred significant losses, some internet companies resisted its burst. Many others have entered the market since. A new and similar era of investment craze in tech start-ups as the one preceding the bubble seems to be occurring now. Two famous examples of internet companies to receive substantial funding infusions from venture capital firms are Uber, with an estimated value exceeding $62 billion, and Airbnb, worth approximately $26 billion. While the industry is more mature than it was by the end of the 1990s, investors voice growing concerns regarding the emergence of a new bubble menacing the stock value of internet companies (Foroohar, 2019). Therefore, it is highly relevant to understand if companies undergoing an IPO in recent years share similarities with those that went public during the DotCom bubble. Consequently, this study intends to contribute to the financial industry with a deeper understanding of the factors that influence internet company performance following an IPO and the short-term and long-term market reactions they cause.

2. Literature Review

IPOs have gained particular attention within contemporary research since the late 1960s (e.g., Chalk & Peavy III, 1967; Reilly & Hatfield, 1969; Stoll & Curley, 1970; McDonald & Fisher, 1972; Logue, 1973). The following section defines the standard processes during an IPO and introduces relevant literature regarding internet company IPOs and the DotCom bubble. Subsequently, we review existing research regarding the determinants of IPO underpricing and, eventually, their long-term performance.

2.1. The Standard IPO Process

An IPO, or 'going public', refers to the process of making a formerly private company available as an investment for public investors through the issuance of shares. For the company, on the one hand, this provides the opportunity to access capital and raise funds. Investors, on the other hand, gain specific benefits and responsibilities as shareholders, such as voting rights, claims on dividends, and insights into basic corporate documents. However, public companies in the US fall under the scrutiny of regulation by the Securities and Exchange Commission (SEC) and need to adhere to a multitude of stock exchange requirements, such as the disclosure of business-relevant information. Furthermore, going public usually implies considerable governance changes like the formation of a board of directors. When interested in an IPO, a company will hire a so-called underwriter and their syndicate to lead the subsequent process. These financial specialists advise the company in deciding upon an issuance date, the initial share price as well as the number of issued shares. The role is typically taken on by investment banks, and the process is known as 'book building'. Companies either draw investor interest through a public announcement or they advertise to underwriters by requesting private bids. Often, underwriters commit to a 'best-effort' agreement in which they consent to distribute as many securities to investors as possible. In other cases, they guarantee to sell all securities by purchasing them directly for reselling purposes. Thus, they carry the full risk under such a 'firm commitment'. In addition to their compensation, underwriters commonly gain the right to an over-allotment, or greenshoe option, which allows them to sell investors up to 15% additional shares to those initially intended by the issuing company if demand exceeds early

expectations. The company itself benefits through the provision of liquidity and price stability.

Alternatives to IPOs when going public exist, such as a Direct Listing without reliance on underwriters or a Dutch Auction, in which investors can bid for shares instead of the company setting an initial price. Yet, IPOs, including the involvement of often several underwriters simultaneously, remain the most common approach. According to existing literature, however, IPOs commonly result in companies' short-term underpricing and long-term underperformance (e.g., Ritter, 1991). Underpricing occurs when companies offer their shares at a price below their real market value when engaging in an IPO, which they converge to at the end of the first trading day. **Figure 1** displays the yearly IPO activity in the US from 1980 until 2019. **Table 1** and **Table 2** summarise the patterns in issuing activity, underpricing, and long-run underperformance during this time, which confirm the aforementioned insights, and which have formed the focus of an extensive theoretical and empirical literature (Ritter & Welch, 2002).

Figure 1: Number of IPOs on US Exchanges per Year
(1980-2019)

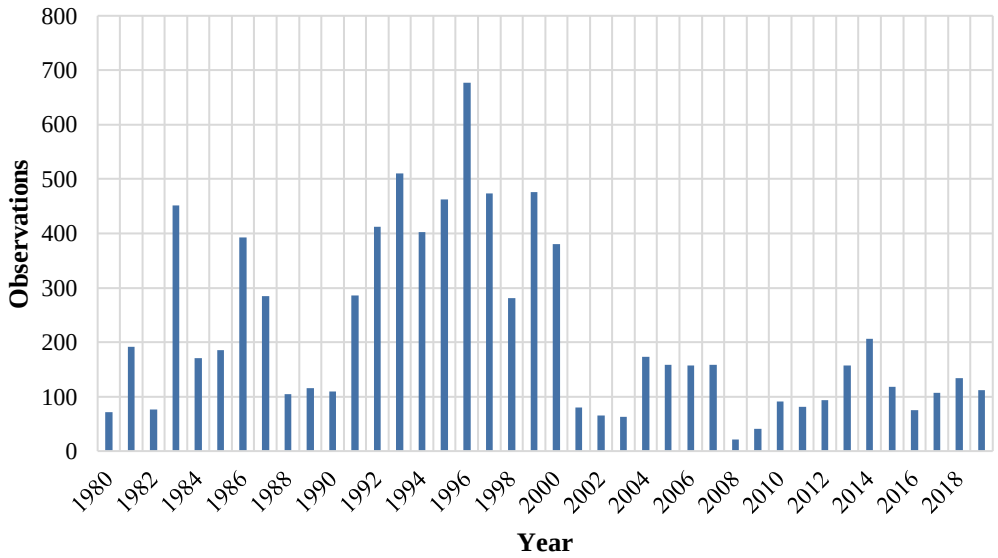


Table 1: Short-Term IPO Performance per Year and Time Period (1980-2019)

Yearly overview of the number of IPOs, average first-day returns, and additional metrics related to post-issue short-term performance from 1980 until 2019. Aggregate numbers indicate statistics for the periods before (1980-1998), during (1999-2000), and after the DotCom Bubble (2001-2019) as well as the entire period (1980-2019). The sample consists of IPOs with an offer price of at least $5.00, excluding ADRs, unit offers, closed-end funds, REITs, natural resource limited partnerships, small best efforts offers, banks and S&Ls, and stocks not listed on CRSP (CRSP includes Amex, NYSE, and NASDAQ stocks). Proceeds exclude overallotment options but include the global offering size. The amount of money left on the table is defined as the closing market price on the first-day of trading minus the offer price, multiplied by the shares offered. Market value includes the market value of all share classes using the post-issue number of shares. Amounts are CPI-adjusted with 2015 as base. Data and descriptions were retrieved from 'Initial Public Offerings: Updated Statistics' (Ritter, 2020).

		Mean First-Day Return				
Year	*Number of IPOs*	*Equal-weighted*	*Proceeds-weighted*	*Aggregate Amount Left on the Table (in bn)*	*Aggregate Proceeds (in bn)*	*Market Value at 1st Closing Market Price (in bn)*
1980	71	14.3%	20.0%	$0.06	$0.32	$2.04
1981	192	5.9%	5.7%	$0.05	$0.89	$4.11
1982	77	11.0%	13.3%	$0.05	$0.41	$2.08
1983	451	9.9%	9.4%	$0.35	$3.74	$17.38
1984	171	3.7%	2.5%	$0.02	$0.89	$3.84
1985	186	6.4%	5.3%	$0.10	$1.86	$6.89
1986	393	6.1%	5.1%	$0.31	$6.20	$21.63
1987	285	5.6%	5.7%	$0.32	$5.60	$21.86
1988	105	5.5%	3.4%	$0.06	$1.94	$10.80
1989	116	8.0%	4.7%	$0.14	$3.04	$11.70
1990	110	10.8%	8.1%	$0.19	$2.35	$9.81
1991	286	11.9%	9.7%	$0.86	$8.82	$31.06
1992	412	10.3%	8.0%	$1.08	$13.43	$44.02
1993	510	12.7%	11.2%	$2.15	$19.16	$76.80
1994	402	9.6%	8.3%	$0.89	$10.74	$40.02
1995	462	21.4%	17.5%	$3.15	$17.97	$81.65
1996	677	17.2%	16.1%	$4.47	$27.83	$142.28
1997	474	14.0%	14.4%	$3.09	$21.51	$95.49
1998	281	21.9%	15.6%	$3.61	$23.14	$112.79
1999	476	71.2%	57.4%	$26.08	$45.45	$458.22
2000	380	56.3%	45.8%	$21.56	$47.08	$466.43
2001	80	14.2%	8.4%	$2.22	$26.03	$87.41
2002	66	9.1%	5.1%	$0.86	$16.72	$63.75
2003	63	11.7%	10.4%	$7.73	$7.40	$31.05
2004	173	12.3%	12.4%	$3.08	$24.86	$117.94
2005	159	10.3%	9.3%	$2.18	$23.26	$86.52
2006	157	12.1%	13.0%	$3.36	$25.92	$114.82
2007	159	14.0%	13.9%	$4.33	$31.20	$185.46
2008	21	5.7%	24.8%	$5.11	$20.67	$57.23

2009	41	9.8%	11.1%	$1.32	$11.92	$53.40
2010	91	9.4%	6.2%	$1.69	$27.43	$103.96
2011	81	13.3%	13.0%	$3.33	$25.60	$150.90
2012	93	17.7%	8.9%	$2.68	$30.14	$175.33
2013	157	21.0%	20.5%	$7.80	$38.09	$252.60
2014	206	15.5%	12.8%	$5.39	$42.15	$237.72
2015	118	19.2%	18.7%	$4.16	$22.00	$150.00
2016	75	14.5%	14.4%	$1.82	$12.68	$80.00
2017	107	13.0%	15.0%	$3.82	$23.78	$167.54
2018	134	18.6%	19.1%	$6.77	$35.46	$228.84
2019	112	23.5%	17.7%	$7.48	$42.26	$357.03
1980-1989	2,047	7.2%	6.1%	$1.48	$24.86	$102.33
1990-1998	3,614	14.8%	13.3%	$19.49	$144.96	$633.92
1999-2000	856	64.6%	51.6%	$47.64	$92.53	$924.66
2001-2019	2,093	14.8%	13.7%	$75.13	$487.56	$2,701.48
1980-2019	**8,610**	**18.0%**	**18.4%**	**$143.75**	**$749.91**	**$4,362.38**

Table 2: Long-Term IPO Performance per Year and Time Period (1980-2018)

Yearly overview of the number of IPOs and the average 3-year buy-and-hold returns as representation of post-issue long-term performance from 1980 until 2018. Aggregate numbers indicate statistics for the periods before (1980-1998), during (1999-2000), and after the DotCom Bubble (2001-2018) as well as the entire period (1980-2018). The equally weighted (EW) average first-day return is measured from the offer price to the first CRSP-listed closing price. EW average 3-year buy-and-hold percentage returns (capital gains plus dividends) are calculated from the first closing market price to the earlier of the 3-year anniversary price, the delisting price, or Dec. 31, 2019. Buy-and-hold returns for IPOs occurring after Dec. 31, 2018 are not calculated. Market-adjusted returns are calculated as the buy-and-hold return on an IPO minus the compounded daily return on the CRSP value-weighted index of Amex, NASDAY, and NYSE firms. Style-adjusted buy-and-hold returns are calculated as the difference between the return on an IPO and a style-matched firm. For each IPO, a non-IPO matching firm that has been CRSP-listed for at least five years with the closest market capitalisation (size) and book-to-market ratio as the IPO is used. Market capitalisation is calculated using the first closing market price after the IPO. If this stock is delisted prior to the IPO return's ending date, or if it conducts a follow-on stock offering, a replacement matching firm is spliced in on a point-forward basis. IPOs with an offer price below $5.00 per share, unit offers, small best efforts offers, natural resource limited partnerships, REITs, closed-end funds, banks and S&Ls, ADRs, and IPOs not listed on CRSP within six months of issuing have been excluded. Data and descriptions were retrieved from 'Initial Public Offerings: Updated Statistics' (Ritter, 2020).

Year	*Number of IPOs*	**Mean 3-Year Buy-and-Hold Return**		
		IPOs	*Market-adjusted*	*Style-adjusted*
1980	71	89.8%	37.0%	18.5%
1981	192	12.0%	-27.2%	11.1%
1982	77	37.5%	-31.5%	-12.0%
1983	451	15.9%	-37.7%	-4.4%
1984	171	50.2%	-28.5%	29.0%
1985	186	5.6%	-41.3%	-12.3%
1986	393	16.9%	-22.6%	-1.3%
1987	285	-2.6%	-19.1%	-11.2%
1988	105	58.0%	9.7%	38.7%
1989	116	48.1%	13.2%	7.2%
1990	110	9.7%	-35.9%	-38.4%
1991	286	31.2%	-1.8%	5.8%
1992	412	37.4%	-0.2%	11.1%
1993	510	44.1%	-8.7%	-9.5%
1994	402	78.0%	-5.7%	-0.9%
1995	462	28.6%	-58.0%	-24.7%
1996	677	25.2%	-56.8%	7.0%
1997	474	58.3%	-2.0%	22.0%
1998	281	23.4%	5.7%	-5.2%
1999	476	-47.6%	-32.5%	-60.6%
2000	380	-60.1%	-30.9%	-56.9%
2001	80	17.8%	14.4%	-28.1%
2002	66	68.6%	39.0%	-0.4%

2003	63	34.0%	-7.7%	-11.2%
2004	173	51.4%	6.9%	-7.0%
2005	159	14.6%	3.1%	-2.5%
2006	157	-28.8%	-11.1%	-4.5%
2007	159	-16.5%	-0.4%	0.5%
2008	21	11.4%	8.1%	5.1%
2009	41	37.0%	-5.1%	-18.3%
2010	91	36.4%	-9.6%	-18.5%
2011	81	38.6%	-8.7%	-11.6%
2012	93	81.9%	31.8%	33.4%
2013	157	12.4%	-14.2%	-16.0%
2014	206	17.1%	-9.7%	-12.3%
2015	118	24.5%	-9.9%	-26.3%
2016	75	70.4%	29.4%	26.0%
2017	107	34.3%	2.4%	18.6%
2018	134	8.3%	-8.6%	6.2%
1980-1989	2,047	22.5%	-22.6%	2.2%
1990-1994	1,720	46.1%	-6.6%	-1.9%
1995-1998	1,894	34.0%	-34.1%	1.2%
1999-2000	856	-53.1%	-31.8%	-58.9%
2001-2018	1,981	23.4%	0.2	-4.5%
1980-2018	**8,498**	**22.4%**	**-17.5%**	**-6.6%**

2.2. Internet Stock IPOs & The DotCom Bubble

Ritter and Welch (2002) categorise internet companies under the technology sector. The scholars define them as companies, which provide their products or services primarily online. They are usually without immediate prospects of becoming profitable after going public and, thus, might carry considerable risk for investors following their IPO.

The rise of the internet fostered the development of the highly innovative business environment of the early 1990s. With it came an exuberance of newly emerging technology companies aiming to redefine the economy, which ultimately resulted in the formation of the internet industry. Netscape began to transform these ideas into reality when developing Mosaic, the first web browser, which created a link between consumers and the commercialisation of the internet. In 1995 Netscape went public according to an innovative investment logic, in which traditional valuation metrics were replaced by discounting expected cash flows. The IPO served as a model for other internet companies, such as Yahoo! with a first-day

return of 152%. Goodnight and Green (2010) summarise the investment cycle during this period: Companies invested in branding to raise public awareness, which would support sustainable profits in the future. The goal was to grow through venture capital funds and proceeds from the IPO, and subsequently pay investors. 'A loop was formed: profits from IPO investments poured back into new venture funds, then into new start-ups, then back out again as IPOs' (p. 124).

The scenario gradually changed after the NASDAQ Composite Index peaked on the 10th of March 2000, indicating the climax of the DotCom bubble. Within less than a month, the index had decreased by more than 16% below its high. The loss equalled almost $1 trillion (Ulick, 2000; Geier, 2015). By October 2000, it had fallen by 78.4%, a plunge that took over 13 years to recover from (Hulbert, 2020; Randewich & Krauskopf, 2020). In accordance, Fong, Lean, and Wong (2008) show that prices of internet stocks multiplied six-fold between 1995 and 2000, outperforming the S&P 500 by a substantial 482%. Subsequently, their prices receded by more than 80% through the end of December 2003. As a result, approximately 800 internet companies disappeared (Goodnight & Green, 2010).

The internet industry has recovered since, and many new companies have entered the market. Among those that performed an IPO many recent examples of being affected to a particular degree by underpricing exist. Twitter, for instance, sold a volume of 70 million shares for $26 per share, when it could have sold them to investors for $45 according to their first-day closing price. Alibaba sold for $68 per share on the first trading day, when it could have sold for $94. As a result, both IPOs left considerable amounts of money on the table.

2.3. IPO Underpricing

The research field concerning first-day returns initially gained momentum during the 1970s (Stoll & Curley, 1970; McDonald & Fisher, 1972; Logue, 1973; Reilly, 1973; Ibbotson & Jaffe, 1975). Ibbotson (1975) finds significant empirical evidence for IPO underpricing during the 1960s and conducted further investigations into why this has contracted a habit. Subsequently, Ritter (1984) and Ritter and Welch (2002) conduct a review on the theory and evidence of IPO activity and reveal a long-term pattern. The scholars show that shares of newly publicly issued firms traded on average at 18.8% above the initial company offer at the end of the first

trading day. Despite the level of underpricing seemingly varying among different industries, a common consensus has been established about IPOs being underpriced on average.

The topic mainly came into vogue following the DotCom bubble, which was responsible for exceptionally high first-day returns on IPOs (Loughran & Ritter; 2004; Coakley, Hadass, & Wood, 2009; Hahn, Ligon, & Rhodes, 2013). Ljungqvist and Wilhelm (2003) focus on IPO pricing during this period specifically and find that in 1996, at the beginning of the bubble, first-day returns of all IPOs overall averaged 17%. Underpricing rose to 73% in 1999 and 58% in 2000. However, internet companies, in particular, exhibited an even more unanticipated rise when compared to other IPOs, reaching an average first-day return of 89% during 1999 and 2000. Karlis (2008) attributes this to the higher uncertainty that investment bankers face when pricing their initial offers for internet companies.

Nonetheless, there is currently no universal consensus regarding the origin of underpricing. As a result, we examine the different potential drivers surrounding the phenomenon. We present a summary of theories, which centre around the dynamic of information asymmetry between the issuer, underwriter, and investor. They include the amount of proceeds raised, the lead underwriter reputation, the size of their syndicate, the type of financial sponsorship companies received, and if the listing occurred in a period of generally high IPO activity. **Table 3** displays an overview of prior research on this IPO underpricing phenomenon.

Table 3: Summary of Prior Literature on IPO Underpricing

An overview of existing research on IPO underpricing. All types of financial sponsorship included in the aggregate. The list is ordered alphabetically by author.

#	Author(s)	Market	Period	Metric	Mean	Median	Sample Size	Comment
1	Ainina & Mohan (1991)	US	1983-1987	First-Day Closing Price	2.4%		-	-
2	Beatty & Ritter (1986)	US	1981-1982	First-Day Closing Price	14.1%		545	-
3	Booth & Chua (1996)	US	1977-1988	First-Day Closing Price	13.1%		-	-
4	Bradley, Cooney, Jordan, & Singh (2004)	US	1981-2000	First-Day Closing Price	20.5%		4,989	-
5	Carter & Manaster (1990)	US	1979-1983	Closing Price 2 Weeks after IPO	6.3%	16.2%	501	-
6	Carter, Dark, & Singh (1998)	US	1979-1991	First-Day Closing Price	8.1%	2.4%	2,292	-
7	Chalk & Peavy III (1967)	US	1975-1982	First-Day Closing Price	21.7%		649	-
8	Chi & Padgett (2005)	China	1996-1997	First-Day Closing Price	127.3%	118.3%	340	-
9	Coakley, Hadass, & Wood (2009)	UK	1985-2003	First-Day Closing Price	10.5%		591	-
9	Coakley, Hadass, & Wood (2009)	UK	1998-2000	First-Day Closing Price	16.9%		101	DotCom Bubble
10	Corwin & Schultz (2005)	US	1997-2002	First-Day Closing Price	39.5%	14.3%	1,638	-
11	Dark & Carter (1993)	US	1979-1984	First-Day Closing Price	10.6%		1,212	-
12	Ferretti & Meles (2011)	Italy	1998-2008	First-Day Closing Price	4.7%		160	-
13	Francis & Hasan (2001)	US	1990-1993	First-Day Closing Price	11.4%		843	-
14	Hahn, Ligon, & Rhodes (2013)	Global	1988-2009	First-Day Closing Price	27.8%	11.1%	2,693	-
14	Hahn, Ligon, & Rhodes (2013)	Global	1999-2000	First-Day Closing Price	71.3%	35.0%	624	DotCom Bubble
15	Hesjedal (2007)	Norway	2004-2006	First-Day Closing Price	3.2%	1.7%	41	-
16	Hoque (2014)	UK	1999-2006	First-Day Closing Price	22.5%	9.5%	831	-
17	Ibbotson (1975)	US	1960-1969	Closing Price at End of Month	11.4%		-	-
18	Ibbotson & Jaffe (1975)	US	1960-1970	Closing Price at End of Month	16.8%		128	-
19	Ibbotson, Sindelar, & Ritter (1988)	US	1960-1987	Closing Price at End of Month	16.4%		8,668	-
20	Ibbotson, Sindelar, & Ritter (1994)	US	1960-1969	Closing Price at End of Month	21.3%		2,661	-
20	Ibbotson, Sindelar, & Ritter (1994)	US	1960-1992	Closing Price at End of Month	15.3%		10,626	-
20	Ibbotson, Sindelar, & Ritter (1994)	US	1970-1979	Closing Price at End of Month	9.0%		1,658	-
20	Ibbotson, Sindelar, & Ritter (1994)	US	1980-1989	Closing Price at End of Month	15.2%		5,155	-
20	Ibbotson, Sindelar, & Ritter (1994)	US	1990-1992	Closing Price at End of Month	10.9%		1,151	-
21	Jog & Riding (1987)	Canada	1971-1983	Closing Price 1 to 10 Days after IPO	9.0%-11.5%		160	-
22	Karlis (2008)	US	1990-1999	First-Day Closing Price	109.7%	83.3%	19	Internet
22	Karlis (2008)	US	1990-1999	First-Day Closing Price	21.6%	14.9%	68	Non-Internet
23	Krigman, Shaw, & Womack (2001)	US	1993-1995	First-Day Closing Price	7.7%-14.2%		578	-
24	Levis (2011)	UK	1992-2005	First-Day Closing Price	18.6%		1,595	-

2.3.1. Information Asymmetry

Information asymmetry is the most prominent conjecture used to explain IPO underpricing and builds the foundation of several theories. It refers to the inequality of information among the key participants during an IPO process (i.e., the issuing firm, the investors, and the underwriters of the IPO). In the case of the issuing firm holding more information than the investor, rational investors fear what Akerlof (1970) calls the lemon problem. His theory refers to the general reduction of product quality in the market due to information asymmetry between buyer and seller. The consequent difference in the perceived value of the investment results in a risk for the buyer, as the seller could attempt to dispose of an inferior 'lemon', yielding an almost guaranteed loss. Thus, they demand a deep discount to compensate for this possibility, which, in turn, discourages sellers from offering products of superior value. As a result, several researchers apply underpricing as a proxy for information asymmetry (Gompers, 1996; Lee & Wahal, 2004; Michala, 2019).

Rock's (1986) model of underpricing distinguishes between informed and uninformed investors. Informed investors can identify if the shares being offered at a given price are overpriced or underpriced, whereas uninformed investors are unable to draw such a distinction and subscribe either to both offering cases or to none. This dynamic creates a dilemma, in which uninformed investors are only allocated shares when informed investors do not consider subscribing to the offer. Therefore, to ensure that uninformed investors gain a positive expected initial return and, thus, have an incentive to join the IPO, issuing firms underprice their shares. Applying Rock's model, Beatty and Ritter (1986) are able to prove that, the higher investors' uncertainty regarding an IPO's value once the shares start to trade publicly, the more underpriced they expect the offering to be. Subsequent research confirms this effect of information asymmetry on underpricing (Michaely & Shaw, 1994; Hoque, 2014). Hence, the uninformed investor requires greater underpricing for a high-risk IPO to compensate for the scenario where information asymmetry is unbalanced to an even more substantial degree. Bradley, Cooney, Jordan, and Singh (2004) argue that granular details such as an integer versus a non-integer offer price can signal uncertainty reduction to investors as the value is assumed to be negotiated between issuer and underwriter. Nonetheless, it is reasonable to assume that internet IPOs fit the definition of this high-risk group, considering that they pertain to a highly competitive environment due to rapid technological changes and

suppressed profitability prospects after their listing (Ritter & Welch, 2002). Therefore, disclosure of details that could place the business success in jeopardy would be necessary to mitigate the consequent asymmetry of information. Besides, Beatty and Ritter (1986) argue that firm assets become easier to assess with progressive growth, which eventually lowers information asymmetry. With an advancing transition towards more intangible-asset-heavy industries since the publication of their study, particular emphasis should be placed on a potential validation of this effect in the setting of a more contemporary industry composition. This interest is further reinforced following the emergence of the internet industry. To this end, the potential effects of tangible IPO characteristics on underpricing via shifts in information asymmetry should be investigated (Benveniste & Spindt, 1989; Megginson & Weiss, 1991; Corwin & Schultz, 2005).

2.3.2. IPO Proceeds & Activity Periods

Besides industry affiliation, trading volume and gross proceeds were theorised to have a significant relation to underpricing early on, with smaller IPOs being considered more speculative (Beatty & Ritter, 1986; Jog & Riding, 1987; Habib & Ljungqvist, 1998; Clarkson & Merkley, 2009). However, Loughran and Ritter (2004) find conflicting evidence with regard to this theory, as companies with higher proceeds were characterised by significantly higher first-day abnormal returns in their sample period from 1990 until 2000, particularly during the DotCom bubble period. Clarkson & Merkley (2009) add that underpricing is lower for firms with lower underwriter fees. These fees are calculated as a percentage of gross proceeds. Thus, underpricing is higher for underwriters with a more substantial interest in maximising proceeds.

Besides, conflicting theories exist regarding the effect of IPOs taking place in periods of high or low activity within the market. While it is argued that periodic over-optimism leads to intervals of high IPO activity, which in turn leads to high first-day returns, a clear statistical relationship cannot be determined across different studies (Ibbotson & Jaffe, 1975; Ritter, 1984; Ibbotson, Sindelar, & Ritter, 1994).

2.3.3. Underwriter Reputation

Another theory regarding IPO underpricing concerns the role of underwriters' reputations in reducing the amount of money 'left on the table' (e.g., Logue, 1973; Beatty & Ritter, 1986; Benveniste & Spindt, 1989). This stream of research associates higher underwriter reputation with a reduction in information asymmetry for investors, ultimately resulting in less severe underpricing (Beatty & Ritter, 1986; Titman & Trueman, 1986; Carter & Manaster, 1990; Michaely & Shaw, 1994; Michaely & Shaw, 1995; Wang & Yung, 2011). Benveniste and Spindt (1989) develop a model that includes the information advantage of market participants. If investors were to estimate the firm higher than the initial valuation performed by the company, then the underwriter would be able to adjust the offering price and raise more funds for the client during the book building. However, investors are not compelled to share their higher valuations, as they prefer to buy the shares at a lower price. The scholars note that negotiations of this kind will repeat and develop a reputation for themselves since underwriters conduct several IPOs throughout the year. Hence, to reach an equilibrium among the three parties, investors share positive information and underwriters incorporate merely a fraction of it into the valuation. This interchange allows the investor to subscribe to an IPO that is still underpriced. Nevertheless, in exchange for the information, these investors are allocated more underpriced shares. All agents benefit from this interaction, and the underwriter enhances their relevance in the market.

2.3.4. Syndicate Size

IPOs either involve one underwriter (sole managed) or a group of several (multiple managers). As these underwriters have different incentives when working on the issuance offer, Corwin and Schultz (2005) argue that the ratio of underwriters to managers could negatively affect the underpricing degree. According to them, the accuracy of the offer price compared to the actual market value increases with syndicate size due to a higher number of valuations and more diverse underwriters being progressively representative of the market as a whole.

2.3.5. Financial Sponsorship

Private Equity (PE) constitutes one primary form of alternative funding for private companies. It refers to the financing of companies, which are not publicly listed, from individual and institutional investors with high net worth. PE investors commonly aim for complete ownership, and long holding periods are usually necessary before liquidity events such as an IPO become feasible, for instance, as part of a Buyout (BO). The latter can be defined as the most common type of PE and refers to improving the financial health of an acquired company before reselling it or listing it on an exchange. In case of a BO being funded through bonds or loans, it is referred to as Leveraged Buyout (LBO).

Venture Capital (VC), another type of PE, refers to the financing of start-ups with high perceived potential for growth in the long term. Venture capitalists are commonly referred to as angels and, often, intangible investments such as their experience and advice are involved. While risky, a successful VC investment strategy can provide attractive returns. To diversify, investors typically split small amounts over several target companies of low maturity.

Consequently, the main difference between BO and VC lies in the type and size of the companies they target and the proportion of ownership they strive for. Due to the dynamics within the technology sector, the internet industry has been of special interest to venture capitalists in particular (Florida & Kenney, 1988; Madill, Haines, & Riding, 2004). According to prior research, VC-backing enhances underpricing (e.g., Jain & Kini, 1995; Levis, 2011; Ritter, 2015). Compared to non-sponsored IPOs, VC-backed issuances exhibit higher underpricing, while BO-backed IPOs do not show any statistically significant difference (Michala, 2019). This outcome is attributed to the distinct company characteristics that the two investor types target. VC-backed companies are usually less mature and feature more uncertainty regarding their prospective performance than more established BO-backed companies. Accordingly, this would lead to VC-backed IPOs being assessed more conservatively initially, before gradually adjusting this discrepancy during the offer day. BO-backed IPOs, in comparison, exhibit lower relative risks associated with maturity and size of a company, yet often more aggressive pricing based on BO investors' incentives. The latter would, ultimately, even lead to lower underpricing than non-backed IPOs. An overview of previous research on underpricing by financial sponsorship can be found in **Appendix I**.

2.4. IPO Long-Term Performance

Prior studies demonstrate that IPOs have been poor long-run investments during the three years after the issuance (Loughran & Ritter, 1995). The long-run performance of IPOs appears to be correlated with the underpricing phenomenon. Carter, Dark, and Singh (1998) investigate the relationship between initial and 3-year-after market returns and find that, in general, firms with higher initial returns tend to provide slightly lower long-run returns than firms with lower initial returns. Nonetheless, Demers and Lewellen (2001) argue that underpricing causes an increase in media coverage, which results in higher web traffic and more conversions for internet companies in the long term. Thus, we review established research on this long-run anomaly before examining if it applies to internet IPOs. In particular, we present an introduction of theories linked to empirical findings that explain the relationship between initial underpricing and long-run performance. **Table 4** displays an overview of prior research on IPO long-term performance.

Table 4: Summary of Prior Literature on IPO Long-Term Performance

An overview of existing research on long-term IPO performance. Research includes all types of financial sponsorship. The list is sorted by performance metric. Metrics include cumulative abnormal returns (CAR) and buy-and-hold abnormal returns (BHAR).

#	*Author(s)*	*Market*	*Period*	*Metric*	*Holding Period (Years)*	*Mean*	*Median*	*Sample Size*
1	Brav, Geczy, & Gompers (2000)	US	1975-1992	CAR	5	-32.0%		4,622
2	Chalk & Peavy III (1967)	US	1975-1982	CAR	0.5	18.0%		649
3	Chi & Padgett (2005)	China	1996-1997	CAR	3	10.3%		409
4	Gompers & Lerner (2003)	US	1935-1972	CAR	3	-4.5%		3,661
4	Gompers & Lerner (2003)	US	1935-1972	CAR	5	2.1%		3,661
5	McDonald & Fisher (1972)	US	1969-1970	CAR	1	-3.2%		142
6	Ritter (1991)	US	1975-1984	CAR	3	-13.0%	-14.3%	1,526
7	Teoh, Welch, & Wong (1998b)	US	1980-1992	CAR	4	-18.9%		1,649
8	Van der Geest & Van Frederikslust (2001)	Netherlands	1985-1998	CAR	3	-9.3%		106
9	Brav, Geczy, & Gompers (2000)	US	1975-1992	BHAR	5	-31.1%		4,622
9	Carter, Dark, & Singh (1998)	US	1979-1991	BHAR	3	-19.9%	-50.7%	2,292
10	Chi & Padgett (2005)	China	1996-1997	BHAR	3	10.7%		409
11	Dong, Michel, & Pandes (2011)	Global	1980-2006	BHAR	3	-12.8%		7,407
12	Eckbo & Norli (2005)	US	1972-1998	BHAR	5	-28.8%		6,139
13	Gompers & Lerner (2003)	US	1935-1972	BHAR	3	-16.7%		3,661
13	Gompers & Lerner (2003)	US	1935-1972	BHAR	5	-21.0%		3,661
14	Gregory, Guermat, & Al-Shawawreh (2010)	UK	1975-2004	BHAR	3	-16.4%	-46.1%	2,499
14	Gregory, Guermat, & Al-Shawawreh (2010)	UK	1975-2004	BHAR	5	-47.6%	-70.2%	2,499
15	Krigman, Shaw, & Womack (2001)	US	1993-1995	BHAR	1	150.0%	130.0%	578
16	Levis (2011)	UK	1992-2005	BHAR	3	-13.5%		1,595
17	Loughran & Ritter (1995)	US	1970-1990	BHAR	3	8.4%		4,753
17	Loughran & Ritter (1995)	US	1970-1990	BHAR	5	15.7%		4,753
18	Michaely & Shaw (1995)	US	1984-1988	BHAR	2	-13.5%		884
19	Reilly (1973)	US	1963-1965	BHAR	1	43.7%	33.9%	53
20	Reilly & Hatfield (1969)	US	1963-1966	BHAR	1	43.7%		53
21	Ritter (1991)	US	1975-1984	BHAR	3	34.5%	-16.7%	1,526
22	Ritter (2015)	US	1980-2012	BHAR	3	-18.8%		7,697
23	Ritter & Welch (2002)	US	1980-2001	BHAR	3	-23.4%		6,249
24	Schuster (2003)	Europe	1988-1998	BHAR	5	-2.1%		686
25	Stoll & Curley (1970)	US	1957, 1959, 1963	BHAR	Varying	-6.5%	-4.3%	195
26	Teoh, Welch, & Wong (1998b)	US	1980-1992	BHAR	4	-15.6%		1,649
27	Wang & Yung (2011)	US	1981-2006	BHAR	0.5	0.4%	-8.2%	6,829
28	Westerholm (2006)	Nordics	1991-2002	BHAR	5	4.5%	-3.1%	247
29	Zheng (2007)	US	1980-1997	BHAR	5	-28.2%		2,493

2.4.1. IPO Proceeds & Activity Periods

Research points towards underperformance in the long term. This pattern is most significant among listings with smaller proceeds. In accordance, Brav and Gompers (1997) find a positive relationship between expected proceeds based on company size and post-issue long-term performance. Subsequent reinvestments from these proceeds result in better long-run performance (Goodnight & Green, 2010).

Moreover, long-term underperformance is most pronounced for relatively young growth companies, especially those going public in years of high IPO volume (Ritter, 1991; Ibbotson, Sindelar, & Ritter, 1994). Internet companies are commonly regarded as such. Specifically, in light of the heightened IPO activity leading up to the DotCom bubble, a differentiation between high and low IPO activity periods becomes of further interest for companies within the internet industry.

2.4.2. Underwriter Reputation & Syndicate Size

Empirically, long-term returns of IPOs handled by less reputable underwriters result to be lower compared to those handled by more reputable underwriters (Michaely & Shaw, 1994; Michaely & Shaw, 1995; Chang, Chung, & Lin, 2010). It is argued that prestigious underwriters, concerned with their reputation, ensure the veracity of the financial statements of the firm going public, thereby limiting any potential earnings manipulation. Less reputable underwriters might have less incentive to adhere to quality standards to attract more issuers, which can result in more aggressive earnings management. Prior research indicates a negative relationship between earnings management and the long-term performance of an IPO firm's stock (Teoh *et al.*, 1998a-c). However, other studies do not find significant evidence of such a relationship (Shivakumar, 2000; Fan, 2007).

Moreover, Dong, Michel, and Pandes (2011) argue that an IPO syndicate consisting of a higher number of individual agents is more representative of the diverse actual market and, thus, further adds to underwriter quality and exhibits better performance in the long run. Nevertheless, they find a reversal of this effect during the height of the DotCom bubble. Higher underwriter quality in terms of underwriter reputation, syndicate size, and absolute price adjustment during the bubble lead to lower post-IPO returns in the long term. This finding could suggest

an alteration in the role of underwriters in this period. Loughran and Ritter (2004) attribute this change to shifted issuer objectives with a lower emphasis on maximised proceeds from IPOs.

2.4.3 Financial Sponsorship

With regard to long-term performance, PE-backed IPOs are said to exhibit superior performance compared to non-sponsored issuances, which is attributed to operational efficiencies through key value drivers such as higher leverage, management experience, and close monitoring (Jensen, 1986; Jensen, 1989; Bergström, Nilsson, & Wahlberg, 2006; Levis, 2011; Ritter, 2015). Both BO-backed and VC-backed stocks experience better performance than non-sponsored IPOs in the long run (Brav & Gompers, 1997; Levis, 2011; Ritter, 2015). This difference is attributed to growth-capital-backed rather than buyout-fund-backed deals within VC-backed IPOs (Ritter, 2015). Growth-capital investing refers to the financing of growing firms, which predominantly invest in tangible assets. Thus, it is usually not observed for firms within the internet industry or the overall technology sector. An overview of prior research on post-issue long-term performance by financial sponsorship can be found in **Appendix II**.

In summary, the research results of several of the theories underlying IPO underpricing and long-term performance remain mostly ambiguous. Moreover, many of the assumptions have not yet been investigated for companies within the internet industry, specifically. The effect of the DotCom bubble is of particular importance for these. Thus, our paper builds upon the existing research literature and contributes along the dimensions of determining which characteristics affect short-run and long-run returns of internet IPOs.

3. Research Question & Hypotheses

The purpose of this research is to examine whether internet IPOs experience post-issue underpricing and long-term underperformance. Consequently, we conduct an in-depth analysis regarding their characteristics, while assessing if IPOs proceeding before, during, and after the DotCom bubble share noticeable similarities. Henceforth, the main research question is:

'Which characteristics influence Internet IPOs' short-term and long-term performance?'

We investigate various sets of hypotheses to advance this study.

3.1. IPO Underpricing Hypotheses

The first set of hypotheses refers to the phenomenon of underpricing for all IPOs in the aggregate and internet IPOs in particular. Based on existing research, more severe underpricing is to be expected for internet IPOs compared to the general level of all IPOs.

Hypothesis 1:
H0: All IPOs in the aggregate do not experience underpricing.
H1: All IPOs in the aggregate do experience underpricing.

Hypothesis 2:
H0: Internet IPOs do not experience underpricing.
H1: Internet IPOs do experience underpricing.

Hypothesis 3:
H0: Internet IPOs exhibit the same degree of underpricing as all IPOs in the aggregate.
H1: Internet IPOs exhibit a higher or lower degree of underpricing than all IPOs in the aggregate.

Next, we analyse internet IPOs in terms of underpricing across a time dimension. The following hypothesis is tested for the periods of (a) before (1996-1998), (b) during (1999-2000), and (c) after (2001-2016) the DotCom bubble.

Hypothesis 4:

H0: Internet IPOs during a period exhibit the same degree of underpricing as internet IPOs during another.

H1: Internet IPOs during a period exhibit a higher or lower degree of underpricing than internet IPOs during another.

Furthermore, assumptions regarding several different IPO characteristics and their effect on the underpricing of internet companies are examined. Based on past literature, one should expect that (a) the amount of offering proceeds exhibits a positive effect on underpricing, whereas (b) a more favourable underwriter reputation, (c) a larger syndicate size, and (d) BO-backing affect underpricing negatively. Conversely, (e) VC-backing and (f) periods of high IPO activity are alleged to exert a positive effect on underpricing. Accordingly, the associated set of hypotheses is:

Hypothesis 5:

H0: A specific characteristic exhibits no effect on the underpricing of internet IPOs.

H1: A specific characteristic exhibits a positive or negative effect on the underpricing of internet IPOs.

3.2. IPO Long-Term Performance Hypotheses

Corresponding sets of hypotheses are also developed regarding the long-term performance of internet IPOs. Research points towards general IPO underperformance in the long run, and this pattern is to be expected for internet companies.

Hypothesis 6:

H0: Internet IPOs do not experience underperformance in the long run.

H1: Internet IPOs do experience underperformance in the long run.

Again, we conduct the analysis with regard to distinct periods surrounding the DotCom bubble [(a)-(c)] and its presumed negative effect on the long-term performance of internet companies.

Hypothesis 7:

H0: Internet IPOs during a period exhibit the same long-term performance as internet IPOs during another.

H1: Internet IPOs during a period exhibit a higher or lower long-term performance than internet IPOs during another.

Eventually, the long-term performance is investigated for the same IPO characteristics as previously to test if their validity holds for internet companies. (a) Proceeds, (b) underwriter reputation, (c) syndicate size, (d) BO-backing, and (e) VC-backing are assumed to exert a positive effect on long-term performance, whereas (f) IPO activity is being tested for a significant negative direction. Besides, the effect of (g) underpricing on long-term performance is assessed for an expected negative relationship.

Hypothesis 8:

H0: A specific characteristic exhibits no effect on the long-term performance of internet IPOs.

H1: A specific characteristic exhibits a positive or negative effect on the long-term performance of internet IPOs.

4. Data Collection & Variable Generation

The following section describes the construction of the dataset required to answer the central research question. The first part outlines the data collection. Then, additional variables are defined for use in the regression models. These are, subsequently, summarised through descriptive statistics that aim to provide more detailed insights into the comprehensive dataset of interest.

4.1. Data Collection

All data required for the underpricing analysis was obtained from the Thomson Reuters Eikon financial data platform. Initially, a dataset of companies that went public on US Stock Exchanges (e.g., NASDAQ, NYSE, Amex) between the 1st of January 1996 and up to and including the 31st of December 2016 was retrieved. Thus, this sample comprises IPOs on any trading day of 21 consecutive years irrespective of industry. Next to the listing date, the country, and the associated US exchange, the data contains the name of each company, the respective stock ticker, the industry, the offer price, underpricing in per cent, the offer proceeds in $ millions as well as the lead underwriter and the syndicate members who participated in the IPO. Whereas the closing price of the offer day did initially not form part of the original dataset, it is retrieved through a combination of the offer price and underpricing in per cent. We cross-checked the calculated first-day closing prices with corresponding first-day closing prices, which were obtained from Wharton Research Data Services to confirm the quality of the data and our data sources. They did, indeed, concur. Due to similar data quality considerations, we restricted the offer price. According to Ibbotson, Sindelar, and Ritter (1988), penny stocks (i.e., stocks with an offer value below $5) may affect the calculation of equally-weighted average initial returns. Following this argument, we removed such stocks from the dataset.

Moreover, although very few observations were affected, some exhibited conspicuous values. While the offer prices of some companies plausibly ranged around zero, observations with negative values would introduce a false and illogical bias regarding the accuracy of the analysis. These observations seemingly resulted from errors directly in the Thomson Reuters Eikon platform. Accordingly, three

companies with unreasonably high proceeds for which we could not find any price information elsewhere were removed from the dataset, as they exceeded credible values. These remained unjustifiably high even after checking for potential conversions from the currency of the companies' originating country at the time of the offering to USD. Overall, the sample does not exhibit any missing values. A total of 4,213 stocks were deemed eligible for this comprehensive dataset, which we use to test hypotheses related to all IPOs.

Next, we extracted data with a specific focus on the internet industry. The extraction procedure ensures that all companies within the internet sample are also present in the aggregate sample of all IPOs. Thus, these observations comprise the same relevant variables. The original sample is filtered for companies belonging to the following sub-industries: 'IT Services & Consulting', 'Software', and 'Online Services'. This classification follows the definition of the internet industry on Thomson Reuters Eikon. Whereas the choice of 'Online Services' is obvious, the remaining two are included, as otherwise a significant fraction of companies that might not have started as internet companies, but can be regarded as such latest since the emergence of cloud computing in the late 2000s, would falsely be excluded from the analysis. Examples are, for instance, 'Salesforce.com Inc' within 'IT Services & Consulting' or 'Blackboard Inc' within 'Software'. In any case, all companies within these sub-industries centre around the internet by definition. The 'Online Services' sub-industry consists of 42 companies, 'Software' consists of 289 companies, and 'IT Services & Consulting' consists of 265 companies. Thus, a total of 596 internet stocks are deemed eligible for the study. While all of them serve for the short-term performance analysis, 572 companies remain for the long-term analysis.

Monthly closing prices for internet stocks were retrieved from Wharton Research Data Services, which provide the basis for long-term performance analyses. They comprise the same time frame as previously, plus an additional 36 months to ensure sufficient long-run data for companies that went public at the end of the IPO sample period. A 36-month period was chosen for the long-term performance analysis as it forms the most common approach within existing research and allows for the inclusion of more, and more recent, IPOs than a, for instance, 60-month time span would. As a result, prices range from January 1996 until and including December 2019. However, during this procedure we observed that companies going public

can inherit tickers from delisted companies. Thus, some tickers were associated with more than one company over the complete time frame, all of which do not necessarily belong to the internet industry. Others, however, include different internet companies that were listed at different times using the same tickers (e.g., FIRE, ELOQ, CALD). These should, thus, remain for the analysis. Consequently, to ensure accurate and consistent data, an automated cross-check was performed based on the company name previously retrieved from Thomson Reuters Eikon to remove price data of irrelevant companies and solely retain data of relevant internet stocks. Finally, some companies were delisted and, subsequently, performed a second IPO at a later point in time with the same stock ticker and name (e.g., DIGX, SQL). However, only very few stocks were affected and, as long as 36 months of consecutive price data are available, this does not pose a problem. Nonetheless, several companies were delisted before accumulating the three complete and consecutive years of monthly price data required for the long-term performance analysis. Ritter (1991) states survivorship bias due to the exclusion of companies with missing returns as a potential hindrance during the long-term performance assessment. By focusing exclusively on companies that survived over three consecutive years after their listing, averages can be overstated. These averages would usually be adjusted downwards through excluded companies, which were often performing poorly before their delisting. Therefore, we consider the returns of the 209 affected companies until their respective delisting when calculating long-term performance measures. This decision aims to avoid survivorship bias and sustain the majority of the original sample size. **Appendix III** displays the number of observations by event month that would otherwise be lost. Finally, price data could not be found on the platform for 24 companies and was, thus, missing altogether. Excluding these stocks with missing prices inadvertently introduces sample selection bias into the analysis. Eventually, a total of 572 internet stocks remain for the long-term analysis after accounting for missing data.

Finally, complementary benchmark data were obtained for subsequent abnormal return calculations, containing daily as well as monthly price data for the NASDAQ Composite Index (.IXIC). Both were fetched from Wharton Research Data Services with the time frame corresponding with the remaining data. We selected the value-weighted NASDAQ Composite as a benchmark due to its composition of mainly technology companies. As a result, it was strongly affected by the DotCom bubble

(Nasdaq, 2015). Adjusting returns based on this market portfolio follows established literature (Ainina & Mohan, 1991; Hogan, Olson, & Kish, 2001). **Appendix IV** provides more information on the index.

All 596 and 572 observations within the internet sample are used for mean and median hypothesis tests regarding underpricing and long-term performance, respectively. However, extreme outliers are removed before performing regressions to ensure the validity of results, as this process transforms returns into distributions with improved normality while still retaining their individual distributional characteristics to a certain degree. Whereas the interpretation of results does not change considerably when including outliers, the soundness of basic OLS assumptions is improved when excluding them. The Mahalanobis distance between observations is assessed to identify outliers. This measure is unitless and takes the correlation among variables into consideration (Mahalanobis, 1936). Any observation with a distance exceeding a pre-specified threshold is deemed an outlier and is removed from the dataset. This will, however, inadvertently amplify any sample selection bias. In terms of the resulting normality of the return distributions, a 1% significance level performs strictly worse than a 5% significance level. A trade-off between skewness (i.e., the asymmetry of the distribution) and kurtosis (i.e., the heaviness of the tails of the distribution) of performance measures emerges for a 5% or 10% significance level. Whereas skewness and kurtosis slightly improve for two of the performance measures, they worsen for the remaining metric. However, a 5% significance level includes significantly more remaining observations. As a result, 496 observations remain for the short-term performance regression and 435 observations for the long-term performance regressions. **Table 5** displays the aforementioned results.

Table 5: Outliers based on Mahalanobis Distance between Observations

Overview of number of outliers and remaining observations per regression according to the Mahalanobis distance between observations for different significance level thresholds (i.e., an alpha of 1%, 5%, and 10%). The Mahalanobis distance is a multivariate distance measure that computes the distance between a point and a distribution. Any observation with a distance exceeding a pre-specified threshold will be deemed an outlier and will be removed from the dataset. In terms of the resulting normality of the performance metric distributions, a 1% significance level performs strictly worse than a 5% significance level. There is a trade-off between skewness and kurtosis for a 5% or 10% significance level. The former includes significantly more remaining observations.

Regression	*Performance Metric*	*Significance Level*	*Observations*	*Outliers*	*Remaining*	*Skewness*	*Kurtosis*
Short-Term	1stDayAR	-	*596*	-	596	*3.4*	*20.8*
Long-Term	3YearCAR	-	*572*	-	572	*3.6*	*32.0*
Long-Term	3YearBHAR	-	*572*	-	572	*3.4*	*26.3*
Short-Term	1stDayAR	1%	596	60	536	1.4	6.2
Long-Term	3YearCAR	1%	572	83	489	0.1	4.1
Long-Term	3YearBHAR	1%	572	83	489	0.8	4.7
Short-Term	1stDayAR	5%	596	100	496	1.0	4.7
Long-Term	3YearCAR	5%	572	137	435	0.0	3.2
Long-Term	3YearBHAR	5%	572	137	435	0.4	3.5
Short-Term	1stDayAR	10%	596	123	473	1.0	4.5
Long-Term	3YearCAR	10%	572	186	386	-0.2	3.2
Long-Term	3YearBHAR	10%	572	186	386	0.2	3.0

Overall, only US listings are deemed eligible for the study due to significantly more pronounced and consistent data availability than for other markets, particularly in the early years of the selected period. This fact could also serve as an explanation for a general emphasis on this market within prior IPO research. Data availability becomes of particular importance for the quality of the analysis considering the early evolution of the technology sector and the frequency of IPOs within the internet industry in the US compared to other countries surrounding the time of the DotCom bubble. According to Ritter (2020), the highest number of IPOs to date occurred in 1996. The following years this annual number diminished considerably and, eventually, stabilised in slightly varying degrees. This phenomenon can also be observed in the internet industry. Therefore, the year 1996 can be understood as a turning point. It indicates the beginning of a gradual focus on ‘quality’ instead of ‘quantity’ in terms of IPO activity. It also coincides with the time leading up to the DotCom bubble. As a result, this marks the starting point of the dataset. The end date of the sample was selected to allow for three years of post-IPO performance records to assess long-term performance. Finally, all collected data are anonymous and not in any manner personal or traceable to any individual, neither directly nor

indirectly. Thus, the process complies with legal and ethical regulations surrounding data, and the NSD Data Protection Services was not notified about this study.

4.2. Variable Generation

Building on the available information in the existing data, new variables are generated for the internet sample. These are required for analysing differences between DotCom bubble periods and for determining the relevance of specific internet IPO characteristics, thus being crucial in the verification of the majority of hypotheses.

Table 6 presents an overview of all variables used throughout the study, whose generation we elaborate on in detail next.

Table 6: Overview of Variables for Hypothesis Testing

A comprehensive list of variables used in hypothesis testing throughout this study. Variables were gathered in three groups, mainly with regard to subsequently performed OLS regressions: (1) Dependent Variables, (2) Independent Variables, and (3) Time-Dimensional Variables concerning the DotCom Bubble.

Dependent Variables	
1stDayAR	Abnormal first-day return (i.e., underpricing). Ratio of the closing price on the first day of trading over initial listing price. Benchmark is the NASDAQ Composite Index.
3YearCAR	Cumulative abnormal return for 36 months after the IPO. Benchmark is the NASDAQ Composite Index.
3YearBHAR	Buy-and-hold abnormal return for 36 months after the IPO. Benchmark is the NASDAQ Composite Index.
Independent Variables	
Proceeds	The total USD proceeds (in millions) raised from the IPO. Offer price times number of shares sold. Adjusted for inflation based on CPI with 2015 as base year. Applied as natural logarithm 'ln (Proceeds)'.
UnderwriterRep	Decimal score from 0 (lowest) to 10 (highest), indicating the level of reputation of the IPO's lead underwriter.
SyndicateSize	The number of syndicate members participating in an IPO.
BOBacked	A dummy variable which equals 1 if the IPO was BO-backed, or 0 otherwise.

VCBacked	A dummy variable which equals 1 if the IPO was VC-backed, or 0 otherwise
IPOActivity	A dummy variable which equals 1 if the IPO occurred in a year of high IPO activity, or 0 otherwise.
1stDayAR	Abnormal first-day return (i.e., underpricing). Ratio of the closing price on the first day of trading over initial listing price. Benchmark is the NASDAQ Composite Index. Used as independent variable in long-term performance regressions.
Time-Dimensional Variables	
PreBubble	A dummy variable which equals 1 if the IPO occurred between the years 1996 and 1998, or 0 otherwise.
Bubble	A dummy variable which equals 1 if the IPO occurred between the years 1999 and 2000, or 0 otherwise.
PostBubble	A dummy variable which equals 1 if the IPO occurred between the years 2001 and 2016, or 0 otherwise.

4.2.1. DotCom Bubble Periods

A growing part of the evidence on underpricing of technology IPOs is related to the DotCom bubble (e.g., Ritter & Welch, 2002; Loughran & Ritter, 2004; Coakley, Hadass, & Wood, 2009; Hahn, Ligon, & Rhodes; 2013). The initial sample of internet companies is split into three distinct sub-samples to explore potentially significant differences between underpricing in the history of IPOs before, during, and after the bubble: The first sample includes companies going public during the period ranging from 1996 to 1998; the second sample includes the years 1999 to 2000; the third and last sample refers to the period between 2001 and 2016. Thus, three mutually exclusive dummy variables (*PreBubble*, *Bubble*, *PostBubble*) are created, indicating the affiliation of an internet IPO to either of the three periods with a value of 1, or 0 otherwise. All three periods exhibit an approximately equal number of observations.

4.2.2. IPO Proceeds

The variable *Proceeds* concerns the total amount of proceeds raised in $ millions for the transaction plus over-allotment. This figure results from accumulating general shares and over-allotment shares sold, multiplied by the offer price for each

tranche within the transaction. Following Carter, Dark, and Singh (1998), proceeds are adjusted for inflation with CPI data that was retrieved from the OECD. For this purpose, the year 2015 serves as the base year. However, for the variables to adapt to a linear model, the natural logarithm of the proceeds is taken. **Figure 2** and **Figure 3** present the distribution of proceeds before and after the logarithmic adjustment of the variables. The original variable displays a sharp skewness to the right. After transforming the variable by taking the logarithm, the skewness adjusts from 21.9 to 0.8. Therefore, the distribution becomes more symmetrical. In the same way, the kurtosis decreases from 513.0 to 3.4. This transformation also aims at reducing the influence of extreme observations.

Figure 2: Histogram of Internet IPO Proceeds (1996-2016)
(in million USD)

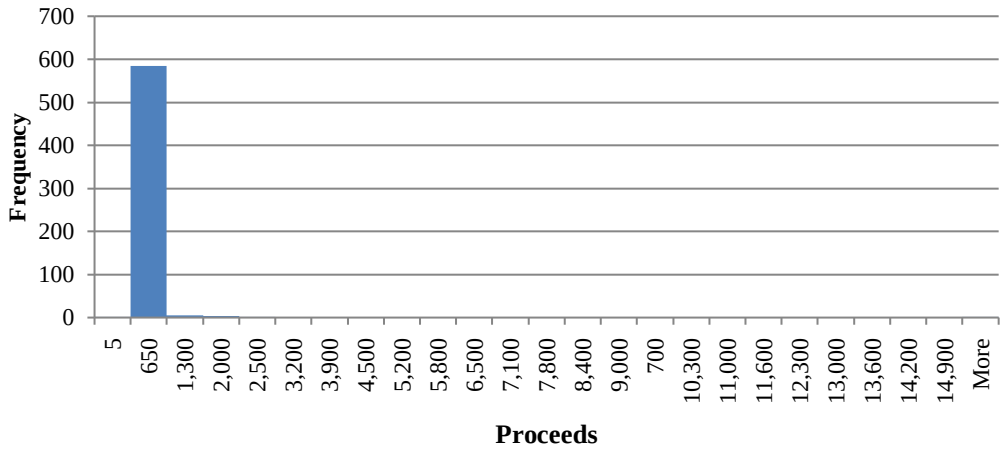
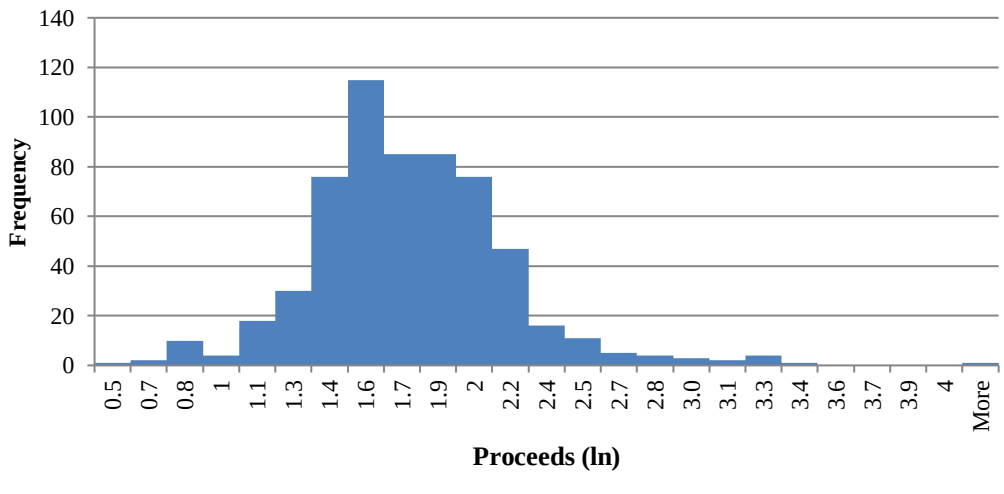


Figure 3: Histogram of the Natural Logarithm of Internet IPO Proceeds (1996-2016)



4.2.3. Underwriter Reputation

Lead underwriter reputation (*UnderwriterRep*) is based on both lead underwriting and syndicate membership across all IPOs in the US during the sample period, independently of their industry. Each lead underwriter is attributed a final reputation score according to these two main dimensions based on a process introduced by Carter and Manaster (1990) and repeated by Carter, Dark, and Singh (1998). We consider only lead underwriters, as they represent the most prominent party to the public during the IPO process. Thus, 442 individual lead underwriters are assessed on their frequency of being the lead underwriter during an IPO and the total amount of proceeds raised during these IPOs. Besides, they are assessed based on their frequency of syndicate membership across IPOs and the total amount of proceeds raised during these IPOs. We assume that the higher the amount of proceeds underwriters manage to raise, the more often they are selected as syndicate members and lead underwriters in the future, which overall results in a positive effect on their reputation. Subsequently, underwriters are sorted and ranked according to each of the four sub-dimensions. Next, they are assigned a score ranging from slightly above 0 (lowest) to 10 (highest) for each dimension. The value zero itself is not assigned to any underwriter and merely serves as a lower boundary. We establish the exact decimal score for each underwriter using linear interpolation between zero and the highest score. Finally, a weighted average of the four dimensions is calculated for each underwriter, with higher importance attached to lead underwriting (30% for each of the two sub-dimensions) than to syndicate membership (20% for each of the two sub-dimensions). Eventually, underwriters are sorted and ranked once more based on their average score. Therefore, it is possible that different underwriters obtain the same score and rank regarding their final reputation. A list of the 50 lead underwriters with the highest score and a histogram regarding the distribution of the variable can be found in **Appendix V**.

4.2.4. Syndicate Size

The datasets also include information relating to the deal-specific number of members within the underwriter syndicate. An existing variable depicts the name of the underwriters who attended each IPO. Based on this information, a variable called *SyndicateSize* is constructed, which represents the total number of syndicate members involved in each transaction. This variable exhibits a minimum value of

1 since at least one lead underwriter is required when engaging in a standard IPO. The maximum value equals 33, which means that at least in one IPO, there were 33 different syndicate members present. The average number of syndicate representation amounts to approximately four underwriters per deal. **Appendix VI** displays a histogram of the associated variable. The distribution contradicts Krigman, Shaw, and Womack's (2001) statement that many issuers are limited in their choice of an underwriter. The scholars argue that this restriction was due to the smaller size and desirability of their IPO. Thus, many would have to choose the only party willing to underwrite their offering. As the majority of listings involves two or more underwriters in reality, internet IPOs do appear to have at least a reasonable selection of syndicate members.

4.2.5. Financial Sponsorship

The initial dataset also includes information regarding whether the IPOs, at the time of the offer, were BO-backed, VC-backed, or non-sponsored. We create two dummy variables according to a list of sponsors for each IPO. The first (*BOBacked*) takes on a value of 1 in case the IPO was sponsored by BO, or the value 0 in case it was not sponsored by BO. The second (*VCBacked*) takes on a value of 1 if the IPO was sponsored by VC, or the value 0 if it was not sponsored by VC. Both dummy variables are not necessarily mutually exclusive. It follows that 51 companies were BO-backed, 393 companies were VC-backed. 29 companies were double-sponsored, whereas the remaining 181 companies were non-sponsored. **Table 7** provides an overview of internet IPO observations by financial sponsorship type and DotCom period. The number of IPOs per period is approximately equal. Nonetheless, the DotCom bubble period exhibits a particularly high number of VC-backed IPOs, while less IPOs are non-sponsored during this period compared to the period before and after the bubble.

Table 7: Internet IPO Observations by Financial Sponsorship and DotCom Bubble Period (1996-2016)

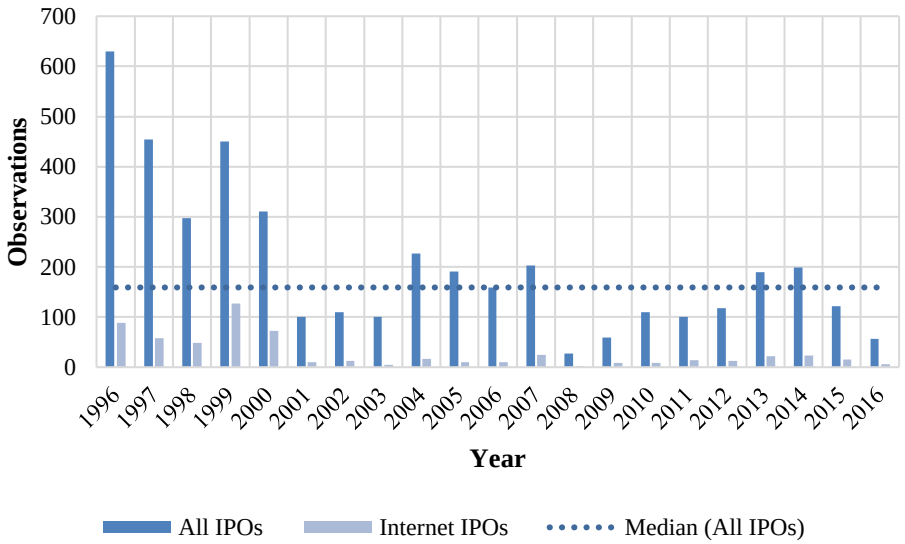
Overview of the number of internet IPOs on any US exchange between 1996 and 2016 per financial sponsorship and DotCom bubble period. Financial sponsorship refers to companies being backed by venture capital (VC) or buyout (BO) during an IPO. VC-backing and BO-backing are not mutually exclusive and, if combined, will result in double-sponsorship. Neither financial backing will result in non-sponsorship. Aggregate numbers indicate observations for the periods before (1996-1998), during (1999-2000), and after the DotCom Bubble (2001-2016) as well as the entire period (1996-2016). The three periods exhibit an approximately equal number of observations. The DotCom Bubble period exhibits a high number of VC-backed internet IPOs despite the shorter time frame compared to the periods before and after.

Period	*BOBacked*	*VCBacked*	*Double-Sponsored*	*Non-Sponsored*	*Total*
PreBubble (1996-1998)	28	103	15	80	226
Bubble (1999-2000)	10	154	8	44	216
PostBubble (2001-2016)	13	136	6	57	212
Total (1996-2016)	**51**	**393**	**29**	**181**	**596**

4.2.6. IPO Activity

When constructing the dummy variable *IPOActivity*, we inspect the total number of IPOs issued annually within the US throughout the period from 1996 to 2016. Subsequently, their median is calculated. Years with a number of IPOs above this median of 159 are classified as a period of high IPO activity. Thus, any IPO occurring during these years is assigned a value of 1. We regard the remaining years with a number of IPOs below the median as periods of low IPO activity. Accordingly, IPOs occurring during these years are assigned a value of 0. Following this procedure, 1996 exhibits the highest activity within the relevant history of IPOs. Examining internet companies specifically, however, 1999 is the year with the highest IPO activity, implying the imminent height of the DotCom bubble. 2008 exhibits the lowest IPO activity for both internet IPOs and all IPOs presumably due to the start of the Global Financial Crisis. **Figure 4** displays the yearly number of IPOs for the sample period.

Figure 4: Number of IPOs per Year (1996-2016)
(US)



Eventually, **Table 8** provides descriptive statistics regarding all variables used throughout the analysis. The average scoring for lead underwriter reputation results to be high. This could hint at few, but prestigious underwriters being assigned to many internet IPOs. Besides, the figures confirm that a large number of internet IPOs in the sample were backed by VC, whilst few were sponsored through BO. Furthermore, they indicate that a vast majority of internet IPOs occurred in periods of generally high IPO activity. This fact confirms the existence of periodic over-optimism regarding internet stock listings. **Appendix VII** displays a correlation matrix for all variables. A noticeable positive correlation between IPO proceeds and syndicate size as well as IPO proceeds and underwriter reputation is potentially explained by the former being a function of the latter two due to negotiations and bargaining of underwriters when using book building (Loughran & Ritter, 2004). At the same time, no definite causality is implied based on these results.

Table 8: Summary Statistics for Internet IPO Variables

Descriptive statistics for internet IPO characteristics, which are used as independent variables in subsequent performance regressions.

Variable	*Mean*	*Median*	*Std Dev*	*Min*	*Max*	*Skewness*	*Kurtosis*
Proceeds	112.7	48.5	655.7	3.3	15,505.6	21.9	513.0
ln(Proceeds)	1.7	1.7	0.4	0.5	4.2	0.8	3.4
UnderwriterRep	9.0	9.3	1.2	2.6	10.0	-2.2	6.3
SyndicateSize	3.9	3.0	2.5	1.0	33.0	5.3	46.9
BOBacked	0.1	0.0	0.3	0.0	1.0	3.0	6.8
VCBacked	0.7	1.0	0.5	0.0	1.0	-0.7	-1.6
IPOActivity	0.8	1.0	0.4	0.0	1.0	-1.8	1.2
1stDayAR	45.3%	21%	77%	-97%	626%	3.4	17.1

5. Methodology & Findings

The following section presents the methodology applied in answering the focal research question and in testing the aforementioned hypotheses. All return calculations follow established IPO performance research (e.g., Ritter, 1991; Chi & Padgett, 2005) by explicitly not applying prior logarithmic transformations. Consequently, raw returns are used throughout the entire analysis. Refraining from the use of log returns aims to preserve the particular distributional assumptions of each performance metric instead of imposing normality. Where necessary, normality will instead be guaranteed to an appropriate degree through the removal of extreme outliers.

5.1. IPO Underpricing Hypotheses

5.1.1. First-Day Abnormal Returns

Loughran and Ritter's (2004) approach is followed to compute initial returns. We measure the first-day return using the listing price and closing price of the offer day, in coherence with the majority of the existing and most recent literature (e.g., Ritter 1984; Beatty & Ritter, 1986; Carter, Dark & Singh, 1998). Subsequently, first-day abnormal returns (AR) are used to infer any insights regarding the underpricing of

IPOs. Thus, returns are obtained in excess of the NASDAQ Composite market portfolio to allow for robust interpretation of the isolated phenomenon.

As a first step, raw returns are calculated as follows:

$$r_{i,t} = \frac{P_{i,t+1}}{P_{i,t}} - 1 \qquad (1)$$

where $r_{i,t}$ is the return of stock i at time t, $P_{i,t+1}$ is the closing price of stock i at time t+1, and $P_{i,t}$ is the closing price of stock i at time t.

Additionally, the return on the NASDAQ Composite market index is computed for subsequent comparison purposes:

$$r_{m,t} = \frac{P_{m,t+1}}{P_{m,t}} - 1 \qquad (2)$$

where $r_{m,t}$ is the comparable market return at time t, $P_{m,t+1}$ is the closing market index value at time t+1, and $P_{m,t}$ is the closing market index value at time t.

In case of first-day returns, the offer price at issuance replaces the closing price at time t, and the closing price on the issuance day replaces the closing price at t+1. Subsequently, the first-day abnormal return for each IPO is calculated as:

$$AR_{i,1} = r_{i,1} - r_{m,1} \qquad (3)$$

where $AR_{i,1}$ is the first-day abnormal return for stock i, $r_{i,1}$ is the first-day return of stock i, and $r_{m,t}$ is the comparable market return on the same day.

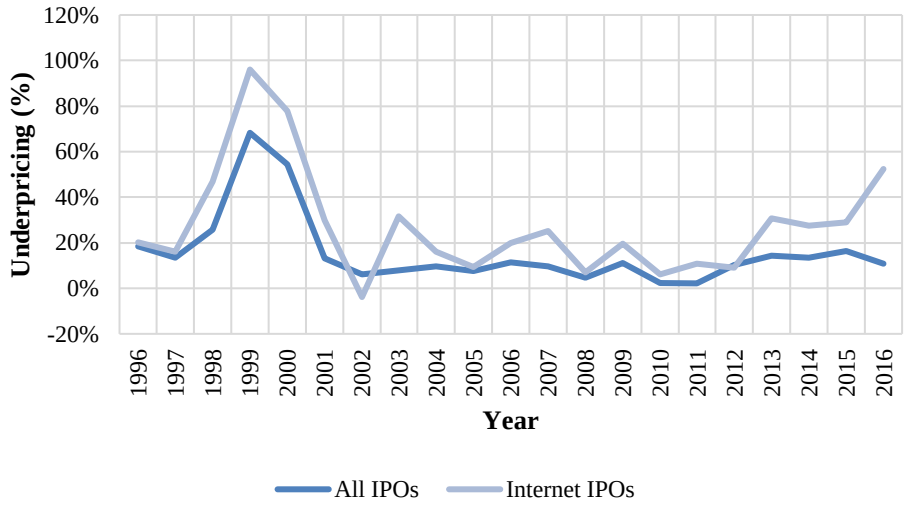
The sample average abnormal return for the first trading day may be viewed as a performance index, which reflects the first-day return on investment over the market return, divided equally among *n* new issuances in a sample. The calculation applies to both internet IPOs as well as all IPOs overall.

$$\overline{AR^{ew}} = \frac{1}{n} \sum_{i=1}^{n} AR_{i,1} \qquad (4)$$

where $\overline{AR^{ew}}$ is the equally-weighted average abnormal return on the first trading day for a sample, n is the number of observations in the sample, and $AR_{i,1}$ is the first-day abnormal return of firm i.

Figure 5 displays the resulting yearly development of IPO underpricing over the sample period.

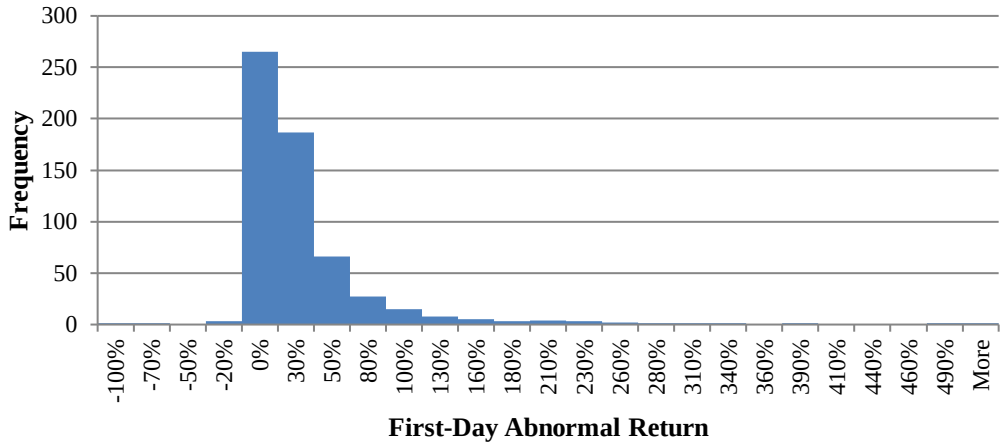
Figure 5: Underpricing per Year (1996-2016)
(US)



5.1.2. Statistical Hypothesis Testing

A histogram of first-day abnormal returns is displayed in **Figure 6**. Their particular distribution follows Ibbotson's (1975) statement that drawing an IPO at random should likely result in high initial returns rather than low or even negative initial returns.

Figure 6: Histogram of First-Day Abnormal Returns (AR) of Internet IPOs (1996-2016)



Student's one-sample t-tests are used for checking if average first-day abnormal returns are statistically significantly different from zero to test if all IPOs in the aggregate and internet IPOs experience underpricing. Moreover, Wilcoxon's signed-rank tests are performed to assess if median first-day abnormal returns are statistically significantly different from zero for both IPOs overall and internet IPOs due to the distinct distribution of first-day abnormal returns. The non-parametric test is argued to exhibit superior accuracy in case of extreme outliers occurring (Barber & Lyon, 1997; Schöber, 2008).

An adaptation of Student's two-sample t-test is performed to test if the difference between the means of both the aforementioned samples is statistically significant from zero. Welch's test exhibits advantages in accuracy when sample sizes are unequal, and when the two samples are assumed to have unequal variance (Welch, 1947). This characteristic is arguably the case for the analysis at hand due to the higher perceived riskiness of internet stocks at listing (Ritter & Welch, 2002). The same test is applied to test a difference in underpricing for IPOs occurring in the three periods surrounding the DotCom bubble, with the period during the bubble presumed to be riskier. Based on the peculiar distribution of returns and following the procedure suggested by Schöber (2008), the non-parametric Wilcoxon-Mann-Whitney test is used to cross-check results on the difference in medians between the respective samples.

Finally, a multivariate ordinary least squares (OLS) regression is performed to test the effect of IPO-specific characteristics on underpricing. As mentioned previously, extreme outliers are removed to support the normality assumptions of OLS regressions with regard to abnormal returns. Thus, to conduct the study relating to post-issue short-term performance, the following model is applied:

$$\begin{aligned}\mathbf{1stDayAR_i} = \ & \alpha_i + \beta_1 ln(Proceeds_i) + \beta_2 UnderwriterRep_i \\ & + \beta_3 SyndicateSize_i + \beta_4 BOBacked_i + \beta_5 VCBacked_i \\ & + \beta_6 IPOActivity_i \ + \varepsilon_i\end{aligned}$$

5.1.3. Discussion of Results

We find strongly significant evidence for underpricing among both IPOs in the aggregate and internet IPOs specifically, with a mean of 29.3% and 45.3%, respectively. The respective medians amount to 5.3% and 20.8%. Besides, the difference between means and medians of both samples is statistically significantly different from zero, with more pronounced underpricing for internet IPOs. **Table 9** displays yearly and aggregate underpricing numbers across samples. While peaking during the bubble in 1999 and 2000, underpricing declined considerably over the following years with an even negative value during 2002. Besides, the overview confirms the particularly emphasised proportion of internet IPOs as a part of all IPOs during the bubble years, which receded to pre-bubble levels during subsequent years.

Table 9: Yearly Underpricing for all IPOs and Internet IPOs (1996 and 2016)

Yearly overview of the number of IPOs, sum of proceeds, and average underpricing for all IPOs and internet IPOs between 1996 and 2016. Proceeds (in USD millions) are defined as the total amount of funding raised at listing. Proceeds are CPI-adjusted with base year 2015. Underpricing is defined as average market-adjusted abnormal return (AR) for the first day of trading. The first-day return is calculated as the closing price over the listing price. On average, internet IPOs exhibit a larger degree of underpricing than all IPOs in the aggregate.

	Observations		**% of all IPOs**	**Proceeds** *(in mn)*		**Underpricing**	
Year	*All IPOs*	*Internet IPOs*		*All IPOs*	*Internet IPOs*	*All IPOs*	*Internet IPOs*
1996	630	89	14%	$43,563	$2,910	18.4%	20.1%
1997	454	58	13%	$38,915	$1,777	13.4%	16.0%
1998	297	49	16%	$38,810	$1,771	25.7%	46.9%
1999	450	127	28%	$64,685	$6,793	68.3%	96.0%
2000	311	73	23%	$44,492	$6,175	54.5%	77.9%
2001	100	10	10%	$36,756	$2,336	13.2%	29.7%
2002	110	13	12%	$30,292	$952	6.0%	-3.8%
2003	100	4	4%	$29,774	$196	7.7%	31.7%
2004	227	17	7%	$45,971	$3,246	9.5%	16.2%
2005	191	10	5%	$38,125	$753	7.6%	9.4%
2006	159	10	6%	$33,286	$1,899	11.3%	19.8%
2007	203	24	12%	$47,726	$2,841	9.8%	25.3%
2008	27	2	7%	$26,826	$176	4.8%	6.9%
2009	59	8	14%	$18,949	$906	11.1%	19.5%
2010	109	9	8%	$39,560	$757	2.2%	6.1%
2011	101	14	14%	$31,608	$2,823	2.2%	10.7%
2012	118	13	11%	$40,168	$16,690	10.2%	8.9%
2013	190	22	12%	$62,159	$5,140	14.4%	30.6%
2014	199	23	12%	$51,236	$4,681	163.4%	27.5%
2015	121	15	12%	$25,033	$3,578	16.4%	29.1%
2016	57	6	11%	$9,847	$764	10.7%	52.5%
Total	**4,213**	**596**	**14%**	**$797,781**	**$67,165**	**29.3%**	**45.3%**
Mean (1996-2016)	201	28		$37,990	$3,198	22.9%	27.5%
Median (1996-2016)	159	14		$38,810	$2,336	11.1%	20.1%

Sample	*Observations*	*Mean*	*Median*	*Std Dev*	*T-statistic*	*Skewness*	*Kurtosis*
All IPOs	4,213	29.3%	5.3%	464.1%	4.1	3.4	12.3
Internet IPOs	596	45.3%	20.8%	77.3%	14.3	1.6	2.7

Furthermore, **Appendix IIX** and **Appendix IX** display short-term performance results by financial sponsorship and by IPO activity period, respectively. VC-backed companies exhibit a stronger degree of underpricing than BO-backed or non-sponsored companies. The levels of the latter two only differ negligibly. Moreover, internet IPOs, which took place in periods of high IPO activity exhibit higher underpricing and, thus, raised considerably lower proceeds on average.

Regarding differences among DotCom bubble periods, a strongly statistically significant divergence is observed between means and medians for the periods before and during as well as during and after the bubble. With a mean of 89.4% and a median of 55.6%, the period during the bubble exhibits four to five times the degree of underpricing as the adjacent periods. The difference in means and medians is statistically significant for the periods before and during the bubble as well as during and after the bubble. No statistically significant difference is revealed between the period before and the period after the bubble, confirming a particular effect of the DotCom bubble on post-issue IPO short-term performance. **Table 10** presents first-day abnormal returns by DotCom bubble period.

Table 10: Short-Term Performance (AR) of Internet IPOs by DotCom Bubble Period (1996-2016)

Summary statistics regarding short-term performance (first-day AR) of internet IPOs for periods before (1996-1998), during (1999-2000), and after the DotCom Bubble (2001-2016). The entire sample ranges from 1996 to 2016. The number of observations is approximately equal across periods. Underpricing was higher on average during the DotCom Bubble compared to the periods before and after.

Period	*Mean*	*Median*	*Std Dev*	*Min*	*Max*	*Avg Proceeds (in mn)*	*Observations*
PreBubble	25.6%	14.1%	56.1%	-96.6%	608.7%	$32.9	196
Bubble	89.4%	55.6%	104.1%	-28.2%	626.4%	$64.8	200
PostBubble	20.5%	15.2%	31.2%	-88.8%	216.4%	$238.7	200
Total	**45.3%**	**20.8%**	**77.3%**	**-96.6%**	**626.4%**	**$112.7**	**596**

Table 11 provides an overview of mean and median underpricing hypotheses and their results.

Table 11: Overview of Underpricing Mean/Median Hypotheses

Overview of hypotheses regarding difference of mean / median tests for first-day AR (abnormal return on the first trading day).
*Significance at 10% = *, at 5% = **, at 1% = ***.*

Hypothesis	*Performance Metric*	*Sample*	*Periods*	*Mean*			*Median*		
				Period 1	*Period 2*	*P-value*	*Period 1*	*Period 2*	*P-value*
H1	1stDayAR	All IPOs	All	29.3%		0.000***	5.3%		0.000***
H2	1stDayAR	Internet IPOs	All	45.3%		0.000***	20.8%		0.000***
H3	1stDayAR	All IPOs, Internet IPOs	All	29.3%	45.3%	0.041**	5.3%	20.8%	0.000***
H4a	1stDayAR	Internet IPOs	PreBubble, Bubble	25.6%	89.4%	0.000***	14.1%	55.6%	0.000***
H4b	1stDayAR	Internet IPOs	Bubble, PostBubble	89.4%	20.5%	0.000***	55.6%	15.2%	0.000***
H4c	1stDayAR	Internet IPOs	PreBubble, PostBubble	25.6%	20.5%	0.268	14.1%	15.2%	0.241

Concerning the regression results to test the effect of individual IPO characteristics on underpricing, we find four to be statistically significant. Higher proceeds, VC-backing, and periods of high IPO activity increase underpricing, whereas a larger syndicate size exerts a negative effect on underpricing. These results would collectively be expected according to prior research.

We confirm Loughran and Ritter's (2004) findings that higher proceeds lead to increased underpricing for the internet industry, particularly during the DotCom bubble. The scholars attribute this effect to companies aiming to reimburse venture capitalists' investments through high initial returns. Thus, the importance of venture capital sponsorship on underpricing is established. Our result contradicts Megginson and Weiss (1991), who find that the first-day returns of VC-backed IPOs are significantly lower than those of non-VC-backed IPOs. Their outcome is based on the belief that venture capitalists guarantee the real value of a firm by participating in the screening, monitoring, and advising processes, which equalises part of the information asymmetry and, thus, decreases the level of underpricing. Lee and Wahal (2004), however, find the underpricing trend to be significantly higher among VC-backed firms, with the difference being more pronounced during

the DotCom Bubble. They argue that this outcome may be attributed to endogeneity: Companies backed by VC tend to belong to riskier industries and, as such, are more difficult to value. Thus, the amount of money left on the table results to be higher. Consequently, VC-backing enhances underpricing presumably due to venture capitalists preferring smaller, thus riskier investments. In accordance, BO-backing was not found to have a statistically significant effect on underwriting, as it is usually associated with more mature and stable industries and companies.

The influence of periods with high IPO activity corresponds with the heightened listing volume during the volatile DotCom bubble period and previous related results. During such over-optimistic times, information asymmetry between issuing companies, underwriters, and investors is periodically enhanced due to higher uncertainty concerning valuations (Ibbotson & Jaffe, 1975).

Moreover, underpricing decreases with syndicate size. Thus, Corwin and Schultz' assumption that a consensus among valuations prevents uncertainty and alleviates information asymmetry between the involved parties is reinforced. This result is attributed to diversity among syndicate members, who represent the market as a whole. Lead underwriter reputation, however, is not found to have a statistically significant effect on underwriting.

Overall, the regression exhibits an Adjusted R_2 of 0.187, and the coefficients are jointly statistically significantly different from zero according to their F-statistics. An output of regression results is displayed in **Table 12**.

Table 12: OLS Regression Summary for Short-Term Performance (AR)

*OLS regression summary for short-term performance with first-day AR as dependent variable and several IPO characteristics as independent variables (incl. a constant). Their individual statistical significance is indicated through respective t-statistics and p-values. Significance at 10% = *, at 5% = **, at 1% = ***.*

Variable	*Coefficient*	*Std Err*	*T-statistic*	*P-value*	*Expected Sign*
Constant	-1.139	0.223	-5.106	0.000***	
Proceeds	0.276	0.045	6.118	0.000***	+
UnderwriterRep	0.041	0.026	1.618	0.106	-
SyndicateSize	-0.085	0.020	-4.283	0.000***	-
BOBacked	-0.084	0.066	-1.275	0.202	-
VCBacked	0.140	0.043	3.245	0.001***	+
IPOActivity	0.339	0.041	8.181	0.000***	+

Observations	496
R_2	0.157
Adjusted R_2	0.147
F-statistic	15.59
P-value (F-statistic)	0.000***

In order to interpret these results appropriately, the validity of OLS assumptions must be inspected and discussed. A Jarque-Bera test indicates that skewness and kurtosis are jointly different from zero. Thus, the sample data does not follow a normal distribution, as mentioned previously. Due to the specific distributions of this analysis, residuals are not normally distributed according to an Anderson-Darling test at a 5% significance level, which will likely affect confidence intervals. Nonetheless, the procedure follows established research despite there being no prior nonlinear transformations on variables except IPO proceeds (e.g., Ritter, 1991; Chi & Padgett, 2005).

Appendix X displays a correlation matrix for variables used in this underpricing regression. It differs from the correlation matrix for all variables used throughout this study, as the regressions disregard outliers. Besides, an overview of Variance Inflation Factors (VIF) per variable is presented in **Appendix XI**. As a rule of thumb, multicollinearity (i.e., a significant linear relation between independent variables) could be present if a correlation is above 0.8, or a VIF is above 10. Definite multicollinearity would be present in case of a VIF exceeding a value of 100, which is only the case for the intercept. The inclusion of this constant could cause high potential overlap with binary variables such as IPO activity. Thus, a high VIF in the intercept could indicate that explanatory variables also involve large constant components, for instance, when a variable exhibits a large mean but merely little variance. Consequently, the multicollinearity assumption is not actually violated.

We apply standard errors consistent with heteroscedasticity and autocorrelation (HAC) during the regression following Newey and West (1987, 1994). Autocorrelation refers to a relationship between values of the same variable over time, whereas heteroscedasticity is defined as the standard deviation of a variable being non-constant across observations. No autocorrelation of residuals can be observed according to a Durbin-Watson test value of 1.9, with values between approximately 1.5 and 2.5 generally indicating that little or no autocorrelation is

present, values far below 2 indicating the potential presence of positive autocorrelation, and values far above 2 indicating the potential presence of negative autocorrelation. Moreover, no indication of heteroscedasticity is found according to a Breusch-Pagan test, which checks for the linear form of heteroscedasticity only, and a more generic White's test. An overview of individual test results is displayed in **Table 18** below.

5.2. IPO Long-Term Performance Hypotheses

5.2.1. Long-Term Abnormal Returns in Event Time

Prior investigations regarding long-run IPO performance contributed to several debates concerning which models intend to measure true abnormal returns in event time. Among the different methods, two emerged to be most common: Cumulative abnormal returns (CAR) and buy-and-hold abnormal returns (BHAR) (Ritter, 1991; Loughran & Ritter, 1995; Barber & Lyon, 1997; Brav & Gompers, 1997). Which of the two measures to use is essential for the interpretation of final results due to their characteristics. BHARs are obtained by compounding single-period abnormal returns, whereas CARs are obtained by aggregating single-period abnormal returns. Due to their process, the former exhibit a tendency to assume extreme values over long periods. Thus, they might interfere with robust statistical testing as a result of their non-normal distribution, while authentically reflecting a buy-and-hold experience. Besides, a low number of firms with excessively high share prices can distort them. The distributional assumptions of CARs are more robust than those of BHARs, yet they tend to be severely biased upwards due to their cumulative set-up. Consequently, although both measures attempt to answer distinct questions, BHARs reflect investors' real experiences more accurately (Schöber, 2008).

The methodology of established research is followed by initially calculating abnormal long-run returns for a period of 36 event months after the first trading month (Ritter, 1991; Chi & Padgett, 2005). Thus, the long-run returns comprise all months between event month 2 and event month 37 after each IPO. Following Ritter (1991), one month includes 21 trading days.

Per previous definitions, the abnormal return for stock *i* in month *t* is determined as:

$$AR_{i,t} = r_{i,t} - r_{m,t} \qquad (5)$$

where $AR_{i,t}$is the abnormal return for stock i in trading month t, $r_{i,t}$ is the return for stock i in trading month t, and $r_{m,t}$ is the return on the market during the corresponding period.

The cumulative abnormal return (CAR) from event month *q* to event month *s* is the sum of a stock's monthly abnormal returns:

$$CAR_{i,q,s} = \sum_{t=q}^{s} AR_{i,t} \qquad (6)$$

where $CAR_{i,q,s}$ is the cumulative abnormal return from event month q to event month s for stock i, and $AR_{i,t}$ is the abnormal return for stock i in trading month t.

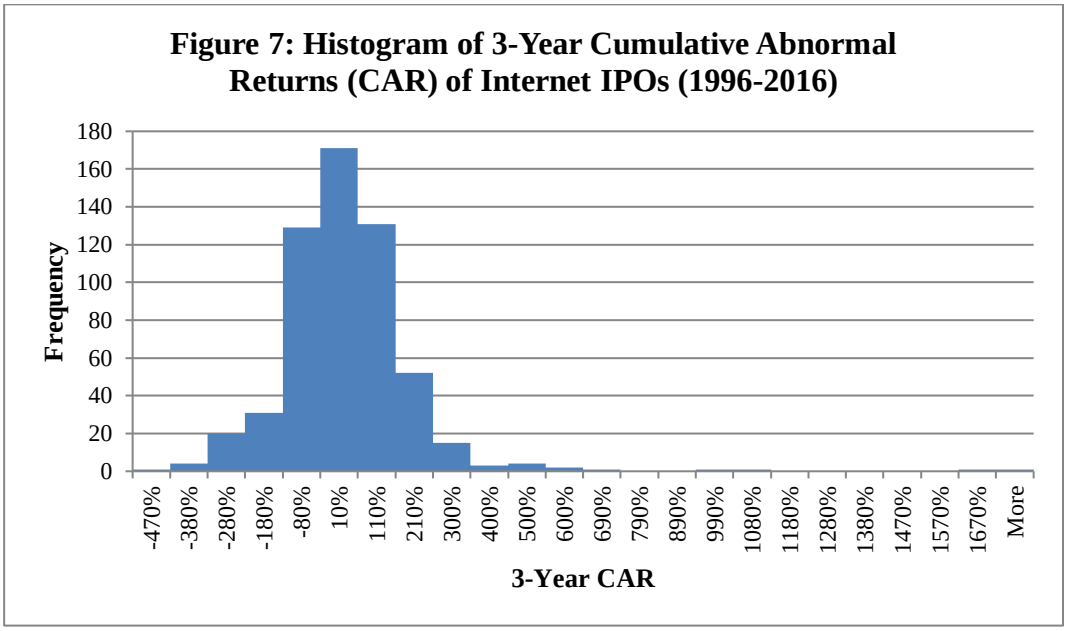
Accordingly, the equally-weighted average cumulative abnormal return across a sample is defined as:

$$\overline{CAR^{ew}} = \frac{1}{n} \sum_{i=1}^{s} CAR_{i,q,s} \qquad (7)$$

where $\overline{CAR^{ew}}$is the equally-weighted average cumulative abnormal return for a sample, n is the number of observations in the sample, and $CAR_{i,q,s}$ is the cumulative abnormal return from event month q to event month s for stock i.

Figure 7 displays the resulting distribution of CARs.

Figure 7: Histogram of 3-Year Cumulative Abnormal Returns (CAR) of Internet IPOs (1996-2016)



The buy-and-hold abnormal return (BHAR) following the first trading month is defined as:

$$BHAR_{i,q,s} = \prod_{t=q}^{s} (1 + r_{i,t}) - \prod_{t=q}^{s} (1 + r_{m,t}) \quad (8)$$

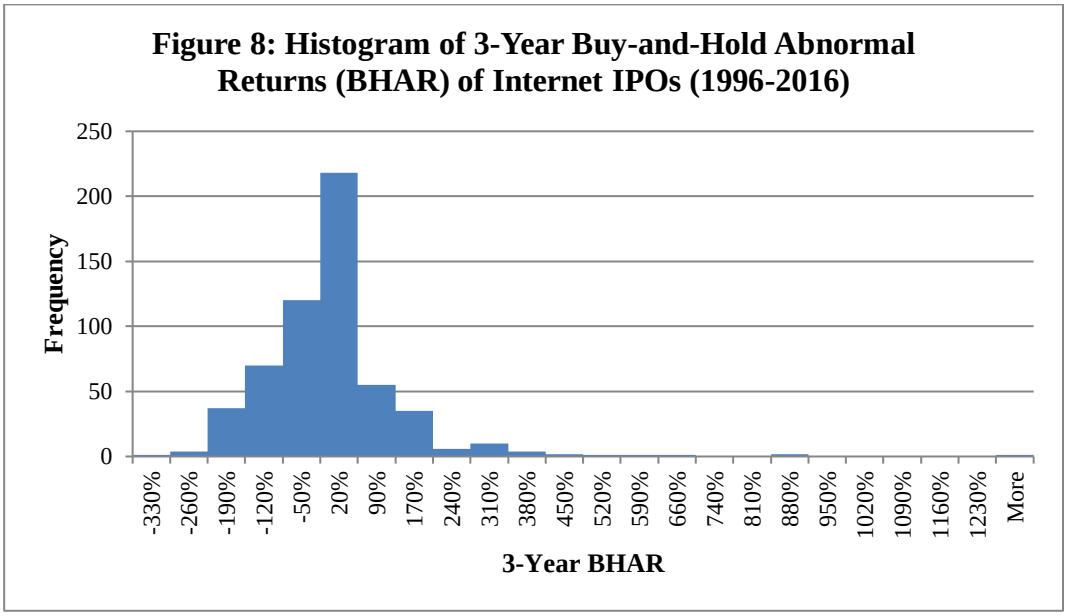
where $BHAR_{i,q,s}$ is the buy-and-hold abnormal return from event month q to event month s for stock i, $r_{i,t}$ is the return for stock i in trading month t, and $r_{m,t}$ is the return on the market during the corresponding period.

Accordingly, the equally-weighted average buy-and-hold abnormal return across a sample is defined as:

$$\overline{BHAR^{ew}} = \frac{1}{n} \sum_{i=1}^{s} BHAR_{i,q,s} \quad (9)$$

where $\overline{BHAR^{ew}}$ is the equally-weighted average buy-and-hold abnormal return for a sample, n is the number of observations in the sample, and $BHAR_{i,q,s}$ is the buy-and-hold abnormal return from event month q to event month s for stock i.

Figure 8 displays the resulting distribution of BHARs.



5.2.2. Statistical Hypothesis Testing

When testing whether internet IPOs experience significant underperformance in the long run, a Student's one-sample t-test is used once more to check if average long-run abnormal returns are statistically significantly different from zero. Again, the distributions of both performance measures have to be taken into consideration. BHARs, on the one hand, are usually not assumed to be normally distributed (Schöber, 2008). Relying solely on a t-test when testing this distribution can be insufficient. CARs, on the other hand, are assumed to be normally distributed (Schöber, 2008). Hence, Wilcoxon's signed-rank tests are performed for both performance measures to assess and confirm if also median long-run abnormal returns are statistically significantly different from zero for internet IPOs. Moreover, Welch's tests and Wilcoxon-Mann-Whitney tests are applied to examine if mean and median long-term abnormal returns differ between periods before, during, and after the DotCom bubble.

We test two separate OLS regression frameworks to assess the effect of IPO characteristics on long-term performance. The two models exhibit the 3-year CAR and 3-year BHAR as dependent variables, respectively. The same explanatory variables as those previously used in the underpricing model are applied. Moreover,

first-day abnormal returns are included as an additional independent variable in either regression to assess their effect on long-run performance.

$$\mathbf{3YearCAR_i} = \alpha_i + \beta_1 ln(Proceeds_i) + \beta_2 UnderwriterRep_i + \beta_3 SyndicateSize_i + \beta_4 BOBacked_i + \beta_5 VCBacked_i + \beta_6 IPOActivity_i + \beta_7 1stDayAR_i + \varepsilon_i$$

$$\mathbf{3YearBHAR_i} = \alpha_i + \beta_1 ln(Proceeds_i) + \beta_2 UnderwriterRep_i + \beta_3 SyndicateSize_i + \beta_4 BOBacked_i + \beta_5 VCBacked_i + \beta_6 IPOActivity_i + \beta_7 1stDayAR_i + \varepsilon_i$$

5.2.3. Discussion of Results

We find strongly significant evidence for post-issue long-term underperformance among internet stocks. Both CARs and BHARs prove to be statistically significantly different from zero and result in negative abnormal returns. CARs exhibit a mean of -16.5% and a median of -34.0%, whereas BHARs exhibit a mean of -29.1% and a median of -38.3%. As previously stated, CARs tend to be severely biased upwards due to their cumulative set-up. In this case, BHARs manage to reflect investors' actual experiences more accurately (Schöber, 2008). **Table 13** displays yearly and aggregate long-term performance results for both CARs and BHARs. The overview does not reveal any obvious yearly pattern in terms of long-term performance.

Table 13: Yearly Long-Term Performance of Internet IPOs (1996-2016)

Yearly overview of the number of internet IPOs between 1996 and 2016 of companies not delisted within 3 years past issuance and their subsequent long-term performance. Long-term performance is defined as average cumulative abnormal return (CAR) and average buy-and-hold abnormal return for 3 years (i.e., 36 months) past listing. Whereas the average CAR is positive, the associated average BHAR is almost symmetrically negative.

Year	*Observations*	*CAR*	*BHAR*
1996	86	-59.4%	-128.8%
1997	52	-55.2%	-79.8%
1998	47	26.7%	39.4%
1999	120	-60.9%	-18.3%
2000	72	80.6%	-14.9%
2001	10	-26.5%	-38.1%
2002	13	38.1%	37.6%
2003	4	-89.7%	-64.9%
2004	16	15.5%	19.2%
2005	10	-14.7%	5.2%
2006	9	11.8%	5.5%
2007	23	24.3%	-9.3%
2008	2	69.2%	112.6%
2009	8	18.9%	11.8%
2010	8	-17.7%	-9.5%
2011	14	-33.8%	-39.8%
2012	12	15.9%	40.1%
2013	22	-70.8%	-59.7%
2014	23	-19.1%	-4.9%
2015	15	12.0%	33.6%
2016	6	21.2%	120.4%
Total	572	**-16.5%**	**-29.1%**
Mean (1996-2016)	27	-5.4%	-2.0%
Median (1996-2016)	14	11.8%	-4.9%

Metric	*Observations*	*Mean*	*Median*	*Std Dev*	*Skewness*	*Kurtosis*
CAR	572	-16.5%	-34.0%	185.6%	3.5	28.5
BHAR	572	-29.1%	-38.3%	138.6%	3.1	21.0

In addition, **Appendix IIX** and **Appendix IX** present long-term performance results by financial sponsorship and by IPO activity period, respectively. For both measures, VC-backed IPOs seem to exhibit a superior long-term performance over other forms of sponsorship. Furthermore, periods of high IPO activity seem to cause lower long-term returns compared to periods of low activity.

Concerning differences among DotCom bubble periods, a gradual increase in long-term performance seems to have occurred from before until after the bubble across both measures. However, we determine statistical significance for means and medians only for the periods before and after the bubble with regard to CARs. The difference in medians is also statistically significant for the time during and after the bubble. For BHARs, the difference in means and medians is significant for the periods before and during as well as before and after the bubble. The difference in means is also statistically significant for the periods during and after the bubble. Therefore, no clear effect of the DotCom bubble on long-term performance can be established overall. While causing a distinct increase in underpricing, the effect of the event tends to correct in the short to medium term. Consequently, a granular analysis on the timing of DotCom bubble effects on long-term IPO performance would be required for sound interpretations. This knowledge could help to understand the exact timing of the effect wearing off. **Table 14** and **Table 15** present long-term abnormal returns by DotCom bubble period for both CARs and BHARs, respectively.

Table 14: Long-Term Performance (CAR) of Internet IPOs by DotCom Bubble Period (1996-2016)

Summary statistics regarding long-term performance (3-year CAR) of internet IPOs for periods before (1996-1998), during (1999-2000), and after the DotCom Bubble (2001-2016). The entire sample ranges from 1996 to 2016.

Period	*Mean*	*Median*	*Std Dev*	*Min*	*Max*	*Avg Proceeds (in mn)*	*Observations*
PreBubble	-36.3%	-65.6%	160.1%	-434.5%	1046.7%	$32.9	185
Bubble	-7.8%	-36.0%	255.7%	-474.6%	1765.9%	$64.8	192
PostBubble	-6.1%	-4.4%	110.1%	-432.8%	542.2%	$238.7	195
Total	**-16.5%**	**-34.0%**	**185.6%**	**-474.6%**	**1765.9%**	**$112.7**	**572**

Table 15: Long-Term Performance (BHAR) of Internet IPOs by DotCom Bubble Period (1996-2016)

Summary statistics regarding long-term performance (3-year BHAR) of internet IPOs for periods before (1996-1998), during (1999-2000), and after the DotCom Bubble (2001-2016). The entire sample ranges from 1996 to 2016.

Period	*Mean*	*Median*	*Std Dev*	*Min*	*Max*	*Avg Proceeds (in mn)*	*Observations*
PreBubble	-72.3%	-130.5%	206.1%	-333.4%	1304.9%	$32.9	185
Bubble	-17.0%	-31.5%	60.9%	-84.9%	588.1%	$64.8	192
PostBubble	0.1%	-20.6%	99.3%	-161.1%	390.2%	$238.7	195
Total	**-29.1%**	**-38.3%**	**138.6%**	**-333.4%**	**1304.9%**	**$112.7**	**572**

To summarise, **Table 16** provides an overview of mean and median long-term internet IPO performance hypotheses and their results.

Table 16: Overview of Long-Term Performance Mean/Median Hypotheses

*Overview of hypotheses regarding difference of mean / median tests for long-term performance. Includes 3-year CAR (cumulative abnormal return) and 3-year BHAR (buy-and-hold abnormal return). Significance at 10% = *, at 5% = **, at 1% = ***.*

Hypothesis	*Performance Metric*	*Sample*	*Periods*	*Mean*			*Median*		
				Period 1	*Period 2*	*P-value*	*Period 1*	*Period 2*	*P-value*
H6	3YearCAR	Internet IPOs	All	-16.5%		0.034**	-34.0%		0.000***
H7a	3YearCAR	Internet IPOs	PreBubble, Bubble	-36.3%	-7.8%	0.194	-65.6%	-36.0%	0.149
H7b	3YearCAR	Internet IPOs	Bubble, PostBubble	-7.8%	-6.1%	0.930	-36.0%	-4.4%	0.034**
H7c	3YearCAR	Internet IPOs	PreBubble, PostBubble	-36.3%	-6.1%	0.034**	-65.6%	-4.4%	0.000***
H9	3YearBHAR	Internet IPOs	All	-29.1%		0.000***	-38.3%		0.000***
H10a	3YearBHAR	Internet IPOs	PreBubble, Bubble	-72.3%	-17.0%	0.001***	-130.5%	-31.5%	0.000***
H10b	3YearBHAR	Internet IPOs	Bubble, PostBubble	-17.0%	0.1%	0.042**	-31.5%	-20.6%	0.113
H10c	3YearBHAR	Internet IPOs	PreBubble, PostBubble	-72.3%	0.1%	0.000***	-130.5%	-20.6%	0.000***

Next, we examine the regression analysis regarding the effect of specific IPO characteristics on long-term performance. Concerning CARs, only syndicate size exhibits a statistically significant coefficient, with a higher value exerting a positive effect. Thus, the assumption that the inclusion of more underwriters fosters accurate company pricing and prevents adverse earnings management in the long term is reinforced (Teoh *et al.*, 1998a-c). In the case of BHARs, proceeds, syndicate size, and IPO activity were individually statistically significant. As expected from prior research, proceeds and syndicate size had a positive effect, and IPO activity hurt long-term performance. Larger proceeds can potentially result in better long-run returns due to reinvestments (Goodnight & Green, 2010). Thus, companies attract investors with deliberately low listing prices, resulting in high first-day returns once the price adjusts. Nonetheless, they manage to maximise proceeds owing to this strategy, which ensures reinvestments to boost subsequent performance. Moreover, the assumption regarding syndicate size and adverse earnings management is further reinforced to have a lasting effect. In terms of periods of high IPO activity, the results confirm that potentially over-optimistic periods tend to have a detrimental effect on long-term performance. The outcome is in accordance with

existing theories that young growth companies, which are common to the internet industry, are particularly affected (Ritter, 1991; Ibbotson, Sindelar, & Ritter, 1994). Lead underwriter reputation, BO-backing, VC-backing, and underpricing do not result in statistically significant coefficients for either of the two long-term performance measures. Hence, rather than the choice of underwriter, the number of underwriters involved tends to have a lasting effect on the performance of internet companies. Whereas BO-backed and VC-backed stocks generally experience better performance than non-sponsored IPOs in the long run (Brav & Gompers, 1997; Levis, 2011; Ritter, 2015), financial sponsorship does not have any influence on the long-term performance of internet IPOs specifically. On the one hand, sponsorship through BO remains a rare type of financing for internet companies. On the other hand, Ritter (2015) attributes the superior long-term performance of overall VC-backed IPOs to a particular sub-category of growth-capital-backed deals (Ritter, 2015). Growth-capital investors, however, do seldom target the technology sector due to their preference for tangible assets. Thus, while an effect of VC-backing on the short-term performance of internet companies can be determined, this result fails to materialise in the long term. As a result, insights into venture capitalists' long-run intentions regarding internet companies as well as their exit timing following an IPO might be of further interest. The experience and guidance provided by venture capitalists alone does not seem to benefit internet companies significantly in the long term.

Finally, the expected negative relationship between underpricing and long-term performance cannot be established. While the individual existence of both phenomena is proven, first-day abnormal returns do not seem to influence the long-term success of internet companies as they mature. Including first-day abnormal results does not significantly affect the performance of long-term regressions due to this missing relationship. The Adjusted R_2 remains close to the original levels of 0.021 (CARs) and 0.186 (BHARs). Moreover, an F-test confirms that coefficients are jointly significantly different from zero in both cases. A comparison of regression results for CARs and BHARs is displayed in **Table 17**. **Appendix XII** presents individual overviews of their results.

Table 17: Long-Term Performance OLS Regression Comparison between 3-year CAR and BHAR

OLS regression summary comparison for long-term performance with 3-year CAR and 3-year BHAR as respective dependent variables and several IPO characteristics as independent variables (incl. a constant). Their individual statistical significance is indicated through respective t-statistics and p-values. (1) excludes MAAR as dependent variable in the regression, (2) includes MAAR as dependent variable in the regression.
*Significance at 10% = *, at 5% = **, at 1% = ***.*

Variable	**3-year CAR**		**3-year BHAR**		*Expected Sign*
	(1)	*(2)*	*(1)*	*(2)*	
Constant	-0.250	-0.342	-1.364***	-1.2546**	
	(0.706)	*(0.713)*	*(0.508)*	*(0.504)*	
Proceeds	0.022	0.050	0.310***	0.2771***	+
	(0.124)	*(0.1290)*	*(0.092)*	*(0.096)*	
UnderwriterRep	-0.051	-0.049	-0.066	-0.068	+
	(0.081)	*(0.081)*	*(0.053)*	*(0.053)*	
SyndicateSize	0.117**	0.1079*	0.129***	0.1398***	+
	(0.054)	*(0.056)*	*(0.045)*	*(0.047)*	
BOBacked	-0.057	-0.065	-0.122	-0.113	+
	(0.193)	*(0.193)*	*(0.130)*	*(0.131)*	
VCBacked	0.143	0.155	0.143	0.129	+
	(0.115)	*(0.114)*	*(0.093)*	*(0.093)*	
IPOActivity	-0.242*	-0.212	-0.230***	-0.3357***	-
	(0.133)	*(0.138)*	*(0.116)*	*(0.118)*	
1stDayAR		-0.086		0.103	-
		(0.119)		*(0.073)*	
Observations	435	435	435	435	
R_2	0.036	0.037	0.183	0.186	
Adjusted R_2	0.022	0.021	0.172	0.172	
F-statistic	4.336	3.857	12.490	10.880	
P-value (F-statistic)	0.000***	0.000***	0.000***	0.000***	

Again, the validity of OLS assumptions must be examined due to the distribution of variables involved in the regressions. For CARs, a Jarque-Bera test indicates a normal distribution of sample data based on skewness and kurtosis being jointly equal to zero, which fulfils previous expectations of sound normality assumptions surrounding this long-term performance metric (Schöber, 2008). Residuals are also strongly statistically significantly normally distributed according to an Anderson-Darling test. A Durbin-Watson test value of 2.0 once more hints at little to no autocorrelation of residuals. Yet, the assumption of homoscedasticity is altogether

rejected according to Breusch-Pagan and White's tests despite the inclusion of heteroscedasticity and autocorrelation consistent standard errors for both long-term performance regressions. For BHARs, normality of sample data is not given according to Jarque-Bera test results. Residuals are not normally distributed according to the Anderson-Darling test, while there is no indication for the presence of autocorrelation with a Durbin-Watson test value of 1.9. Besides, the assumption of homoscedasticity is confirmed through both a Breusch-Pagan and a White's test. Once more, a correlation matrix for variables used in the long-term performance regressions can be found in **Appendix X**. Moreover, the associated overview of VIFs per variable is presented in **Appendix XI**. Again, no possible or definite multicollinearity that would violate the associated OLS assumption can be determined based on either method. An overview of individual test results is displayed in **Table 18**.

Table 18: Overview of OLS Assumption Test Results for IPO Performance Regressions

An overview of test results for OLS assumptions of short-term and long-term IPO performance regressions.
Jarque-Bera test for normality of sample data: High p-values indicate normality through skewness and kurtosis being jointly equal to zero.
Anderson-Darling test for normality of residuals: Low p-values indicate non-normality of residuals.
Durbin-Watson test for autocorrelation of residuals: Values around 1.5-2.5 indicate little or no autocorrelation, values <2 indicate the potential presence of positive autocorrelation, values >2 indicate the potential presence of negative autocorrelation.
Breusch-Pagan & White's tests for homoscedasticity of residuals: Low p-values indicate no presence of heteroscedasticity among residuals.

*Significance at 10% = *, at 5% = **, at 1% = ***.*

Test	*Assumption*	*Regression (Dependent Variable)*		
		1stDayAR	*3YearCAR*	*3YearBHAR*
Jarque-Bera	Normality	0.000***	0.559	0.001***
Anderson-Darling	Normality of Residuals	0.000***	0.126	0.000***
Durbin-Watson	No Autocorrelation	1.86	2.03	1.86
Breusch-Pagan	Homoscedasticity	0.000***	0.219	0.002***
White	Homoscedasticity	0.000***	0.169	0.004***

Finally, a comprehensive overview of all hypotheses and sub-hypotheses analysed during this study and their results regarding post-issue underpricing and long-term performance is provided in **Table 19**.

Table 19: Overview of Hypothesis Test Results

A comprehensive overview of hypotheses assessed throughout this study. The overview is divided by horizon into short-term hypotheses and long-term hypotheses. Short-term hypotheses refer to metric first-day AR (abnormal return on the first trading day). Long-term hypotheses are further sub-divided by metric into 3-year CAR (cumulative abnormal return) and 3-year BHAR (buy-and-hold abnormal return). The respective sample and IPO characteristic are exhibited by hypothesis. The expected and actual signs as well as the associated p-values are displayed to indicate test results.

*Significance at 10% = *, at 5% = **, at 1% = ***.*

Horizon	*Hypothesis*	*Performance Metric*	*Sample*	*Variables*	*Expected*	*Actual*	*P-value*
Short-term	H1	1stDayAR	All IPOs	[Median]	≠0	≠0	0.000***
	H2	1stDayAR	Internet IPOs	[Median]	≠0	≠0	0.000***
	H3	1stDayAR	All IPOs, Internet IPOs	[Median]	≠0	≠0	0.000***
	H4a	1stDayAR	Internet IPOs	PreBubble, Bubble	≠0	≠0	0.000***
	H4b	1stDayAR	Internet IPOs	Bubble, PostBubble	≠0	≠0	0.000***
	H4c	1stDayAR	Internet IPOs	PreBubble, PostBubble	≠0	=0	0.241
	H5a	1stDayAR	Internet IPOs	Proceeds	+	+	0.000***
	H5b	1stDayAR	Internet IPOs	UnderwriterRep	-	+	0.106
	H5c	1stDayAR	Internet IPOs	SyndicateSize	-	-	0.000***
	H5d	1stDayAR	Internet IPOs	BOBacked	-	-	0.202
	H5e	1stDayAR	Internet IPOs	VCBacked	+	+	0.001***
	H5f	1stDayAR	Internet IPOs	IPOActivity	+	+	0.000***
Long-term (3 years)	H6	3YearCAR	Internet IPOs	[Median]	≠0	≠0	0.000***
	H7a	3YearCAR	Internet IPOs	PreBubble, Bubble	≠0	=0	0.149
	H7b	3YearCAR	Internet IPOs	Bubble, PostBubble	≠0	≠0	0.034**
	H7c	3YearCAR	Internet IPOs	PreBubble, PostBubble	≠0	≠0	0.000***
	H8a	3YearCAR	Internet IPOs	Proceeds	+	+	0.698
	H8b	3YearCAR	Internet IPOs	UnderwriterRep	+	-	0.546
	H8c	3YearCAR	Internet IPOs	SyndicateSize	+	+	0.055*
	H8d	3YearCAR	Internet IPOs	BOBacked	+	-	0.737
	H8e	3YearCAR	Internet IPOs	VCBacked	+	+	0.175
	H8f	3YearCAR	Internet IPOs	IPOActivity	-	-	0.126
	H8g	3YearCAR	Internet IPOs	1stDayAR	-	-	0.468
	H9	3YearBHAR	Internet IPOs	[Median]	≠0	≠0	0.000***
	H10a	3YearBHAR	Internet IPOs	PreBubble, Bubble	≠0	≠0	0.000***

	H10b	3YearBHAR	Internet IPOs	Bubble, PostBubble	≠0	=0	0.113
	H10c	3YearBHAR	Internet IPOs	PreBubble, PostBubble	≠0	≠0	0.000***
	H11a	3YearBHAR	Internet IPOs	Proceeds	+	+	0.004***
	H11b	3YearBHAR	Internet IPOs	UnderwriterRep	+	-	0.198
	H11c	3YearBHAR	Internet IPOs	SyndicateSize	+	+	0.003***
	H11d	3YearBHAR	Internet IPOs	BOBacked	+	-	0.385
	H11e	3YearBHAR	Internet IPOs	VCBacked	+	+	0.164
	H11f	3YearBHAR	Internet IPOs	IPOActivity	-	-	0.004***
	H11g	3YearBHAR	Internet IPOs	1stDayAR	-	+	0.161

6. Conclusion

This study answers the research question of which characteristics influence the short-term and long-term performance of internet IPOs through a respective sample of 596 and 572 stocks listed in the US between 1996 and 2016. Our analysis reveals that internet companies do experience substantial first-day abnormal returns and subsequent long-term underperformance when benchmarked against the NASDAQ Composite Index. Underpricing is more pronounced for internet stocks than for the average IPO listed on any US exchange during the same time frame. Nevertheless, a significant relationship between underpricing and long-term returns cannot be established as internet companies mature, whilst both phenomena are confirmed individually. Thus, despite large first-day returns, investors' long-term returns result to be negative based on both average 3-year cumulative abnormal returns and average 3-year buy-and-hold abnormal returns. A particular effect can be attributed to the DotCom bubble. This volatile period severely amplifies the underpricing phenomenon, presumably due to increased risks from information asymmetry between issuing company, underwriters, and investors. However, the effect wears off within the three years following a listing. Thus, the DotCom bubble exerts no clear effect on the long-term performance of internet IPOs. Instead, long-term performance in general seems to have gradually improved over the three periods before, during, and after the bubble.

We found several characteristics to cause a significant influence on the post-issue performance of internet stocks. IPO proceeds, syndicate size, and periods of high IPO activity influence both short-term and long-term results. The effect of the three

characteristics is attributed to changes in the information asymmetry between the involved parties. A deliberately low listing price intends to attract investors and yet ultimately higher proceeds ensure stability through continuous reinvestments into the company later on. Moreover, a larger and more diverse syndicate affects the dynamic by reflecting market expectations as a whole and over a long prospective period. Thus, involving more underwriters generally reduces the uncertainty surrounding an IPO. Over-optimistic periods regarding IPO activity result in higher short-term and lower long-term performance through enhanced uncertainty regarding the accurate valuation of issuing companies. However, this persisting effect seems to be attributed to shorter sentiments on a yearly basis instead of exceptional longer-lasting events, as we could not find significantly worsened long-term performance for companies that were listed during the DotCom bubble. Sponsorship by risky venture capitalists also influences short-term performance yet tends to wear off within the three years after listing. We assume that this either stems from venture capital investors exiting the company early on or the effect of their guidance wearing off over time. Consequently, post-issue performance is further assumed to be related to short-term and long-term intentions of investors, the issuing company, and the underwriters involved.
Lead underwriter reputation is not found to have a statistically significant effect on performance. Neither is buyout backing, another form of financial sponsorship, which remains rare for internet companies due to buyout investors' preference for mature and stable industries.

In conclusion, internet companies are overall no exception to established research regarding more mature industries and uncertain listing conditions. We determine characteristics that directly influence the information asymmetry between issuing internet companies, underwriters, and investors. Adjustments of these factors that precede the listing, such as the choice of a syndicate, enable companies to actively manage investors' expectations regarding short-term and long-term post-issue performance. Thus, they can, ultimately, contribute to the lasting success of an IPO.

7. Contribution & Further Research

Despite being guided by methodologies commonly applied in established research within the field of IPOs, we identify a substantial interest in more advanced methods to improve the validity of analysis results and facilitate interpretations. These procedures should be apt to deliver an accurate and reliable outcome while retaining the particular distributional assumptions of abnormal returns related to IPOs.

Besides, the general framework conditions of the internet industry offer broader areas of research. Financial sponsorship becomes of further interest on a granular level when considering how it evolves over the three years following an IPO and what effect this can have on long-term performance. Thus, particular emphasis might be placed on the intentions and the associated exit timing of private investors. Moreover, the unique effects of the DotCom bubble on the subsequent development of internet companies should be further established to understand at what moment they ceased to influence performance. These insights might assist in interpreting the results of this study.

Finally, we disregard the effect that a delisting and a second listing can have on IPO underpricing and long-term performance during this analysis. Muscarella and Vetsuypens (1989) suggest significantly lower underpricing for relistings due to reduced pricing uncertainty. Cook and Officer (1996) provide evidence for a reversed effect if the relisting takes place within the same year of delisting. However, reissuers exhibit superior long-term performance compared to non-reissuers overall. Thus, the effect of this particular dynamic on analysis results should be further investigated. Moreover, we do not take companies' previous listings on other stock exchanges foreign to the US into consideration during the data selection process. This circumstance could, however, also influence the initial pricing of a subsequent IPO on a US exchange. For the sake of simplicity and due to ambiguous effects, this factor is disregarded during the analysis, yet might deserve further research itself. In general, the analysis could be extended to include markets outside of the US once sufficient data availability is guaranteed.

Nonetheless, we believe that our study provides a sound foundation for further research into the various factors that determine the post-issue success of IPOs within an industry of indubitable relevance and continually increasing importance.

8. Appendices

Appendix I: Prior Literature on IPO Underpricing by Financial Sponsorship

Table 20: Summary of Prior Literature on IPO Underpricing by Financial Sponsorship

An overview of existing research on IPO underpricing by financial sponsorship. Underpricing is consistently measured as ratio of first-day closing price over offer price. Financial sponsorship includes PE = Private Equity, BO = Buyout, VC = Venture Capital, and NS = Non-Sponsored (or Non-PE). BO and VC are both sub-categories of PE. The list is ordered alphabetically by author within sponsorship type.

#	Author(s)	Market(s)	Period	Metric	Mean	Median	Sample Size	Financial Sponsorship
Private Equity								
1	Bergström, Nilsson & Wahlberg (2006)	France	1994-2004	First-Day Closing Price	4.2%		24	PE
1	Bergström, Nilsson & Wahlberg (2006)	UK	1994-2004	First-Day Closing Price	10.3%		128	PE
2	Ferretti & Meles (2011)	Italy	1998-2008	First-Day Closing Price	1.9%		66	PE
3	Hamao, Packer, & Ritter (2000)	Japan	1989-1994	First-Day Closing Price	19.2%		355	PE
4	Levis (2011)	UK	1992-2005	First-Day Closing Price	9.1%		204	PE
5	Ritter (2015)	US	1980-2012	First-Day Closing Price	22.6%		3,757	PE
6	Schertler (2002)	France	1997-2000	First-Day Closing Price	16.0%		44	PE
6	Schertler (2002)	Germany	1997-2000	First-Day Closing Price	52.0%		118	PE
7	Van der Geest & Van Frederikslust (2001)	Netherlands	1985-1998	First-Day Closing Price	13.0%		38	PE
8	Vu, Worthington, & Laird (2008)	Australia	1996-2007	First-Day Closing Price	39.6%		45	PE
Buyout								
9	Ainina & Mohan (1991)	US	1983-1987	First-Day Closing Price	2.1%		92	BO
10	Ang & Brau (2002)	US	1981-1996	First-Day Closing Price	5.5%		334	BO
11	Cao & Lerner (2009)	US	1981-2003	First-Day Closing Price	12.9%		526	BO
12	Cook & Officer (1996)	US	1983-1991	First-Day Closing Price	1.9%		111	BO
13	Hogan, Olson, & Kish (2001)	US	1987-1998	First-Day Closing Price	7.6%		232	BO
14	Holthausen & Larcker (1996)	US	1983-1988	First-Day Closing Price	2.0%		90	BO
15	Michala (2019)	US	1975-2013	First-Day Closing Price	10.5%		897	BO

16	Muscarella & Vetsuypens (1989)	US	1983-1987	First-Day Closing Price	2.0%		74	BO
17	Ritter (2015)	US	1980-2012	First-Day Closing Price	8.9%		987	BO
18	Schöber (2008)	US	1990-2006	First-Day Closing Price	9.9%	5.3%	701	BO
Venture Capital								
19	Barry, Muscarella, Peavy III, & Vetsuypens (1990)	US	1978-1987	First-Day Closing Price	8.4%	2.8%	433	VC
20	Francis & Hasan (2001)	US	1990-1993	First-Day Closing Price	13.5%		415	VC
21	Jain & Kini (1995)	US	1967-1988	First-Day Closing Price		3.8%	136	VC
22	Lee & Wahal (2004)	US	1980-2000	First-Day Closing Price	26.8%		2,383	VC
23	Levis (2011)	UK	1992-2005	First-Day Closing Price	14.9%		250	VC
24	Megginson & Weiss (1991)	US	1983-1987	First-Day Closing Price	7.1%		320	VC
25	Michala (2019)	US	1975-2013	First-Day Closing Price	27.9%		2,763	VC
26	Ritter (2015)	US	1980-2012	First-Day Closing Price	29.4%		2,426	VC
27	Vu, Worthington, & Laird (2008)	Australia	1996-2007	First-Day Closing Price	32.1%		54	VC
Non-Sponsored								
28	Ainina & Mohan (1991)	US	1983-1987	First-Day Closing Price	2.8%		0	NS
29	Ang & Brau (2002)	US	1981-1996	First-Day Closing Price	8.0%		334	NS
30	Barry, Muscarella, Peavy III, & Vetsuypens (1990)	US	1978-1987	First-Day Closing Price	7.5%	1.3%	1,123	NS
31	Bergström, Nilsson & Wahlberg (2006)	France	1994-2004	First-Day Closing Price	9.5%		482	NS
31	Bergström, Nilsson & Wahlberg (2006)	UK	1994-2004	First-Day Closing Price	14.7%		888	NS
32	Ferretti & Meles (2011)	Italy	1998-2008	First-Day Closing Price	6.6%		94	NS
33	Francis & Hasan (2001)	US	1990-1993	First-Day Closing Price	10.1%		428	NS
34	Hamao, Packer, & Ritter (2000)	Japan	1989-1994	First-Day Closing Price	12.7%		355	NS
35	Jain & Kini (1995)	US	1967-1988	First-Day Closing Price		0.0%	136	NS
36	Levis (2011)	UK	1992-2005	First-Day Closing Price	21.1%		1,141	NS
37	Megginson & Weiss (1991)	US	1983-1987	First-Day Closing Price	11.9%		320	NS

38	Michala (2019)	US	1975-2013	First-Day Closing Price	14.1%	3,373	NS
39	Ritter (2015)	US	1980-2012	First-Day Closing Price	13.5%	3,940	NS
40	Van der Geest & Van Frederikslust (2001)	Netherlands	1985-1998	First-Day Closing Price	17.0%	68	NS
41	Vu, Worthington, & Laird (2008)	Australia	1996-2007	First-Day Closing Price	70.7%	182	NS

Appendix II: Prior Literature on IPO Long-Term Performance by Financial Sponsorship

Table 21: Summary of Prior Literature on IPO Long-Term Performance by Financial Sponsorship

An overview of existing research on long-term IPO performance by financial sponsorship. The latter includes PE = Private Equity, BO = Buyout, VC = Venture Capital, and NS = Non-Sponsored (or Non-PE). BO and VC are both sub-categories of PE. The list is ordered by metric within sponsorship type. Metrics include cumulative abnormal returns (CAR) and buy-and-hold abnormal returns (BHAR).

#	*Author(s)*	*Market*	*Period*	*Metric*	*Holding Period (Years)*	*Mean*	*Median*	*Sample Size*	*Financial Sponsor-ship*
Private Equity									
1	Bergström, Nilsson & Wahlberg (2006)	UK / France	1994-2004	CAR	3	-28.6%		152	PE
1	Bergström, Nilsson & Wahlberg (2006)	UK / France	1994-2004	CAR	5	49.8%		152	PE
2	Van der Geest & Van Frederikslust (2001)	Nether-lands	1985-1998	CAR	3	2.0%		38	PE
3	Levis (2011)	UK	1992-2005	BHAR	3	13.8%		204	PE
4	Ritter (2015)	US	1980-2012	BHAR	3	-7.5%		3,757	PE
Buyout									
5	Schöber (2008)	US	1990-2006	CAR	5	3.1%	19.1%	484	BO
6	Cao & Lerner (2009)	US	1981-2003	BHAR	3	7.3%	-15.5%	526	BO
7	Ritter (2015)	US	1980-2012	BHAR	3	2.7%		987	BO
8	Schöber (2008)	US	1990-2006	BHAR	5	3.2%	-37.0%	484	BO
Venture Capital									
9	Brav & Gompers (1997)	US	1972-1992	BHAR	5	-20.7%		934	VC
10	Levis (2011)	UK	1992-2005	BHAR	3	-3.9%		250	VC
11	Ritter (2015)	US	1980-2012	BHAR	3	-14.9%		2,426	VC
Non-Sponsored									
12	Bergström, Nilsson & Wahlberg (2006)	UK / France	1994-2004	CAR	3	-72.9%		1,370	NS
12	Bergström, Nilsson & Wahlberg (2006)	UK / France	1994-2004	CAR	5	-103.6%		1,370	NS
13	Van der Geest & Van Frederikslust (2001)	Nether-lands	1985-1998	CAR	3	-15.6%		68	NS
14	Brav & Gompers (1997)	US	1975-1992	BHAR	5	-49.3%		3,407	NS
15	Levis (2011)	UK	1992-2005	BHAR	3	-20.2%		1,141	NS
16	Ritter (2015)	US	1980-2012	BHAR	3	-29.6%		3,940	NS

Appendix III: Internet IPO Delistings by Event Month

Table 22: Internet IPO Delistings by Event Month

Overview of monthly delistings of internet IPOs for three event years after an IPO. The three event years consist of 36 event months, namely the 1st until the 36th trading month after the listing month (i.e., month 2 to 37).

Event Month	*Observations*	*Delisted*	*Cumulative*	*Remaining*
1	572	-	-	100%
2	572	0	0	100%
3	571	1	1	100%
4	571	0	1	100%
5	570	1	2	100%
6	568	2	4	99%
7	564	4	8	99%
8	561	3	11	98%
9	560	1	12	98%
10	554	6	18	97%
11	551	3	21	96%
12	543	8	29	95%
13	535	8	37	94%
14	534	1	38	93%
15	531	3	41	93%
16	527	4	45	92%
17	518	9	54	91%
18	505	13	67	88%
19	503	2	69	88%
20	493	10	79	86%
21	488	5	84	85%
22	481	7	91	84%
23	473	8	99	83%
24	465	8	107	81%
25	456	9	116	80%
26	450	6	122	79%
27	443	7	129	77%
28	431	12	141	75%
29	424	7	148	74%
30	419	5	153	73%
31	414	5	158	72%
32	403	11	169	70%
33	394	9	178	69%
34	386	8	186	67%
35	379	7	193	66%
36	371	8	201	65%

Appendix IV: NASDAQ Composite Index

The NASDAQ Composite Index (.IXIC) is a stock market index for securities trading on the American stock exchange NASDAQ. Due to the exchange's composition, it is highly associated with technology companies and commonly serves as a benchmark for domains such as the internet or e-commerce industries. As the majority of such companies is often smaller and less established, the index is considered more volatile than other major indices. The NASDAQ Composite Index is market-capitalisation weighted and includes almost all domestic and international types of stock that are listed exclusively on the NASDAQ stock exchange. Thus, securities or companies such as common stocks, ordinary shares, shares or units of beneficial interest, limited liability companies, or limited partnership interests are eligible for the index, whereas preferred stocks, exchange-traded funds, rights, warrants, units and other derivative securities, closed-end funds or convertible debentures are excluded (Nasdaq, 2020a; Nasdaq, 2020b).

Figure 9: NASDAQ Composite Index
Monthly Price Development (1996-2019)
(in USD)

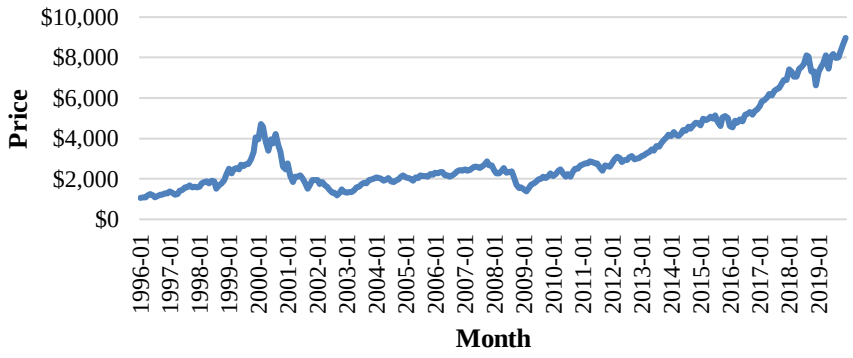
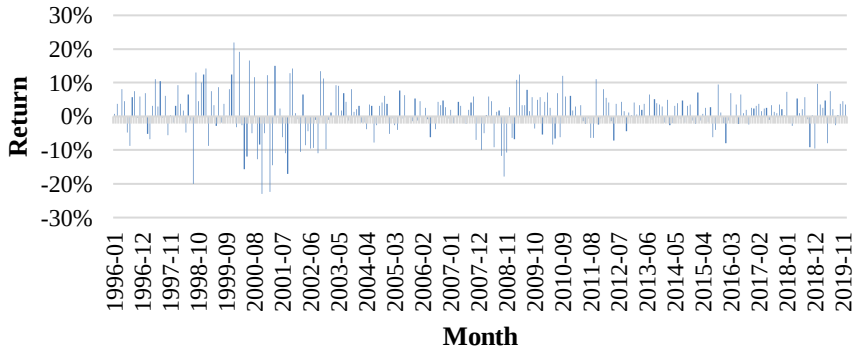


Figure 10: NASDAQ Composite Index
Monthly Return Development (1996-2019)
(in %)



Appendix V: Lead Underwriter Reputation

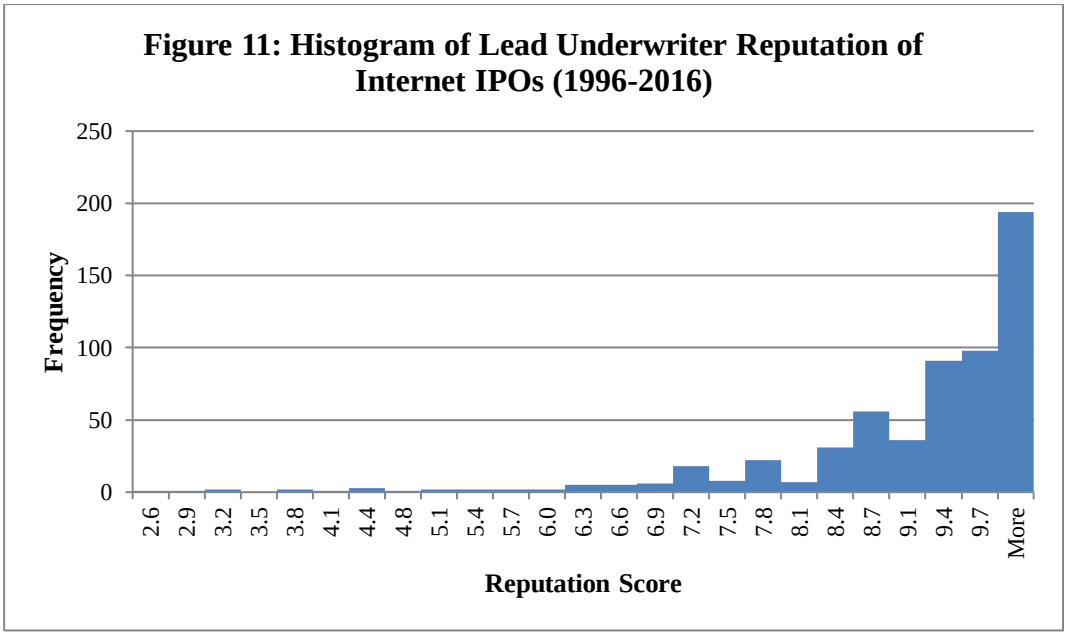
Table 23: Top 50 Lead Underwriters with Highest Scores for Reputation

List of highest-ranking lead underwriters with regard to reputation for all IPOs on any US exchange between 1996 and 2016. Lead underwriter reputation can range from a score of 0 (lowest) to a score of 10 (highest). It consists of four weighted components on the same scale: Lead proceeds (i.e., a score for the aggregate amount of proceeds raised as lead underwriter during all IPOs on any US exchange between 1996 and 2016), lead frequency (i.e., a score for the aggregate number of times acting as lead underwriter during all IPOs on any US exchange between 1996 and 2016), syndicate proceeds (i.e., a score for the aggregate amount of proceeds raised as syndicate member during all IPOs on any US exchange between 1996 and 2016), and syndicate frequency (i.e., a score for the aggregate number of times acting as syndicate member during all IPOs on any US exchange between 1996 and 2016). The respective weights will be presented in a separate table.

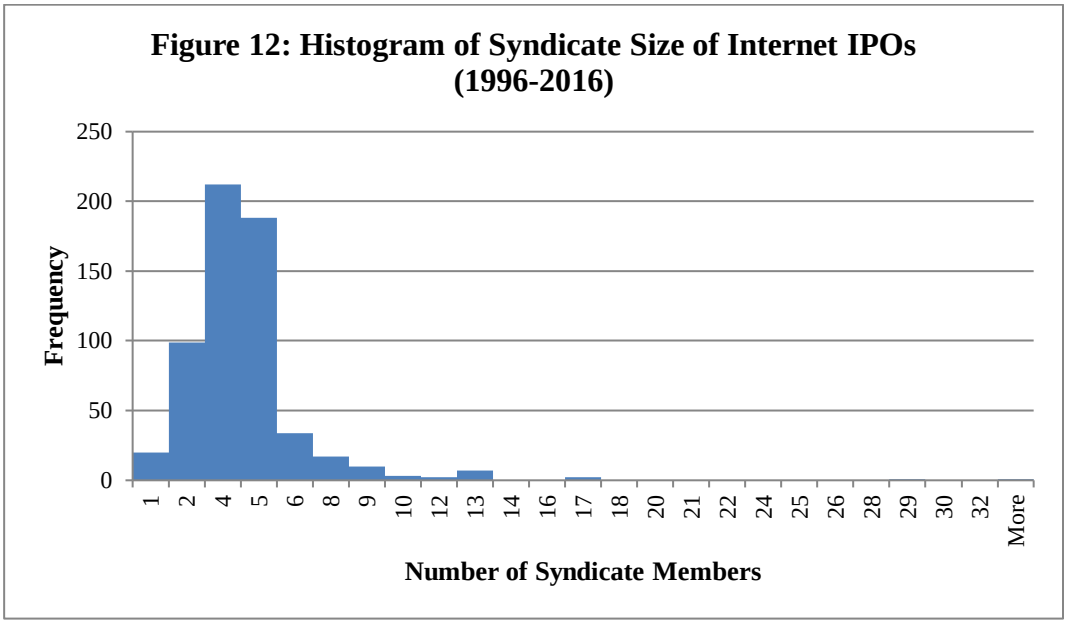
		Scoring				
Rank	*Lead Underwriter*	*Lead Proceeds*	*Lead Frequency*	*Syndicate Proceeds*	*Syndicate Frequency*	***Weighted Final***
1	Goldman Sachs & Co	9.98	9.98	10.00	9.95	**9.98**
1	Merrill Lynch & Co Inc	9.95	10.00	9.95	10.00	**9.98**
1	Morgan Stanley	10.00	9.95	9.98	9.98	**9.98**
4	Citi	9.93	9.86	9.93	9.89	**9.90**
5	JP Morgan & Co Inc	9.89	9.77	9.91	9.91	**9.86**
6	First Boston Corp	9.82	9.93	9.80	9.86	**9.86**
7	Lehman Brothers	9.75	9.89	9.82	9.93	**9.84**
8	Credit Suisse	9.77	9.71	9.89	9.82	**9.79**
9	Morgan Stanley & Co	9.80	9.84	9.64	9.57	**9.73**
10	Citigroup	9.91	9.62	9.75	9.41	**9.69**
11	Donaldson Lufkin & Jenrette Inc	9.64	9.82	9.41	9.84	**9.69**
12	Deutsche Bank	9.73	9.46	9.86	9.64	**9.66**
13	Bear Stearns & Co Inc	9.52	9.66	9.59	9.71	**9.62**
14	Salomon Smith Barney	9.84	9.59	9.57	9.32	**9.61**
15	Alex Brown & Sons Inc	9.62	9.91	8.67	9.75	**9.54**
16	CS First Boston Corp	9.66	9.73	9.30	9.30	**9.54**
17	UBS Investment Bank	9.68	9.41	9.55	9.37	**9.51**
18	PaineWebber Inc	9.43	9.64	9.14	9.50	**9.45**
19	Prudential Securities Inc	9.34	9.55	9.25	9.52	**9.42**
20	Bank of America Merrill Lynch	9.59	9.28	9.66	9.03	**9.40**
21	Morgan Stanley Dean Witter & Co	9.86	9.57	9.16	8.67	**9.40**
22	Deutsche Bank Securities Corp.	9.50	9.12	9.68	9.25	**9.37**
23	Montgomery Securities	9.23	9.80	8.46	9.66	**9.33**
24	Raymond James	8.82	9.25	9.73	9.80	**9.33**
25	RBC Capital Markets	9.19	8.85	9.84	9.73	**9.32**
26	Raymond James & Associates Inc	8.80	9.23	9.71	9.77	**9.31**
26	Oppenheimer & Co Inc	8.96	9.43	9.48	9.46	**9.31**
28	Barclays	9.32	9.03	9.77	9.16	**9.29**
29	William Blair & Co	8.76	9.48	9.39	9.68	**9.29**
30	Banc of America Securities LLC	9.25	9.10	9.50	9.23	**9.25**
31	Credit Suisse First Boston Corp	9.46	9.30	9.28	8.80	**9.24**

32	Stephens Inc	9.03	9.52	8.87	9.34	**9.21**
33	Hambrecht & Quist Inc	9.05	9.75	8.05	9.55	**9.16**
34	Salomon Brothers Inc	9.28	9.39	8.62	9.05	**9.13**
35	Piper Jaffray Inc	8.89	9.34	8.71	9.48	**9.11**
35	Wells Fargo Securities LLC	9.48	8.53	9.52	9.00	**9.11**
37	Stifel Nicolaus & Co Inc	8.67	8.87	9.62	9.59	**9.10**
38	Jefferies & Co Inc	9.14	9.07	8.91	9.21	**9.09**
39	Cowen & Co	8.64	9.37	8.96	9.39	**9.07**
40	AG Edwards & Sons Inc	8.62	8.89	9.46	9.62	**9.07**
41	Smith Barney Incorporated	9.30	9.50	8.26	8.87	**9.07**
42	Wachovia Securities Inc	9.41	8.69	9.19	8.78	**9.02**
43	Piper Jaffray Cos	8.78	9.14	9.05	9.10	**9.00**
44	Robert W Baird & Co Inc	8.39	8.71	9.43	9.43	**8.90**
45	Robertson Stephens & Co	8.98	9.68	7.31	9.19	**8.90**
45	Deutsche Bank Securities Inc	9.39	8.33	9.34	8.57	**8.90**
47	UBS Securities Inc	9.10	8.80	9.03	8.39	**8.85**
48	Morgan Keegan Inc	8.53	8.98	9.00	8.96	**8.85**
49	UBS Warburg	9.12	8.64	8.94	8.51	**8.82**
50	Friedman Billings Ramsey Group	9.21	9.32	7.87	8.37	**8.81**

Figure 11: Histogram of Lead Underwriter Reputation of Internet IPOs (1996-2016)



Appendix VI: Syndicate Size



Appendix VII: Correlation Matrix for All Variables

Table 24: Correlation Matrix for all Variables

Correlation matrix including all dependent, independent, and periodic dummy variables (i.e., related to the DotCom Bubble) used throughout this study. A correlation value can range between -1 (perfect negative correlation) and +1 (perfect positive correlation), with a value of 0 indicating no correlation between variables. Correlation is a mathematical concept and is not to be confused with a causal relation between variables.

1stDayAR	1											
3YearCAR	-0,08	1										
3YearBHAR	0,01	0.38	1									
Proceeds	0,11	0.07	0.15	1								
UnderwriterRep	0,08	0.04	-0.05	0.42	1							
SyndicateSize	-0,04	0.11	0.19	0.70	0.23	1						
BOBacked	-0,05	-0.02	-0.03	-0.06	-0.03	0.04	1					
VCBacked	0,13	0.09	0.07	0.05	0.15	0.06	-0.06	1				
IPOActivity	0,18	-0.04	-0.12	-0.27	-0.12	-0.24	0.07	-0.04	1			
PreBubble	-0,18	-0.07	-0.22	-0.50	-0.18	-0.35	0.14	-0.20	0.31	1		
Bubble	0,41	0.03	0.06	0.00	0.05	-0.11	-0.09	0.17	0.32	-0.50	1	
PostBubble	-0,23	0.04	0.15	0.50	0.13	0.46	-0.05	0.03	-0.63	-0.50	-0.51	1
	1stDayAR	*3YearCAR*	*3YearBHAR*	*Proceeds*	*UnderwriterRep*	*SyndicateSize*	*BOBacked*	*VCBacked*	*IPOActivity*	*PreBubble*	*Bubble*	*PostBubble*

Appendix IIX: Performance by Financial Sponsorship

Table 25: Short-Term Performance (AR) by Financial Sponsorship for Internet IPOs (1996-2016)

Overview of summary statistics by financial sponsorship for underpricing (first-day AR) as indication of short-term post-issue performance. Observations include internet IPOs on any US exchange between 1996 and 2016. Financial sponsorship refers to companies being backed by venture capital (VC) and / or buyout (BO) during an IPO. VC-backing and BO-backing are not mutually exclusive and, if combined, will result in double-sponsorship. Neither financial backing will result in non-sponsorship.

Financial Sponsorship	*Mean*	*Median*	*Std Dev*	*Min*	*Max*	*Observations*
BOBacked	32.1%	13.1%	80.9%	-84.2%	515.4%	51
VCBacked	52.3%	25.6%	83.0%	-94.6%	626.4%	393
Double-Sponsored	45.5%	16.4%	104.8%	-84.2%	515.4%	29
Non-Sponsored	33.8%	16.4%	65.9%	-96.6%	608.7%	181
Total	**45.3%**	**20.8%**	**77.3%**	**-96.6%**	**626.4%**	**596**

Table 26: Long-Term Performance (CAR) by Financial Sponsorship for Internet IPOs (1996-2016)

Overview of summary statistics by financial sponsorship for long-term post-issue performance (3-year CAR). Observations include internet IPOs on any US exchange between 1996 and 2016. Financial sponsorship refers to companies being backed by venture capital (VC) and / or buyout (BO) during an IPO. VC-backing and BO-backing are not mutually exclusive and, if combined, will result in double-sponsorship. Neither financial backing will result in non-sponsorship.

Financial Sponsorship	*Mean*	*Median*	*Std Dev*	*Min*	*Max*	*Observations*
BOBacked	-31.5%	-38.9%	157.0%	-285.7%	459.9%	50
VCBacked	-4.6%	-20.5%	206.6%	-474.6%	1765.9%	383
Double-Sponsored	-6.8%	-5.5%	181.1%	-285.7%	459.9%	29
Non-Sponsored	-37.6%	-36.3%	127.8%	-432.8%	503.2%	167
Total	**-16.5%**	**-34.0%**	**185.6%**	**-474.6%**	**1765.9%**	**572**

Table 27: Long-Term Performance (BHAR) by Financial Sponsorship for Internet IPOs (1996-2016)

Overview of summary statistics by financial sponsorship for long-term post-issue performance (3-year BHAR). Observations include internet IPOs on any US exchange between 1996 and 2016. Financial sponsorship refers to companies being backed by venture capital (VC) and / or buyout (BO) during an IPO. VC-backing and BO-backing are not mutually exclusive and, if combined, will result in double-sponsorship. Neither financial backing will result in non-sponsorship.

Financial Sponsorship	*Mean*	*Median*	*Std Dev*	*Min*	*Max*	*Observations*
BOBacked	-43.4%	-65.4%	156.1%	-294.8%	624.3%	50
VCBacked	-21.9%	-36.2%	128.0%	-333.4%	826.9%	383
Double-Sponsored	-41.2%	-44.0%	129.1%	-294.8%	362.1%	29
Non-Sponsored	-43.5%	-42.3%	154.9%	-324.8%	1304.9%	167
Total	**-29.1%**	**-38.3%**	**138.6%**	**-333.4%**	**1304.9%**	**572**

Appendix IX: Performance by Activity Period

Table 28: Short-Term Performance (AR) of Internet IPOs by Activity Period (1996-2016)

Summary statistics regarding short-term performance (first-day AR) of internet IPOs for periods of high and low IPO activity. The threshold between periods is determined as the yearly median number of IPOs across all listings on any US exchange between 1996 and 2016. This median equals 159 IPOs in 2006 and ensures an equal number of years pertaining to each activity period.

Period	*Mean*	*Median*	*Std Dev*	*Min*	*Max*	*Avg Proceeds (in mn)*	*Observations*
High	51.3%	24.1%	82.7%	-96.6%	626.4%	$78.3	497
Low	14.9%	12.0%	23.5%	-88.8%	92.1%	$285.4	99
Total	**45.3%**	**20.8%**	**77.3%**	**-96.6%**	**626.4%**	**$112.7**	**596**

Table 29: Long-Term Performance (CAR) of Internet IPOs by Activity Period (1996-2016)

Summary statistics regarding long-term performance (CAR) of internet IPOs for periods of high and low IPO activity. The threshold between periods is determined as the yearly median number of IPOs across all listings on any US exchange between 1996 and 2016. This median equals 159 IPOs in 2006 and ensures an equal number of years pertaining to each activity period.

Period	*Mean*	*Median*	*Std Dev*	*Min*	*Max*	*Avg Proceeds (in mn)*	*Observations*
High	-19.4%	-38.2%	197.4%	-474.6%	1765.9%	$78.3	475
Low	-1.8%	5.3%	96.7%	-285.6%	186.1%	$285.4	97
Total	**-16.5%**	**-34.0%**	**185.6%**	**-474.6%**	**1765.9%**	**$112.7**	**572**

Table 30: Long-Term Performance (BHAR) of Internet IPOs by Activity Period (1996-2016)

Summary statistics regarding long-term performance (BHAR) of internet IPOs for periods of high and low IPO activity. The threshold between periods is determined as the yearly median number of IPOs across all listings on any US exchange between 1996 and 2016. This median equals 159 IPOs in 2006 and ensures an equal number of years pertaining to each activity period.

Period	*Mean*	*Median*	*Std Dev*	*Min*	*Max*	*Avg Proceeds (in mn)*	*Observations*
High	-36.7%	-40.5%	143.6%	-333.4%	1304.9%	$78.3	475
Low	8.7%	9.6%	105.2%	-161.1%	390.2%	$285.4	97
Total	**-29.1%**	**-38.3%**	**138.6%**	**-333.4%**	**1304.9%**	**$112.7**	**572**

Appendix X: Correlation Matrices for Regressions

Table 31: Correlation Matrix for Independent Variables in Short-Term Performance Regression

Correlation matrix for independent variables used in the short-term performance (i.e., first-day AR as dependent variable) OLS regression. A correlation value can range between -1 (perfect negative correlation) and +1 (perfect positive correlation), with a value of 0 indicating no correlation between variables. Correlation is a mathematical concept and is not to be confused with a causal relation between variables. Absolute correlation values above 0.8 can be regarded as indication of multicollinearity among independent variables.

Proceeds	1					
UnderwriterRep	0.44	1				
SyndicateSize	0.70	0.40	1			
BOBacked	-0.16	-0.03	-0.06	1		
VCBacked	0.08	0.02	0.15	-0.06	1	
IPOActivity	-0.29	-0.14	-0.34	0.06	-0.04	1
	Proceeds	*UnderwriterRep*	*SyndicateSize*	*BOBacked*	*VCBacked*	*IPOActivity*

Table 32: Correlation Matrix for Independent Variables in Long-Term Performance Regressions

Correlation matrix for independent variables used in the long-term performance (i.e., 3-year CAR and 3-year BHAR as dependent variables) OLS regressions. A correlation value can range between -1 (perfect negative correlation) and +1 (perfect positive correlation), with a value of 0 indicating no correlation between variables. Correlation is a mathematical concept and is not to be confused with a causal relation between variables. Absolute correlation values above 0.8 can be regarded as indication of multicollinearity among independent variables.

Proceeds	1						
UnderwriterRep	0.44	1					
SyndicateSize	0.72	0.39	1				
BOBacked	-0.13	-0.02	-0.05	1			
VCBacked	0.07	0.00	0.13	-0.04	1		
IPOActivity	-0.28	-0.13	-0.33	0.06	-0.04	1	
1stDayAR	0.19	0.08	-0.03	-0.08	0.12	0.24	1
	Proceeds	*UnderwriterRep*	*SyndicateSize*	*BOBacked*	*VCBacked*	*IPOActivity*	*1stDayAR*

Appendix XI: Variance Inflation Factors

Table 33: Variance Inflation Factors (VIF) as Indicator for Multicollinearity among Independent Variables

Overview of Variance Inflation Factors (VIF) for short-term (i.e., first-day AR as dependent variable) and long-term (i.e., CAR or BHAR as dependent variables) independent multiple regression variables. VIFs are a measure of multicollinearity among multiple regression variables. The VIF equals the ratio of the overall model variance to the variance of a model that includes only the respective independent variable. A VIF above 10 indicates the potential presence of multicollinearity. A VIF above 100 indicates certain multicollinearity.

Variable	*Regression*	
	Short-Term	*Long-Term*
Constant	148.7	175.7
Proceeds	2.2	2.5
UnderwriterRep	1.3	1.3
SyndicateSize	2.1	2.3
BOBacked	1.0	1.0
VCBacked	1.0	1.0
IPOActivity	1.1	1.2
1stDayAR		1.2
Cases of possible multicollinearity (>10)	1	1
Cases of definite multicollinearity (>100)	1	1

Appendix XII: Regression Summaries for Long-Term Performance

Table 34: OLS Regression Summary for Long-Term Performance (CAR)

OLS regression summary for long-term performance with 3-year CAR as dependent variable and several IPO characteristics as independent variables (incl. a constant). Their individual statistical significance is indicated through respective t-statistics and p-values.
*Significance at 10% = *, at 5% = **, at 1% = ***.*

Variable	*Coefficient*	*Std Err*	*T-statistic*	*P-value*	*Expected Sign*
Constant	-0.342	0.713	-0.480	0.631	
Proceeds	0.050	0.129	0.388	0.698	+
UnderwriterRep	-0.049	0.081	-0.604	0.546	+
SyndicateSize	0.108	0.056	1.916	0.055*	+
BOBacked	-0.065	0.193	-0.335	0.737	+
VCBacked	0.155	0.114	1.356	0.175	+
IPOActivity	-0.212	0.138	-1.532	0.126	-
1stDayAR	-0.086	0.119	-0.726	0.468	-
Observations	435				
R_2	0.037				
Adjusted R_2	0.021				
F-statistic	3.857				
P-value (F-statistic)	0.000***				

Table 35: OLS Regression Summary for Long-Term Performance (BHAR)

OLS regression summary for long-term performance with 3-year BHAR as dependent variable and several IPO characteristics as independent variables (incl. a constant). Their individual statistical significance is indicated through respective t-statistics and p-values.
*Significance at 10% = *, at 5% = **, at 1% = ***.*

Variable	*Coefficient*	*Std Err*	*T-statistic*	*P-value*	*Expected Sign*
Constant	-1.255	0.504	-2.490	0.013**	
Proceeds	0.277	0.096	2.900	0.004***	+
UnderwriterRep	-0.068	0.053	-1.289	0.198	+
SyndicateSize	0.140	0.047	3.006	0.003***	+
BOBacked	-0.113	0.131	-0.868	0.385	+
VCBacked	0.129	0.093	1.392	0.164	+
IPOActivity	-0.336	0.118	-2.847	0.004***	-
1stDayAR	0.103	0.073	1.402	0.161	-
Observations	435				
R_2	0.186				
Adjusted R_2	0.172				
F-statistic	10.880				
P-value (F-statistic)	0.000***				

9. References

Ainina, F. M., & Mohan, N. K. (1991). When LBOs go IPO. *Journal of Business Finance & Accounting*, 18(3), 393–403.

Akerlof, G. A. (1970). The Market for 'Lemons': Quality Uncertainty and the Market Mechanism. *The Quarterly Journal of Economics*, 84(3), 488–500. doi:10.2307/1879431

Barber, B. M., & Lyon, J. D. (1997). Detecting long-run abnormal stock returns: The empirical power and specification of test statistics. *Journal of Financial Economics*, 43(3), 341-372.

Barry, C. B., Muscarella, C. J., Peavy III, J. W., & Vetsuypens, M. R. (1990). The Role of Venture Capital in the Creation of Public Companies: Evidence from the Going-Public Process. *Journal of Financial Economics*, 27(2), 447-471.

Beatty, R. P., & Ritter., J. R. (1986). Investment banking, reputation, and the underpricing of initial public offerings. *Journal of Financial Economics*, 15(1-2), 213-232.

Benveniste, L. M., & Spindt, P. A. (1989). How investment bankers determine the offer price and allocation of new issues. *Journal of Financial Economics*, 24(2), 343-361. doi:10.1016/0304-405X(89)90051-2

Bergström, C., Nilsson, D., & Wahlberg, M. (2006). Underpricing and Long-Run Performance Patterns of European Private-Equity-Backed and Non-Private-Equity-Backed IPOs. *Journal of Private Equity*, 9(4), 16-47.

Booth, J. R., & Chua, L. (1996). Ownership Dispersion, Costly Information, and IPO Underpricing. *Journal of Financial Economics*, 41(2), 291-310.

Bradley, D. J., Cooney, J. W., Jordan, B. D., & Singh, A. K. (2004). Negotiation and the IPO Offer Price: A Comparison of Integer vs. Non-Integer IPOs. *Journal of Financial and Quantitative Analysis*, 39(3), 517-540.

Brav, A., & Gompers, P. A. (1997). Myth or reality? The long-run underperformance of initial public offerings: Evidence from venture and non-venture capital-backed companies. *Journal of Finance*, 52(5), 1791-1821.

Brav, A., Geczy, C., & Gompers, P. A. (2000). Is the Abnormal Return following Equity Issuances Anomalous? *Journal of Financial Economics*, 56(2), 209-249.

Cao, J., & Lerner, J. (2009). The Performance of Reverse Leveraged Buyouts. *Journal of Financial Economics*, 91(2), 139-157.

Carter, R. B., Dark, F. H., & Singh, A. K. (1998). Underwriter reputation, initial returns, and the long-run performance of IPO stocks. *Journal of Finance*, 53(1), 285-311.

Carter, R., & Manaster, S. (1990). Initial public offerings and underwriter reputation. *Journal of Finance*, 45, 1045–1068.

CB Insights (2020, April 14). The 2020 Tech IPO Pipeline. Retrieved from: https://www.cbinsights.com/research/report/tech-ipo-report-2020/

Chalk, A. J., & Peavy III, J. W. (1987). Initial Public Offerings: Daily Returns, Offering Types and the Price Effect. *Financial Analysts Journal*, 43(5), 65-69.

Chang, S.-C., Chung, T.-Y. & Lin, W.-C. (2010). Underwriter reputation, earnings management and the long-run performance of initial public offerings. *Accounting & Finance*, 50, 53-78. doi:10.1111/j.1467-629X.2009.00329.x

Chi, J., & Padgett, C. (2005). The performance and long-run characteristics of the Chinese IPO market. *Pacific Economic Review*, 10(4), 451-469.

Clarkson, P., & Merkley, J. (2009). Ex Ante Uncertainty and the Underpricing of Initial Public Offerings: Further Canadian Evidence. *Canadian Journal of Administrative Sciences / Revue Canadienne des Sciences de l'Administration*, 11, 54-67.

Coakley, J., Hadass, L., & Wood, A. (2009). UK IPO Underpricing and Venture Capitalists. *European Journal of Finance*, 15(4), 421-435.

Cook, J. P., & Officer, D. T. (1996). Is Underpricing a Signal of Quality in 'Second' Initial Public Offerings? *Quarterly Journal of Business and Economics*, 35(1), 67-78.

Corwin, S. A., & Schultz, P. (2005). The Role of IPO Underwriting Syndicates: Pricing, Information Production, and Underwriter Competition. *Journal of Finance*, 60(1), 443-486. doi:10.2139/ssrn.389723

Dark, F. H., & Carter, R. B. (1993). Effects of Differential Information on the After-Market Valuation of Initial Public Offerings. *Journal of Economics and Busines*s, 45(5), 375-392.

Demers, E. A., & Lewellen, K. (2001). The marketing role of IPOs: Evidence from internet stocks. *Journal of Financial Economics*, 68(3), 413-437.

Dong, M., Michel, J.-S., & Pandes, J. A. (2011). Underwriter Quality and Long-Run IPO Performance. *Financial Management*, 40, 219-251. doi:10.1111/j.1755-053X.2010.01140.x

Eckbo, B. E., & Norli, Ø. (2005). Liquidity Risk, Leverage and Long-Run IPO Returns. *Journal of Corporate Finance*, 11(1), 1-35.

Fan, Q. (2007). Earnings management and ownership retention for initial public offering firms: theory and evidence. *Accounting Review*, 82, 27–64.

Ferretti, R., & Meles, A. (2011). Underpricing, Wealth Loss for Pre-Existing Shareholders and the Cost of Going Public: The Role of Private Equity Backing in Italian IPOs. *Venture Capital*, 13(1), 23-47.

Florida, R., & Kenney, M. (1988). Venture Capital and High Technology Entrepreneurship. *Journal of Business Venturing*, 3(4), 301-319.

Fong, W., Lean, H., & Wong, W. (2008). Stochastic dominance and behavior towards risk: The market for Internet stocks. *Journal of Economic Behavior & Organization*, 68(1), 194-208.

Foroohar, R. (2019, January 27). Another Tech Bubble Could Be About To Burst. *Financial Times*. Retrieved from https://www.ft.com/content/43d5e972-2098-11e9-b2f7-97e4dbd3580d

van der Geest, R., & van Frederikslust, R. A. I. (2001). Initial Returns and Long-Run Performance of Private Equity-Backed Initial Public Offerings on the Amsterdam Stock Exchange. EFMA 2001 Lugano Meetings.

Geier, B. (2015, March 12). What Did We Learn From the Dotcom Stock Bubble of 2000? *Time*. Retrieved from https://time.com/3741681/2000-dotcom-stock-bust/

Gompers, P. A. (1996). Grandstanding in the venture capital industry. *Journal of Financial Economics*, 42 (1), 133-156.

Gompers, P. A., & Lerner, J. (2003). The Really Long-Run Performance of Initial Public Offerings: The Pre-Nasdaq Evidence. *Journal of Finance*, 58(4), 1355-1392.

Goodnight, G. T., & Green, S. (2010). Rhetoric, Risk, and Markets: The Dot-Com Bubble. *Quarterly Journal of Speech*, 96(2), 115-140.

Gregory, A., Guermat, C., & Al-Shawawreh, F. (2010). UK IPOs: Long Run Returns, Behavioural Timing and Pseudo Timing. *Journal of Business Finance & Accounting*, 37(5-6), 612-647.

Habib, M. A., & Ljungqvist, A. P. (1998). Underpricing and IPO proceeds: a note. *Economics Letters*, 61(3), 381-383.

Hahn, T., Ligon, J. A., & Rhodes, H. (2013). Liquidity and Initial Public Offering Underpricing. *Journal of Banking Finance*, 37(12), 4973–4988.

Hamao, Y., Packer, F., & Ritter, J. R. (2000). Institutional affiliation and the role of venture capital: Evidence from initial public offerings in Japan. *Pacific-Basin Finance Journal*, 8(5), 529-558.

Hesjedal, K. (2007). IPO Underpricing and Management Quality: An Empirical Study of the Norwegian Equity Market.

Hogan, K. M., Olson, G. T., & Kish, R. J. (2001). A comparison of reverse leveraged buyouts and original initial public offers: Factors impacting their issuance in the IPO market. *The Financial Review*, 36(3), 1-18.

Holthausen, R. W., & Larcker, D. F. (1996). The Financial Performance of Reverse Leveraged Buyouts. *Journal of Financial Economics*, 42(3), 293-332.

Hoque, H. (2014). Role of asymmetric information and moral hazard on IPO underpricing and lockup. *Journal of International Financial Markets, Institutions and Money*, 30, 81-105.

Hulbert, M. (2020, March 8). Lessons from the Dot-Com Bust. *The Wall Street Journal*. Retrieved from https://www.wsj.com/articles/lessons-from-the-dot-com-bust-11583192099

Ibbotson, R. G. (1975). Price performance of common stock new issues. *Journal of Financial Economics*, 2(3), 235–272. doi:10.1016/0304-405x(75)90015-x

Ibbotson, R. G., & Jaffe, J. F. (1975). 'Hot Issue' Markets. *Journal of Finance*, 30(4), 1027-1042. doi: 10.2307/2326721

Ibbotson, R. G., Sindelar, J. L., & Ritter, J. R. (1988). Initial Public Offerings. *Journal of Applied Corporate Finance*, 1(2), 37–45. doi:10.1111/j.1745-6622.1988.tb00164.x

Ibbotson, R. G., Sindelar, J. L., & Ritter, J. R. (1994). The Market's Problems with the Pricing of Initial Public Offerings. *Journal of Applied Corporate Finance*, 7(1), 66-74. doi:10.1111/j.1745-6622.1994.tb00395.x

Jain, B. A., & Kini, O. (1995). Venture Capitalist Participation and the Post-Issue Operating Performance of IPO Firms. *Managerial and Decision Economics*, 16 (6), 593-606.

Jensen, M. C. (1986). Agency Costs of Free Cash Flow, Corporate Finance, and Takeovers. *American Economic Review*, 76, 323-329.

Jensen, M. C. (1989). Eclipse of the Public Corporation. *Harvard Business Review*, 67, 61-74.

Jog, V. M., & Riding, A. L. (1987). Underpricing in Canadian IPOs. *Financial Analysts Journal*, 43(6), 48-55. doi:10.2469/faj.v43.n6.48

Karlis, P. L. (2008). IPO Underpricing. *The Park Place Economist*, 8(1), 81-89.

Krigman, L., Shaw, W. H., & Womack, K. L. (2001). Why do firms switch underwriters? *Journal of Financial Economics*, 60(2-3), 245-284. doi:10.1016/S0304-405X(01)00045-9

Lee, P. M., & Wahal, S. (2004). Grandstanding, certification and the underpricing of venture capital backed IPOs. *Journal of Financial Economics*, 73(2), 375-407.

Levis, M. (2011). The performance of private equity-backed IPOs. *Financial Management*, 40(1), 253-277.

Ljungqvist, A. J., & Wilhelm, W. J. (2003). IPO Pricing in the Dot-com Bubble. *Journal of Finance*, 58, 723-752. doi:10.1111/1540-6261.00543

Logue, D. (1973). On the Pricing of Unseasoned Equity Issues: 1965-1969. *Journal of Financial and Quantitative Analysis*, 8(1), 91-103. doi:10.2307/2329751

Loughran, T., & Ritter, J. R. (1995). The new issues puzzle. *Journal of Finance*, 50(1), 23-51.

Loughran, T., & Ritter, J. R. (2004). Why has IPO underpricing changed over time. *Financial Management*, 33(3), 5-37.

Lowry, M., Officer, M. S., & Schwert, G. W. (2010). The Variability of IPO Initial Returns. *Journal of Finance*, 65(2), 425-465.

Lowry, M., & Schwert, G. W. (2002). IPO Market Cycles: Bubbles or Sequential Learning? *Journal of Finance*, 57(3), 1171-1200.

Madill, J. J., Haines, H. H., & Riding, A. L. (2005) The Role of Angels in Technology SMEs: A Link to Venture Capital. *Venture Capital*, 7(2), 107-129. doi:10.1080/1369106042000316341

Mahalanobis, P. C. (1936). On the generalised distance in statistics. *Proceedings of the National Institute of Sciences of India*, 2(1), 49–55.

McDonald, J. G., & Fisher, A. K. (1972). New-Issue Stock Price Behavior. *Journal of Finance*, 27(1), 97-102.

Megginson, W. L., & Weiss, K. A. (1991). Venture Capitalist Certification in Initial Public Offerings. *Journal of Finance*, 46, 879-903. doi:10.1111/j.1540-6261.1991.tb03770.x

Michaely, R., & Shaw, W. (1994). The Pricing of Initial Public Offerings: Tests of Adverse-Selection and Signaling Theories. *The Review of Financial Studies*, 7(2), 279-319.

Michaely, R., & Shaw, W. (1995). Does the Choice of Auditor Convey Quality in an Initial Public Offering? *Financial Management*, 24(4), 15-30.

Michala, D. (2019). Are private equity backed initial public offerings any different? Timing, information asymmetry and post-IPO survival. *Journal of Corporate Finance*, 59, 31-47.

Miller, R. E., & Reilly, F. K. (1987). An Examination of Mispricing, Returns, and Uncertainty for Initial Public Offerings. *Financial Management*, 16(2), 33-38.

Muscarella, C. J., & Vetsuypens, M. R. (1989). The Underpricing of 'Second' Initial Public Offerings. *Journal of Financial Research*, 12(3), 183-192.

Nasdaq (2015). 3 Lessons for Investors from the Tech Bubble. Retrieved from https://www.nasdaq.com/articles/3-lessons-investors-tech-bubble-2015-02-11

Nasdaq (2020a). Dow, Nasdaq, S&P 500: What does it all mean? Retrieved from https://www.nasdaq.com/education/dow-nasdaq-sp-500-what-does-it-all-mean

Nasdaq (2020b). Nasdaq Index Methodology - NASDAQ Composite Index. Retrieved from https://indexes.nasdaqomx.com/docs/methodology_COMP.pdf

Newey, W. K., & West, K. D. (1987). A Simple, Positive Semi-Definite, Heteroskedasticity and Autocorrelation Consistent Covariance Matrix. *Econometrica*, 55, 703–708.

Newey, W. K., & West, K. D. (1994). Automatic Lag Selection in Covariance Matrix Estimation. *Review of Economic Studies*, 61, 631–653.

Randewich, N., & Krauskopf, L. (2020, February 18). 20 years after Dot-Com Peak, Tech Dominance keeps Investors on Edge. *NASDAQ*. Retrieved from https://www.nasdaq.com/articles/graphic-20-years-after-dot-com-peak-tech-dominance-keeps-investors-on-edge-2020-02-18

Reilly, F. K. (1973). Further Evidence on Short-Run Results for New Issue Investors. *Journal of Financial and Quantitative Analysis*, 8(1), 83-90.

Reilly, F. K., & Hatfield, K. (1969). Investor Experience with New Stock Issues. *Financial Analysts Journal*, 25(5), 73-80.

Ritter, J. R. (1984). The 'Hot Issue' Market of 1980. *Journal of Business*, 57(2), 215-240.

Ritter, J. R. (1991). The Long-Run Performance of Initial Public Offerings. *Journal of Finance*, 46, 3-27. doi:10.1111/j.1540-6261.1991.tb03743.x

Ritter, J. R., & Welch, I. (2002). A review of IPO activity, pricing, and allocations. *Journal of Finance*, 57(4), 1795-1828.

Ritter, J. R. (2015). Growth Capital-Backed IPOs. *Financial Review*, 50(4), 481-515. doi:10.1111/fire.12075.

Ritter, J. R. (2020). Initial Public Offerings: Updated Statistics. Retrieved from https://site.warrington.ufl.edu/ritter/files/IPOs2019Statistics.pdf

Rock, K. (1986). Why new issues are underpriced. *Journal of Financial Economics*, 15(1-2), 187-212.

Schertler, A. (2002). The Certification Role of Private Equity Investors: Evidence from Initial Public Offerings on the Nouveau Marché and the Neuer Markt.

Schöber, T. (2008). Buyout-backed Initial Public Offerings. doi:10.13140/RG.2.1.1054.9927.

Shi, C., Pukthuanthong, K., & Walker, T. (2013). Does Disclosure Regulation Work? Evidence from International IPO Markets. *Contemporary Accounting Research*, 30(1), 356-387.

Shivakumar, L. (2000). Do firms mislead investors by overstating earnings before seasoned equity offerings? *Journal of Accounting and Economics*, 29, 339–371.

Stoll, H. R., & Curley, A. J. (1970). Small Business and the New Issues Market for Equities. *Journal of Financial and Quantitative Analysis*, 5(3), 309-322. doi:10.2307/2329998

Teoh, S. H., Wong, T. J., & Rao, G. (1998a). Are accruals during initial public offerings opportunistic? *Review of Accounting Studies*, 3, 175–208.

Teoh, S. H., Welch, I., & Wong, T. J. (1998b). Earnings management and the long-run market performance of initial public offerings. *Journal of Finance*, 53, 1935–1973.

Teoh, S. H., Welch, I., & Wong, T. J. (1998c). Earnings management and the underperformance of seasoned equity offerings, *Journal of Financial Economics*, 50, 63–99.

Titman, S., & Trueman, B. (1986). Information quality and the valuation of new issues. *Journal of Accounting and Economics*, 8(2), 159-172.

Ulick, J. (2000, April 3). Nasdaq Sinks 350 Points. *CNN Money*. Retrieved from https://money.cnn.com/2000/04/03/markets/markets_newyork/

Vu, N., Worthington, A. C., & Laird, P. (2008). The Pricing and Performance of Initial Public Offerings in Australia, 1996-2007: A Comparison of Ordinary, Venture Capital and Private Equity-Backed Issues.

Wang, W., & Yung, C. (2011). IPO Information Aggregation and Underwriter Quality. *Review of Finance*, 15(2), 301-325.

Welch, B. L. (1947). The generalization of 'Student's' problem when several different population variances are involved. *Biometrika*, 34 (1–2), 28–35.

Westerholm, P. J. (2006). Industry Clustering in Nordic Initial Public Offering Markets. *International Review of Finance*, 6(1-2), 25-41.

Zheng, S. X. (2007). Are IPOs Really Overpriced? *Journal of Empirical Finance*, 14(3), 287-309.